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Newsletter

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President's Message

I am honoured to be serving as President of the IAEE during 2004. From humble beginnings, the Association has advanced to a position where it is the pre-eminent organisation that serves the broad range of professional interests of energy economists around the globe. However, we must not become complacent. Our profession is expanding rapidly in order to address energy infrastructure, environmental, and security concerns. The IAEE through its conferences, newsletter, and journal must remain at the forefront of rigorous analysis and debate on these issues. Our achievements to date have been due to the commitment and enthusiasm of members over the past quarter-century. With the "greying" of the organisation, and individuals within it (for those who can see my picture in colour!), it is essential that younger practitioners be encouraged to drive the organisation forward to meet these challenges of tomorrow. To this end, I intend to give special emphasis and encouragement during my year in office to expanding the already excellent facilities and financial support provided to student members by the IAEE. I would welcome input from all members, particularly those entering the profession and younger researchers, on possible initiatives.

I am delighted to welcome new members to the Council for 2004. Arnie Baker of Sandia National Laboratories has been elected President in 2005, and will thus serve as President-elect this year. Georg Erdmann of the Technical University of Berlin joins as Vice President for Publications, whilst Einar Hope of the Norwegian School of Economics and Business Administration takes on the role of Vice President for Conferences. Mine Yucel from the Federal Reserve Bank of Dallas adds the role of elected Council member to her position as 2004 President of the USAEE. In keeping with past practice, two Council members have been appointed to represent the affiliate organising the following year's conference: Neng-Pai Lin from Taiwan Power Company and Yunn-Ming Wang from the Energy Commission, Taiwan Ministry of Economic Affairs. They are joined by two Presidential appointees: Mark Jaccard of Simon Fraser University and Sophie Merritet of Dauphine University-CGEMP. We also bid farewell with thanks to retiring Council members Paul Horsnell, Ernesto Marcos, Arild Nystad, Adam Sieminski, and Matt Simmons, as well as Seyed Alavi one of the (two) representatives of the Iranian affiliate. The other, Majid Abbaspour, remains on Council as Vice President & Secretary.

Towards the end of last year, Council adopted a recommendation that our highly successful "Student Council Member" initiative be modified to permit greater continuity. The two student members will now each serve two years on an overlapping basis. Thus one will be elected annually. I wish to thank Eliska Kotikova (Czech Republic) and Steffen Sacharowitz (Germany) for their outstanding contribution to the IAEE during 2003 in their role as Student Council Members. As a result of the new arrangement, Steffen will remain a student member in 2004. He will be joined by Carole Le Henaff (France).

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Editor's Notes

New wholesale electricity market structures and restructured state electricity regulatory frameworks are engendering increased market transparency and new techniques for evaluating the provision of retails supplies in many Northeast and Mid-Atlantic States in the U.S. Joseph Cavicchi examines various approaches that can be utilized to estimate costs to serve retail consumers relying primarily on publicly available wholesale electricity market data.

John Brodman looks at U.S. Energy Security Policy noting that though supply disruptions are unpredictable, they are

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

The Energy Journal has established an enviable reputation for publishing rigorous original analytical work in energy economics. This is in no small part due to the excellent editorial team of Campbell Watkins, Adonis Yatchew, and Geoff Pearce. The IAEE greatly appreciate the considerable workload undertaken by these quiet achievers.

For many members this will be the first issue of the IAEE Newsletter that they will receive only in electronic form. Although hard copies will still be available on request, members are encouraged to shift to the electronic version. This move represents a significant saving for the IAEE in both printing and mailing charges. Further initiatives into electronic media will come over the next year or two. In addition to reducing operating costs, these developments will provide members with a faster, up-to-date, expanded range of professional services.

Members will be aware of the US Administration's refusal of a licence for the IAEE to organise the scheduled 27th International IAEE Conference in Tehran, 25-27 May 2004. Despite this setback, it is nevertheless going ahead as an IRAEE (the Iranian affiliate to the IAEE) conference. Details are available on the IRAEE web site via its link with the IAEE web site. On a personal basis, I would encourage colleagues to attend this conference and, if possible, one of the exciting post conference tours on offer.

Another date for your diary is July 4, and American Independence Day celebrations in Washington. A further incentive for visiting the US capital at that time is the 24th Annual North American Meeting of the USAEE/IAEE a few days later (8-10 July). The theme is "Energy, Environment and Economics in a New Era", and a big turnout is expected (as is usually the case in Washington). Later in the year, 2-3 September, the Swiss Affiliate is hosting the 7th IAEE European Energy Conference on "Modelling in Energy Economics and Policy" in Zurich. Later still, 21-23 November, the Czech affiliate will host a conference with the theme "Critical Energy Infrastructure" at the Municipal House (for those who attended last year's international meeting in Prague, that was the stunning restaurant where the conference dinner was held).

Tony Owen

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

inevitable. Given this, a flexible policy has been developed at the heart of which is a desire to promote and protect resilient international oil and energy markets that transcend political partisanship. The goal of this is to reduce the threat and incidence of disruption.

Doug Reynolds finishes his series of articles based on his book on Alaska. This time he explains Alaska's desire to own a natural gas pipeline and the problem of risk. Governments like Alaska's state government tend to be risk averse to energy investments, which hinders creating new infrastructure.

Paul Tempest notes that twenty years ago one-third of Gulf oil exports went east while two-thirds went west. Today those proportions are reversed with the prospect of Asia steadily increasing its share. This suggests that the U.S. and Europe urgently needs to reexamine their assumptions on increasing their imports from this area.

Fred Banks posits that electricity deregulation has failed in Sweden, given that the price of electricity has increased much faster than the Swedish consumer price index in recent years. Much of this failure, he attributes to the difficulties (if not the inability) to develop a fully functioning derivatives market.

DLW

FUTURE USAEE / IAEE EVENTS

Annual Conferences

July 7 - 10, 2004	24th USAEE/IAEE North American Conference Washington, DC Capital Hilton
September 2-3, 2004	6th Annual IAEE European Conference Zurich, Switzerland Swiss Federal Institute of Technology
June 3-6, 2005	28th IAEE International Conference Taipei, Taiwan Grand Hotel

!!!!!MARK YOUR CALENDARS – PLAN TO ATTEND!!!!!

Energy, Environment and Economics in a New Era

24th Annual North American Conference of the USAEE/IAEE

July 8 – 10, 2004 • Washington, DC – Capital Hilton Hotel

Dear Energy Professional:

We are pleased to announce the 24th Annual North American Conference of the USAEE/IAEE, Energy, Environment and Economics in a New Era, scheduled for July 8-10, 2004, in Washington, DC at the Capital Hilton Hotel.

Please mark your calendar for this important conference. Some of the key themes and sessions for the conference are listed below. The plenary sessions will be interspersed with concurrent sessions designed to focus attention on major sub-themes. Ample time has been reserved for more in-depth discussion of the papers and their implications.

A New Era in Oil Market Management?

- Future investment requirements and crude oil prices
- The International Energy Forum: Agenda of producer-consumer dialogue
- Role of intergovernmental coordination in balancing industry investment

Competition in the Electricity Industry?

- International comparisons of privatization and restructuring
- Federalism and competition in North America: States and Provinces
- Competitive strategies

The Price of Balancing the Natural Gas Market

- Meeting long-term capital requirements
- Industrial demand destruction
- Implications for energy efficiency, conservation and environmental protection

Impact of Climate (Non) Policy on the Energy Sector

- The impacts of the Kyoto Protocol on the Canadian energy sector
- Climate policy uncertainties and business risks
- Implications for multi-national companies in the United States

International LNG

- Global supply/demand balance
- Frameworks for LNG supply investments
- Impediments to increased LNG utilization

Transportation Energy Substitution and Reduction

- Policies to reduce petroleum use by passenger vehicles
- Cost-effectiveness of greenhouse gas measures
- Reducing transportation oil use: substitution vs. efficiency?

Russian Energy

- Russia's electricity sector: Can reform be implemented and what will it look like?
- Russia's infrastructure: How will new pipelines and export capacity be developed?
- Developments in Russia's gas sector

Commercial Issues: Operating in Volatile Markets

- Current market developments on energy and environmental trading post-Enron
- Renewable energy trading emissions trading
- Weather derivatives

The Global Energy, Environment and Investment Outlook

- Long-term energy investment outlook
- Energy, environment and developing countries
- Global energy outlook

State & Regional Ascendancy in Energy Policy

- Environmental drivers for states' push on energy policy
- Texas: An unlikely leader on this front
- A state patchwork: Implications for Federal regulation?

Energy Security

- The cost of oil security
- Global oil supply projections – how realistic?
- LNG – will enough be available?

Urban Transport in Developing Countries

- Projections of transportation demand
- Implications for oil demand
- Urban planning and urban transport

Electricity Reliability: How Much, at What Cost?

- How much would different customers pay to avoid an outage?
- What mechanism could work to create a market allowing customers such choices?
- What would this mean for electric industry infrastructure, imperatives and investment?

There are 24 planned concurrent sessions. Given the location of the meeting in Washington, DC, we anticipate a good draw to our concurrent sessions.

Washington, DC is an inspiring city and a great place to begin (arrive early to celebrate Independence Day/July 4th) or end a vacation. Single nights at the elegant Capital Hilton Hotel are $155.00 per night. Contact the Capital Hilton Hotel at 202-797-5820 or 1-800-HILTONS to make your reservations. Conference registration fees are US $570.00 for USAEE/IAEE members and US $670.00 for non-members. Your registration fee includes 3 lunches, 3 receptions and numerous coffee breaks, all designed to increase your opportunity for networking. These prices make it affordable for you to attend a conference that will keep you abreast of the issues that are now being addressed in the energy industry.

Our current program announcement can be found by visiting http://www.iaee.org/en/conferences Please take advantage of the pre-registration discounts and make both your conference and hotel reservations as soon as possible. July in Washington is a celebration! Further information on Washington, DC may be obtained at: http://www.dcregistry.com/sights.html

If you have any questions call 216-464-2785 / usaee@usaee.org. We look forward to seeing you at the 24th Annual North American Conference of the USAEE/IAEE.

Visit the Conference website at http://www.iaee.org/en/conferences

Wholesale Electricity Procurement Strategies for Serving Retail Demand

*By Joseph Cavicchi**

Introduction

With retail electricity competition starting out slowly in those states where the ability to choose a supplier has been introduced, there has been limited visibility into the challenges facing companies that compete to supply electricity supplies at retail. Due to the proliferation of administratively determined retail rates that resulted from most states' electricity industry restructuring laws, large numbers of retail electricity consumers have enjoyed stable, low rates during the transition process that has been ongoing in many states over the past several years. The combination of the end of these transition periods and a significant excess supply of new generation units is starting to spur more competitive solicitations to supply these retail loads. At the same time, state regulatory commissions are beginning to grapple with how to ensure that those consumers who are not receiving competitive supply offers will realize stable, competitive rates in the future. With these changes now beginning to take hold, an increased focus on bridging the wholesale and retail electricity markets will emerge. The ability of entities to carefully manage load and price volatility will increase as companies test the limits of the wholesale markets to provide the types of flexible products needed to manage retail loads. These increased experiences will help to define procurement approaches that will stand the test of time and offer parties on both sides of a contract the type of protection they need. At the same time, consumer demands will begin to be registered more accurately in the forward and spot markets as wholesale purchases and sales become more active.

This paper discusses approaches available to wholesale suppliers for pricing retail offers either to large groups (or classes) of consumers or to individual consumers or consumer classes. Because we believe that the approach that results in manageable risks requires the purchase of fixed priced hedges, and on occasion options, we provide empirical analyses that show how the premiums for these combinations of products will impact retail price offerings. Our analytical approach relies on a set of forecasts of future hourly spot prices[1] and market-based forward prices that are then combined with concurrent expected hourly loads to evaluate pricing levels that minimize cost variance for suppliers, but that explicitly consider future supply and demand levels. We believe that these types of analyses will become more common (if they have not already, given the increased availability of hourly data) as industry participants engage the more transparent wholesale markets that are emerging as a result of industry restructuring.

Our results clearly show that it is possible to use combinations of wholesale electricity products to manage price and demand risk while offering consumers short- and medium-term fixed prices. The use of forward market hedges permits suppliers (and could also permit large users) to levelize their estimates of cost to offer services by limiting ability to benefit from lower future prices and protecting against higher future prices. In addition, the use of options can provide insurance against both price and demand risk, although this insurance comes at a cost that requires careful consideration vis-à-vis low probability high price or high load migration events. In all cases these various approaches are actively reducing the amount of volatility that suppliers (and consumers) face in the wholesale market. The final outcome is limited exposure to occasional short-term market price spikes.

Although during recent times it may have seemed that competitive wholesale electricity markets were slow to provide benefits, many entities have expended significant efforts to ready themselves to compete in these markets, and it is only a matter of time before the increased efficiencies that are resulting will appear in the form of lower prices and improved service offerings. As market participants enhance their ability to use wholesale market products and various bilateral contracts as a means of offering fixed prices to consumers, a mature group of competitors will begin to solidify, using some of the techniques described in this paper to manage the risks associated with selling electricity.

Various Future State Default Service Policy Changes Will Increase Demand for Various Fixed-, Longer-, and Shorter-Term Retail Rates

The increased focus on default service has been noted in many forums.[2] In many states the restructuring process included the provision of electric service to most consumer classes at rates that were established through regulatory proceedings. Unless a state envisioned offering retail consumers rates that were determined by ongoing competitive solicitations, consumers are insulated from wholesale market price variations.[3] Behind many of these fixed rates are either long-term supply contracts between electricity distribution companies and those entities that now own or have built power plants in the region where load is located, or power plants that continue to be owned by a corporate entity that has both regulated and unregulated operating divisions. Throughout the transition period, wholesale price variation risks have largely been managed through these contracts and/or plant ownership.

The impending modification of default service pricing policies will significantly impact the retail and wholesale marketplaces. In many instances, default service pricing that has been utilized to date did not require that consumers understand the types of price risk they actually faced given the invariant rates.[4] Heretofore these risks have been falling on suppliers or distribution companies, although in many instances back onto consumers through ex post rate adjustments carried out at some date in the future long after the

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* Joseph Cavicchi is a Vice President at Lexecon Inc., Cambridge MA where his work focuses on emerging market structures and analytical frameworks resulting from the ongoing restructuring of the U.S. Electricity Industry.

[1] See footnotes at end of text.

expenditures were incurred. Depending upon contractual arrangements between suppliers and distribution companies, and upon how distribution companies' transitions were managed by regulators, there are various levels of monies in dispute related to the distribution of this price risk.

As regulators consider modifications to default service pricing policies, there is considerable discussion about how to ensure that consumers see rates that are consistent with the regulatory goals outlined by various states. Because the onset of competitive suppliers has varied significantly among rate classes, we see approaches being taken to managing default service provision that vary along the lines of consumer class. For example, Massachusetts has recently decided that larger consumers should have default service rates that are closely tied to the wholesale markets, while residential consumers should have available rates that do not change too often.[5] Similarly, Maryland has recently completed a significant investigation of the provision of standard offer service (in Maryland, this is default service) and determined that competition to supply residential consumers is limited and that it is in the public interest to provide these consumers with rates based on portfolio procurements of electricity.[6] New Jersey has recently adopted descending auction formats to solicit its default service supplies (basic generation supply) for its distribution company consumers that are not served by competitive suppliers. Default service procurement policies can vary considerably, and given the large number of consumers served on these rates, how suppliers are asked to price service to these loads will impact the wholesale market and drive the types of contractual arrangements that are necessary to manage the risks.

