IAEE INTERNATIONAL ASSOCIATION FOR ENERGY ECONOMICS

IAEE Newsletter

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Fourth Quarter 2004

President's Message

The onset of summer is a reminder for us in the Southern Hemisphere that the year is drawing to a close, and with it my term as President of the IAEE. It has been a privilege and an honour to serve as the IAEE's President during 2004, and I will look back upon this year with a great deal of pride and a sense of fulfilment. The IAEE ends the year on a financially sound basis, intellectually supported by a first tier academic journal, an enviable agenda for future international and regional conferences, and a vigorous student support program emerging from its fledgling state. Of course, my personal contribution has been negligible in the context of the excellent situation I inherited, the fundamentals of which were established over a decade ago. For ensuring the ongoing success of our organisation, I would like to thank all members of the 2004 Council for the time and effort they allocated to its development and operation during the year. I would also like to take this opportunity to pay tribute to the officers of the U.S. chapters and the international affiliates for their contribution during the year. Finally, my role was made so much easier by the support I received from Dave Williams Sr. and Jr. at Headquarters. Their efficient administration of our organisation has played a major part in its myriad of accomplishments over the past 13 years, and I would like to thank them personally for their support and friendship throughout my term in office.

At the recent European conference in Zurich, a format for future IAEE European Conferences was developed to ensure that a structured approach to integrating a third flagship IAEE meeting per year could be achieved. Henceforth, there will be IAEE-sponsored conferences every year in all three locations, except where the international conference coincides with one of them. Next year, therefore, the international conference will be held in Taipei (June), the European in Bergen (August) and the North American in Denver/Boulder (September). The following year (2006) the international conference will be held in Potsdam (Berlin), and this will also serve as the European meeting, whilst the North American meeting will be held in Detroit. Offers for hosting the 2007 international conference are now being sought.

Oil prices on their way to US$60 a barrel and Russia ratifying the Kyoto Protocol emphasise the role that energy economists can play in contemporary society. This is a time when as a profession we should exhibit a high profile, and our annual conferences should provide the springboard to achieve this objective. Earlier this year the Tehran conference closed with a journalist session addressing oil price volatility and oil price scenarios. Audience participation was exceptional for its depth of understanding of the many complex and interrelated oil market issues. These are messages and explanations that can be "sold" to the world's media to promote the IAEE and convince the public that there exists a substantial body of international expertise that can interpret such complicated issues. Let us all set some goals for the profile of the profession in 2005!

In closing I extend to incoming President Arnie Baker and his team my best wishes for 2005, and to all IAEE members across the world I hope that you have a happy, healthy and prosperous New Year.

Tony Owen

Editor's Notes

Fereidun Fesharaki comments on the global oil market asking the question has the market reached a new plateau or is this just another cycle. He concludes that the fundamentals have changed and there is an unusual confluence of positive factors coming together in the oil and gas markets.

Toshihiko Nakata and Ryo Kinugasa examine the intro-

(continued on page 2)

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

duction of clean coal technologies into the electricity market in Japan, and explore the policy options for the promotion of clean coal technologies. They note that for a nation like Japan, which highly depends on imported fossil fuels, effective use of coal technology is important and necessary for the strengthening of the energy security of the country.

Malika Saidkhodjaeva reviews the energy position of five central Asian states, Uzbekistan, Kazakhstan, Turkmenistan, Tajikistan and the Kyrgyz Republic and then places them within the wider framework of the Euro-Asian energy market.

Mohammad Mazraati and Mehran Amirmoeni provide an overview of the changes in the structure of the Iranian oil industry from the discovery of oil there in 1908 up to the present. They look at the current structure and point out the difficulties with it and suggest how it could be improved.

Fereidoon Sioshansi discusses the changing roles of natural gas, oil, coal, nuclear and renewables, worldwide and asks the question, "how are going to wean our fossil-based economies from increasing reliance on oil?" He suggests that natural gas will replace oil as the dominant fuel by 2025.

DLW

7th USAEE/IAEE/Allied Social Science Association's Meeting, Philadelphia, PA – January 7 - 9, 2005

The IAEE annually puts together an academic session at the ASSA meetings in early January. This year's organizing committee will be Carol Dahl of the Colorado School of Mines and Fred Joutz at George Washington University.

The theme for the session will be "Volatility in Energy Markets."

Papers presented at the session will be published in the Proceedings of the next North American Conference of the USAEE/IAEE.

The program including abstracts will be posted at www.iaee.org/en/conferences by September 1, 2004.

For complete ASSA meeting highlights and pre-registration information please visit:

http://www.vanderbilt.edu/AEA/anmt.htm

Conference Proceedings on CD Rom
24th North American Conference
Washington, DC, USA, 8-10 July, 2004

The Proceedings of the 24th North American Conference of the USAEE/IAEE are available from USAEE Headquarters on CD Rom. Entitled ***Energy, Environment and Economics in a New Era***, the price is $100.00 for members and $150.00 for non members (includes postage). Payment must be made in U.S. dollars with checks drawn on U.S. banks. Complete the form below and mail together with your check to Order Department, USAEE, 28790 Chagrin Blvd., Suite 350 Cleveland, OH 44122, USA.

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28TH IAEE ANNUAL INTERNATIONAL CONFERENCE

Hosted by:

International Association for Energy Economics (IAEE)

Chinese Association for Energy Economics (CAEE)

Globalization of Energy: Markets, Technology, and Sustainability

3-6 June 2005

at the Grand Hotel, 1 Chung-Shan N. Road, Section 4, Taipei, Taiwan 104, ROC

Conference Themes and Topics

1. Prospects for Global Energy Development:
- Global and Regional Energy Demand and Supply
- New Paradigm under the World Trade Organization
- Restructuring and Deregulation
- Energy Security and Reliability among Regions
- Liberalization and Market Power
- Role of International Energy Suppliers

2. Prospects for Energy Technology Development:
- Green and Renewable Energy Technology
- Conservation Know-how and R&D
- Fuel Cell and Hydrogen Technology
- Distributive Energy Systems
- Diffusion and Collaboration in Energy Technology

3. Sustainability:
- Sustainable Energy Development
- Global Warming and Energy
- Energy and Pollution Control
- Nuclear Safety and Waste Disposal
- Rationality and Energy Selections
- Policy Options and Strategies

Keynote Plenary Session Theme:

The Future of Energy: Solar Energy and Photovoltaics

4. Individual Energy Sectors:
- Coal
- Oil
- Natural Gas (including LNG)
- Electricity
- Renewable Energy and New Energy

5. Energy Efficiency and Energy Modeling:
- Energy Statistics and Energy Efficiency Indicators
- Energy Modeling, Simulation, and Forecasting
- Energy Conservation Program and Demand-Side Management
- Integrated Resource Planning and Demand Response
- ESCO and New Business Models

Dual Plenary Session Themes:
- The Middle East Situation and Energy Security
- Regulation vs Deregulation of the Energy Market
- Global Policy Options Dealing with GHGs Emission Control
- Rethinking of the Nuclear Energy
- Prospects for New Energy Technology
- Emerging Issues

***** CALL FOR PAPERS *****

Abstract Submission Deadline: 2 December 2004

(Include a short CV when submitting your abstract)

We are pleased to announce the Call for Papers for the 28th IAEE Annual International Conference entitled 'Globalization of Energy: Markets, Technology, and Sustainability', scheduled for 3-6 June 2005 at the Grand Hotel in Taipei. Please mark your calendar for this important conference. There will be at least 9 plenary sessions and 36 concurrent sessions. During the conference, we will also ensure that you and your spouses can enjoy the wonderful hospitality and rich content of traditional Chinese and Taiwanese culture.

Abstracts should be double-spaced and between 300-500 words giving an overview of the topic to be covered. Abstracts must be prepared in standard Microsoft Word format or Adobe Acrobat PDF format and within one single electronic attachment file. Complete contact details should be included in the first page of the abstract, which should be submitted to the IAEE 2005 Taipei Conference Secretariat either through the e-mail system (as an electronic mail attachment) or the postal system (in a 1.44Mb diskette) to: **Yunchang Jeffrey Bor**, Ph.D., Conference Executive Director, Chung-Hua Institution for Economic Research (CIER), 75 Chang-Hsing Street, Taipei, Taiwan 106, ROC, Tel: 886-2-2735-6006 ext 631; 886-2-8176-8504, Fax: 886-2-2739-0615, e-mail: iaee2005@mail.cier.edu.tw

General Organizing Committee

Vincent C. Siew: General Conference Chairman; Chairman of the Board, Chung-Hua Institution for Economic Research (CIER), Taiwan, ROC. **Yunn-Ming Wang**: Program Committee Chairman; Chairman of the Board, Chinese Association for Energy Economics (CAEE), Taiwan, ROC. **Ching-Chi Lin**: Organizing Committee Chairman; Chairman of the Board, Taiwan Power Company; Taiwan, ROC. **Ching-Tsai Kuo**: Sponsorship Committee Chairman; Chairman of the Board, Chinese Petroleum Corporation, Taiwan, ROC.

IAEE BEST STUDENT PAPER AWARD: US$1,000 cash prize plus waiver of conference registration fees. If interested, please contact IAEE headquarters for detailed applications/guidelines. **STUDENT PARTICIPANTS**: Please inquire about scholarships for conference attendance to **iaee@iaee.org**

The Global Oil Market: Have We Reached a New Plateau or Just Another Cycle?

By Fereidun Fesharaki*

Plateau Change vs. Cyclical Movement

We have seen many cyclical movements in the global oil market in the past 3 decades. But in the recent past, the volatility has increased significantly. Are we in the midst of another cyclical change or have we entered a new plateau?

It is our view that we have now entered a new plateau with very different market dynamics. Still, cycles will be seen and volatility will continue, but now from a *higher price base.* The plateau change is of great significance, much in the same way that the previous plateau change in the early 1970s showed a shift in the control of oil from oil companies to oil producing governments and OPEC.

We have essentially graduated from a $15-25/b (Dubai/AL) oil market to a $25-35/b in the short to mid term. Beyond 2010, we may well be in a long-term $40-50/b market. The rate of economic growth, inventory situation, futures market, and OPEC policies can lead to more volatility than in the recent past. *But this time, the fundamentals have changed.*

A multitude of factors are responsible for such a fundamental change. It is not just China or just the U.S. or just economic growth. It is a change in the fundamentals.

Supply and Demand Issues

Demand growth has been unusually strong, but it is a mistake to assume continued demand growth at current rates. The growth will surely slow down. Still, even the low growth is outstripping the supply in the medium term.

Capacity additions inside of OPEC have good prospects, but circumstances due to politics, legal issues, and lack of sufficient investment prospects will slow down the process. While currently only minor surplus capacity exists in Saudi Arabia, other countries such as Iran, Kuwait, Abu Dhabi, Nigeria, Venezuela, and Libya, as well as Saudi Arabia are planning new capacity. A smooth expansion process might only be seen in Saudi Arabia and Libya. Others will struggle with politics, legal issues, as well as a variety of other social factors and will surely face delays.

How about non-OPEC oil? While we do not subscribe to the theory of a global peak and a collapse in non-OPEC production by 2010, *there is a fundamental change in oil supply prospects.* Incremental non-OPEC oil supply which has been in excess of one million b/d in the past decade is drying up. Non-OPEC incremental growth by 2010 may be between zero to 300 kb/d only. While supplies in Russia and Central Asia will rise, declines in other areas will offset the growth. Thus, OPEC may recover its lost market share with little effort if it can muster enough production capacity.

This means that all new demand growth needs to come from OPEC and OPEC is neither ready nor prepared for the volumes needed.

Those who argue we are running out of oil (including some of our friends) have now mixed up politics and anti-Arab sentiments with reality. Attacking Saudi Arabia and arguing that the Saudis are unreliable suppliers and do not have adequate reserves does not serve any purpose and is counter-productive.

Meanwhile, the other camp (again, including some of our friends) is arguing that the world oil supplies will grow indefinitely, ignoring the geological realities. *A realistic analysis is lost in this argument.*

Are the Middle East oil reserves a big lie? Is there going to be a collapse in production? Proven Middle East reserves are not certified and we doubt that all the reserves are actually proven *as of now.* But, there will be no collapse in production for sure and it is more than likely that with application of new technologies and enhanced recovery, these reserves can be proven or even rise *in the fullness of time!*

An Impossible Future?

When the IEA or EIA do their forecasts showing very large OPEC production, their analysis are seen by the uninitiated as the evidence that such a production will be forthcoming from OPEC. It is not! All that the forecasts show is that OPEC production must reach a certain level *to balance the market.*

Indeed, the forecasts that show 22-24 million b/d of Saudi production by 2025 do not mean that Saudi production will reach these levels. The forecasts are simply indicative of the consequences of business as usual and show us an **impossible future**. There is virtually no chance of Saudi Arabia producing oil at these levels on a sustained basis for technical reasons. Oil demand must simply be reduced by higher prices or technological breakthroughs. As such, these forecasts do us a great service so we can understand the consequences of the present path, but it behooves us to understand what these numbers really mean.

There will be no oil shortage or collapse in the world economy! Higher prices will reduce demand and encourage alternatives as economic theory tells us: All we have to do is to be aware, to help the transition, not put up roadblocks, and not encourage unrealistic government policies.

On the supply side, we will be exhausting the supply growth potential, if demand remains strong. Higher prices are inevitable unless demand is drastically curtailed by recession, taxation or through regulatory mechanisms.

Can High Oil Prices Reduce Demand?

What level does the price of oil need to reach to stop the demand growth or reduce the demand? Is the price already too high?

Figure 1 shows the real and nominal price of oil and our base case forecasts for Arab Light. The price of oil today is not much higher than it was in 1973, in real terms. Even our forecast of real prices by 2020 is at $40/b and nominal price at $55-65/b are still lower than the 1979/80 peak. Unless

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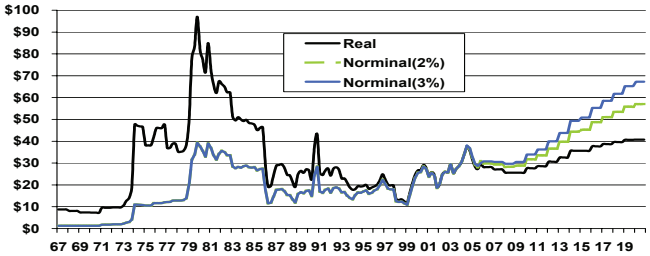
the world is facing a serious economic recession, we doubt that these prices will create a collapse in oil demand. If the demand does remain strong, the price needs to reach much higher levels ($70+/b nominal) and then demand will decline and new technologies will bring in new alternative sources.

Short-Term Price Direction

In the short term, the price will decline as demand slows down and supply inventories build up. Indeed currently, supply exceeds demand by some 1.5 million b/d. Though, the hedge funds net buying position has not changed much in the past six months, their involvement has had an impact of several dollars a barrel on oil prices. Once they unload (and they will unload), the price will come down to WTI of $30-35/b. Indeed, they may even go lower temporarily, but there is a fundamental floor below prices now. We expect the range of $25-35/b to hold for the next few years. We may even be too conservative!

Figure 1
Price of Arab Light Crude in Nominal and Real 2003 Prices
(U.S. Dollars per Barrel)



Are Natural Gas Prices in a New Plateau Too?

The natural gas prices have entered a new plateau too, led by the U.S. market. After decades of gas being sold in the United States at $2/MMBtu range, the price has risen to some $6/MMBtu. This is more dramatic than the oil market shift. While U.S. natural gas prices may also ease, it is highly doubtful that they will go below $4/MMBtu and very likely will be higher.

Gas prices of $6/MMBtu corresponds to WTI prices of well over $40/b. The change in plateau is comprehensive and supported by fundamentals of both oil and gas markets.

As the U.S. leads the global gas market, becoming the second largest LNG importer in the span of less than a decade (and perhaps the largest by 2015-2020), the global gas price will shift upward in line with the global oil market and will be dominated by the U.S. futures prices for gas.

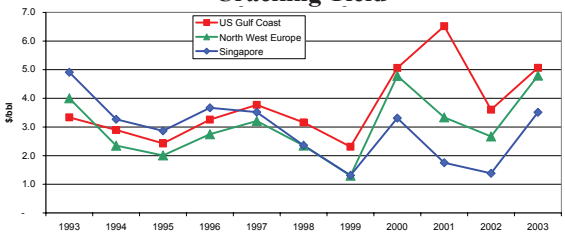
Is the Refining Business Also Entering a New Plateau?

The refining business is also entering a new plateau. For many years, independent refining outside of the integrated oil companies seemed like a no-win proposition. Crude oil prices moved sharply with OPEC policies and political crises, but product prices lagged. Except for war periods where military needs for product supplies raised product prices, the refining margins sagged.

The Asian margins were always the strongest, followed by European, and then the U.S. (Figure 2). Strong competition among U.S. refiners, rising environmental costs, threat of product imports, and slow oil demand growth capped the margins in the United States.

The Asian margins dropped in 1997 when the Asian refining surplus emerged. In 1996, two major Thai refineries (led by Shell and Caltex) came onstream at the heels of a major expansion by Exxon. Meanwhile, the Asian economic crisis of 1997/98 seriously reduced oil demand and resulted in major overcapacity.

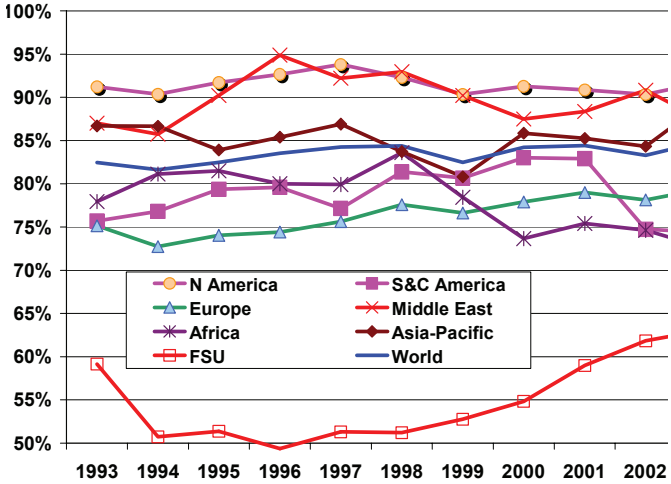
Figure 2
Gross Refining Margins Based on Arab Light Crude Cracking Yield



In the U.S., rising demand, increased environmental standards, and inability to add any new capacity soaked up all excess refining capacity, closed down a few smaller less efficient ones, and began to reverse the trend, making the U.S. margins higher than Europe or Asia.

The rising demand everywhere has soaked up capacity as shown in Figure 3. Excluding former Soviet Union, the global refinery utilization is over 90%, the highest in recorded history–led by the United States.

Figure 3
Refinery Utilization by Region

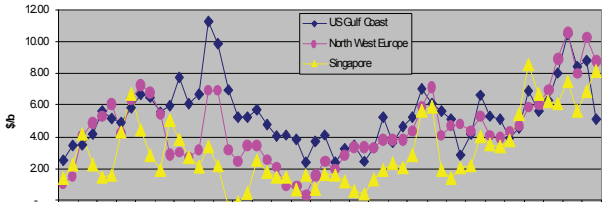


For the United States, Mexico and Venezuela are ideally placed to become the major beneficiaries, if they added new refining capacity. Both countries, beset by political problems, legal restrictions, and anti-American sentiments have not taken advantage of this great opportunity. The Middle East, with its large refining capacity, has fallen so behind in quality that it cannot supply the U.S. and Europe, and just barely Asia. Asian specs do not meet the U.S. standards with a few exceptions and few refiners are willing to raid their pool just to export to the United States.

The result has been higher margins for everyone (Figure 4). Indeed in the recent past, the Asian margins have once again overtaken the United States and Europe, though this will likely be temporary.

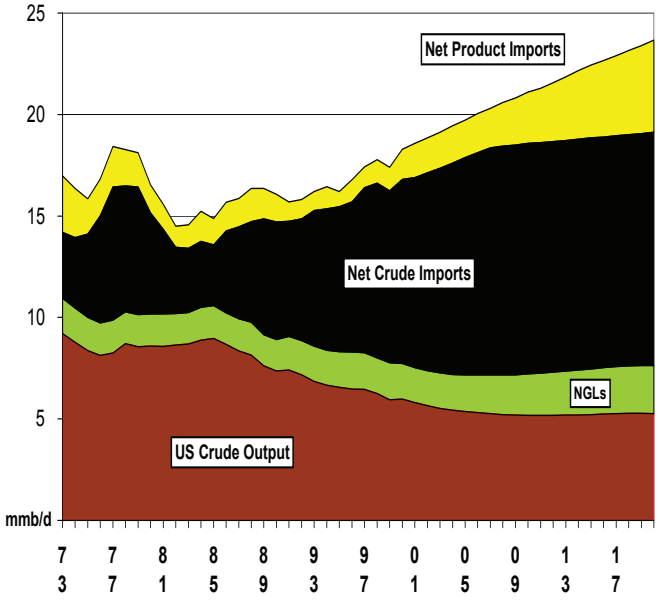
The U.S. will remain the region with the best long-term margins (Figure 5), simply because it cannot add new capacity. In Asia, new capacities from China and India are on the horizon. For the U.S., demand is the key. As long as demand does not decline, even a moderate growth will keep margins in place. The margins will face cycles for certain. Ups and downs will continue, but the base line has now shifted upwards.

Figure 4
Monthly Gross Refining Margins for U.S., Europe and Asia Based on Cracking Yield of Arab Light Crude



For the time being, the only alternative supply for the U.S. is Europe, but the system is stretched there too. As Europe moves towards dieselization and as GTL projects from Qatar come onstream, Europe can release more products for export to the United States.

Figure 5
EIA: U.S. Oil Supply to 2020



By 2012-2015, the three major regions—U.S., Asia, and Europe—will have very similar product quality standards. Something close to a *global product market is on the horizon* in the not too distant a future. Is this bad or good for the margins? The U.S. advantage for certain will disappear as products will move more easily across the globe. Still, California politicians and CARB will more than likely come up with *something* to ensure limited competition from the outside world!

What Does All This Mean?

Upstream business is likely to be the key beneficiary. Oil companies will make more money whether they like it or not!!

The downstream business will also do well in the U.S., but margins in Asia and Europe are unlikely to do as well as the U.S.

OPEC countries have become fundamentally richer with no new effort as their resources gain in value. Economic reform will surely slow down and subsidies will be maintained or even increased with the new riches. Military expenditures are also sure to rise in the key oil exporting countries.

Today, there is an unusual confluence of positive factors coming together in the oil and gas markets: Everyone is making money in every part of the business—be it E&P, refining, shipping, trading, storage, etc. *This is unprecedented in history.*

If you are clever you can make a lot of money. If you are not, you can still make a lot of money!

The Economic Aspects and Policy Options of Clean Coal Technologies

*By Toshihiko Nakata and Ryo Kinugasa**

Clean coal technologies (CCT), such as a pressurized fluidized-bed combustion (PFBC), an integrated coal gasification combined cycle (IGCC), and an integrated coal gasification fuel cell combined system (IGFC), are recognized as efficient and environmentally sound technologies. Although CCT has a possibility to enhance energy security, the cost, such as the specific capital cost and ancillary operating cost of CCT is higher than those of other power plants, such as gas combined cycle power and advanced coal-fired power plants. Therefore, in this study, after we analyzed the introduction of CCT into the electricity market in Japan, we assumed the introduction of both an energy tax and a carbon tax as policy options to promote the introduction of CCT into the electricity market. Moreover, we have assumed that the tax revenue which is gained by the carbon tax and energy tax is returned to the specific capital cost of CCT as a subsidy. From the result of our study, it is seen that an energy tax has an impact on the promotion of CCT. In particular, the subsidy for the specific capital cost of CCT has a large impact on the electricity market.

Introduction

Coal has some advantages, for example, coal has the largest reserves/production (R/P) ratio of any of the fossil fuels such as natural gas and crude oil, and has a regionally uniform distribution of producing countries (British Petroleum, 2002). On the other hand, there are some disadvantages, namely that the carbon content of coal is larger than that of any of the other fossil fuels, and is not environmentally friendly. Thus, it is important for strengthening energy security, to develop and promote the technologies which can use coal efficiently and in an environmentally friendly way.

The research and development of CCT, such as PFBC, IGCC, and IGFC, are widely recognized. The PFBC and the IGCC have been commercialized already in Europe and the United States. In Japan, PFBC is already commercialized, but the IGCC is still in the demonstration stage. In Europe, the development of CCT is promoted as a way to reduce dependence on natural gas which is expected to increase in demand. In the United States, in response to severe environmental regulations, the development of CCT has been promoted by the government (U.S. Department of Energy, 1987). For Japan, which depends on imported resources for its energy supply, clean coal technologies become important from the view point of energy security. Thus, for the development of CCT, it is necessary to examine the introduction characteristics of CCT from a long-term technical and economic view.