For example, if distribution companies are required to establish short-term rates for certain consumer classes, then LSEs will be in the market regularly buying potentially large quantities of power for delivery in the next month or quarter. Because prices are much more volatile over shorter versus longer terms, these rates will be elevated compared to rates that are levelized over some longer time period. The expectation is that consumers facing these rates will solicit supplies from the competitive market in order to manage this price risk. To the extent this occurs, the wholesale market benefits as generation plant owners ultimately see more stable revenues and buyers face more stable prices. Because suppliers have rarely been asked to provide these sorts of products to distribution companies, their need will drive the development and use of various techniques to meet these uncertain demands over time.

At the same time there are several states that will act to stabilize the rates faced by consumer classes that are not aggressively courted by competitive suppliers.[7] Currently there are some default procurement policies that provide limited rate stability to these smaller consumers while still exposing them to changes in wholesale prices,[8] while there are some policies that clearly do not expose these smaller consumers to wholesale market price variations. As default policies are reviewed and modified to adapt to the end of restructuring transition periods, an increased demand will be placed upon retail suppliers to offer various longer-term fixed rate products. The demand for these products will be important to the underlying health of the generation side of the industry and will also lead to innovation and creativity in the types of techniques used to manage the risks associated with these longer-term products. Although there are currently these types of longer-term agreements in place between large generation-owning companies and their affiliate LSEs, when the regulatory framework begins to shift to further embrace competition, there will be greater competition to provide these products.

At the same time, regulators can consider offering consumers who receive default service under rates that have been historically invariant new rate structures that link usage to market-based pricing. Even though these consumers' demands will be planned for by default service providers, to the extent they experience rates that engender an interest in searching for an alternative supplier (e.g., an entity willing to provide a fixed price over some time frame), their demand will be registered elsewhere. This risk of consumer migration can be managed by suppliers as a function of individual company wholesale market price expectations. In many instances, consumers may be switching to the same supplier and paying less as the certainty provided to the supplier will lead to a lower price, but over a longer time period. Therefore, it is possible to continue efforts on programs to improve consumer pricing while at the same time allowing wholesale markets to mature.

As we continue to adapt to the new institutional structures that have been put in place to facilitate the provision of electricity service competitively at both retail and wholesale, market participants will actively adapt themselves to meet these new challenges.[9] Surely many of the most interesting arrangements will remain invisible to the outside world, although their complexity has already increased dramatically, and the means by which contracts are satisfied, and risks are distributed, will change accordingly. The rest of this paper focuses on illustrating various approaches that can be utilized to manage wholesale procurement in order to satisfy fixed retail rate commitments. Going forward, these types of approaches, and others, will emerge, as market participants become comfortable with the types of analyses that are required to manage these risks. It is the management of these risks that we have asked the competitive market to handle and the demands placed on suppliers will greatly impact the later stages of transition. The need for good, efficient contracting (and institutions that support it) is crucial to the success of the industry.

Wholesale Procurement Approaches to Satisfy Retail Loads at Fixed Prices

In this section we empirically examine hedging approaches for using standard wholesale market electricity products to provide supplies for delivery at retail. To conduct these pricing analyses, we used forecasted locational marginal prices for various future scenarios (calculated using a security-constrained dispatch model) in combination with publicly available electricity forward price data.[10] In adopting this analytical approach, we are recognizing that first, historical market price data for electricity products have only been widely available and truly market-based for a few years, and second, that discrete decision-making is more easily bounded by a scenario analysis that includes various options. This analysis can be thought of as a branch of a decision tree where other branches might be to own or build a resource, procure only on the spot market, or use combinations of physical and financial hedges.[11]

Before adopting this approach, we considered a more explicit statistical approach, but due to the limited availability of historical data it is very difficult to rely on statistical pricing approaches as a primary means of estimating future costs to supply various consumer classes.[12] Additionally, statistical techniques require that assumptions be made for the distributions of underlying random variables (most notably price), and currently there is no general agreement on the most suitable distribution assumption for hourly electricity prices.[13] By using a structural modeling approach, we are able to consider location risks, supply disruptions, regulatory frameworks, and other important elements of actual wholesale electricity markets.[14] Therefore, we have elected to rely on structural modeling techniques combined with well known decision-making approaches that can be effectively used by businesses.[15]

A major issue of importance in our analysis was the use of a portfolio of supplies, including various types of hedge products. Pricing formulations tend to rely on accurate statistical measures that can then be used to calculate prices that presumably can be offered without hedging if the statistical results are accurate. Although hedges and options can increase costs, they provide the type of insurance against major risks that entities desire when participating in electricity markets. Using a scenario-based structural approach allows a straightforward investigation into the potential benefits that result when using different purchasing strategies.[16] For example, when buying hedges for firm delivery and/or put and call options, it is possible to calculate the projected costs and benefits of these approaches based on expected spot prices and demands. Although the process is not exhaustive (compared to a Monte Carlo approach), it does provide considerable insight into how costs can change under various future scenarios and permits an analyst to focus on those uncertainties that are the most significant from a risk management perspective. Our analysis focuses on evaluating a spectrum of costs that could be incurred to serve various demand patterns, given the recognition that some level of insurance is necessary to account for future uncertainty.[17]

In the following sections, we present various analyses that use hourly locational marginal price forecasts and forward market data as a means of developing retail price estimates. We provide examples of how wholesale markets can be exclusively used to supply retail consumers for terms of between months upwards to three to five years. We examine thE costs and benefits of using various hedging scenarios compared to the alternative of relying exclusively on the spot market. Our results are reported as expected costs to serve various retail consumer classes; these values represent ranges of pricing that could be proposed by a supplier bidding to serve retail loads. New suppliers providing the type of mid-term, fixed-price products we evaluate will be critical to the ongoing competitive transformation of the electricity industry.

Procurement Approaches

The provision of fixed price electricity services can entail a considerable amount of risk. Because most widely traded electricity forward products envision the delivery of fixed blocks of power, we cannot rely on an analytical formulation that envisions a product that cannot be purchased in a conventional forward contract.[18] There are actually a variety of approaches that can be envisioned for developing pricing based on available wholesale products, although each has the potential to under- or over-estimate future supply costs so that offering a fixed price can, in some instances, be a rather risky proposition. Below are three approaches that can be used to resolve this problem. We first describe the elements of the approach that are common across all three examples; we then describe in greater detail components that are specific to an individual approach. Finally, we present and discuss the results of the analysis for each approach and compare it with a no-hedging approach that assumes all purchases are made at the forecasted hourly spot prices.

Each of the following approaches relies in part on a so-called overall procurement approach that refers to the underlying portfolio of supplies that a buyer decides to have available to serve its consumers. For example, a buyer that has, or expects to have, the responsibility to serve a set of consumers over a time frame of a few years will likely elect to procure various supply products ahead of expected delivery. For example, an entity might elect to buy 20% of its expected deliveries for a term of three years in advance, 20% two years in advance, and 30% one year in advance in order to provide some cost certainty. Remaining amounts can be procured using various risk management approaches applicable to purchases made in months, weeks, or days prior to expected delivery. Various combinations of terms and quantities can be explored within the price and quantity expectations that a buyer develops (i.e., within each approach there can be a range of expected costs to meet demand). Estimates of the costs associated with these various approaches can be developed, recognizing the risks associated with electricity procurement. Finally, with any of the approaches there has to be recognition and inclusion of various additional costs incurred by a supplier including, but not limited to, transmission fees (including losses), ancillary services fees, capacity costs, congestion costs, and overhead and profit.

Our three examples illustrate how fixed retail prices could be calculated under different procurement approaches. Our analyses focus on the state of Massachusetts in the Northeast and Pennsylvania in the Mid-Atlantic. In the analyses for each of these states we calculate estimates of the costs to supply retail service for various consumer classes under each of the three approaches (these estimates would form the basis of pricing offers). One approach assumes that a combination of the spot market and annual forward market products are used exclusively to procure supplies (limited hedging); a second approach assumes that additional forward procurements beyond those envisioned in the limited hedging scenario are made on a monthly or seasonal basis (a larger portfolio of short- and long-term contracts) in order to provide additional cost certainty and less reliance on the spot market; and, a third approach assumes that in addition to the portfolio of short- and long-term contracts developed for scenario two, call options are purchased as insurance against short-term (less than one year in the future) price and load volatility. The general approach for making these calculations is described as follows.

First, as we described above, for each approach we make purchasing assumptions that intend to strike a balance between forward and spot purchases.[19] In the limited hedging approach, we assume all purchases are made as a combination of forward market annual contract purchases and future hourly spot markets (ISO-New England and PJM Interconnection). For the remaining two approaches, we make portions of the purchases ahead of the delivery time and accordingly reduce exposure to the spot markets. For each approach we report calculated cost estimates as weighted averages, although the calculations are made on an hourly and monthly basis before averaging.

Table 1 shows numerically the considerable difference in volatility of these price streams. The low volatility products are those that provide supplies for months and years, while the high volatility supplies are for short-term delivery such as day-ahead. Limiting exposure to the high volatilities while capturing the benefits available from the lower volatility products is a key focus of our analysis. Each of the approaches is described as follows.

Table 1
Daily, Monthly and Annual Volatility within NEPOOL Forward and Spot Markets

	Spot Market Houly Prices	Forward Market Year 2001 on-Peak Contract	Forward Market Year 2002 on-Peak Contract	Forward Market Year 2003 on-Peak Contract
Daily Volatility	26.11%	1.97%	1.18%	5.21%
Monthly Volatility	128.83	9.04	8.27	23.86
Annual Volatility	444.52	31.18	28.55	82.32

Note: The assumes 250 peak days per year and 21 peak days per month.
Source: NEPOOL and Natsource.

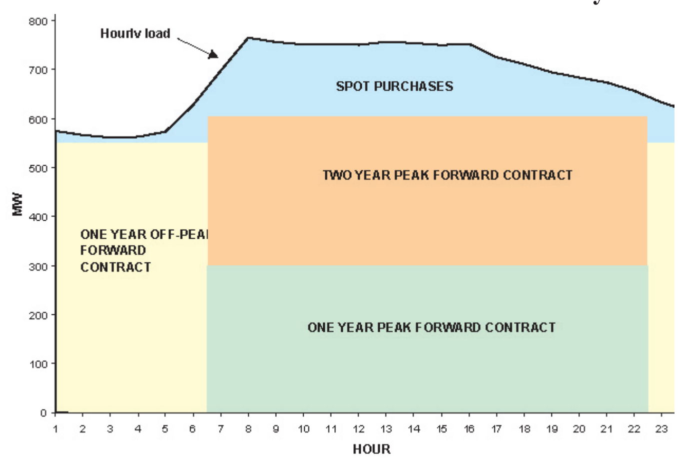
Approach 1: Limited Hedging

Methodology

This approach might be utilized if an entity has the expectation that future spot market prices will not be very volatile, or if an entity has a physical hedge available. The basic idea behind this approach is to determine minimum expected monthly hourly on-peak and off-peak demands and make forward purchases to cover these minimums, and then assume that the balance of the required energy is purchased from the spot market using expected hourly spot market prices (i.e., the forecasted location marginal prices). A practical description of an approach to carry out this calculation is as follows.

First, we need to select procurement quantities consistent with the approach we are using. We use consumer class monthly hourly demands developed from historical data to determine forward purchase amounts that are designed to avoid the need to sell back supplies during shoulder hours.[20] Using this analysis we establish procurement quantities in megawatts on-peak and off-peak per month. Figure 2 illustrates an example of how we identify quantities for this portfolio approach. The figure illustrates how forward purchase quantities for ISO-New England's Northeast Massachusetts/ Boston area were determined for the analysis. Based on the forward market data available during Spring 2003, we determined the minimum yearly hourly demand and assumed the purchase of a one-year off-peak energy delivery contract at this level for the years 2003 and 2004. Thereafter we determined the minimum on-peak hourly demand and assumed the purchase of one-year and two-year forward contracts that both are at a quantity that splits the yearly minimum on-peak demand evenly.[21] The result is a portfolio of purchases made at forward market prices that prevailed during Spring 2003.

Figure 2
Limited Hedging Procurement Strategy-Samle Load Curve and Breakdown of Purchases for a Day



With assumed forward contract purchases identified, we then use forward contract price data to establish estimates of costs that will be incurred to carry out these forward purchases. We then calculate average total energy costs to serve the projected consumer class hourly demands using appropriate combinations of forward contract and forecasted locational marginal spot prices as applicable by year.[22] Finally we add 1.5 cents/KWh for other additional costs such as ancillary services, transmission, capacity, and overhead and profit that need to be added to the energy price to determine a complete estimate of the cost to serve.[23]

Results

The results of the calculations are shown on monthly and annual bases in Tables 2-4. The results presented are

Table 2A
Forecast Monthly Electricity Cost Using Various Procurement Strategies to Meet Retail Demand
Massachusetts-Boston Region
Procurement Cost and Range (cents per KWH)*
(range in parenthesis)

Consumer Class/ Month	No Hedging	Limited Hedging	Intermediate Hedging	Aggressive Hedging
Residential				
Jul-03	5.88-7.26 *(1.37)*	5.63-6.36 *(0.72)*	6.36-6.50 *(0.14)*	6.45-6.62 *(0.17)*
Aug-03	6.56-8.13 *(1.57)*	5.98-6.86- *(0.89)*	6.35-6.63 *(0.28)*	6.46-6.66 *(0.2)*
Sep-03	5.25-5.88 *(0.63)*	5.20-5.46 *(0.26)*	5.37-5.52 *(0.15)*	5.36-5.51 *(0.15)*
Jan-04	4.40-5.83 *(1.42)*	4.88-5.76 *(0.88)*	5.72-6.03 *(0.31)*	5.72-6.03 *(0.31)*
Feb-04	4.19-5.47 *(1.28)*	4.75-5.52 *(0.77)*	5.69-5.87 *(0.19)*	5.65-5.85 *(0.21)*
Large C&I				
Jul-03	5.76-7.07 *(1.31)*	5.42-5.92 *(0.5)*	5.86-5.99 *(0.13)*	5.99-6.14 *(0.15)*
Aug-03	6.41-7.89 *(1.48)*	5.68-6.32 *(0.64)*	5.93-6.19 *(0.26)*	6.05-6.24 *(0.19)*
Sep-03	5.16-5.75 *(0.59)*	5.11-5.28 *(0.18)*	5.19-5.32 *(0.12)*	5.18-5.31 *(0.13)*
Jan-04	4.33-5.64 *(1.32)*	5.08-5.59 *(0.51)*	5.59-5.78 *(0.19)*	5.53-5.76 *(0.23)*
Feb-04	4.13-5.32 *(1.19)*	5.02-5.45 *(0.43)*	5.55-5.69 *(0.13)*	5.49-5.66 *(0.16)*
Medium C&I				
Jul-03	5.99-7.53 *(1.53)*	5.72-6.52 *(0.8)*	6.47-6.64 *(0.17)*	6.65-6.83 *(0.17)*
Aug-03	6.69-8.37 *(1.68)*	6.06-6.99 *(0.94)*	6.44-6.75 *(0.31)*	6.59-6.81 *(0.22)*
Sep-03	5.33-5.98 *(0.65)*	5.27-5.57 *(0.29)*	5.49-5.63 *(0.14)*	5.48-5.63 *(0.15)*
Jan-04	4.42-5.84 *(1.42)*	5.00-5.75 *(0.75)*	5.82-6.04 *(0.22)*	5.74-6.01 *(0.27)*
Feb-04	4.20-5.49 *(1.29)*	4.88-5.56 *(0.68)*	5.78-5.92 *(0.14)*	5.70-5.88 *(0.18)*
Small C&I				
July-03	5.80-7.14 *(1.34)*	5.60-6.39 *(0.8)*	6.27-6.49 *(0.22)*	6.46-6.62 *(0.16)*
Aug-03	6.43-7.93 *(1.49)*	5.95-6.88 *(0.93)*	6.32-6.62 *(0.3)*	6.41-6.66 *(0.25)*
Sep-03	5.13-5.72 *(0.59)`*	5.09-5.39 *(0.3)*	5.27-5.44 *(0.16)*	5.27-5.44 *(0.16)*
Jan-04	4.32-5.63 *(1.32)*	4.80-5.60 *(0.8)*	5.54-5.86 *(0.32)*	6.14-6.42 *(0.28)*
Feb-04	4.12-5.30 *(1.18)`*	4.70-5.39 *(0.68)*	5.48-5.69 *(0.21)*	5.53-5.72 *(0.18)*

*Cost range results from evaluating future procurement costs using five forecast scenarios for hourly electricity prices. The values shown are the calculated energy cost plus a 1.5 cent cost adder that is used to account for additional costs such as ancillary services, transmission (to utility boundary) capacity, overhead and profit.