Several studies have been conducted on the technical and economic specifications of CCT. Campbell studied the energy efficiency and the electricity price of an IGCC plant in Puertollano, Spain, by using the ECLIPSE process simulator (Campbell, 2000). McMullan studied the techno-economic aspects of PFBC and IGCC and whether they are competitive with existing power plants in the electricity market by using the process simulator (McMullan, 2001). Moreover, introduction of a carbon tax in energy systems has been examined by many researchers. Williams analyzed optimal policy introducing carbon taxation by using a global warming model (Williams, 1995).

However, very few attempts have been made to research both energy conversion efficiencies and economic aspects, such as specific capital cost and competitive power, in the long-term electricity market. Moreover, there has been no study that analyzed the return of tax revenue from carbon taxation as the subsidy for CCT. In this paper, we develop an energy-economic model to consider both the economic aspects and energy conversion efficiencies of CCT. By analyzing this model, we examine the introduction of CCT into the electricity market. And then, we analyze the impact of taxation on the introduction of CCT and explore effective options to accelerate the introduction of CCT.

An Energy-economic Model

Japan Model

We have developed the detailed model in the electricity sector based on the Japan model which has been designed by Nakata et al. (Nakata, 2000; 2001. The Japan model has eighty-two processes; includes eight demand nodes in the industrial, commercial, residential and transportation sectors; and contains thirteen resource nodes modeling purchases of coal, natural gas, petroleum and nuclear fuel in the world markets. Additional processes model the electricity sector, transportation services, and the conversion of fuel to heat. Nakata, et al. analyzed the impact of carbon taxes on energy systems in Japan using this model. The Japan model runs from the year 1999 to 2044 in increments of 5 years.

Electricity Sector Model

The Japanese electricity model consists of oil-fired power, gas-fired power, coal-fired power, hydro power, renewable energy, such as photovoltaics and wind power, and nuclear power. Gas-fired power consists of gas combined cycle power plant, gas turbine power plant, and gas boiler power plant. Coal-fired power consists of additional conventional coal boiler power plant and advanced coal boiler power plant. In this study, we have assumed that conventional coal boiler power plants and oil boiler power plants will not be constructed, and the amount of electricity power generation by them will decrease.

We have designed three nodes of clean coal technologies such as PFBC, IGCC and IGFC in the electricity market. Then, in terms of the introduction of clean coal technologies into the electricity market, we have defined the following

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three scenarios:

a) Most likely case
The cost and the share of CCT in Japan are derived from the actual performances of CCT's commercialization in the United States and Europe.

b) High cost case
This case assumes that the cost of CCT in Japan becomes higher than that of the actual performance of CCT's commercialization in the U.S.A. and Europe. Therefore, the cost in this case becomes higher than that of the *Most likely case*.

c) Advance case
As compared with the *Most likely case*, this case assumes that the technological innovations in CCT arise in around five years. Therefore, the cost of CCT becomes lower than that of the *Most likely case*.

Moreover, we have assumed another case as follows: Commercialization of CCT will not be done on a large scale. This is the business as usual (BAU) case.

In this case, in terms of coal-fueled power plants, both conventional coal boiler and advanced coal boiler power plants exist in the electricity market.

The technical parameters of CCT such as the specific capital cost, the ancillary operating cost, and the energy conversion efficiency are summarized in Table 1. These parameters are carefully examined from current references (Longwell, 1995; Takahashi, 2001; U.S. Department of Energy, Energy Information Administration, 2002).

Table 1
Technical and Cost Parameters of CCT

	Case	Specific capital cost($/(mmBtu/year))	Ancillary operating cost ($/mmBtu)	Efficiency %	Available Year
Conv. Coal		75.3	3.45	39	
Adv. Coal		66.9	3.25	41.5	
	High cost	80.3	6.25	40.5	
PFBC	Most likely	73.9	5.75	41	1998
	Advance	68.8	5.75	42	
	High cost	86.9	6.86	42	
IGCC	Most likely	80.0	6.32	43	2004
	Advance	74.5	6.32	44	
	High cost	91.7	7.08	48	
IGFC	Most likely	84.4	6.52	50	2009
	Advance	78.6	6.52	52	

Policy Options for the Promotion of Clean Coal Technologies

As the specific capital cost and the ancillary operating cost of CCT are higher than those of other power plants such as advanced coal boiler power and gas combined power plants, the electricity price of CCT becomes higher than that of other power plants. Since price differences obstruct the introduction of CCT, it is important for the introduction of CCT to reduce the electricity price.

A carbon tax and an energy tax are expected to be an efficient approach to reduce carbon dioxide emissions. It has been implemented already in both Sweden and Denmark in 1990s. In Japan, the introduction of these taxes has been discussed extensively. These taxes will promote the shift from lower energy efficiency technologies to higher energy efficiency technologies. In particular, the carbon tax will raise the price of high-carbon fuels such as coal and petroleum, and promote the energy shift from high-carbon fuels to low-carbon fuels such as natural gas.

In this study, it is assumed that a carbon tax and an energy tax are imposed as the method of reducing the price difference of electricity between the CCT and other power plants. In terms of the amount of tax, it is assumed to reduce 10% of CO_2 emissions in the year 2044 in the BAU case. In the case of carbon taxation, the tax reaches $80/tonC. In the case of energy taxation, the tax reaches $3/mmBtu. To mitigate the impact of taxation on energy systems, the taxes were introduced gradually over time, increasing the tax rate in uniform steps each period until the maximum rate was reached in 2044 .

A large amount of tax revenue is gained by the imposition of taxes. In Northern European countries, this tax revenue is used for general finances. In this study, it is assumed that the tax revenue is used as the subsidy for the introduction of CCT. It is assumed that 10% of the specific capital cost of CCT is subsidized by the tax revenue.

Since the electricity sector accounted for 33% of total CO_2 emissions in the year 1999, the total amount of subsidy took 33% of the amount of carbon tax revenue.

Tools for the Analysis

In this study, we have used the META•Net economic modeling system which was developed at the Lawrence Livermore National Laboratory. The META•Net is a partial equilibrium modeling system that allows for explicit price competition between technologies, and can constrain or tax emissions. It allows a user to build and solve complex economic models. Although the changes in the economy are largely driven by consumers' behavior and the costs of technologies and resources, they are also affected by various government policies. These can include constraints on prices and quantities, and various taxes and constraints on environmental emissions. The META•Net can incorporate many of these mechanisms and evaluate their potential impact on the development of the economic system (Lamont, 1994).

Initial Conditions for the Analysis

Several key assumptions are required to drive any analysis of this type. These include growth rates and demand response to changes in price. In this study, we assumed a moderate rate of growth over the time horizon. Table 2 shows the assumptions for the growth and demand elasticities in each sector. As for IGCC and IGFC, these have not yet been commercialized in the Japanese electricity sector. Therefore, it is assumed that the introduction of IGCC begins from the year 2004, and the introduction of IGFC begins from the year 2009 in this model.

Table 2
Growth Rate and Elasticity Assumptions for End-use Sector

Sector	Annual rate of demand growth[a)]	Demand elasticity[b)]
Industrial heat demand	0.001	-0.340
Industrial electricity demand	0.005	-0.340
Commercial heat demand	0.009	-0.230
Commercial electricity demand	0.021	-0.230
Residential heat demand	0.003	-0.380
Residential electricity demand	0.006	-0.380
Truck transportation demand	0.003	-0.170
Personal transportation demand	0.003	-0.230

a) Energy Data and Modeling Center. (2002) *EDMC Handbook of Energy & Economic Statistic in Japan*, Tokyo.

b) Nagata, Y. (2000) Personal communication. June 21, 2000.

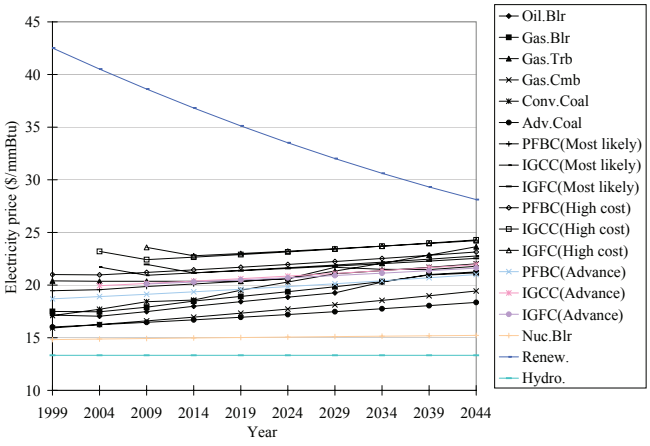
Results of the Analysis

Electricity Price and Electricity Power Generation of CCT

The discussion in this section highlights the analytical results of the electricity price and the electricity power generation of CCT.

First, the electricity prices are shown in Figure 1. In each case, the electricity prices of CCT became higher than those of other power plants such as gas combined power plant and advanced coal boiler power plant. The electricity price of

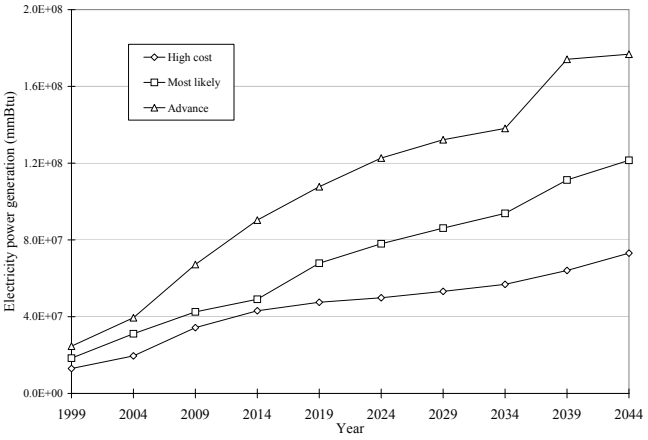
Figure 1
Electricity Price



IGFC became lower than that of IGCC. Although the specific capital cost and ancillary operating cost of IGFC are higher than those of IGCC, since the energy efficiency of IGFC is much higher than that of IGCC, the electricity price of IGFC becomes lower than that of IGCC.

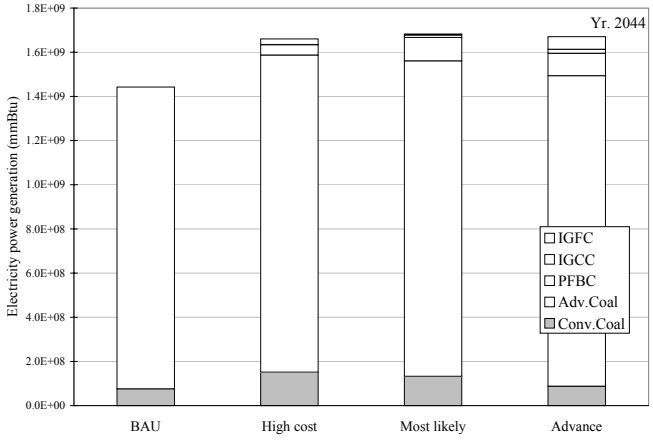
Second, the electricity power generation of CCT is shown in Figure 2. The growth rate of electricity power generation of CCT depends on the electricity cost. For the advanced and high cost cases, the electricity power generation of CCT in the advanced case becomes 2.4 times larger than that of CCT in high cost case in the year 2044.

Figure 2
Electricity Power Generation of CCT in Each Case



The component of coal-fueled power generation is shown in Figure 3.The electricity power generation of conventional coal boiler power plants decreases, so that the electricity power generation of CCT increases. In the advanced case, which increased the introduction of CCT into the electricity market, electricity power generation of CCT reached 11% of coal-fueled power generation. Moreover, since the electricity price of IGFC is lower than that of IGCC, the electricity power generation of IGFC becomes larger than that of IGCC.

Figure 3
Electricity Power Generation of Coal-fueled Power Plant of each Case in 2004



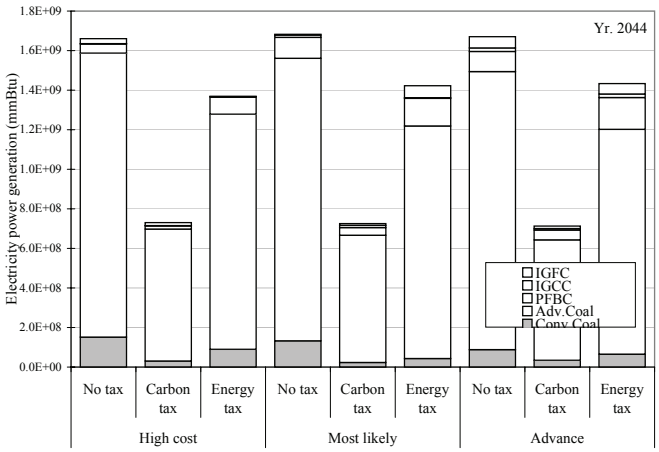
Electricity Power Generation of CCT When Carbon and Energy Tax are Imposed

The discussion in this section highlights the analytical results of electricity power generation of CCT when a carbon tax and an energy tax are imposed.