Table 2B
Forecast Monthly Electricity Cost Using Various Procurement Strategies to Meet Retail Demand
Pennsylvania-Central East Region
Procurement Cost and Range (cents per KWH)*
(range in parenthesis)

Consumer Class/ Month	No Hedging	Limited Hedging	Intermediate Hedging	Aggressive Hedging
Residential				
July-03	5.94-7.38 *(1.44)*	5.48-6.20 *(0.72)*	5.91-6.07 *(0.16)*	6.04-6.19 *(0.14)*
Aug-03	6.61-8.22 *(1.61)*	5.8-6.65 *(0.85)*	5.94-6.24 *(0.3)*	6.05-6.29 *(0.24)*
Sep-03	5.26-5.90 *(0.64)*	4.97-5.21 *(0.23)*	5.05-5.20 *(0.14)*	5.04-5.20 *(0.15)*
Jan-04	4.39-5.79 *(1.4)*	4.63-5.56 *(0.94)*	5.08-5.51 *(0.43)*	5.95-6.34 *(0.39)*
Feb-04	4.18-5.44 *(1.26)*	4.50-5.29 *(0.8)*	5.05-5.30 *(0.25)*	5.94-6.17 *(0.23)*
Large C&I				
Jul-03	5.74-7.03 *(1.29)*	5.16-5.65 *(0.48)*	5.45-5.58 *(0.13)*	5.55-5.69 *(0.14)*
Aug-03	6.37-7.82 *(1.45)*	5.41-6.00 *(0.59)*	5.52-5.79 *(0.28)*	5.60-5.82 *(0.22)*
Sep-03	5.15-5.74 *(0.59)*	4.82-4.99 *(0.17)*	4.87-5.00 *(0.13)*	4.85-5.00 *(0.14)*
Jan-04	4.33-5.66 *(1.33)*	4.81-5.21 *(0.39)*	5.03-5.20 *(0.16)*	5.00-5.20 *(0.19)*
Feb-04	4.13-5.33 *(1.2)*	4.72-5.08 *(0.36)*	5.01-5.12 *(0.11)*	4.95-5.11 *(0.16))*
Medium C&I				
Jul-03	5.80-7.15 *(1.34)*	5.22-5.79 *(0.57)*	5.52-5.70 *(0.18)*	5.69-5.84 *(0.15)*
Aug-03	6.46-7.96 *(1.51)*	5.52-6.24 *(0.72)*	5.63-6.94 *(0.31)*	5.77-6.00 *(0.22)*
Sep-03	5.20-5.80 *(0.61)*	4.87-5.08 *(0.21)*	4.93-5.06 *(0.13)*	4.93-5.06 *(0.13)*
Jan-04	4.36-5.72 *(1.36)*	4.80-5.30 *(0.5)*	5.06-5.29 *(0.23)*	5.09-5.29 *(0.2)*
Feb-04	4.15-5.38 *(1.23)*	4.67-5.15 *(0.48)*	5.02-5.18 *(0.16)*	5.77-5.92 *(0.15)*
Small C&I				
Jul-03	5.91-7.36 *(1.45)*	5.41-6.14 *(0.73)*	5.81-6.03 *(0.21)*	6.03-6.18 *(0.15)*
Aug-03	6.61-8.23 *(1.62)*	5.75-6.63 *(0.88)*	5.90-6.22 *(0.32)*	6.06-6.29 *(0.23)*
Sep-03	5.27-5.90 *(0.63)*	4.97-5.23 *(0.26)*	5.06-5.19 *(0.13)*	5.06-5.19 *(0.14)*
Jan-04	4.38-5.77 *(1.39)*	4.72-5.43 *(0.71)*	5.11-5.41 *(0.3)*	5.92-6.21 *(0.3)*
Feb-04	4.18-5.44 *(1.26)*	4.60-5.25 *(0.65)*	5.08-5.28 *(0.2)*	5.99-6.21 *(0.21)*

*Cost range results from evaluating future procurement costs using five forecast scenarios for hourly electricity prices. The values shown are the calculated energy cost plus a 1.5 cent cost adder that is used to account for additional costs such as ancillary services, transmission (to utility boundary) capacity, overhead and profit.

for a representative utility distribution company in each state examined. In the case of Massachusetts, the analysis is focused on the Boston region, while in Pennsylvania, the focus is the central-eastern region of the state. The results show the estimated future costs to meet the demands of four consumer classes (residential, and large, medium, and small commercial and industrial) for various months, and on an annualized basis, using the three different procurement approaches described above to manage risk. The case where all supplies are assumed purchased on the hourly spot market is also shown to illustrate the benefits of hedging. The resultant values can be thought of as the price level, or range of price levels, that an entity would charge to provide service to a particular consumer class. Tables 2A-B depict the monthly results of the analysis for those months where we assumed hedges would be purchased. Table 3 shows similar results, although they are presented on an annualized basis. All the results shown in Tables 2A-B and 3 are the estimated range of monthly and annual costs that result from using five different hourly spot price forecasts to make the calculations.[24] Finally, Table 4 shows the same results for a single price forecast where we test the impact on the results of introducing 30 $500/MWh spikes during the months of July and August. Most importantly, the results show how the procurement approaches impact price range and level and reveal the premiums associated with insuring against spot market volatility.

Table 3
Forecast Monthly Electricity Cost Using Various Procurement Strategies to Meet Retail Demand
July 2003 - June 2004

Massachusetts - Boston Region
Procurement Cost and Range (cents per KWH)*
(range in parenthesis)

Consumer Class	No Hedging	Limited Hedging	Intermediate Hedging	Aggressive Hedging
Residential	4.84-5.92	5.10-5.67	5.37-5.73	5.38-5.73
	(1.08)	*(0.58)*	*(0.36)*	*(0.35)*
Large C&I	4.81-5.81	5.16-5.51	5.32-5.54	5.33-5.55
	(1)	*(0.35)*	*(0.22)*	*(0.22)*
Medium C&I	4.94-6.05	5.20-5.76	5.46-5.80	5.47-5.80
	(1.11)	*(0.56)*	*(0.34)*	*(0.33)*
Small C&I	4.79-5.79	5.02-5.59	5.27-5.63	5.40-5.73
	(1)	*(0.57)*	*(0.36)*	*(0.33)*

Pennsylvania-Central East Region
Procurement Cost and Range (cents per KWH)*
(range in parenthesis)

Consumer Class	No Hedging	Limited Hedging	Intermediate Hedging	Aggressive Hedging
Residential	4.83-5.92	4.86-5.45	5.01-5.39	5.50-5.86
	(1.09)	*(0.59)*	*(0.38)*	*(0.35)*
Large C&I	4.81-5.80	4.84-5.16	4.92-5.14	4.93-5.15
	(0.99)	*(0.32)*	*(0.22)*	*(0.23)*
Medium C&I	4.85-5.88	4.87-5.27	4.96-5.23	5.13-5.37
	(1.03)	*(0.4)*	*(0.27)*	*(0.24)*
Small C&I	4.91-5.98	4.91-5.43	5.04-5.38	5.40-5.70
	(1.08)	*(0.52)*	*(0.34)*	*(0.3)*

*Cost range results from evaluating future procurement costs using five forecast scenarios for hourly electricity prices. The values shown are the calculated energy cost plus a 1.5 cent cost adder that is used to account for additional costs such as ancillary services, transmission (to utility boundary) capacity, overhead and profit.

In the case of the limited hedging strategy we immediately observe the significant reduction in the estimated range of costs that would be incurred when serving the different consumer classes. In particular we see that just simply buying a portion of the expected required supply in annual contracts leads to a substantial reduction in the risk of cost variance. For example, Tables 2 and 3 show that the range of estimated costs decreases by nearly 50% (or more) on both a monthly and an annual basis. Results in Tables 2A-B show how substantial additional benefits occur in the summer months, when not only is the range of cost much lower, but both the low and high cost estimates are reduced, showing the benefit of making long-term purchases where pricing is much less volatile. Tables 2A-B also show how the benefits of the annual contracts are less prominent in winter months, when low side costs increase and high side costs do not decrease as much when compared to the summer months. Table 3 shows how the results change when we consider annualized values. Here we consistently see that the low-end cost estimates increase, while the high-end values continue to decrease. Of particular interest in these results is how the low-end increases are higher for Massachusetts when compared to Pennsylvania.

Table 4
Forecast Monthly Electricity Cost Using Various Procurement Strategies to Meet Retail Demand
Price Spike Case

Massachusetts - Boston Region
Procurement Cost (cents per KWH)

Consumer Class/Mo.	No Hedging	Limited Hedging	Intermediate Hedging	Aggressive Hedging
Residential				
July-03	7.84	6.72	6.56	6.54
Aug-03	8.75	7.26	6.74	6.68
Jul03-Jun04	6.02	5.74	5.75	5.74
Large C & I				
Jul-03	7.63	6.19	6.10	6.07
Aug-03	8.46	6.63	6.30	6.24
Jul03-Jun04	5.92	5.56	5.56	5.54
Medium C & I				
Jul-03	8.21	6.95	6.78	6.74
Aug-03	9.03	7.41	6.87	6.81
Jul03-Jun04	6.17	5.83	5.83	5.81
Small C & I				
Jul-03	7.71	6.78	6.63	6.59
Aug-03	8.49	7.26	6.72	6.67
Jul03-Jun04	5.89	5.66	5.65	5.73

Pennsylvania-Central East Region
Procurement Cost (cents per KWH)

Consumer Class/Mo.	No Hedging	Limited Hedging	Intermediate Hedging	Aggressive Hedging
Residential				
Jul-03	8.00	6.58	6.20	6.17
Aug-03	8.86	7.05	6.36	6.31
Jul03-Jun04	6.02	5.51	5.42	5.83
Large C & I				
Jul-03	7.58	5.91	5.68	5.66
Aug-03	8.38	6.28	5.87	5.83
Jul03-Jun04	5.90	5.21	5.15	5.14
Medium C & I				
Jul-03	7.72	6.09	5.83	5.79
Aug-03	8.54	6.57	6.08	6.02
Jul03-Jun04	5.98	5.33	5.25	5.37
Small C & I				
Jul-03	7.99	6.53	6.18	6.14
Aug-03	8.86	7.04	6.38	6.31
Jul03-Jun04	6.10	5.51	5.41	5.69

*The values shown are the calculated energy cost plus a 1.5 cent cost adder that is used to account for additional costs such as ancillary services, transmission (to utility boundary) capacity, overhead and profit.

Additionally the results reveal the variation in costs to serve different consumer classes. The benefits of serving load shapes associated with larger customers are noticeable—consumers with load shapes that permit hedging strategies to be highly effective provide greater price reductions. Consumer classes that see less benefits from the hedging strategies we examined—residential and small commercial and industrial—might call for more refined hedging approaches. The structure of the analysis permits additional research into how best to serve individual and combinations of consumer classes.

Finally, comparing the results from Tables 2A-B and 3 with those of Table 4 provides some insight into the estimated costs of protecting against 30 price spikes.[25] Here we see how limited hedging significantly reduces cost exposure in the summer months where we simulated the price spikes. Although limited hedging provides protection, a comparison of these tables clearly reveals that price spikes drive up estimated costs considerably when compared to the results obtained using the five hourly price forecasts. This is because in the less-hedged strategies, there are procurements made at the higher price spike levels that are eliminated as hedges are put in place. But the added hedges result in losses in lower load hours due to selling back excess power that offsets some of the gains of the hedges.[26] This emphasizes the importance of carefully considering how likely wholesale market price spikes are in various spot markets. To the extent they are likely, procurement strategy can be altered accordingly, as we discuss below.

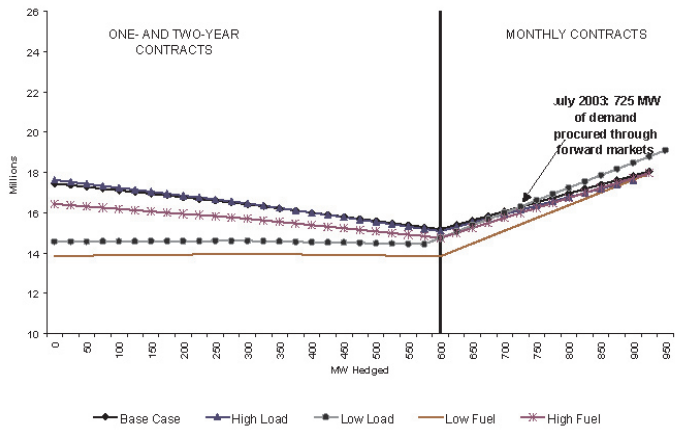
Approach 2: Intermediate Hedging

Methodology

This approach utilizes a portion of the limited hedging approach, but does not assume that all required energy above a certain minimum amount is purchased through the spot market. Instead a portion of the expected hourly demand above monthly minimum on-peak demands is purchased for future delivery, recognizing that some of the quantity purchased will not be needed in certain hours and will therefore need to be sold in the wholesale market on the day of delivery.[27] To achieve the envisioned hedging requires the use of more in-depth analytical techniques. The following additional analysis beyond that described in the limited hedging approach is required to execute this strategy.

Using our forecast scenarios of hourly spot prices, we developed an analysis that examines the costs and benefits of purchasing various fixed-price forward market on-peak hedges. We determined the point where monthly quantity hedged would provide both downside and upside protection that are approximately equal given future expected spot prices. The result of this particular portion of the analysis is the identification of a quantity of electricity that is purchased for firm delivery. For example, Figure 3 shows the results for the month of July 2003, where we selected a hedge purchase quantity of 725 MW for the large commercial and industrial classes. The figure depicts estimates of the costs to serve these consumers for the month of July using five expectations of future spot prices and incorporating various combinations of hedges and spot market purchases against quantities of firm hedges purchased. The figure includes both the annual hedges described in the limited-hedging approach (depicted to the left of the vertical line) and a representation of the change in estimated procurement costs as firm hedges are added for the month.

Figure 3



Selection of Monthly Hedge Quantites

The selected hedge quantity is the amount where the increase in costs associated with the need to sell back portions of the hedge that are not needed in the spot market are approximately equal to the benefits provided by the hedge as a means of price protection. This balance point is shown on Figure 3 as the area where the lines intersect with one another.[28] This is the point where, given these different expectations of future spot prices, estimated costs are roughly equalized at the shown hedge quantity. We then evaluated these hedge purchases for all applicable months with expected hourly on-peak spot prices and calculated an expected overall cost of energy for various future hourly price forecasts. We then add any remaining costs as described in the limited hedging approach.

Results

Tables 2-4 also show the results for the intermediate hedging approach. Once again the intermediate hedging results clearly show how the range of expected costs narrow compared to a spot market-only strategy; the results also show that the range also narrows considerably when compared to the limited-hedging approach. The compressed cost range we observe is lowering the expected variance in cash flow that a company faces when serving these time-variant demands. Unfortunately, this more narrow range comes at a cost—the low-end cost estimates are significantly higher than those we observe in the case of limited hedging. In effect, we are starting to see a cost premium associated with hedging; as with more firm hedges—purchased on a monthly basis where volatility is higher—we are giving up opportunities to purchase power on the spot market when prices are low in exchange for having fixed cost supplies available when the spot market prices are high. The result is substantial protection against high price outcomes, especially in summer months, with lower benefits available to reduce low-end costs.[29]

Comparing the results from Tables 2A-B and 3 with th se of Table 4 again provides some insight into the estimated costs of protecting against 30 price spikes. In the intermediate hedging case, we see a similar outcome where costs are elevated, but we also see that the additional protection lowers expected costs, revealing that additional benefits are realized in the case where there are price spikes. These benefits put downward pressure on expected annualized expenditures that are also shown on Table 4. To the extent price spikes are a significant concern, it is worthwhile to consider using the intermediate hedging strategy.

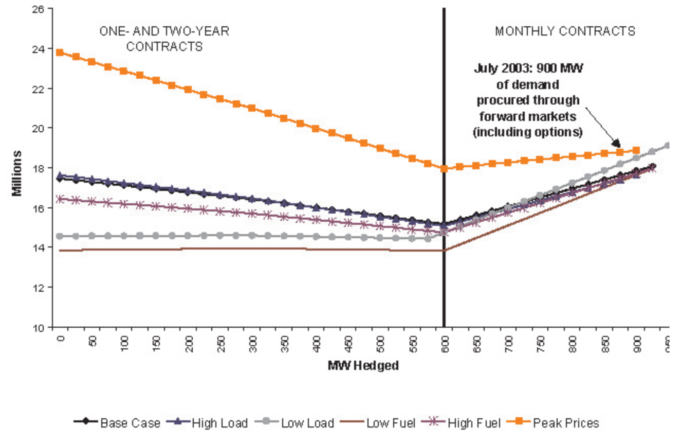
Approach 3: Aggressive Hedging

Methodology

This approach utilizes the intermediate hedging strategy as an initial approach, but then adds the purchase of call options as a means of insuring against future price and load risk. To the extent a supplier faces the risk of consumer migration (if serving a default service contract) or just plain uncertainty related to the weather, it can purchase call options that will provide a specific quantity at a set price if the electricity is perceived as necessary.[30] The call option simultaneously provides insurance against load and price variation. As the results below show, the use of these instruments can be expensive and it can be difficult to forecast the costs of options for any period longer than six to twelve months. Suppliers will clearly need to gain experience managing load and price volatility risk using these instruments in order to estimate the costs. To add these options to the portfolio required the following additional analysis beyond that described in the intermediate hedging approach.

The intermediate hedging approach is used as a starting point to determine how much load remains to be served given the fixed purchases made for the portfolio. The hourly loads are analyzed on a monthly basis, and we examined for various months (those that can reasonably be expected to have volatile prices and loads) the potential amount of additional demand that might need to be served on an hourly basis. This provided a quantity that could be considered as potentially necessary to meet demand on a given day during a specific month. To simulate the costs of hedging against the potential need to serve this demand, we envisioned the purchase of call options.[31] We did not optimize the purchase of these call options, but instead assumed that we would buy options up to the point where the risk faced from potential excessive spot market spikes was limited. For example, using Figure 4 (Figure 3 with an added cost line), we depict an estimated cost line that includes price spikes of $500/MWh during the months of July and August of 2003. Figure 4 shows that a quantity of 175 MW of call options (difference between 900 MW and 725 MW shown in Figure 3) provides protection against these price spikes at demand levels greater than those selected using firm hedges based on spot price estimates. We then evaluate the impact of the cost of the options based on whether they would be exercised, given our various forecasts of hourly prices. Finally, we calculate the overall cost to serve for each of the future forecast scenarios as in the other two cases.

Figure 4
Selection of Monthly Option Quantities



Results

Tables 2-4 show the results of the aggressive hedging approach. Although these results show a narrowing of expected expenditures, as we have observed in the other hedging cases, we now see that low- and high-end costs are both rising when we envision the purchase of call options. This is primarily due to the fact that the strike price for the call option is nearly equal to the cost of procuring a monthly forward contract. Therefore, the purchase of the call option's up-front premium payment is not completely offset by the savings obtained when the option is called. In effect, even though there is no sell-back required with the call option, the premium payment is resulting in a financial loss similar to that experienced when selling back power at prices less than what was paid in the forward market. In our examples, there are limited benefits associated with the purchase of call options.[32]

Comparing the results from Tables 2A-B and 3 with those of Table 4 again provides some insight into the estimated costs of protecting against 30 price spikes. Here we clearly see that the estimated costs of using call options are similar to or higher than the estimated costs using the other hedging strategies. These results reveal that very little is gained by using call options when compared to the purchase of firm monthly hedges. Overall, the intermediate hedging strategy provides the best protection to a risk-adverse market participant while leaving some opportunity to obtain exposure to lower-than-expected market prices.

Conclusions

With careful consideration of risk tolerance levels, wholesale electricity markets can be utilized to meet retail demands. As the market begins to see a greater number of standard offer service-type solicitations, there will be a greater emphasis on developing hedging strategies that draw on portfolios of supplies to serve these varying loads. We have shown that just using mid-term wholesale products to hedge expected retail demands results in a clear ability to understand the costs and benefits of hedging. The reductions in cost variance we observe in our results translate into reduced risks of higher costs, which lower potential cost exposure by millions of dollars. Going forward, it will be critical that these wholesale markets be available and utilized to ensure price transparency and an ability to obtain hedges that make managing risks possible.

Furthermore, with models in place that easily allow repetitious analyses to be completed for a variety of different input assumptions, we can easily develop several different cost estimates based on different combinations of wholesale products. For example, it is straightforward to introduce more structured bilateral contracts into the analysis as hedges and then evaluate a more complex portfolio of supplies. With the building blocks of an analysis in place, all that is required to ensure new and innovative supply offerings is transparent wholesale markets and a sufficient number of competitors. In most parts of the country, the marketplace is able to provide what is necessary to secure the benefits of retail competition.

Footnotes

[1] Thanks are extended to Tabors, Caramanis and Associates for providing a set of hourly locational marginal price forecasts for the 2003-2004 time period. Thanks are also extended to Zeljka Bosner and Marin Boney for their valuable assistance with various aspects of the analysis.

[2] See, for example, Graves, Frank C., and Wharton, Joseph B., *New Directions for Safety Net Service – Pricing and Service Options*, EEI White Paper, Edison Electric Institute, May 2003; and Center for the Advancement of Energy Markets, *Electricity Retail Energy Deregulation Index*, April 2003, at 9-13.

[3] Maine, Massachusetts, and New Jersey currently utilize competitive procurements to supply certain captive retail loads, while many other states (for example, Connecticut, Pennsylvania, Ohio) are in the process of deciding how retail consumers' rates will be set following the completion of transition periods.

[4] An example of where consumers face this risk regularly is the purchase of home heating oil. As any consumer with a home-heating system that utilizes oil knows, price variations season-to-season and year-to-year can be considerable, and most suppliers offer various levels of insurance in the form of fixed and/or fixed/variable pricing arrangements.

[5] Order Number D.T.E. 02-40-B, Investigation by the Department of Telecommunications and Energy on its own Motion into the Provision of Default Service, April 24, 2003.

[6] Order No. 78400, In the Matter of the Commission's Inquiry into the Competitive Selection of Electricity Supplier/Standard Offer Service, Case No. 8908, April 29, 2003.

[7] In states that have retail competition, offers to supply residential consumers have for the most part been limited. Although aggregation efforts have overcome this problem in certain states, there is clear evidence that even when it would appear that competitive suppliers could capture retail consumers, competitive offers are not made by suppliers.

[8] For example, Maine and New Jersey.

[9] Numerous trade press articles report the adoption of new consumer care systems and back office computing systems that can be used to more closely monitor consumers' demands and wholesale market prices.

[10] Using these forecasts of hourly price and demand for various geographic regions, we were able to calculate estimates of the wholesale costs to serve various utility consumer classes assuming different levels of risk management. Our analysis assumes that various over-the-counter electricity products (both energy and capacity products) are available, as well as reasonably well-behaved wholesale spot markets (i.e., limited price spikes as capacity is assumed to be compensated through longer-term markets).

[11] Our branch then becomes "bushier" as different hedging options are evaluated.

[12] We consider consumer classes to be residential, and large, medium, and small commercial and industrial.

[13] Many pricing formulations require that prices be distributed lognormally. The validity of this assumption has not yet been thoroughly tested, especially given that price distributions can be bimodal. Also, time series econometric price forecasting techniques are also difficult to implement, given the sensitivity of electricity prices to changes in supply from month-to-month and year-to-year.

[14] This approach is, of course, not new, but is likely now easier to apply given the time that has elapsed since the introduction of transparent spot markets and the development of more liquid forward markets. See, for example, Henney, Alex, and Keers, Greg, "Managing Total Corporate Electricity/Energy Market Risks," *The Electricity Journal*, October 1998, Volume 11, Number 8.

[15] When considering other approaches we reviewed various formulaic approaches available to convert electricity forward market pricing information into an annualized fixed price that can then be offered to a retail consumer. (There are some formulas available to make this calculation, although they rely on an extensive amount of input data that must be estimated using either various modeling techniques or the analysis of historical data. See for example, Eakin, Kelly, and Faruqui, Ahmad, "Pricing Retail Electricity: Making Money Selling a Commodity," in *Pricing in Competitive Electricity Markets*, Kluwer Academic Publishers, 2000.) Although these formulations rely on forecasted spot prices in the same way that our analysis does, we wanted an approach that allowed us to explicitly evaluate the impacts of hedging expected demands. Additionally, there are various statistical techniques available to price hedge products that could be offered directly to consumers facing real time rates (based on analyses using similar forecast data), although the number of consumers facing hourly rates is small and it is likely that most consumers large enough to face these rates would prefer greater price certainty. (See for example, Chapman, Bruce, *et al.*, "Hedging Exposure to Volatile Retail Electricity Prices," *The Electricity Journal*, June 2001.)

[16] There are also new approaches being developed that combine structural and statistical approaches to evaluate market place interactions dynamically. See, for example, Ilic, Marija D., and Skantze, Petter L., Valuation, *Hedging and Speculation in Competitive Electricity Markets*, Kluwer Academic Publishers, 2001.

[17] An advantage of this approach is the ease with which the exposure of an entity to price spikes can be tested. (Price spikes introduce significant problems for statistically based approaches.) Once scenarios have been established and expected hourly prices calculated, it is simple to review the impacts of extremely volatile prices in order to assess the potential liability of a low probability event. Through this type of analytical exercise the level of volatility that is implied in options prices can be examined directly against the risk that is taken when short-term expected demand is expected to exceed hedged positions. This permits a degree of *ex ante* consid-

(Continued on page 18)

BIEE

BRITISH INSTITUTE OF ENERGY ECONOMICS

Award of Jane Carter prize 2004

The British Institute of Energy Economics, in association with the International Association for Energy Economics and the Association for the Conservation of Energy, will be awarding the Jane Carter prize in 2004 for the best essay on the following subject:

"What role can energy efficiency gains play in the stabilisation and reduction of carbon emissions from the consumption of fossil fuels?"

Details of the prize and conditions of the prize competition are as follows:

- The prize amount is US$800 (£500 or 700 euros).
- Essays must be no longer than 2500 words in length.
- Essays must be submitted for judging by Friday 26th March 2004.
- Applicants must have been in full time education and under 30 years of age on 31st December 2003.
- Applicants must provide with their application the name of their educational institution and the name of their academic supervisor.
- The competition will be judged by Professor John Chesshire of the University of Sussex on the basis of a short list of three drawn up by representatives of the BIEE, IAEE and ACE.
- The prize will be awarded at a BIEE event to be held in June 2004.

Essays should be submitted to the following address (hard copy):

Mr. Michael Smith
Head, Energy Analysis, Economics Unit
BP plc
1 St. James's Square
London SW1Y 4PD
United Kingdom
Fax: +44 (0)20 7496 4533

Or by e-mail to:
smithmd2@bp.com

Energy (In)Security in the 21st Century

*By John R. Brodman**

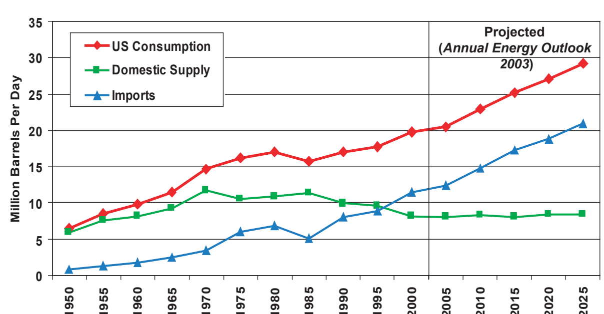
Energy security, like beauty, is in the eye of the beholder. What is it? How do you define it or measure it? How much is enough? While the answers to these questions depend in large measure on your perspective, our energy security concerns are a dominant factor in U.S. energy policy for many reasons:

1. Many of our long-standing concerns about energy security stemming from developments in the Middle East are still with us;
2. Energy security is often an entry point or rationale for government interference or involvement in energy markets;
3. There are many new challenges in the area of energy security itself, some stemming predominantly from our growing concerns with terrorism;
4. Oil producing countries, old and new, large and small, are increasingly facing new challenges and new threats, often from internal sources of instability, which can have an impact on our energy security; and
5. There is concern that our growing dependence on oil and gas imports may have considerable influence on our foreign policy.

Growing reliance on imported oil was a major consideration in the development of the President's National Energy Policy (NEP), which was issued in May 2001. The NEP recognizes that U.S. dependence on imported oil has serious economic and national security implications. Just let me run through a few basic charts to define the problem and set the stage for our discussion:

Chart one shows the evolution of U.S. dependence on imported oil. Consumption is rising with income and population growth, and domestic production is at best trying to hold its own.

Chart 1
Increasing U.S. Petroleum Consumption



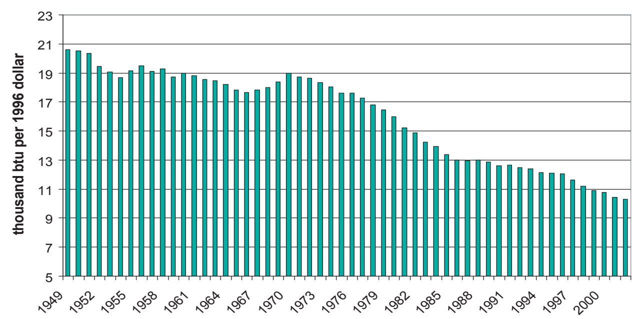
Our dependence on imports has gone from nil in 1950 to close to 50% in the late 70's, declining after that as a result of Alaska and high prices, then rising to 50% in the late 90's and on up since then. It is expected to keep rising through the forecast period to close to 70% by 2025.

We have experienced major supply disruptions in the past, including the OPEC production cuts in '99 and 2000, and their impacts on oil prices. And, of course, it is the impact of the oil price increases that has the negative effects on our economy and our economic security.

The coincident timing of the oil price increases and periods of economic recession in the U.S. is noteworthy. The period of stable prices up to 1973 was marked by surplus capacity and price controls, and an underrealization by OPEC of its market power.

Chart 2 shows that the U.S. economy is becoming more resilient. In the last 50 years, we have reduced the amount of energy required to produce a $1.00 of GDP by half. Now we know that this gross measure disguises a lot of different factors at work, but it is, nevertheless, significant. Oil consumption per unit of GDP, however has only declined about half as much as total energy per unit of GDP.

Chart 2
U.S. Energy Consumption per Dollar of GDP



Now let me turn for a moment to recent developments in the market.