The components of a coal-fueled power plant when the taxes are imposed is shown in Figure 4. When a carbon tax or an energy tax is imposed, the electricity power generation of coal-fueled power plant decreased. However, in the case of energy taxation, the electricity power generation of CCT

becomes larger. When a carbon tax is imposed, the electricity price of CCT rises more than that of other power plants because the CCT uses coal which has the highest carbon content of any other fossil fuels. Since the relative electricity price

Figure 4
Electricity Power Geneation of Coal-fueled Power Plant When the Taxes are Imposed

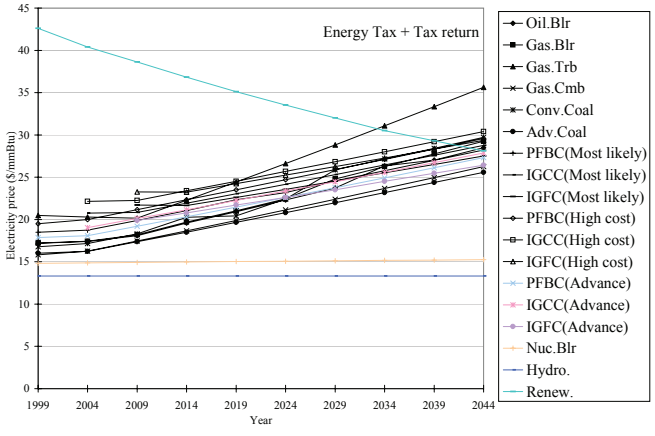


of CCT becomes higher in the electricity market, the electricity power generation of CCT decreases. However, when an energy tax is imposed, the electricity price of CCT rises less than that of other power plants because CCT has the higher energy efficiency. Therefore, the electricity power generation of CCT becomes larger than that of the zero taxation case.

Electricity Power Generation of CCT When Tax Revenue is Returned

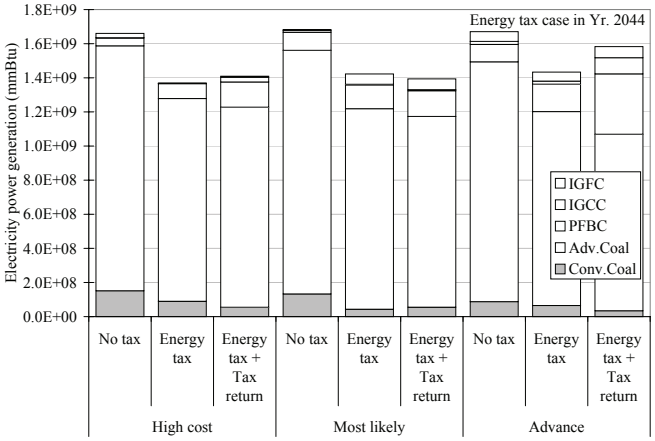
The discussion in this section highlights the analytical results of electricity power generation of CCT when the tax revenue is returned to the specific capital cost of CCT.

Figure 5
Electricity Price with Energy Tax and Tax Return



The electricity price, when the energy tax is imposed and the tax revenue is returned, is shown in Figure 5. The component of electricity power generation of coal-fueled power plants with energy tax and tax return is shown in Figure 6. By using the tax revenue as a subsidy, the specific capital cost of CCT became lower than that of the zero subsidy case.

Figure 6
CO_2 Emission from the Electricity Sector with Energy Tax and Tax Return



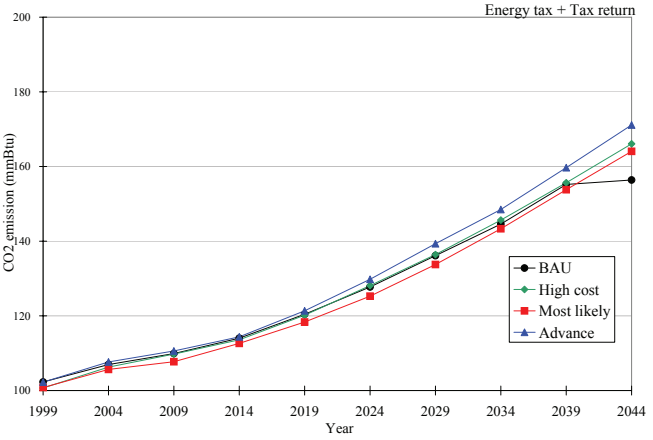
Therefore, the electricity price becomes lower than that of the zero subsidy case. Since the difference of electricity price among CCT and other power plants such as gas combined cycle power plant and advanced coal-fired power plants becomes small, the competitive power of CCT becomes strong in the electricity market. On condition that the energy tax is imposed, the electricity power generation of CCT became up to 2.9 times as large as that of zero subsidy case. In other words, by reducing specific capital costs ten percent, CCT becomes competitive in the electricity market. For the promotion of CCT, energy taxation has a larger impact than carbon taxation.

The CO_2 emissions from the electricity sector with energy tax and tax return is shown in Figure 7. In each case, CO_2 emission from the electricity sector increases. Although the energy efficiency of CCT is higher than that of existing power plants, CO_2 emissions increase because the consumption of coal rises by the increase in the demand of CCT.

Conclusion

In this study, we have developed an energy-economic model in which we can take both energy conversion efficien-

Figure 7
CO_2 Emission from the Electricity Sector with Energy Tax and Tax Return



cies and the economic aspects into consideration. Then we have evaluated the impact of CCT on energy systems in the electricity sector in Japan. The results of our analysis show that the introduction of CCT is not widely promoted largely because the electricity price of CCT becomes higher than that of other power plants.

Then, we have analyzed the effect of a carbon tax and an energy tax on the electricity price of CCT and other power plants in the electricity market. A carbon tax increases the difference in these electricity prices. In contrast, an energy tax can mitigate the price difference, and promote the introduction of CCT. Moreover, the results of our analysis shows that the tax return to the specific capital cost of CCT has a strong effect on the introduction of CCT. With respect to CO_2 emissions, the introduction of CCT has little impact on their reduction.

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Energy Priorities in the Central Asian States

*By Malika Saidkhodjaeva**

Overview

This paper reviews the current energy position and prospects of five Central Asian States (CAS) with particular emphasis on Uzbekistan, Kazakhstan and Turkmenistan and noting the degree of trade and inter- dependence between the states. The final paragraphs of the paper place the five Central Asian States within the wider context of the Euro-Asian energy market and the opportunities offered by new pipeline/ transmission line projects to provide links with Europe and through Afghanistan and Iran to Pakistan and India on one side as well as to China and the Middle East.

The five Central Asian States of Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan have a total population of some 56 million. They cover an area of 4.35 million square km, of which more than 60% is accounted for by Kazakhstan. They are characterized by their landlocked location, and Uzbekistan is one of the two double landlocked countries worldwide. This makes access to and from international markets quite difficult for the CAS countries, and also constitutes a hindrance to the enhanced export of primary energy sources to Europe or East and South Asia. Trade within the region, including energy trade, is also hampered by a number of other factors, although the fact that the countries are richly endowed with different types of energy resources is, in general, a positive stimulus to regional trade.

The Central Asian States are fossil fuel rich countries, which have been successful in implementing an export-led growth strategy for their economic development based on these natural resources. Among them, Kazakhstan has been the most successful with its vast oil resources and early recognition that foreign investment and know-how are a necessity to exploit the resources as well as to find and capture new markets. Turkmenistan has also been successful in capturing some of the CIS markets. However, hydro-rich Kyrgyz Republic and Tajikistan, despite having the hydro potential and being able to export hydroelectricity, face their own problems in implanting growth strategies into the regional energy market, and in attracting new external investment sources.

Current Position of CAS Energy Market Players

Uzbekistan has significant oil, coal and natural gas reserves. Although the country's oil and gas production has increased in the past decade, Uzbekistan's export potential is hindered by a lack of export routes from landlocked Central Asia. Uzbekistan's only current crude oil export option is to reverse an existing pipeline that brings oil from Russia to Uzbek refineries. However, the relatively small volume of Uzbek oil that will be available for export over the next 10-20 years will probably be insufficient to support the construction of a new export pipeline unless additional volumes are added from other countries in Central Asia. Uzbekistan has signed a memorandum of understanding with Turkmenistan, Afghanistan and Pakistan to build the Central Asia Oil Pipeline (CAOP), which, if constructed, would transport Central Asian oil via Afghanistan to a proposed new deepwater port at Gwadar on Pakistan's Arabian Sea coast. In addition to the COAP, Uzbekistan could tie into the proposed 1,800-mile pipeline from Kazakhstan to China.

The country's gas reserves are estimated at 1,873 billion cbm. Uzbekistan is the third largest natural gas producer in the CIS and one of the top ten gas-producing countries in the world. Since becoming independent, Uzbekistan has ramped up its gas production nearly 33% from 42 billion cbm in 1992 to 56 billion cbm in 2000. Although Uzbekistan's gas production has been on the increase, the country's growing gas consumption (40 billion cbm in 2000) has meant that the amount of gas available for export - approximately 14 billion cbm - has remained relatively steady since 1998. Uzbekistan exports natural gas to Kazakhstan, Kyrgyz Republic, Russia and Tajikistan via the Central Asia - Central Russia Pipeline. Russia and Uzbekistan have reached agreement on Russian payment for Uzbek gas supplies, but frequent non-payment by Kazakhstan and Kyrgyz Republic has been a problem, forcing Uzbekistan to cut gas supplies to these countries to demand payment for gas already received. In an effort to expand and diversify its customer base for gas exports, Uzbekistan has sought to develop alternative routes such as extensions of the Trans Caspian Gas Pipeline (TCGP) for exports to Europe, and the Central Asia Gas Pipeline (CentGas) to export gas to Afghanistan, Pakistan and India. In addition, Uzbekistan is looking to participate in a proposed 5,000-mile pipeline to bring gas from Turkmenistan and Kazakhstan to East China.

Crude oil and condensate production in 2001 amounted to 8 million tons. The refining capacity of the three refineries totals 222,000 bbl/day. Uzbekistan's coal production in 2000 stood at 2.5 million tons, which means a sharp decrease compared to the production of 5.9 million tons in 1991. Uzbekistan's coal reserves amount to 4 billion tons, primarily in the Angren, Baisun and Shargun deposits. Most mining production equipment has virtually exhausted its service life. In response, the government is implementing a program to update the country's coal sector by modernizing production facilities. A project concerning the refurbishment of the Angren coal mine, which is the largest mine, hopes to raise coal extraction to 4.5 million tons and to cut production costs. Uzbekistan plans to upgrade mining operations at its other deposits as well in order to produce a surplus of coal for export in the future.

Uzbekistan's total primary energy consumption has increased from 48.91 million toe in 1995 to 54.61 million toe in 2000. Consumption in 2000 consists of 12% oil products, 84% gas, 2% coal and 1% hydro power, equivalent to 6.2 GWh that came from 25 hydro power plants with a total capacity of 1,710 MW. Per capita consumption is 2.2 toe, which is amongst the highest in the region.

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Kazakhstan has significant petroleum reserves, with estimates ranging from 0.8 to 2.5 billion tons of oil. Kazakhstan produced approximately 39.8 million tons of oil in 2001, this being a sharp increase from the 25.6 million tons produced in 1998. The country's remoteness from world markets, along with its lack of export pipelines, has so far hindered the further growth of exports. Kazakhstan took a major step towards increasing its oil exports in March 2001 with the launch of the 990-mile Caspian Pipeline Consortium (CPC) pipeline, which allows piping of oil directly from the Tengiz field to Russia's Black Sea port of Novorossiisk.