The Organization of Petroleum Exporting Countries (OPEC) continues to employ a production policy that has resulted in low inventories and relatively high world oil prices. In late 2001, the combination of reaction to September 11 and slowing economic activity sent oil prices for a brief period below $20 (for New York Mercantile Exchange West Texas Intermediate). OPEC cut its official production quota in both September 2001 (by 1 million barrels per day) and January 2002 (by 1.5 million bpd) in an effort to support its price goals. The latter cut was taken in conjunction with cooperation from key non-OPEC producers such as Russia, Norway, and Mexico. The market responded to the cuts in production, with oil prices rising in the first few months of 2002. Crude oil prices spent most of 2002 in a range of $26 to $30 a barrel.

The strike in Venezuela in December 2002 and the resulting cut in Venezuela's exports hit the United States particularly hard. The U.S. had typically imported 1.5-2.0 million bpd of oil from Venezuela. Oil imported from Venezuela is also considered "short-haul," in that there is a 5-7 day transit time to the United States, compared to 40-45 days for crude

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oil shipped from the Middle East. Crude oil prices began rising with the December strike in Venezuela, then were pushed higher in early 2003 by the uncertainties created by the situation in Venezuela, strikes and upcoming elections in Nigeria, and the looming possible conflict with Iraq. Crude oil prices peaked in the upper $30's in late February and early March. With Saudi Arabia and other producers taking action to ensure supply, prices fell back below $30 a barrel in the days leading up to the March 20 start of the war in Iraq.

Oil prices have fluctuated around $30 since the end of the war in Iraq. OPEC took action in late April 2003 to get its production down from its pre-war heights (raising its official quota, but with the goal of reducing "real" production), in order to make room in the market for the return of Iraqi oil. OPEC then surprised the world oil market at its September 24, 2003, meeting by taking a more "proactive" role in managing the market, by looking ahead and anticipating the expected weakness in the second quarter of 2004, and by cutting production by 900,000 bpd.

U.S. crude oil and primary product inventories have been running lower than normal for some time. They never fully recovered from the loss of Venezuelan supplies. U.S. crude oil inventories spent most of 2003 below the low-end of the average range designated by the Energy Information Administration. For several weeks in February and March of 2003, crude oil inventories hovered near the 270 million barrel level, designated by EIA as "lower operational inventory." Gasoline and distillate inventories have joined crude in remaining below normal for most of 2003. Low inventories have been a factor in supporting oil prices.

One of the current causes of volatility in this market place has been the uncertainty about the pace of recovery of Iraqi oil output. It has fluctuated between almost nothing and 3 mmbd in a very short period of time.

OPEC has had a difficult time coping with this and the other uncertainties, but we feel that they have done a better job in the last few years of anticipating weakness in the marketplace and cutting output, than they have done at anticipating tightness in the market and increasing production. We wish they were more symmetrical in their behavior towards the market. They, on the other hand, feel that we don't appreciate everything they are doing to keep the market supplied. But at least we're talking.

Energy Security Policy

What have we learned from all this? In the last thirty years, developments in the world oil market dominated our energy security concerns, and we have been impacted by six serious interruptions of supply:

- The Arab oil embargo
- The Iranian revolution
- The Iran/Iraq war
- The Iraqi invasion of Kuwait, the first Gulf war, and the subsequent embargo
- The recent strikes in Venezuela, and to a lesser extent in Nigeria, and
- Regime change in Iraq

But even this is not the whole story. By some counts there has been one major disruption every three years in the last half century, and four in the last two years alone. The point made by many observers is that oil supply disruptions while unpredictable, are inevitable.

We have devoted a great deal of effort over the years to analyzing the differences between import dependence on the one hand, and vulnerability to supply disruptions on the other. In the short term, we learned to allow market forces to allocate supplies, and to depend on the use of excess production capacity and strategic reserves to augment supplies if required. We learned that oil is a fungible commodity, and that the marginal barrels are the determining factor in the marketplace. In the longer term, we strove to improve our energy security through diversity, in both the types of energy we use and in the sources of supply, and through efficiency gains, which limit the economic damages of price shocks on our economy.

We developed over time, with varying degrees of success, a flexible, or organic energy security policy that was based on a changing mix or combination of policies. This combination of policies is a mix of:

- Reliance on market forces
- Opening markets to free trade and investment in energy resources
- Energy efficiency
- Diversification of supplies, both in the types of energy we use and in their sources
- Science and technology, research and development for the long term
- Good relations with the rest of the world
- A strong military to protect our interests, and
- Strategic petroleum reserves, both as a deterrent and as a supply of last resort.

At the heart of this flexible, multiple policy approach was and is a desire to promote and protect resilient international oil and energy markets through the application of sustained policies that transcend political partisanship and stand the test of time. The goal was to reduce the threat and incidence of disruption, and to mitigate the effects of a disruption if it did occur.

We have also come to realize that there is no magic or "silver bullet" policy prescription for our energy security concerns. It isn't Russia, it isn't West Africa, it isn't ANWR, it isn't renewables, and it isn't restrictions on consumption. Its not nuclear, or hydrogen. Rather, it is all of them taken together that give us a measure of protection. Higher excise taxes on petroleum may make economic sense, but they are politically improbable.

U.S. energy policy is founded on the belief that open markets ensure optimal production and supply of energy. But government policy also recognizes that open markets largely reflect the situation here and now, and that the government has a role to play in assuring that technologies are developed to ensure the most efficient use of energy, to facilitate the use of alternative fuels and energy carriers such as hydrogen, fusion and nuclear, and to develop new, secure energy supplies to meet the energy needs of today and the future.

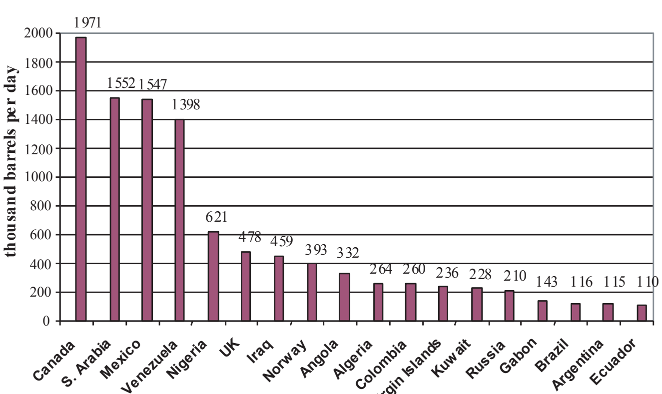
Also, from an energy security point of view, U.S. government energy policy has a strong role to play in assuring our energy supplies represent a diverse set of energy resources from a diverse set of energy suppliers. The National Energy Plan, issued in May 2001, embodies these fundamental principles and recommends actions that will help achieve these objectives. The Plan also recognizes that the United States cannot address its energy concerns alone, and that our energy security is intricately linked to international markets as a result of our increasing dependence on external sources of supply.

U.S. energy policy recognizes these new international challenges, and the National Energy Plan calls for strengthening our global alliances through such important mechanisms as our existing bilateral relationships with key countries and regions around the world, and through our participation in multilateral energy institutions such as the IEA and IEF. Security of supply is the driving force behind our policy engagement on energy issues with most countries.

In this context, I would like to say a few words about diversity. Thirty years ago oil was produced in commercial quantities in just over 60 countries around the world, and the share of the top ten producers in overall world supply was greater than 80 percent. Today, oil is being produced in commercial quantities in over 90 countries, and the share of the top ten producers has fallen to about 60 percent. While some of this increase in the number of producers can be attributed to the breakup of the former USSR into separate countries, there are also many new producers, in Africa, Latin America and elsewhere.

Chart 3 shows the current makeup of U.S. imported oil supplies, with the position of the top four, Saudi Arabia, Mexico, Canada, and Venezuela, being followed by a diverse set of suppliers from all over the globe.

Chart 3
U.S. Petroleum Imports by Source
2002



Note: Combined crude oil and product imports
Source: Energy Information Agency *Petroleum Supply Annual*

Russia, the Caspian, the Western Hemisphere and Africa are important sources of our imports of oil and natural gas, and that their importance is likely to grow in the future. They are likely to be an important source of additional supplies for decades to come. But their proven reserves and production will never allow them to replace the Middle East in importance to world energy markets. Eventually, our dependence on the Middle East will grow again. This is what I call the geologic facts of life.

Now what does that mean for energy security? In the first place, we have always favored a strategy that promotes a diversity of supplies. In this sense, this new diversity is generally viewed as a good thing. While you can argue that more oil from diverse sources might raise the risk of disruption simply because there are more producers, you can also argue that the disruption will likely be smaller in the first place, and more likely to be offset by compensating increases from the other sources.

While our policy of supply diversity has been successful to some degree, the development of many frontier oil provinces carries with it its own set of political, economic and security risks. Our policy of diversifying supplies relies on commercial investment in energy projects. We don't tell our companies where to invest or where to buy oil. It is up to them, and there are a considerable number of obstacles to realizing this commercial investment, directly related to economic, political, and security risks.

An unfavorable business climate may keep needed resources locked away from development for a long time.

The emerging threats to energy security in many new producing countries and regions, and indeed, as recent developments in Venezuela and Nigeria have demonstrated, in older producing regions as well, are somewhat different than those we have faced in the past. As a result, they may also require new policy responses. In the past, supply disruptions came from sovereign political decisions, revolutions, conventional wars, and acts of nature. Today there are increased risks from non-traditional, and often internal, sources of conflict, such as:

- Corruption and a lack of transparency
- Governance issues and human rights
- Federal, state, and local jurisdictional disputes
- Ethnic/religious conflicts
- Border and territorial disputes
- Energy sector revenue management issues, poverty and the distribution of income
- Lack of managerial capacity
- Political instability
- Environmental issues
- Lack of "rule of law" and dispute settlement procedures, unfavorable business climate

These threats to energy security, clearly recognized in the National Energy Plan, may not always lend themselves to conventional security solutions. These new threats call for a continuation (and possible enhancement) of the balanced and sustained engagement with the oil-producing countries that we have been pursuing, to help them manage and utilize their revenues in a way that promotes political stability and sustainable economic growth. For this reason, it may be that sustainable development is the real frontier battleground for energy security in the 21st century. The lack of good governance is also a fertile breeding ground for terrorism, and we may have not yet grasped the full implications of terrorism for the energy sector.

Speaking rhetorically, it may be reasonable to ask why and whether oil consumers or developers should be responsible for promoting sustainable economic development in many of the new oil producing countries? I would respond that we may need to be more engaged on sustainable development issues with energy producers in order to minimize many of these new, internal threats to stability, and to promote, protect and defend our own security of supply, and our own security in commercial energy and trade relationships.

Let me now turn to the Strategic Petroleum Reserve. Figure 1 shows the evolution of our SPR policy. The EPCA authorized the establishment of an SPR up to 1 billion barrels. There are currently about 640 million barrels in the reserve, or an amount equivalent to 60 days of our net oil imports. We are currently filling the SPR with federal royalty oil at a rate of about 150,000 bpd, and we expect to reach capacity of 700 million barrels by the middle of 2005.

Figure 1
SPR Development History

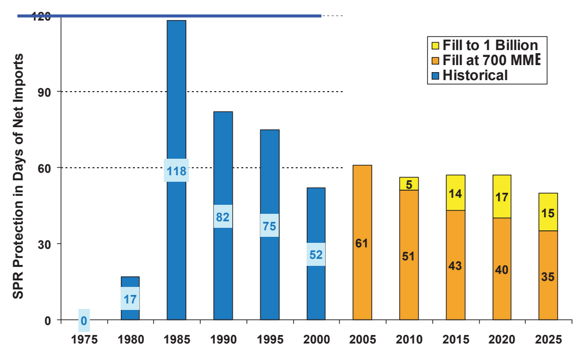
- 1975 *Energy Policy and Conservation Act (EPCA)* authorizes establishment of an SPR up to **1 Billion Barrels**.
- 1976 DOE submitted Plan to **establish a 500 MMB** Reserve based on 1974 and 1975 levels.
- 1978 DOE submitted Plan Amendment to Congress to **increase Reserve to 750 MMB.**
- 1990 Congress directed DOE to **submit a Plan for expansion** of the Reserve to 1 Billion Barrels.
- 1991 DOE **submitted a Report** to Congress **on Candidate Sites** for the 1 Billion Barrel Reserve.
- 1991 DOE notified Congress it **would not expand** the Reserve **until** fill of the currently available capacity **approached a need** for further capacity development.
- 1992 DOE **completed the development** of the Reserve **to 750 MMB**.
- 2001 President Bush **directed** the Reserve **to be filled to Capacity** using Federal Royalty Oil.
- 2001 The U.S. House unanimously passed a Resolution urging the Bush Administration **to increase the Reserve to 1 Billion Barrels.**

Chart 4 shows that the days of import coverage afforded by the 700 million barrels is expected to decline after 2005 as imports continue to rise. The light increment on the chart shows the additional increment of protection we would get if the size of the SPR were increased from 700 million to 1 billion barrels.

Now on SPR use policy, which is much more controversial, there are probably as many as many views about the right way to manage strategic petroleum reserves in this room, as there are people. For example, during this recent period marked by the strike in Venezuela and the lead up to the war with Iraq, some people believe that the mere existence of strategic reserves, coupled with an active debate in IEA Member Country capitals about how and when to use them, was enough to incentive, in addition to the already high prices, to push producers to raise output to keep the market adequately supplied, and to put a lid on speculative activity. They argue that this prevented governments from actually having to intervene.

Then, there are others who feel that the strike in Venezuela was a tailor made text book case for a use of the U.S. SPR. We lost 2 mmbd of short haul oil, and any replacement oil from Africa or the Mideast would take weeks to get to our ports. Why not use the SPR as a bridge mechanism to fill this temporary gap? In the end, we felt that with the possibility of war, it would be better to get spare production on line asap, so it would already be available by the time an even more serious loss might occur.

Chart 4
Projected SPR Protection



In addition, European Union energy ministers recently debated a proposal that would have them using their reserves in a more proactive, interventionist way to deal with market fluctuations, and promote a managed stability in the oil market. Fortunately, they decided against it.

I think there is a danger here. The more governments use their strategic reserves to intervene in the market, the easier it becomes to justify more intervention. It is a slippery slope in policy terms, and once you start down this road it is hard to stop. Also, frequent use of strategic reserves will remove the incentive for private stockholding activity, and reduce the incentive for producers like Saudi Arabia to hold spare production capacity. Where would we be without spare production capacity? I would argue in the spirit of newfound cooperation between producers and consumers, that reliance on the market and use of this spare production capacity is our best and first line of defense.

Spare production capacity has varied widely in the past 30 years. Spare production capacity costs money, and there will only be an incentive for producers to maintain spare capacity in the future if they are able to use it from time to time to take advantage of market fluctuations and earn some extra bucks.

Today spare capacity is around 2.5 mmbd, but most of that is in one country: Saudi Arabia.

The other challenge surrounding strategic reserves continues to be the need to integrate the new strategic reserve policies of China, India and other large consumers into the mainstream.

China

Any discussion of energy security today would be incomplete without acknowledging the potential growth of demand for oil in China, India and other large consumers. If motor vehicle ownership in China and several other countries even begins to approach the levels of the developed world, spare production capacity as it exists today could disappear quickly, and capacity could be hard pressed to keep up with growing demand. China's demand is growing at a rate of 15% per year, and its imports are growing at a rate close to 30%. China's imports could rise to 4-5 mmbd by 2010 and to a level similar to our own by 2030.

Is this a potential threat to our energy security? It could be in some circumstances. It could also signal the beginning of a new era of much higher oil prices that may or may not be coupled with the imposition of controls or limits on the growth of oil consumption in some countries. In any event, it bears watching.

Finally, the newfound cooperation between producers and consumers shows how much improved communication can prevent misunderstanding and help to keep the market adequately supplied. While improved cooperation between producers and consumers is generally regarded as a good thing, it does have the potential of going full circle and raising a whole new series of transparency concerns.

Wholesale Electricity Procurement Strategies *(continued from page 12)*
eration of managing certain spot market risks that may arise during unexpected unit and transmission line outages.

[18] Structured products are available in bilateral markets, but their prices are not widely reported.

19 We use Natsource, Platts, and TrueQuote as sources for forward contract pricing data. These data were collected during Spring 2003 such that our analyses look forward starting with June 2003.

[20] Because wholesale products are most typically sold as blocks of on-peak power, in many instances when hedging is carried out there is a need to sell back excess quantities.

[21] In our analysis for the PJM region, the forward contract data available were for forward terms that were shorter. Therefore, for this analysis, we assumed two one-year forward contract purchases for the yearly minimum on-peak and off-peak demands for 2003 and 2004.

[22] We used various utilities' load profile data and total consumer counts to develop hourly demand profiles that were then combined with forecasted demands used in the modeling to determine expected hourly demands. We did not make any adjustments for potential impacts of consumer migration during the study period, but instead assumed that all demand must be served regardless of how individual entities end up serving it. It is straightforward to take this same analysis and examine how serving various combinations of consumer classes will affect projected costs.

[23] Developing estimates of these costs will vary by state and region. In some instances, these services will be purchased from the incumbent investor-owned utility in the region, while in other instances, they can be purchased from the wholesale market. Our capacity cost estimates assume the use of longer-term contractual instruments for the provision for capacity.

[24] In Tables 2A-B and 3 we show that monthly and annual cost estimates would fall into a range that is associated with the underlying fundamental assumptions used for the price forecast. For example, the low side value would be associated with lower load or fuel prices when compared to a base case that uses extant market information at the time the forecasts are developed, while the high side would represent higher fuel prices, load or unit outages.

[25] The price forecasts include many hours where prices are above $100/MWh, but all forecasted prices assume that supplies are offered to the energy market based on generating unit marginal operating costs.

[26] This underscores the point that hedges are protective and do not generally lower costs, but instead stabilize costs.

[27] In these example analyses, we purchase these firm hedges for the months of July-September and January-February.

[28] This pictorial representation provides the intuition behind identifying the amount of hedge to purchase. In our analysis, we minimized the relative difference between each of the lines and the base case when selecting the hedge amount.

[29] Variations among consumer classes are similar to those observed in the limited hedging approach.

[30] The opposite approach—purchasing puts if more firm on-peak hedge positions were taken than described—is equally feasible, although we did not use this approach.

[31] We used call option pricing data obtained from Trueqoute.com as a source of call option prices.

[32] Additional analyses would look at different combinations of hedges to see if a particular approach that combines call options and firm monthly purchases is more cost effective.

Energy Security in an Insecure World

*By Paul Tempest**

My intention here is to place North American energy issues in a global context with particular relevance to the Middle East. I intend to focus on the prospects of the international trade in oil and natural gas over the next twenty years and the likely political consequences of the most probable shifts in the pattern of global demand and supply.

In previous visits to Mexico, I have spoken for the British national interest, for Shell International and at the World Petroleum Council AGM. Now I am free of affiliation and speak my own personal view: *bis-sarahat min galbi*, as it would be put in Arabic – *frankly and from the heart.*

Global Energy Import Demand is Rising Sharply

The International Energy Agency, World Bank and many others expect global energy demand to increase by at least 60% over the next 20 years. A sustained population rise in the developing world, swift urbanisation and widening expectations of enhanced mobility will be the bedrock of this rising global demand for energy. Recession and credit collapse may result in local and temporary downturns, but the global numbers appear robust. Moreover, contrary to general opinion a decade ago, U.S. and European energy demand has resumed a vigorous upward trend.

With coal constrained by environmental considerations and nuclear power limited by concerns over safety and weapons proliferation, the bulk of increasing global demand will have to be met within this period by new oil and natural gas production, much of it imported. Alternative energy including hydro-electricity will bring little change to the global energy mix within the period.

Intense Competition for New Oil and Gas Imports

Four main groupings will be in conflict to secure additional imports of oil (*see Tables 1,2 and 3)* and also of gas.

- The United States, currently importing 11 mbd net of oil is expected to add 8-12 mbd to oil imports. Rising natural gas demand may be met by new massive pipeline imports from Canada (and possibly also Mexico) and imported LNG and other gas liquids.
- Europe currently importing net 10 mbd of oil, pins its hopes on new pipeline supply from Russia. Its high dependence on Russian gas imports may be increased if adequate pipeline infrastructure can be installed and updated in time.
- South-East Asia, led by China, Japan and South Korea will provide the strongest impetus to oil and gas development in other Asian states, notably the leading Gulf producers of oil and gas.
- The Advanced Developing Countries will face massive step-jumps in economic activity, much of which can only be sustained by increased oil imports.

Table 1
Global Oil: North America's Share in 2002
Mbd

	Consumption	Production	Shortfall (-) Surplus (+)
USA	19.7	7.7	-12.0
Canada	2.0	2.9	+0.9
Mexico	1.8	3.6	-1.8
N America	23.5 (31.0%)	14.2 (18.8%)	- 9.3

Source: BP Statistical Review of World Energy, June 2003

Table 2
Global Oil: Asia Pacific's Share in 2002
Mbd

	Consumption	Production	Shortfall (-) Surplus (+)
China	5.6	3.4	- 2.2
Japa	5.3	-	- 5.3
S.Korea	2.3	-	- 2.3
India	2.1	0.8	-1.3
Other	6.1	3.1	- 3.0
Asia Pacific	21.4 (28.3%)	7.3 (9.6%)	-14.1

Source: BP Statistical Review of World Energy, June 2003

Table 3
Global Oil: The Middle East Share in 2002
Mbd

	Consumption	Production	Shortfall (-) Surplus (+)
Saudi Arabia	1.4	8.7	+7.3
Iran	1.1	3.4	+2.3
Iraq*	0.5	2.0	+1.5
Kuwait	0.2	1.9	+1.7
UAE/Qatar	0.3	3.0	+2.7
Other	0.8	2.0	+1.2
Middle East	4.3 (5.6%)	21.0 (27.7%)	+16.7

Source: BP Statistical Review of World Energy, June 2003

The Bulk of New Oil and Gas Supply Will Have to Come from the Gulf States

The Gulf producers hold 63.8% of proved global oil reserves and 34.5% of proved global gas reserves. The Russian Federation holds a further 30.5% of the gas total. (*See Table 4)*. Much of the rest involves higher average costs of extraction and often more difficult access to markets.

"The Numbers Do Not Add Up !"

A best guess of oil import demand in 2025 (78-92 mbd) and the likely availability of oil exports (56-68 mbd) leaves a massive shortfall of 10-36 mbd. (*see Table 5).*

A Free or A Managed Market?

U.S. complacency is based on the assumption that the economic weight of the United States (25% of global energy consumption), operating on a free open world market for oil and an emergent spot market for natural gas, will ensure that it can outbid its competitors for the available supply. The USA

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would thereby be in a strong position to redirect the flow of oil and gas to the United States whenever this is needed and, with the flexible use of the U.S. Strategic Petroleum Reserve and the assistance of a strong naval if not military presence in the Gulf, will be well-placed to manage the global oil and gas market to its own advantage.

Table 4
Global Proved Reserves of Oil and Gas at End-2002

	Oil (000mnbls)	%	Gas (TCF)	%
USA	30.4	2.9	183.5	3.3
Canada	6.9	0.7	60.1	1.1
Mexico	12.6	1.2	8.8	0.2
N. America	**49.9**	**4.8**	**252.4**	**4.6**
Iran	89.7	8.1	812.3	14.3
Qatar	15.2	1.5	508.5	9.2
Saudi Arabia	261.8	25.0	224.7	4.1
Iraq	112.5	10.7	109.8	2.0
Kuwait	96.5	9.2	52.7	1.0
UAE	97.8	9.3	212.1	3.9
Other	13.1	1.4	49.5	0.9
Middle East	**685.**	**65.4 %**	**1979.7**	**36.0%**
Russia FED	*60.0*	*5.7*	*1680.0*	*30.5*
Other FSU	17.8	1.7	272.6	5.0
Total FSU	**77.8**	**7.4**	**1952.6**	**35.5%**
Other – ROW	236.4	22.4	1316.8	23.9
Total World	**1047.7**	**100%**	**5501.5**	**100%**

Source: BP Statistical Review of World Energy June 2003

This assumption ignores the realities of the Asian market today and also the growing economic and political ties between the leading Gulf producers and the leading Asian consumers led by China, Japan and South Korea.

If large volumes of oil and LNG are to be switched to the United States and Europe at the expense of Asia, there are other risks to be taken into account, most notably the length and cost of the Cape route and the safety and security hazards of transiting the Suez Canal or trans-shipment of large volumes by pipeline across Egypt.

Table 5
PTA Estimates of Global Oil Trade 2025
Based on IEA, World Bank, APERC and Industry Estimates
Mbd

Major Net Importers		Major Net Exporters	
USA	18-22	Middle East	21-24
Europe	19-21	FSU	7-9
Japan	7-9	West Africa	5-7
China	10-12	Ven/ Mex	6-7
ROW`	24-28	ROW	17-21
Total	78-92	Total	56-68

These estimates produce a global shortfall of 10—36 mbd and throw into question the validity of the net import estimates.

One alternative, recently aired in Washington DC, of a new pipeline for Iraqi, Saudi and Kuwaiti oil to be carried across Jordan and Israel to new loading terminals on the Mediterranean would inflame public opinion and unite opposition throughout the Middle East. The history of previous pipelines on this route is not good.

Summary

Twenty years ago about one-third of Gulf exports of oil went East and two-thirds went West. Gas (LNG) exports were in their infancy. Today the proportions for Gulf oil exports are reversed with the prospect of Asia steadily increasing its share of Gulf supply. These bilateral arrangements are being enmeshed in long-term trading, financing and economic co-operation arrangements and contracts which deliberately isolate them from the open market. The multinationals and other carriers of Gulf oil and gas will not, therefore, be able to divert their cargoes to the West whatever the price offered by the United States and Europe.

This suggests that the United States and Europe should be re-examining urgently their assumptions about enhanced imports of oil and gas. This, together with the likely prospect of a rising long-term oil and gas-price, may stimulate new investment in domestic resources such as the U.S. Continental Shelf and Alaska and in other sources of European imports such as those available in Russia and Central Asia. Energy demand management, particularly fiscal incentives for improved efficiency of energy use, may also be coming up for radical review.

Nonetheless, there is considerable hope that, as all sides recognise the above realities of the market, there will be room for some Gulf oil and gas to flow West. The Gulf producers will not wish to put all their eggs in the Asian basket and will wish to obtain Atlantic prices from their Asian customers by participating in small measure in that Atlantic market. The Asian consumers, who are already united by their anger over the "Asian premium", the differential between f.o.b. prices on Gulf cargoes going East and West, will nonetheless be competing vigorously with each other.

The U.S. military and naval protection of the key sea-lanes and notable choke-points (notably the Straits of Hormuz and the Straits of Malacca) will almost certainly be financed willingly and amply, directly or indirectly (in cash or in oil and gas) by the principal Asian importing states and the lead Gulf producers.

Such a benign and peaceful outcome in global economic and political terms is likely to be frustrated if it is widely perceived in the Middle East that the U.S./UK mandate in Iraq, whether of short or long duration, involves any expropriation of Iraqi oil.

All the Gulf states have a fundamental interest in a peaceful stable political environment to enhance development and prosperity, and regard the growing violence, social turbulence, economic development delay and widespread individual suffering in Iraq as a magnet for dangerous outside dissidents. This poses the threat of a spill-over, challenging their own stability and security. Any collapse in confidence in the Gulf political system would also effectively put a block on most investment in new oil and gas production capacity.

The litmus test of good faith will be clear if revenue from sales of Iraqi oil is seen to be being wasted or not fully and efficiently deployed for the direct benefit of the Iraqi people or is seen to be diverted elsewhere, directly or indirectly, outside Iraqi control.

Economic Theory and an Update on Electricity Deregulation Failure in Sweden

*By Ferdinand E. Banks**

Abstract

The deregulation of electricity has failed in Sweden. Since the beginning of the deregulation *experiment*, the trend price of electricity has increased much faster than the consumer price index, especially during recent years. More important, because of (1) the lack of investment in domestic generating (and perhaps transmission) facilities by Swedish power companies, (2) the questionable strategy employed by these firms to manage hydroelectric reserves, (3) increased and to some extent irrational energy taxes, and (4) the beginning of nuclear disengagement, households and businesses are vulnerable to a prolonged spike in electricity prices. Everything considered, the recent history of the Swedish electricity sector – and particularly that of the overpraised Nordic Electric Exchange (i.e., Nord Pool) – should be considered a wake-up call instead of an example.

The first Nordic country to initiate reform in the electric sector was Norway, in l991. Next was Finland, in l995, Sweden in l996, and finally Denmark toward the end of l999. The government of Iceland does not seem to have committed itself on this subject.

The exact theory behind the proposed deregulation – or restructuring as it is usually called in English speaking countries – is difficult to pin down, since Norway and Sweden already had the lowest cost electricity in the world; and although various taxes and levies have resulted in substantial differences between the market price and the cost of power, Swedish and Norwegian households (and probably most businesses) were still favored as compared to their counterparts in neighboring countries, including those on the other side of the Baltic who now enjoy a growing access to Swedish power. There was, however, a significant belief among decision makers that switching from regulation to competition would bring significant efficiency gains, including lower consumer prices. Among other things this provoked a desire to widen the market for trading electricity. Exactly what effect these new arrangements could have on final consumers in Norway and Sweden was not spelled out in detail, but it was repeatedly claimed that one of the purposes of deregulation was to shift risk from consumers to producers and investors.

At this point readers should make some effort to understand the significance in Scandinavia of the "taxes" and "levies" referred to above, since these are often overlooked in the mainstream discussions of restructuring. As Braconier (2003) recently pointed out, during a period in which the price of electricity in Sweden, before the addition of taxes, is extremely high for the time of year, various taxes and levies have tended to increase this price by more than l00 percent. This is not a healthy arrangement for a country whose overall standard of living is at least partially based on inexpensive electricity. Because of their external commitments – e.g., the enormous direct and indirect costs of belonging to the European Union (EU) – the Swedish government apparently feels that these and similar taxes are essential.

What especially needs to be kept in mind is that the matter of risk management – which the Yale economist Robert Shiller calls the primary subject matter of financial economics – is much more complex in electric markets than in most commodity markets. One reason is that the electricity sector per se is more complex, as was recently demonstrated in Brazil and North America! Moreover, it was not made simpler by restructuring, since almost everywhere this process has raised issues of gaming, market power, price spikes, reliability in distribution networks, and congestion that are not readily understood by persons without both a technical and economics background, and which have not always been successfully addressed even when these issues are understood perfectly.

At the International Association for Energy Economics (IAEE) meeting in Prague, a colleague from New Zealand suggested that there should be little difference between risk management procedures for natural gas and electricity, while there are researchers who apparently believe that a market for electricity derivatives (i.e., futures, options and swaps) can function more smoothly than one for natural gas. As it happens though, gas can be stored in a conventional manner, and so although its price volatility is much larger over short and medium time intervals than for items such as oil and and various financial assets, it is still well below that of electricity. What this intimates is that while sophisticated risk management techniques are an essential element of restructured electricity markets, there is plenty of evidence indicating that even in the long run, their availability on a large scale cannot be taken for granted.