Kazakhstan has proven natural gas reserves of between 1,840 and 1,980 trillion cbm, mainly in the Kashagan, Karachaganak and Tengiz fields, ranking it in the top 20 countries in the world. Natural gas production was increased to about 12 billion cbm in 2000 from 5.9 billion cbm in 1995. However, the lack of internal pipelines connecting the country's natural gas producing areas to the industrial belt between Almaty and Shymkent has hampered Kazakh natural gas production, with many oil producers flaring the natural gas instead of using it. Natural gas consumption still far exceeds the country's domestic production. Kazakhstan currently imports significant shares of its natural gas consumption needs, mainly from Uzbekistan, but with small amounts from Russia as well. In July 2001, KazTransGaz and Uztransgaz, the Uzbek natural gas monopoly, entered into a five-year agreement on natural gas supplies, with Kazakhstan purchasing 1.68 billion cbm in 2002.

With sufficient investment in its natural gas fields and pipeline infrastructure, however, the country could easily become a net natural gas exporter. In August 2001, the Kazakh Ministry for Energy and Mineral Resources approved a 15-year strategy for developing the country's natural gas sector that would increase natural gas production tenfold. Key to the strategy is the development of natural gas reserves at Kashagan, Karachaganak and Tengiz.

Kazakhstan's reserves of coal amount to around 185 billion tons. Despite a contraction of the coal industry since the break-up of the Soviet Union, it remains a major coal producer, consumer and exporter. Between 1992 and 1999, Kazakh coal production declined by 54% from 126.6 million tons to 58.2 million tons. Coal production declined in large part because of non-payment by customers and the lack of incentives to export to Russia (due to high rail tariffs for transporting coal within Russia), as well as due to the collapse of domestic demand. Kazakh coal consumption fell nearly 58%, from 85.5 million tons to 35.8 over this time period.

After nearly a decade of decline, Kazakh coal production is apparently on the rise again. After producing approximately 68 million tons in 2000, Kazakhstan planned to produce 80.5 million tons of coal in 2001. Transportation is the key problem for the coal trade in the Central Asian region, given the great distances that separate markets from deposits. Coal is a high-volume, low-value commodity, ideally suited to rail transportation. At present, Kazakhstan transports coal by railroad to its own internal markets, and exports coal by rail to Russia, Ukraine, the Kyrgyz Republic, and Uzbekistan. But the infrastructure is limited and in poor condition. Negotiations are underway to sell coal to Turkey and Iran, but inadequate infrastructure is a stumbling block.

Total primary energy consumption in Kazakhstan has declined from 63.0 million toe in 1995 to 39.7 million toe in 2000. Consumption in 2000 consists of 29% oil products, 20% natural gas, 49% coal and 2% hydro power.

Energy policy in **Kyrgyz Republic** is heavily weighted toward development of its extensive hydroelectric power resources and expansion of its electricity grid. The country has a very large hydroelectric potential with more than 163,000 GWh per year, of which at present less than 10% is exploited. In addition to the presently installed capacity of 2.95 GW, Kambarata No. 1 with 1,900 MW and No. 2 with 360 MW are considered as the next candidates for expansion. Primary electricity production from hydropower accounts for more than 80% of total primary energy production.

Kyrgyz Republic has also significant deposits of brown coal. Its coal production had been subsidized in the Soviet era, but has declined since independence, from 2.2 million tons in 1992 to 0.17 million tons in 1999. This steep decline has meant that Kyrgyzstan is now a net coal importer. Development of a large mine at Kara-Keche, however, could produce enough to displace imported coal that is being fired at the country's largest thermal power plant in Bishkek. There are presently discussions going on with the German KfW about support for a detailed investigation of the possibility for increased use of local brown coal.

The proven crude oil reserves are currently only 5.7 million tons. Estimates of total reserves - as yet unproven - in the Fergana valley and the depression at Chuy range up to 414 million tons. Current oil production is only 100,000 tons per year. Kyrgyz Republic has estimated natural gas reserves of about 5.7 billion cbm, but these are difficult to exploit. Natural gas accounts for more than 20% of the country's total energy consumption. Kyrgyzstan consumed 0.67 billion cbm of natural gas in 2000, almost all of which came from imports. Its own natural gas production in 1999 was a mere 0.01 billion cbm.

Total primary energy consumption has increased from 2.38 million toe in 1995 to 2.77 million toe in 2000. Consumption in 2000 consists of 25% oil products, 21% gas, 20% coal and 33% hydro power. This is the highest share of hydropower in total primary energy consumption in all Central Asian Countries. Consumption of primary energy amounts to only 0.56 toe per capita. Together with Tajikistan, this is the lowest value of all countries in the region.

Tajikistan is endowed with an enormous hydro power potential that is the major primary energy resource. Total hydropower reserves amount to more than 300,000 GWh, of which presently only about five percent are exploited. In 2000, 92% of the total electric power was generated by hydro plants. Completion of the Rogunsk (3,600 MW) and Sangtuta (670 MW) hydro power plants are the next steps for exploitation of hydropower and considered as priorities by the Tajik Government. Construction of these two power plants had started even before independence. Furthermore,

the Tajik government is resuming a program to build 15 small hydropower plants. A start has been made on supplying equipment for five of these with a total capacity of 634 MW. Apart from hydropower, proven primary energy reserves are quite limited. The country has in addition natural gas reserves of just 5.7 billion cbm.

Tajikistan has a very small oil industry. In 2000, it produced approximately 200,000 tons of crude oil, while the consumption of petroleum products stands at 1,400,000 tons. Tajikistan has no oil refineries. Most of the imported oil products come from Uzbekistan. Domestic gas production was 0.068 billion cbm in 2000. Tajikistan's annual consumption of 1.16 billion cbm forces the country to rely heavily on natural gas imports from Uzbekistan and Turkmenistan. Tajikistan has tried to increase its own gas production by exploratory drilling in the Khatlon region in 2000. Apparently, some of the drilling has been successful enough so that interest has been expressed by China in future drilling in Tajikistan.

Coal production in Tajikistan has plummeted by 90% since the country's independence from 228,000 tons to just 22,000 tons in 2000. An important reason for reduced coal consumption is the switch of residential consumers from coal to electricity for heating after the increase in coal prices. The same holds true for oil products.

Tajikistan's total primary energy consumption decreased from just below 8 million toe in 1991 to 2.6 million toe in 1995, mainly as a result of a substantially reduced level of economic activity. This also led to an increased share of the residential sector in total consumption as compared to 1991. Primary energy consumption increased again to 3.74 million toe in 2000. Primary energy consumption in 2000 is accounted for by 39% oil products, 28% gas, 2% coal and 32% hydro power, the latter being a high value by any standard. Per capita primary energy consumption amounts to 0.58 toe.

Turkmenistan's primary energy reserves consist mostly of gas. Proven natural gas reserves amount to approximately 2.8 trillion cbm. Although the country's gas sector is not fully developed and output dropped throughout the 1990s, Turkmenistan still produced 22.4 billion cbm of gas in 1999, rebounding from 1998 when Turkmenistan, locked in a pricing dispute with Russia over the export of its gas, produced a low of 13.2 billion cbm. With high world gas prices and a Turkmen-Russian agreement on Turkmen gas exports, the country's gas production soared up to 47 billion cbm in 2000. 34 billion cbm (72%) of the gas production was exported, with around 25.7 billion cbm sent to Russia, 5 billion cbm to Ukraine and 3 billion cbm piped to Iran. Gas exports in 2000 were thus four times as high as in 1998.

In order to further increase its exports and reach its full potential, Turkmenistan must solve the problem of getting its gas to consumers and getting paid in hard currency. The country has been unable to capitalize on its gas wealth because it lacks a pipeline to transport the gas to worlds markets. Russia holds a virtual monopoly over Turkmenistan's gas export routes. As part of its strategy to increase its natural gas exports, Turkmenistan is developing alternatives to Russia's pipeline network. The most important proposed project is the 1,020-mile Trans-Caspian Gas Pipeline (TCGP), which would run from Turkmenistan under the Caspian Sea to Azerbaijan, through Georgia, and then to Turkey. The pipeline's initial gas throughput would be 15.8 billion cbm/year, eventually rising to 30 billion cbm/year. Total costs of the pipeline are estimated at around US$ 2 billion, so that substantial foreign investment would be required for the project.

Turkmenistan produced 8.02 million tons of oil and oil condensate in 2001, which was 12% more than in the previous year. The country has announced plans to increase oil production to more than 10 million tons per year, with additional output due to come from newly developed wells in the west of the country. Under a 10-year program the country aims to raise crude oil production to nearly 50 million tons per year. To achieve this, however, substantial foreign investment in the country's oil infrastructure will be needed. While Turkmenistan has attempted to ease restrictions on foreign investment, many obstacles still exist that might distract foreign investors.

Turkmenistan's total primary energy consumption increased substantially from 7.3 million toe in 1995 to 13.1 million toe in 2000. With shares of 11% oil products and 89%

Table 1
Primary Energy Resources in Central Asia

Fossil Fuel Reserves	Unit	Kazakhstan	The Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan	Total
Crude Oil	MTOE	1,100	5.5	1.7	75	82	1,264
Gas	MTOE	1,500	5	5	2,252	1,476	5,237
Coal	MTOE	24,300	580	500	Insignificant	2,851	28,231
Total	MTOE	26,900	591	507	2,327	4,409	34,732
% of Total		77.4	1.7	1.5	6.7	12.7	100
Hydro Potential	GWh/year	27,000	163,000	317,000	2,000	15,000	524,000
	MTOE/year	2.3	14	27.3	0.2	1.3	45.1
% of Total	%	5.2	31.1	60.5	0.4	2.9	100

Source: BP Global Energy Statistics, World Bank Reports

gas in 2000, the consumption pattern is unique. Per capita consumption amounts to 2.42 toe.

However, both Kyrgyz Republic and Tajikistan are quite poor countries, small economies and to compound the problems, are highly indebted. Therefore, in order to pursue their export-led development options, they have recognized the need to attract foreign private investments to the development of these schemes.

Electric Energy Use

The electric energy generation and transmission system in the five countries of Central Asia was formed during the former Soviet Union and adapted to the needs of the wider Soviet power supply system. With the disintegration of the Soviet Union and the formation of new independent states, this system was suddenly confronted with new national borders that did not match the technical system. As a consequence it was necessary to find arrangements for regional cooperation, which is often a difficult undertaking in an environment where newly created states are looking for an independent status in all respects.

Since 1990 there has been a decline in consumption of electricity in all five Central Asian States, although a slight recovery has taken place over the last couple of years. All countries suffered a decline in consumption in the first half of the 1990s. From then on consumption stabilised in most countries except in South Kazakhstan, and at the end of the decade the consumption had increased slightly in both Uzbekistan and in Turkmenistan.

With a GDP per capita of between US$ 160 and US$ 1,230 in 2000, the five Central Asian Republics belong to the group of low income and lower middle income countries. This

Electricity in Central Asian Republics

The electricity grids of the Kyrgyz Republic, Tajikistan, Uzbekistan, South Kazakhstan and Turkmenistan belong to the Central Asian Power System (CAPS) of the former Soviet Union. They are adequately interconnected by a 500 kV transmission system enabling power exchange among the grids. They have also interconnections at 220 kV and lower voltage levels. Even after the dissolution of the Soviet Union, the synchronous operation of the grids continue, and the countries have established a Central Asian Power Council, which is responsible for preparing schedules for power exchange at three month intervals. Central dispatch is handled from Tashkent by the Unified Dispatch Center (UDC), called Energia, based on these schedules and the need to balance the systems in real time and regulate voltage and system frequency. Uzbekistan generates 52 percent of the total power in the CAPS, Tajikistan 16 percent, the Kyrgyz Republic 15 percent, Turkmenistan 11 percent, and southern Kazakhstan 6 percent. By and large, most of the power exchanges are based on the IGIAs concluded among the states for the water discharges from the Toktogul reservoir and Naryn cascade of HPPs in the Kyrgyz Republic. Turkmenistan is not involved in these types of exchanges, arising from IGIAs relating to Syr Darya basin.

The volume of power exchanges among these states declined by 70% during 1990-2000, even though the overall consumption level was about 80% of that in 1990. This decline in exchanges is attributed to the internationalization and monetization of the energy trade, as well as the energy self sufficiency policy followed by each country, upon attaining independence .