In what follows, no attempt will be made to describe the exact structure and mechanics of the electricity derivatives markets in Sweden or anywhere else, but instead attention will be focussed on various issues associated with these markets. One of the most important is the attempted marginalizing of the long term contracts for physical electricity that are traditionally used to minimize risk on the wholesale (i.e., generation) side of the electric market. Instead, the ambition was to construct a system in which financial instruments in the form of exchange traded futures and options would be at the center of risk managing efforts. This is an extremely important objective, because it suggests that if generators could readily hedge against unfavorable outcomes, they might find it profitable to furnish the expensive power plants needed to meet a rising demand without consumers having to endure

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destructive price escalations. But as Budhraja (2003) points out, in an environment of uncertainty, adequate new capacity is unlikely to be constructed.

An Introduction to the Risk Management Scene

On 1 January, 1990. Sweden joined the Norwegian electricity exchange (Stattnett Marked AS) to form the first multinational market for trade with electricity, which was called Nord Pool. Four years later Finland and Denmark became members.

Initially the only trades were for physical electricity, with the goal – implicit or otherwise – of establishing a market that, as the one proposed for California, was to be mainly of the spot variety. (In Scandinavia this market is the major component of Nord Pool, and is called *Elspot.*) Exactly how much the persons who have launched restructuring across the world know about microeconomics is vague, but clearly the intention in these two regions was to treat electricity as much as possible like any other commodity. As later events in California and elsewhere have shown, electricity does not fit this description, since in a large part of the world it is even more important than oil, which many observers insist is the most important commodity of all times. In the words of Budhraja, "electricity is the lifeblood of the digital economy".

Under a (Walrasian) competitive scheme, consumers could contact an auction-type spot market (e.g., Elspot) and buy as much electricity as they desired for delivery at any time, to include immediate delivery, at the prevailing and visible (or transparent) price. This, of course, is unrealistic for technical reasons, and certainly is inconceivable for an item that cannot be stored for even a millisecond. Accordingly, the relevant version of an *ideal* electricity spot market became the day ahead market, which involves trading in standardized hourly contracts for physical delivery the following day. Elspot receives quantity and price bids from buyers, and offers from sellers that, under mainstream textbook circumstances, would form a market-clearing price that could be announced by the (independent) systems operator (who is a kind of surrogate for Walras' auctioneer). Here it should be appreciated that buyers are not households, but distribution companies, where these establishments and their customers form the retail side of an electricity market. Wangensteen and Holtan (1995) introduce these topics.

The modern electric grid is monitored in real time to assure that production always matches consumption, and if it turns out that something prevents Elspot from obtaining a supply-demand equality, the systems operator can turn to a balancing (or regulation) market where suppliers bid the quantities that they are prepared to offer at various prices**,** but at a very short notice! This has been called a "spot market at the margin". Bergman (2002) provides some useful insights into these and related matters, and among other things points out that the large hydroelectric installations in Norway and Sweden facilitate adjusting to variations in demand. This is probably because of the ease with which they can be switched on and off.) In the case of Scandinavia, part of the balancing mechanism appears to be managed by or associated with the segment of Nord Pool called Elbas, which operates with a two-hour time frame, as well as a facility that is unambiguously titled *Balance Service*, which operates in real time. Participants in the balancing power market must respond to notification of the need to adjust their production or demand within 15 minutes. As orignally conceived, the accessibility of these facilities should put the systems operator in position to designate an *equilibrium* (i.e., market clearing) *price* which ensures that transactors on the demand side of the market can buy the electricity they require from profit maximizing sellers in every minute of every day of the year.

Just now, approximately 30 percent of the electricity consumed in the Nordic countries is traded in one form or another at Elspot, with the rest being supplied by an exterior bilateral market in which contracts are signed for a period of a few days up to several years. Strictly speaking, these are conventional forward contracts, with Nord Pool providing a clearing service for these bilateral transactions. This might also be the place to note that in Sweden, generation and supply (or billing, customer relations, etc.) are unregulated, while transmission and distribution are considered natural monopolies.

In your microeconomics text, there might be a passing reference to a forward market adding its advantages to the spot-type market mentioned above, however the non-transparent bilateral arrangements referred to are hardly likely to play a prominent role in the mainstream books and lectures used to describe bona-fide competitive markets to undergraduate economics students. The same can be said about the forward contracts which are handled at Eltermin, but which are conventional forwards only in that deliverability is specified. (They are standardized, which is unusual for forwards, and do not require any physical delivery, which is also out of the ordinary for forwards).

These forwards have been designated *week-ahead* (or *some-time-period-ahead*) assets which hopefully can be traded in an exchange, and which unfortunately are confused with futures by many observers. (The futures contracts on Eltermin, however, are settled daily, while the forward contracts are settled at the end of the contract period.) As for standardized futures and options of the kind that were examined in your finance courses, these are also available and an impression has been given that they have attained an importance at Nord Pool which they definitely lack elsewhere, but I happen to be skeptical about this – especially when I hear talk about the availability of futures with maturity periods of up to 3 years: futures contracts with maturities of greater than a few months tend to be highly illiquid. There is also a swaps – or contracts-for-differences (CfD) – market that recently came into existence, but strangely enough does not appear to have achieved any momentum. As an outsider, it appears to me that restructuring has increased the complexity of the electric market, although I recognize that without these proposed addendums, a restructured market runs the risk of losing its credibility.

Initially, trade in forward contracts took place for both base-load and peak-load power, but trade in the latter could not be sustained, and so these contracts were abandoned. (Base load power is power that is always on the line.) In looking at the situation in the United States at the time when I was preparing my energy economics textbook, NYMEX futures contracts were only valid for on-peak periods, which covered approximately 4416 hours of the year out of an annual total of 8760. Similar dispositions prevail in Australia, which suggests that futures (and in the case of Sweden quasi-futures) will have a difficult time being accepted as the ultimate hedging instrument.

In Scandinavia, forward contracts that have some of the characteristics of futures contracts and CfD were necessary because most Norwegian and Swedish power companies were uninterested in the marking-to-market procedures, and possible margin payments, that help to define a genuine futures market. (Marking to market normally entails losers being held accountable on a daily basis for losses, in which case they must pay a margin in order to retain their position. Margin plays an important role in the Michael Douglas film *A Perfect Murder*, since it was the prospect of heavy margin calls that led to Mr Douglas' decision to do away with his wife.) Additionally, in Scandinavia and elsewhere, major financial players are reluctant to join this game, which generally guarantees a shortage of the kind of serious liquidity that can only be provided by prominent firms which trade to make money rather than to hedge prices.

Naturally, the original intention in Scandinavia, as in California, was that an extensive bilateral market was to be a transitory phenomenon, and orthodoxy in the form of a large-scale spot market would soon be established, but this was more easily said than done. As pointed out early by Peter Jasinski and George Yarrow of the Regulatory Policy Reseach Centre of Oxford University, "…a combination of pooling arrangements and the freedom to strike longer-term bilateral deals appears to us to offer the prospect of workably competitive and efficient outcomes in an industry unlikely ever to be characterized by anything approximating perfect competition". Shortly after this belief surfaced in the UK, and began to circulate widely among researchers and decision makers, it was only a matter of time before both the conceptual and practical shortcomings in exchange-based activities were identified. Once this happened, it was easy to detect the virtues of bilateral contracts that are negotiated in non-transparent private markets between generators and their customers.

It is necessary to reemphasize that almost from the beginning of the restructuring experiments in Scandinavia, California, and Australia, it was generally recognized (even if reluctantly advertised) that the new regime (i.e., competition) could greatly increase price risks for producers and consumers, and comprehensive efforts should be made to introduce the kind of derivatives that had been so successful in many commodity and financial markets. The assumption was that they would not only enable price risk to be satisfactorily hedged, but would increase market transparency to a degree that, on the basis of visible spot and futures prices, it would be possible to obtain a sharper insight into the expectations of market participants.

There are many arguments as to why conventional electricity futures and options should not be expected to consistently function in a desirable manner. These arguments turn on the very large price volatility associated with exchange traded derivatives, which often means an intolerable basis risk for futures, while option premiums could be extremely expensive. This has led to over-the-counter swaps – or contracts for differences (CfD) as they are usually called – becoming the derivative of choice in various electricity markets. (Basis risk quite simply can be thought of as the price going against the buyer or seller of a dereivative, who then receives a margin call from the exchange. These margin calls can be very bad news, and this is one of the reasons why power companies in Scandinavia were reluctant to utilize conventional futures.)

Simple observation immediately reveals that the lack of liquidity has played havoc with the plans of many exchange executives, and potential transactors. The most sophisticated exchange in the world, NYMEX, delisted a batch of its electric and gas derivatives about a year ago; and although the design of the electricity contract at the Sydney Futures Exchange had the assistance of a Nobel Prize winner in economics – Professor Vernon Smith – it lacks liquidity or, in the words of an exchange executive, " market depth". It has also been suggested that the troubles of the Sydney exchange can be atrributed to the absence of a population background in the tens of millions, and in this respect Nord Pool may be lucky, because Scandinavia is an extremely electricity intensive part of the world, and eventually all the countries in the Baltic region might become heavily involved with Nord Pool. In addition, the UK might increase its commitment.

There is, however, no guarantee that the trading of physical electricity is on an upward trend. Restructuring seemed to offer a greatly increased scope for trading, and it was believed in Sweden, as elsewhere, that trading could be an activity that was at least as profitable as production, but this was wrong. (As the U.S. energy giant Dynegy could testify, their trading activities caused them only pain, and one observer has called Goldman Sachs and Morgan Stanley the "last men standing" in the trading "debacle".) For *The Economist* (July 26, 2003), Nord Pool is the most liquid European electric market in that it "trades or clears" 150 million megawatt hours per month (= 150 MMWh/m); but as it happens, trading is one thing, and clearing bilateral transactions is quite another, and so this *Economist* perception is virtually meaningless.

A closer examination of this latter situation inevitably leads to the the conclusion that there is something peculiar about all this, because financial markets in the UK have usually enjoyed an enormous advantage over those of other European countries, and the shortage of both physical and paper electricity trading activity in that country – together with an inability or lack of desire to adopt the Nord Pool model – suggests that Nord Pool either possesses some unique factor or characteristic that the others lack, or the long term survival of Nord Pool may eventually require important changes in its structure and products. It was also recently pointed out in *The Economist* that although Leipzig's 53.7 MMWh/m is small for a country of 80 million souls, it has a lively futures market. This contention should not be taken too seriously, because if NYMEX, with the most experienced and talented traders and executives in the world cannot construct and maintain a platform for large scale trading, then the continued success of Leipzig's futures operation is highly problematical.

In a private communication, Professor Robert Wilson of Stanford University questions the present trend in the U.S. where futures contracts do not specify deliverability. By way of contrast, he saw some merit in the Nord Pool arrangements where in some sense actual or potential delivery appears to play a significant role in the derivatives picture. The opinion here, however, is that if deliverability had any special redeeming features, it would also have been universally adopted in the U.S. Furthermore, in considering the development of futures markets in general, cash settlement seems to have increased in importance relative to deliverability.

At the same time, I am prepared to admit that on this last item I might have overlooked some decisive evidence. As one observer pointed out about these matters: "It's being invented as we go along. There are some serious structural flaws in these emerging restructuring power markets." It's theoretically possible then that when or if these flaws are corrected at some point in the near or distant future, things like deliverability and large-scale trading will become more important – although this is not certain.

The Conventional Wisdom and its Shortcomings

According to Larry Makovich, a director of research for the Cambridge Energy Research Associates, "The conventional wisdom is that this is a business that's moving very rapidly to a competitive structure". But then he added, "It's a very patchwork quilt. That gap is going to remain for years to come." The business to which he is referring is the power market in the United States, and there are people who are prepared to claim that instead of years, decades may be required to make the restructuring dream come true. This kind of pessimism is not very well known in the U.S. or elsewhere, and where it is known it is often not very well received; however, a great deal of the competitive structure that Mr. Makovich was referring to was predicated on the availability of inexpensive natural gas. The way the international gas market is shaping up at the present time, the vision of small scale power plants fueled by cheap gas in a highly competitive market does not appear to be especially realistic. This also appears to be true in the UK, where recently the price of natural gas spiked to a near-record high.

When the UK government passed the Electricity Act in l989, its goals included introducing full competition, reducing prices, and opening up price and risk management opportunities. Once again we are facing one of those situations in which decision makers and their advisors and experts are envisioning a platform that would eventually be dominated by exchange traded futures, since these could (in theory) generate the (visible) scarcity or efficiency prices that everyone learns about in the first course in economics, although the exact meaning of this designation is not usually expounded on. (This term "efficiency" was used earlier, and it deserves a short comment. In moving from a regulated to a deregulated system, the explicit desire was to eliminate any practices that prevented a maximum output from being obtained with a given amount of resources. One of those practices might be executives overdecorating their offices, while another might be using too much capital relative to labor. Of course, still another simply has to do with using too much labor, and in Germany this matter was addressed by removing 70,000 employees from the electric sector. Here we have a possible source of the productivity increase that many observers interpret as the kind of efficiency bonus that restructuring engenders.)

If we stick to abstract economic theory, efficiency is usually pictured as being obtainable in a world featuring atomistic consumers and very large numbers of profit maximizing producers, where utility curves (for consumers) and production functions (for producers) have the *right* mathematical properties, where there is a complete system of contingency and/or derivatives markets to hedge uncertainty, and where things like *spillovers* (i.e., externalities) are conspicuous by their absence.

As alluded to earlier, electric futures and options were not destined to enjoy a great deal of success. This does not mean, however, that it is certain that they have no place at all in the risk management picture, although informal conversations that I have had with persons familiar with the happenings at NYMEX and the International Petroleum Exchange (London) indicate that financial players in the electricity derivatives markets must learn to handle various pricing factors that do not appear when the *underlying* is oil or bonds, etc. and given the unimpressive risk-return tradeoff, they may not be willing to make the effort. Mainstream economic theory then suggests that with a shortage of transactors, we could find outselves with an extremely thin derivatives market, and the subsequent inability to hedge price risk would discourage the participation of producers. This is what has happened in Australia, where to an overwhelming extent producers have turned to hedging their price risk with bilateral contracts, mergers, etc.

That brings us to swaps, but first I want to make a comment about options. These have not received any attention in the previous discussion, but readers should attempt to comprehend that in a market where price volatility can go right off the Richter scale, option prices (i.e, premiums) could be unacceptable to rational players. Moreover, as I have noted elsewhere, electricity price volatility in l998 was so large that even contracts that were initially deep out-of-the-money imposed severe losses on option writers. Once enough of these transactors were burned, the options market was quickly reduced to a shadow of its intended size.

Interestingly enough, there are observers who feel that the introduction of various exotic options will boost trading at Nord Pool. Whether this is true or not is something that I am regrettably unable to comment on, but as long as volatility plays a similar role in the pricing of these new options as it does in the well known Black-Scholes (option pricing) equation, options cannot be expected to be attractive to enlightened players.

Now for contracts-for-differences. At the simplest level they lock the buyer and seller into a strike price that is independent of the pool price. For example, suppose that Mr. B and Ms. S have been able to agree – usually with the help of a third party – that they want to fix a price of 80, and in the present period the relevant pool price for both of them turns out to be 75. It would happen then that if Mr. B is hedging against a high price, he pays 5 to Ms. S. On the other hand, if the pool price was 85, then Mr. B receives 5 from Ms. S (via the third party).

Nothing in derivatives theory could be easier than this. The conventional CfD market is a brokered, telephone intensive market which brings well-matched counterparts (i.e., buyers and sellers) together, and I get the impression that with Nord Pool an arrangement of this type was (or is) combined with a forward contract. In fact, if the reader thinks about it, a swap (i.e., CfD) market can be structured in such a way as to be considered (for theoretical purposes) a futures market without speculation. However, unlike many exchange-based futures markets all over the world, its outlook would not be especially promising.