World Bank Report, (Gray book)

Table 2

Shifts in Electricity Trade in Central Asian Power System 1990-2000

Electricity Trade in 1990 (GWh)

			Imports				
Exports	Kazakhstan	The Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan	Outside CA*	Total
Kazakhstan	--	277	0	0	310	0	587
The Kyrgyz Republic	697	--	0	0	2,383	0	3,080
Tajikistan	0	324	--	0	2,344.2	0	2,668.2
Turkmenistan	0	0	0	--	6,066	0	6,066
Uzbekistan	8139	0	3,927	946	--	0	13,012
Outside CA*	0	0	0	0	0	--	0
Total	8836	601	3,927	946	11,103.2	0	

Electricity Trade in 2000 (GWh)

			Imports				
Exports	Kazakhstan	The Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan	Outside CA*	Total
Kazakhstan	--	0	0	0	0	0	0
The Kyrgyz Republic	1,252.9	--	154.4	0	1,925.6	0	3,332.9
Tajikistan	0	125.7	--	0	243.9	0	369.6
Turkmenistan	34.8	0	818.7	--	67.7	0	921.2
Uzbekistan	0	194.6	728.8	32.5	--	0	955.9
Outside CA*	2,224.3	0	0	0	0	--	2,224.3
Total	3,512	320.3	1,701.9	32.5	2,237.2	0	

World Bank Report, 2003

means that local resources for enhancement of the infrastructure system are generally quite limited. In the power sector, this is exacerbated by the fact that power tariffs are very low and well below long-run marginal costs, commercial losses are high and revenue collection rates are low. Power utilities thus cannot create the revenues they require to operate the system efficiently and in particular to maintain it at the required standards.

Generally there is a close interrelation between GDP and energy consumption, although causal factors also include population growth and per capita consumption. Predictions of GDP are often difficult, and as an alternative future demands could be forecast by extrapolation of past trends. Two such forecasts estimate that by 2025 the annual electricity demand in Central Asia will increase by between 35 TWh and 78 TWh in one case and by 41 TWh in the other. These represent percentage increases of 37-82 % and 42% respectively. Past and predicted future energy use in the region is summarised in Table 3.

Table 3
Energy Use in Central Asia (TWh[1])

Year	Kazakhstan[2]	KyrgyzStan	Tajikistan	Turkmenistan	Uzbekistan	Total
1990	25.9	9.2	19.3	9.6	54.0	118.2
1995	14.7	10.9	15.4	8.3	46.1	95.6
2000	9.2	11.8	15.5	8.9	48.1	93.7
2010[3]	11.8	15.1	19.8	11.4	61.6	120

1. 1 TWh = 10^9 kWh
2. South Kazakhstan only
3. 2.5% annual growth rates assumed for all countries
- Power Transmission Modernisation Project in the Central Asia Region – ADB project TA 5960-RETA

Current and Future Generating Capacity

The electricity demand forecasts for 2025 suggest the need for net capacity increases of between 5,300-12,000 MW in one case and around 10,000 MW in the other. However, since some existing capacity will have to be decommissioned because of age, the actual new/replacement capacity required in this period is likely to be in the order of 12,000–18,000 MW (see Table 4).

Table 4
Forecast of Required Electrical Generating Capacity

	2000	2025 Additional Net Capacity Requirement	
	Net capacity	Forecast (1)	Forecast (2)
Capacity (‘000 MW)	18.9	5.3 - 11.9	9.8
Capacity requirement (%)		28 - 63%	52%

(1) Power Transmission Modernisation Project in the Central Asia Region – ADB project TA 5960-RETA
(2) Extrapolation of 1996-2000 data, GEF AGENCY of the IFAS

The CAS’s energy resources are sufficient to meet projected demand, but mobilizing the investment required capital and converting resources into available supplies, will be depend on the ability of the energy sector to compete with other sectors of the economy. In this case , the energy-investment challenge is heightened by the fact that capital needs in the next 15 years will be much larger, in real terms, than over the past 15 years. In the case of electricity, the investment requirement will be nearly three times greater. This makes it all the more important that investment conditions in the energy sector are right to attract the required amounts of capital. According to international experts, the electricity sector dominates the investment needs picture: power generation, transmission and distribution will absorb almost 60% of total energy investment needs.

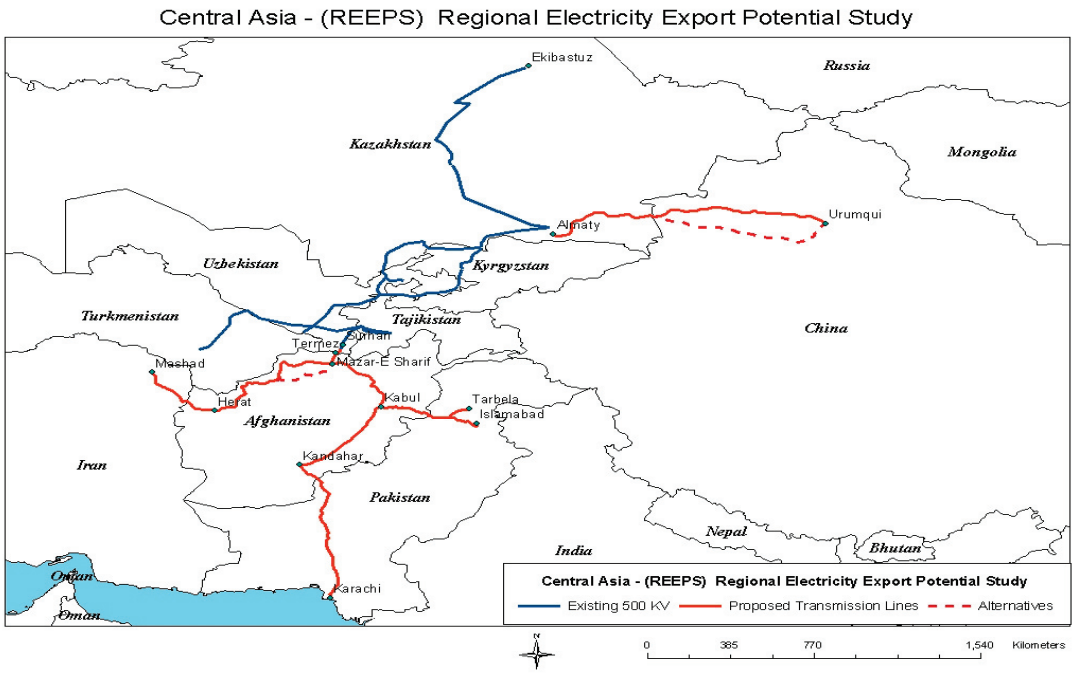
Central Asia States and its Neighboring Electricity Export Markets

Most governments will continue to seek greater private participation in the energy sector. Some governments will continue to finance oil and gas investment directly or through their national companies, but they will often have to pay more for their capital than major international companies. Governments everywhere will have to pay attention to how the policy, legal and regulatory framework affect investment risk and how barriers to investment can be lowered, if this investment is to come from outside the government.

If the Governments of the CAS would like to promote competitive investments into the energy market of the region , they also need to create more stable, transparent and predictable regulatory conditions in order to ensure that market structures do not impede investments that are economically viable. Some compromises will be necessary, for example, on long-term take-or pay contracts for exported electricity.

In regard to the markets for electricity from Central Asia, there are some real possibilities: Iran is experiencing a shortage during its peak (summer, which complements well with the Central Asian Power systems which are all winter-peak systems), and the opening up of Afghanistan, with whom CAS’s not only share a long border but have transmission links since the times of the Soviet Union; and there would be a need for additional power within CAS’s – in Kazakhstan and possibly Uzbekistan.

Power supply to northern Afghanistan was interrupted some five years ago due to non-payment of debts. Since then,



World Bank Report, 2004

some sections of the transmission lines and substation equipment in Afghanistan have been destroyed. During the discussions, the relevant agencies in Uzbekistan and Tajikistan expressed their willingness to participate in the economic development of Afghanistan, and resume power supply when the technical and administrative problems are resolved. It would thus be possible to resume power supply at least to the northern Provinces of Afghanistan, namely to the Mezari Sharif Region from Uzbekistan and the Kunduz Region from Tajikistan possibly as soon as this year 2004. According to the World Bank's Central Asia Regional Electricity Export Potential Study, Afghanistan energy market has a vital and actual need, but the amount of energy/electricity is small. There may also be a payment problem over next 10 years. However, under the World Bank's encouragement, it may be possible to use Donors Trust Funds.

The best approach is to supply electricity in exchange for right-of-way to deliver electricity to Iran and Pakistan. Pakistan and Iran are real markets. Both have asked the World Bank to help create an electricity trade with the Central Asia region. Another big player is Russia, which is interested, under certain circumstances, in importing power from Central Asia. This year Russia has made a start with some imports from Kyrgyz Republic.

Another option for a future market comes from China which has a huge growth in demand and current shortages. Targets are for 356,000 MW installed capacity to triple by 2020 and the idea to "Develop the West" Initiative focuses on Xinjiang, but Xinjiang has enough capacity and gas resources, and in this case only internal (China) transmission can make the necessary linkage to a huge market.

The Central Asian energy market product, electricity, needs to be competitive with importing countries' electricity and local generation costs. The generation cost plus transmission costs should be less than US cents 5.6/kWh in Pakistan and US cents 5/kWh in Iran. Also there is a need to ensure year-round supply.

These two conditions can perhaps be met with: (a) a combination of surpluses from existing generation plus new power: and (b) formation of a Water-Energy Consortium . The recent World Bank Study outlines the way to benefit the whole region, and gives cost estimates of the various options.

Summary

The trade in energy resources in Central Asia States is hampered by a number of factors that include political, technical, institutional and commercial components. A prime obstacle is the fact that for virtually all governments in the region, with their background in the FSU, "self-sufficiency" has been an economic policy goal and most of the countries of the region have had programs of import substitution. This policy has been extended to electricity. The effect is that some states are generating electricity using high value fossil fuels rather than importing electricity from neighboring countries with surplus electricity generated from renewable resources.

Structural Changes in NOCs: A Proposal in the Case of NIOC

*By Mohammad Mazraati and Mehran Amirmoeni**

In spite of some efforts to separate the functions and roles of Iran's Ministry of Petroleum and the National Iranian Oil Company (NIOC) the situation is still full of ambiguity. A regulatory body is still lacking. Although operating companies have restructured themselves and are trying to do their business based on a "Business Units Model", a lack of meritocracy, professionalism and efficiency incentives, are among the dominant factors hindering performance. Establishing an effective fiscal regime will increase incentives for NIOC to resolve its problems. In fact, transparency leads to a clear-cut distinction between policy-making and operation in the oil industry. This paper suggests a framework, which includes a royalty for the government and recognizes NIOC as an operating company. The paper concludes that applying such a fiscal regime will help NIOC to commercialize its activities.

Introduction

The international oil industry has undertaken a number of measures to increase efficiency. These include restructuring, downsizing, commercializing, portfolio restructuring, diversification of activities, mergers, acquisitions, and so on.

Contrary to the international oil companies (IOCs), the national oil companies (NOCs) are not concerned about their survival in the markets. Therefore, they have paid less attention to restructuring and commercializing their activities. However, the growing size of the public sector, soaring state expenditures, high population growth rates, management incompetence, and other factors have caused governments to pursue policies leading toward subsidy elimination, increasing profitability and reducing government interference.

Structural Changes in the Iranian Oil Industry

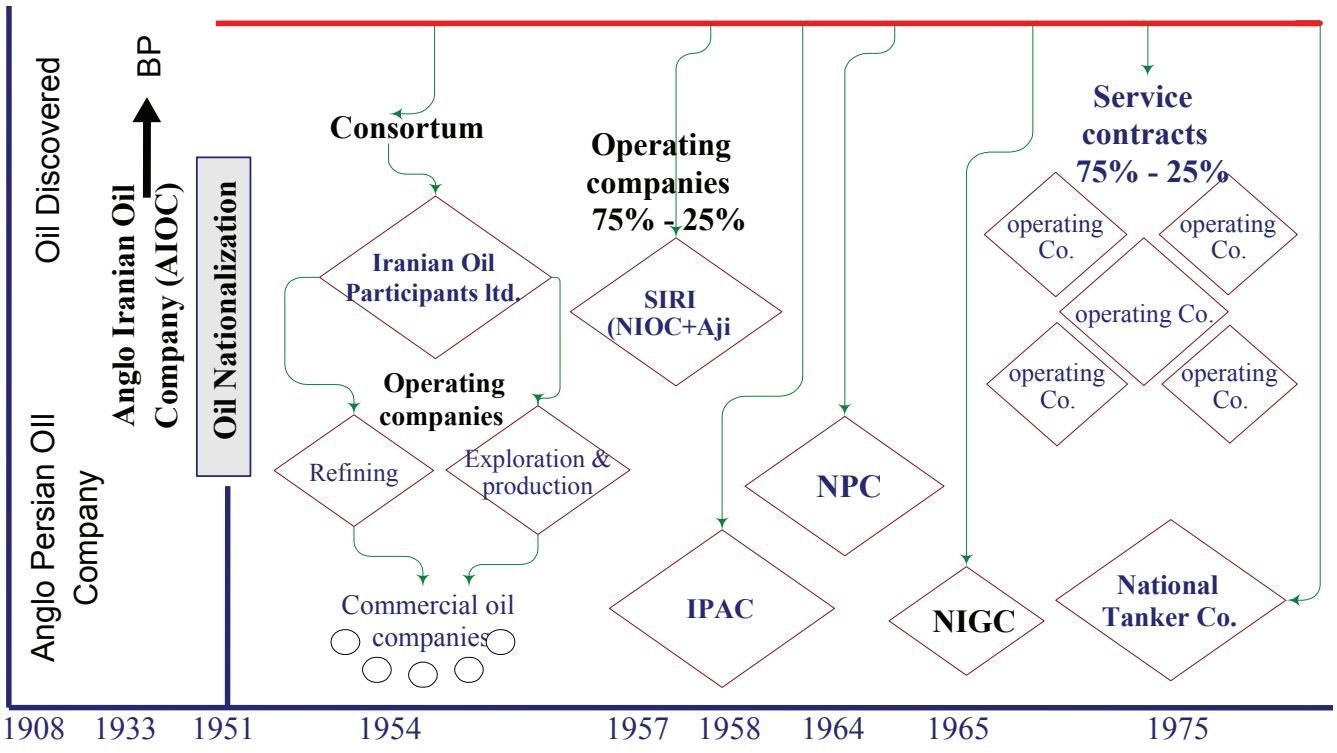
In 1908 oil was discovered and the Anglo Persian Oil Company was formed. In 1914 the UK government purchased a considerable part of the company with 50 percent voting rights.

After Iran's oil nationalization in 1951, what was then the Anglo-Iranian Oil Company's contract was canceled. Pursuiant to Iranian law, the whole southern oil industry was transferred from the Anglo-Iranian Oil company (AIOC) to the newly-created National Iranian Oil Company (NIOC). A new era dawned for Iran's oil, almost exactly half a century after the granting of D'Arcy's concession.

After protracted negotiations, the Iranian Oil Consortium was formed with an ownership of 40% by AIOC, 14% by Royal Dutch, 40% by five major American oil companies and 6% by French oil company, CFP. This was ratified in 1954 by the Iranian Congress and Senate.

Figure 1 shows the evolution of the structural changes in oil industry in Iran before the revolution. As can be seen,

Figure 1
Oil Industry Structure Before the Revolution of 1979
Establishment of the National Iranian Oil Company (NIOC)



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See footnotes at end of text.

all oil activities in the upstream were supervised by NIOC and operated through an Iranian based joint company. The contracts were so-called 50%-50% contracts. Since the foreign partner had to pay a 25% tax to the Iranian government, the share to Iran was 75%. Because of this the contracts also were called 25%-75% as well.

The contracts included production sharing and service aggrements.

With the revolution in 1979, the Consortium agreement came to an end. Calm on the oil front ended after a quarter of a century.

After revolution the structure of oil industry was changed. The Ministry of Petroleum was formed and NIOC and other affiliated companies were placed under its authority. The oil industry was managed centrally, fully integrated, and bureaucratically during the next 20 years.

Figure 2 shows the structure governing the oil industry after establishment of the Ministry of Petroleum. As can be seen, all active operating companies in the Iran offshore were merged into one company called the Iranian Offshore Oil Company(IOOC). All oil activities from upstream to downstream came under supervision of Ministry of Petroleum. But all other companies were as sub companies of NIOC in the sense that they had to operate under all NIOC's regulations and procedures. The financial relationship between the companies was not based on market prices and in many cases subsidies were allocated subjectively.

In 1998 the Ministry of Petroleum undertook an extensive restructuring. As can be seen from Figure 2, four parent companies were established. NIOC is an exploration and production (E&P) company, NIGC is responsible for the domestic gas market, NIORDC is the domestic oil refiner and petroleum products distributor. NPC is responsible for investing, producing, supplying and marketing of petrochemical products. All these parent companies have sub companies or business units. For example, within NIOC there are three main oil and gas producing companies, the National Iranian South Company, the National Iranian Central Company and the Iran Offshore Oil Company. All these companies are functionally separated but the old processes remain and a restructuring of financial, commercial, HSE, etc., is needed. Based on the current structure any improvement in efficiency is a far-reaching target.

The structure governing the oil industry should be changed at two levels. One is at the aggregate level and the other is at the level of parent companies their sub companies.

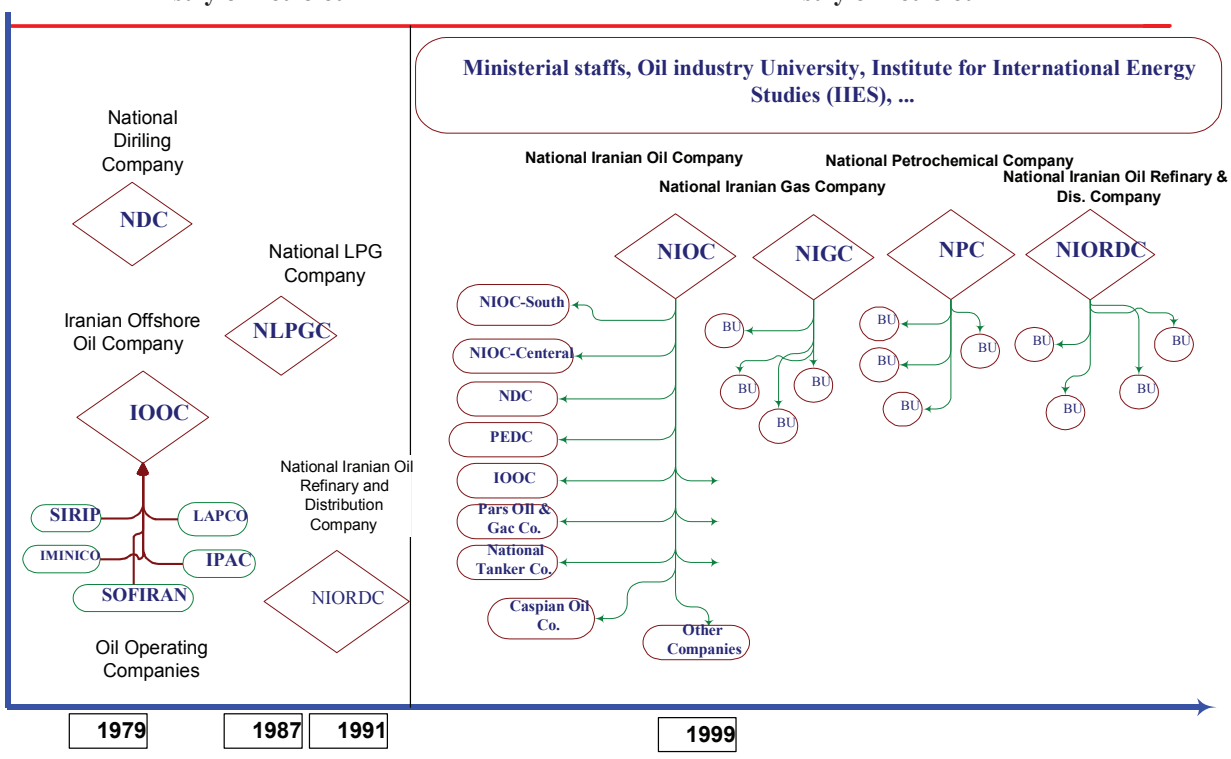
In the next section the necessity of clarifying the financial relation between parent companies and each company with the government is addressed.

NIOC's Changed Position

As mentioned earlier, before the revolution, NIOC was responsible for all upstream and downstream activities in Iran on behalf of Iranian government. The relationship with international companies was based on a fiscal regime that distributed revenues between the host and the foreign company. In fact, the government's revenue was provided through royalties, corporate taxes, and share interests.

Post revolution, the prevailing fiscal relationship is the

Figure 2
Iran's Oil Industry Restructuring After the 1979 Revolution



government's strict supervision of the oil industry with the aim of capturing oil revenues.[1] Consequently, NIOC was transformed from a government company acting as a business into a mere operational unit providing the government with financial resources. Ever since, NIOC's income has been completely siphoned into the treasury and it has had to bargain over its budget. This situation has offset any motivation by NIOC to optimise its costs and improve efficiency. Its competence has declined dramatically simply because the financial resources were not allocated appropriately to it.

Lack of transparency in this fiscal relationship and some budget commitments caused the government and the parliament to develop other ways to provide financial resources. Revenue from the export of oil products was given to NIOC. In addition, NIOC could take advantage of bank loans, government's public resources, and a share of oil product exports. The procedures of allocating these financial resources have changed on a yearly basis, so evaluating and examining them is practically impossible.

A Restructuring Plan

A restructuring of NIOC will lead to better performance and higher efficiency when it includes a clear and transparent inter and intra-corporate fiscal relationship.

Considering the fact that the main goal of parent companies is to commercialize their activities, commercialization should be the basis of such relationships. In fact, each company has to offer its services and products to other companies based on its own costs. In this case, transparency in financial performance will make it possible to assess each company which in turn can encourage the companies to improve their management and competence.

When intra-corporate relationships between parent companies are improved, government subsidies become transparent and are internalized in the budget. Then, if the government wants to give subsidies to the society, it has to compensate for the losses undergone by the company, e.g., NIORDC.

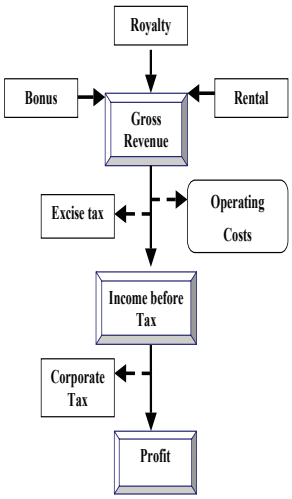
The fiscal relationship between the state and NIOC, NIGC, NIORDC and NPC based upon a corporate tax would be transparent. However, the corresponding relationships in the upstream sector are more complicated. In upstream activities economic rent is generated from such factors as ownership rights, land rent, hydrocarbon resources that are non-renewable, and the availability of lower-cost reserves compared with other regions.

Economic rent is defined as part of the production yield that can be paid by the producer without hindering the process of production. Therefore, governments are seeking some legal levers to take the premium accrued from oil and gas exploration and exploitation activities.

Economists believe that governments can generate revenues by means of levying taxes. This is true particularly in the oil and gas industries where such special tolls as royalties, bonuses, rentals, surtaxes, and special taxes are assumable.

Such being the case, the companies will be able to interact with the government under a fiscal regime with oil contracts formed on such a fiscal basis. As of signing the contracts, companies will be obliged to pay a share of their earnings from oil and gas exploitation as royalty, rentals, special taxes, and corporate taxes to the government. As a result, the relationship between the government and the company becomes clearer. Figure 3 illustrates the interests accrued from exploration and exploitation activities divided between the government and the company.

Figure 3
Suggested Distribution of Revenues Between the Government and NIOC



As mentioned earlier, in this case, financial statements are prepared based on certain standards so that it would be possible to evaluate the company's performance with ease.

Establishing a fiscal regime would enable us to regulate corporate relationships. Such a regime could determine not only minimum and maximum royalty, rental and so on but also oil product taxes as well as excise taxes. Moreover, this could make the system of awarding subsidies more transparent.

In a fiscal regime, the duties are divided between the government as a policy maker and NIOC as an operating company. And NIOC, aiming to maximize its interests with regard to existing restrictions, will be able to plan within a macroeconomic framework drawn by the government or its deputy, the Ministry of Petroleum.

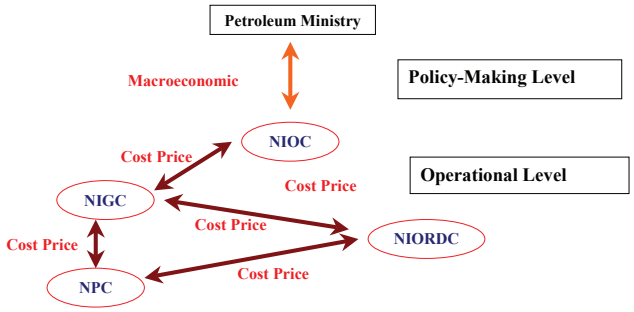
Figure 4 depicts NIOC's inter- and intra-corporate relationships under this proposal. Due to such relationships, NIOC will be financially independent and budget planning will be logical. Additionally, each company's performance will be more transparent and complications and ambiguities in their financial statements will vanish. In fact, every company will act based on its articles of association and will be obliged to report its financial performance.