Conclusions

In this brief paper I have not been overly concerned with my likes and dislikes in the disputatious world of electric deregulation. What I have tried to do up to now is to present some pedagogical work that should be available elsewhere – for instance in standard textbooks on derivatives – but for one reason or another is absent. (One of the reasons might be that the authors of these textbooks do not believe in the future of electricity derivatives.) In any event, more pedagogical efforts are required, because misunderstandings are endemic when the topics are deregulation or oil.

To see this, I can refer to a very useful paper by Losekann and Evans (2003). They say that there are "business and institutional reasons" for the lack of sufficient electric generating capacity in Scandinavia – by which they mean or should mean the lack of reserve capacity. "Demand is not strong," they say. The truth is, however, that demand continues to expand, and the cables across the Baltic will provide many new buyers. The reason for the lack of investment in capacity might be – given the arguments in the present paper – that the uncertainty associated with this investment – which is sometimes called *regulatory uncertainty* – is excessive, and cannot be adequately hedged. Of course, another reason could be that the Scandinavian power companies want profits even larger than the record profits they are now realizing, and one way to get them is to restrain the expansion of output by not increasing local productive capacity. Electricity can, of course, be imported, but (short run) marginal cost pricing will result in all domestically generated output being sold at the import price, which typically is well above the average Swedish price.

"From here in Ontario, the news is good," Professor John Grant wrote in an IAEE newsletter about a year ago. Some of us think that it was better than good, considering that only a few months later, the deregulation experiment in that province of Canada was suspended. As in California, it may eventually be resusitated, however, expensive natural gas in North America, and insufficient investment by generating companies that are managed by persons who not only have read their economics textbooks, but also understand them, should ensure that deregulation will always create problems for a large fraction of the population.

Earlier in this exposition I claimed that contracts-for-differences are becoming increasingly important as a tool for dealing with the uncertainty in electricity markets, but at the same time I mentioned that the electricity swaps (CfD) market in Sweden is in a state of disrepair. Why is this? One possible explanation is that Nord Pool forward contracts function or have functioned as a swap, or something like a swap. This I would call an ad-hoc arrangement, primarily designed for the benefit of decision makers who believe that institutions such as Nord Pool improve the quality of the electricity market, and any and everything should be done to keep its doors open.

There is probably no subject in finance that is so badly understood as electricity derivatives. One hears things about these derivatives that cannot possibly be true; however this is a situation where we should try to understand that we are dealing with an extremely important human emotion: the one associated with the belief that more money is better than less. Accordingly, these markets may never be understood properly, because it is not impossible that many electricity markets will revert to their previous regulated form at some point in the future. In fact, when I began this paper a "crisis meeting" was taking place between the industry minister and executives from the Swedish forestry industry about what the latter regards as ruinous electricity prices. (And on the basis of the clearly expressed desire by EU commissioner Mario Monti to see the level of energy taxes on Swedish industry raised by a very large amount, these meetings could become a weekly event.) Like many other alert persons, these executives can examine a plot (over time) of electricity prices and the Consumer Price Index, and immediately see that the growing gap between these two can only be due to deregulation. (This gap first emerged when Sweden became associated with Nord Pool in l991.)

I conclude by mentioning that to my way of thinking, bilateral and other forward arrangements should maintain the dominant role in electricity trading, while conventional futures and options should be minimized for the simple reason that they cannot be expected to yield the desired results. At the same time, the utility of CfD (i.e., swaps) should be more widely recognized. I can also note that Mats Leijon, professor of electrical engineering at Uppsala University, recently claimed that from an engineering point of view, competitive frictions between the wholesale and retail side of the electric market that followed in the wake of deregulation, have led to a decreased technical standard for the Swedish electrical network. Of course, from a technical point of view that network is one of the best in the world – or maybe even *the* best; however, it is just as possible for it to be seriously damaged by virtue of faulty restructuring as by an accident or sabotage. In fact, this is exactly what Robert Kuttner said in the *New York Times* (August 16, 2003), where in addition he wonders why the residents of the United States are unable to recognize the damage that electric deregulation is capable of causing an indispensable service.

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IAEE Leadership in Taipei

Plans are being made to for the Chinese Association for Energy Economics to host the 28th IAEE International Conference in Taipei, June 3 – 6, 2005. IAEE President Tony Owen, President-Elect Arnold Baker and IAEE's Executive Director visited Taipei in November. Tony Owen was one of CAEE's distinguished speakers addressing "The Transition to Renewable Energy Technologies."

The Taiwanese are rolling out the red carpet for participants of this international conference. The meeting will be held at the world renowned Grand Hotel (visit www.grandhotel.tw). Progress has been made on lining up a well balanced international program. Please visit http://www.iaee.org/en/conferences/2005.aspx to keep posted on the developments of the program and social events. You may also order a Taipei IAEE International Conference promotional CD-Rom which will showcase the conference venue, program and cultural attractions of Taiwan. We're told that all spouses/guests can be ensured of a wonderful time experiencing all that Taipei has to offer (shopping, dinning and relaxing!!).

L to R, Jeffrey Bor, Tain-Jy Chen, Tony Owen, Vincent Siew, Arnie Baker and Dave Williams

Government Ownership of Energy Infrastructure: The Case of Alaska

*By Douglas B. Reynolds**

Alaska's North Slope holds one of the largest oil and gas plays in the world. The biggest oil field there is Prudhoe Bay. But while the vast oil reserves of the North Slope have been developed, there is still a huge natural gas potential that has not yet been developed but could be. Both Prudhoe Bay and the Point Thompson gas fields have substantial natural gas reserves that could produce four or more billion cubic feet (BCF) per day of gas for consumption in the Pacific Rim or more probably in the Lower 48 of the United States. The problem is getting the reserves to market. A gas pipeline is needed. In my book *Alaska and North Slope Natural Gas*, I look at all the options to get just such a gas line for the state.

Over the years, it has been the dream of many if not most Alaskans that the state of Alaska should own its own natural gas pipeline to do just that. Alaskans not only want to get their natural gas to market but they want to have some control over the way it gets to market to insure that Alaska maximizes its own economic welfare. I believe this dream is also characteristic of many oil and gas producing countries. Energy producers want equity ownership. Thus while the situation in the State of Alaska is different to that of other countries, the similarities are also many, especially the desire to own oil and gas capital assets.

One of the reasons Alaska wants to own a natural gas pipeline is because of the bad experience it had with the construction and regulation of the Trans-Alaska oil pipeline. See Fineburg (1990) and Scott (1990). I believe the Alaskan experience with its oil industry development is similar to bad experiences other countries have had with the multi-national oil companies, and the Alaskan experience also makes for an interesting case study for how governments and multi-national oil companies interact. The case study for the Trans-Alaska pipeline starts with the discovery of Prudhoe Bay which was actually not found by a multi-national oil company but rather by a leading independent oil company named Atlantic Richfield Company (ARCO). ARCO has since been bought out by BP. After the oil was found, and after much financial wrangling, the trans-Alaska oil pipeline was built to get the oil to market, although at a higher than expected cost. Alas, this took money. The majors came through with the financing and Alaska benefited greatly from the project, but the final regulated pipeline tariffs to pay for the pipeline was much too high and it came to haunt Alaska after the pipeline was built.

The trouble began with the Federal Energy Regulatory Commission (FERC) which regulated tariffs. For a number of reasons FERC allowed the tariff to be six dollars per barrel even though about two or three dollars would have been adequate to pay for the pipeline. Since the tariff on the pipeline was so high it greatly reduced royalties to the state of Alaska thereby reducing state revenues and increasing the profitability of the oil to the majors. So Alaska felt gypped. This made many Alaskans distrust the majors and call for state ownership of the natural gas pipeline in order to insure that this kind of tariff problem never happens again. Next time, we thought, we will get all the profits for ourselves.

So one reason to own a natural gas pipeline is for the state to control natural gas pipeline tariffs and, therefore, increase state revenues. Another advantage of Alaskan ownership of the natural gas pipeline is that as a state, and under certain circumstances, Alaska can have the right to not pay any federal taxes on the project. That would give Alaska higher state revenues at the expense of the U.S. Federal tax revenues, which is good for Alaska, but bad for everyone else in America. Unfortunately the loss in federal taxes while it can create more revenue for the state of Alaska can actually reduce profitability of developing the natural gas fields for the natural gas lease holders themselves due to accounting considerations.

Well, while all this Alaskan ownership sounds like the best thing since sliced bread, there is one problem: risk. In order to build such a massive project such as an Alaskan North Slope natural gas pipeline, a lot of money must by invested while the returns on that investment are subject to market vagaries. For example, Alaska actually has a permanent fund that is worth some twenty or more billion dollars which could be used to build a natural gas pipeline. Currently the dividends from the fund are given directly to residents of Alaska and can also be used for state government revenue in lieu of taxes.

When I ask Alaskans if they would like to use the twenty billion plus fund to build a pipeline they almost always say no, it is too risky. The problem with a natural gas pipeline is that the costs of construction could be higher than expected, and the price of the natural gas, where it is sold, could be lower than expected, causing the project to lose money or at least to give a lower pay back than our current investments. Simply stated people don't like risk. They want a safe secure return on their investments. One idea to reduce that risk has always been to sell LNG to Japan, Korea, and China and obtain twenty year contracts at a set price. However, even LNG markets these days are subject to sharp market swings and buyers can get the upper hand on suppliers to either force very low prices on long run contracts or to take the lowest cost suppliers on the competitive spot market.

Usually Alaskans say that we can simply sell bonds on the bond market to raise 70% or more of the financing of a project. But if all those bond holders give their money and there are cost over runs, price fluctuations, or demand destruction with fewer buyers, then who will be responsible for paying the bond holders their return if the project is losing money? What if the project sells LNG to China and China suddenly decides it cannot pay for the gas any more? What if the project has severe cost overruns? Who will pay for losses on the project? What if the project goes to the lower

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48 and prices plummet and again we can't pay the bond holders? Well, the bond holders will realize this ahead of time and force Alaska to sell bonds at very high interest rates if there is little or no equity investment from Alaska, or else bond buyers will simply not buy the bonds and not finance the project.

In theory it is a great idea. Alaska can put none of its own money into a risky project and then just reap all of the benefits and profits and leave the bond holders or possibly the major oil companies to pay for any losses. In practice it's unworkable. The majors need a healthy return, although how healthy is certainly a debatable issue, in order to take the risks to build such a project. Alaska is basically only willing to buy into a risk free project. But risk free doesn't exist. In essence the only way to make money on any investment whether it is in oil and gas or in the high tech industry is if you take a risk. If there was absolutely no risk to making a profit on any given investment then somebody would have already done it and made a lot of money. If Alaska wants to make money on building a natural gas pipeline then it must put its money where its mouth is and take the risk and use its own permanent fund to finance the project. No one is willing to do that so chances are Alaska will not own the natural gas pipeline. Rather Alaskans will sit back and let the majors risk building it and owning it while Alaska receives royalties, severance taxes and property taxes like all the other states.

There is then one interesting parallel that Alaska has with many OPEC countries. One of the dimensions of OPEC, that I believe is not widely enough used in energy analyses, is how each OPEC country itself is risk averse to expanding its own oil production capacity. Either OPEC countries are risk averse to investing their own money into their own national companies to expand new fields, or they are risk averse to allowing a healthy return to multinationals to expand production for them. Either way, production stays stagnant. Thus OPEC countries do not have significantly greater capacities to expand production largely due to risk factors.

This idea of risk averse factors is widely acknowledged by the economics profession at large. For example, Rubin and Thaler (2001) show that the marginal utility to gains becomes increasingly more elastic while the marginal utility to losses becomes increasingly more inelastic causing very risk averse behavior indeed. Even the 2002 Noble prize winner, Daniel Kahneman, with help from Amos Tversky, (1997) looked closely at risk and behavior. Using these same types of risk analyses Banks (2002) and Reynolds (2000a) show that energy supplies may be constrained. Risk factors could also affect Russian oil and gas supplies and reduce the supply increase there should Russia decide to take over control and ownership of its petroleum industry. That actually looks like a possibility now that Russia has arrested its leading oil and gas oligarch Mikhail B. Khodorkovsky. The arrest could signal realignment. If Russian oil production were to then stagnate, a readjustment of world oil prices to real 1980 levels or beyond is a possibility.

Alternatively there may be a new round of risk factors now that LNG trade is going world wide. Currently LNG looks very competitive with natural gas producing countries bending over backwards to give what ever it takes to get new projects on line. But that can change. As LNG matures, there is a possibility that risk aversion will creep into the market and make LNG exporters become risk averse to new natural gas projects and project expansions. Exporters will become wary of multinationals starting new projects and obtaining more profits than the multinationals deserve. That could create tougher negotiations, less projects, and a stagnant LNG supply. Assets could be nationalized. Yet in the mean time, countries will not themselves invest in their own national oil company LNG projects due to being risk averse. It will be OPEC all over again.

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1-3 March 2004, The IASTED International Conference on Alternate Energy Sources and Technology - AEST 2004 at Marina del Rey, CA, USA. Contact: IASTED Secretariat - AEST 2004, IASTED, #80, 4500 16th Ave. NW, Calgary, AB, T1V 1N3, Canada. Phone: 403 288 1195. Fax: 403 247 6851 Email: calgary@iasted.org URL: http://www.iasted.com/conferences/2004/marina/aest.htm

2-2 March 2004, African Gas-LNG 2004 at Le Meridien Waldorf Hotel, London. Contact: Babette van Gessel, Group Mananging Director, Global Pacific & Partners International, 264 Groot Hertoginnelaan, The Hague, Netherlands. Phone: +31 70 324 6154. Fax: +31 70 324 1741 Email: info@glopac.com URL: www.petro21.com/events

3-5 March 2004, World Sustainable Energy Days 2004 at Austria. Contact: Conference Division, O.O. Energiesparverband, Landstrabe 45, A-4020 Linz, Austria. Phone: 43-732-772014380. Fax: 43-732-7720-14383 Email: office@esv.or.at URL: www.esv.or.at

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11-12 March 2004, Marine Construction Amsterdam 2004 at Marriott Amsterdam Hotel. Contact: Sandra Gregory, Conference Coordinator, Quest Offshore Resources, Inc., 10701 Corporate Dr, Suite 188, Stafford (Houston), TX, 77477, USA. Phone: 1 281-491-5900. Fax: 1 281-491-5902 Email: sandra.gregory@questoffshore.com URL: www.MCAmsterdam.com

15-19 March 2004, Petroleum Licensing at London, UK. Contact: Justin Bambridge, Marketing Executive, CWC Associates, 3 Tyers Gate, London, SE1 3HX, UK. Phone: +44 207 089 4184. Fax: +44 207 089 4201 Email: jbambridge@thecwcgroup.com URL: thecwcgroup.com

22-23 March 2004, Third Annual Green Trading Summit at McGraw-Hill Conference Center, NYC. Contact: Peter Fusaro, Chairman, Global Change Associates, Inc, 268 Berkeley Plc, Brooklyn, NY, 11217, USA. Phone: 718-230-5402. Fax: 718-230-4798 Email: myuen@greentrading.biz URL: www.greentradingsummit.com

28-31 March 2004, Dubai Tanker Event 2004 at Grand Hyatt, Dubai. Contact: Anders Baardvik, Executive Manager, INTERTANKO, St Clare House, 30-33 Minories, London, EC3N 1DD, England. Phone: +44 20 7977 2010. Fax: +44 20 7977 2011 Email: anders.baardvik@intertanko.com URL: http://www.intertanko.com

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18-21 April 2004, ICEED's 31st Annual International Energy and 25th Annual International Area Conference at Boulder, CO. Contact: Dorothea H. El Mallakh, Director, Intl Research Center for Energy & Economic Development, 850 Willowbrook Rd, Boulder, CO, 80302, USA. Phone: 303-442-4014. Fax: 303-442-5042 Email: iceed@stripe.colorado.edu URL: www.iceed.org

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