Only when the above mentioned conditions are fully realized can we be hopeful that such measures as restructuring and rearranging will lead to improved management and increased efficiency in the Iranian oil industry.

The experiences of Venezuela and Norway indicate that there can be a transparent fiscal relationship between the

state and a national oil company[2]. Under such a regime the government is entitled to claim royalty, land rent, corporate taxes and special taxes based on the specifications of the field under contract.

Figure 4
Financial Tranparency Between Parent Companies: Cost Price Approach



According to Venezuelan Hydrocarbon Law, royalty is set at the range of 16.67 to 30 percent of total production. Additionally, the Venezuelan government obliges PDVSA to pay a rental and corporate tax of 67.7 percent of profit. Furthermore, the government as a shareholder of PDVSA receives the corresponding dividends.

In Norway, royalty which varied between 8 to 16 percent of sales was abolished in 1986 and an income tax replaced it thereafter. Norwegian oil companies must pay an area fee and corporate and special taxes have been introduced to absorb the economic rent of oil activities.

In Norway the state takes 28% of companies' profits. But in the oil sector companies must pay 50% of their profit to the government as a special tax. Additionally, another source of the Norwegian government's income is dividends paid by state-owned Statoil. The Venezuela and Norway approach leads to an improvement in the efficiency of their state oil companies.

Therefore, it is recommended that Iran draw up hydrocarbon resource regulations or a fiscal regime that create transparent relationships and financial independence. This should improve the oil industry's performance.

Simulation of government receipts, on the basis of the suggested fiscal regime, indicates that the Iranian government will be able to gain 85 percent of gross oil and gas revenues on average. The suggested fiscal regime consists of the following elemnets:

1. Royalty is set at 30 percent,
2. Iranian government receives 25 percent of NIOC profit,
3. A special tax of 40 percent is levied on NIOC in order to absorb economic rent,
4. Dividends are paid to the government by NIOC

However, in the second phase, the government should set the royalty rate based on the specifications of the field under question and then award it to NIOC under a contract. Under this plan NIOC should be able to improve its performance.

Conclusions

Clarifying the interaction of governments and their national oil companies (NOCs) is a form of structural change within the oil industry. The triangle of policy-making, regulatory authority, and operating companies shows a distinct role for each partner. If all functions are definitely identified and recognized, then few reforms are needed. Otherwise drastic change in the structure would be required. It is believed that the best case is one in which a country has all three of these entities.

As for the Iranian oil industry, these three different functions and roles are intertwined. In spite of the fact that some efforts have been made to separate the functions and roles of the Ministry of Petroleum and the national oil company (NIOC) the situation is still full of ambiguity. Now the Ministry is responsible for the policy delineation and strategies and the parent companies (National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refining and Distributing Company) are responsible for operation. Still a regulatory body is lacking. Although these operating companies have restructured themselves and are trying to do their business based on a "Business Units Model", lack of meritocracy, professionalism and efficiency incentives, are among the dominant factors hindering performance. Lack of responsibility, budgetary autonomy, and discretion to make investment decisions within the affiliated companies have worsened the management of oil activities in Iran.

The reason for all these problems is the ambiguous relationship between the government and NIOC. The lack of an efficient and transparent fiscal regime between the two has caused the above mentioned barriers. Establishing an effective fiscal regime will increase incentives for NIOC to resolve its problems.

Oil-rich governments, aiming to maximize their oil and gas revenues, must try to impose a financial regime on their hydrocarbon resources in such a way that the revenues will be divided proportionately between the government, the NOC and the contractor. In such a regime, levers must be devised to enable the host government to obtain economic rent from upstream activities. These levers may include royalty, corporate taxes, and special taxes.

Transparency in financial relationships between the government and NIOC will enable the government to include the subsidies in its budget and accounts. It will also motivate NIOC to enhance its efficiency. In fact, transparency will lead to a clear-cut distinction between policy-making and administration in the oil industry. This paper suggests a framework which comprises royalty for the government and recognizes NIOC as an operating compony. Applying such a fiscal regime will help NIOC to comercialize its activities.

Footnotes

[1] The enforement of sub-article 38 (1980 Budget Act) caused the revenue of oil and oil products to go directly to the treasury.

[2] Petroleos de Venezuela S.A(PDVSA) and Statoil.

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1.Brown John, 1999, "Looking to the future BP Amaco's strategic outlook", a presentation to the financial community, London and New York 15/16 July 1999.

2.IIES, 2003, suggesting NIOC-State financial relationship, not published.

Natural Gas To Replace Oil As Dominant Fuel By 2025

By Fereidoon Sioshansi*

Oil has been the dominant fuel of the past 50 years, feeding the world's industries as well as the increasingly important transportation sector. But like other dominant fuels that preceded it, namely wood and coal, the dominance of oil – many experts believe – may be on the wane.

The problem is not an imminent shortage of supplies. Rather, the growing demand will simply outrun our ability to find and pump enough out of the ground. In September 2004, PFC Energy, a Washington-based consultancy, shocked many by pointing out the inevitable result of world's ever increasing addiction to cheap petroleum. Looking at what is known to be underground and our ability to pump it out, PFC predicts that world oil production will probably peak around 100 million barrels per day, from the current 82. While that may sound like good news, it is not enough to meet the increasing demand, currently growing at 2.4% annually, if not faster. Moreover, "Even production of 100 million barrels a day can only be sustained for a few years," according to Roger Diwan, the PFC study's main analyst. The real bad news is that the world has essentially been living on borrowed time for some time, and most of us didn't even know it. Mr. Diwan says, "Every year since the 1970, we have been consuming much more oil than we have been discovering."

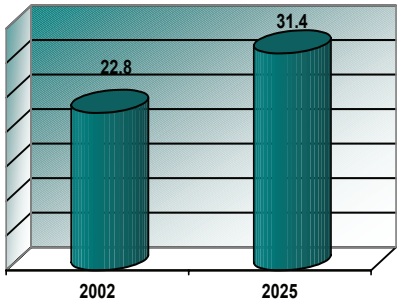
Although there are some dissenters to this view, the consensus appears to be that world oil production will peak some time in the next decade or two, followed by a gradual decline. reached the same conclusion. By 2050, according to an article by Roger Bentley and Michael Smith (see Third Quarter issue of the *IAEE newsletter*), world oil production would return to the 1960s levels, roughly half of the 2020 peak.

The question is "How are we going to wean our fossil-based economies from increased reliance on oil?" The answer depends on whom you ask. Renewable energy advocates would like to see a growing role for wind, solar, hydro and biomass. Nuclear proponents think nuclear energy can fill the void created by diminishing oil supplies and/or higher prices. Others believe that we have to use the next two decades to develop the basis for a more sustainable hydrogen-based economy, perhaps fueled by renewable energy resources on a grand scale or using clean-coal technologies.

Energy efficiency gurus believe that the ultimate answer is to use less energy, and use it wisely and sparingly. Scarcity and higher prices, they believe, will force us in that direction regardless of which path we choose.

While these alternatives are likely to compete for the support and inevitable subsidies of policy makers, the reality is that natural gas is the most likely candidate for carrying us through for another while – perhaps a few decades after oil has become too scarce and pricey to use in all but selective applications.

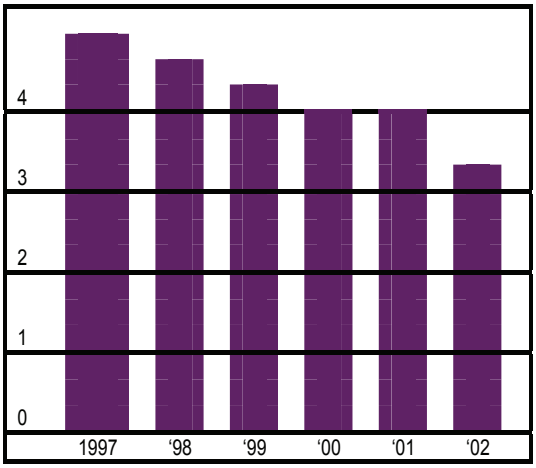
United States Consumption of Natural Gas
2002 and 2025 Projection
trillion cubic feet



Source: Annual Energy Outlook 2004, Energy Information Administration

The reasons are straightforward. Natural gas is plentiful and – with the appropriate level of investments in the transportation, storage and distribution infrastructure – is likely to replace oil in many applications. It is also cleaner, a significant bonus in combating global climate change. In the US alone, natural gas consumption is projected to grow at 1.4% per annum between 2002 and 2025. The electric power and the industrial sector account for over 70% of the projected growth in demand in the U.S. In many industrialized countries with no or few indigenous energy sources, the demand growth for natural gas will be considerably more robust.

Annual Production of Natural Gas from Fields in the Gulf of Mexico
trillion cubic feet



Source: US Department of the Interior

Up to now, however, natural gas has been playing the role of second fiddle to oil. As a gas, it is bulky and expensive to transport over long distances – putting it at a significant disadvantage to oil. By and large, it has been transported and distributed though pipelines from wellhead to major markets in Europe and North America. Major reserves, which are concentrated in the Middle East and Russia, are far from where the gas is in high demand. Despite the best efforts, domestic

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supplies in North America and Europe have not kept up with the rapidly growing demand.

This picture, however, is about to change. The advent of liquefied natural gas (LNG), now widely used to transport natural gas from distance fields to Japan and Korea, will spread over the next two decades just as supplies of oil dwindle – and its price continues to rise – relatively speaking. Why has LNG not taken off already? The answer is partly economic and partly has to do with so-called *economies of scale*:

- With oil at $50+ per barrel, relatively expensive LNG becomes cost-competitive; and
- As more investment goes to develop and expand LNG shipping and receiving facilities and specialized tankers, the per-unit costs will drop, making LNG an even better bargain.

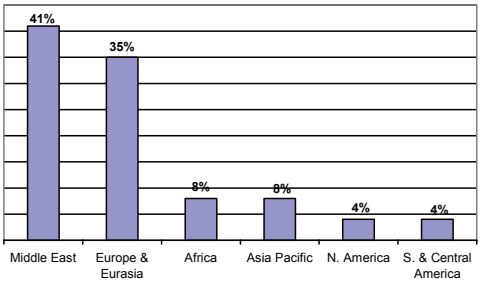
The case for LNG becomes even more compelling if it is agreed that oil will remain pricey – or become pricier over time. LNG makes sense once natural gas prices exceed $3.50 per million British Thermal Units (MMBTUs). With prices in the all-important U.S. market hovering above $5/MMBTUs and expected to remain high, the incentives to develop LNG facilities is enormous.

What is the hold-up? First, the scale of investments required is non-trivial, of the order of $5 billion or more for a single processing port and facilities. Worldwide, the amount of investment required over the next decade is expected to top $100 billion, and that may not be enough to meet the needs of giant new consuming countries like China. The second obstacle is to get the necessary environmental and siting permits – a daunting task in the post 9/11 era, especially in the U.S. where LNG terminals are sorely needed. Don't expect an overnight shift to LNG as developing the infrastructure on both ends will take years, perhaps a decade, from making a decision to finish.

Distribution of Proven Reserves of Natural Gas

percent, 2003

6,205 trillion cubic feet = 176 trillion cubic meters



Source: BP's Statistical Review of World Energy, June 2004

Where will the natural gas come from? There is no shortage of supplies if you are willing to go half way around the world. But once the gas is liquefied and the LNG transport and receiving system is developed, LNG will become a world-class commodity, just as oil or soybeans is today. The stuff can travel from the distant fields to the world markets.

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Two Examples of National Student Sections: France and Mexico[1]

By Sophie Meritet and Alberto Elizalde Baltierra*

Editor's Note: IAEE has a strong, and growing commitment toward its student members. The Association finds that the formation of active student groups within established Affiliates leads to increased student participation in Affiliate and International conferences and events. We encourage all Affiliate leaders to nominate a student member within their organization to act as a coordinator for arranging student activities, seminars and networking opportunities.

Below are two examples of student sections which are active within IAEE Affiliates.

Student Section in France:

The French student section has been very dynamic for several years. Currently, around 30 students are members and a dozen of them are very active and member of the national student council. Though this number might appear unimportant, it is in comparison with the number of French Ph D. students in energy economics. The student section allows Ph D. students to meet regularly, share ideas, develop lasting friendships, and work on projects of mutual interest.

Each year at least one conference is organised (the next one is in October of 2004). Some students from different laboratories present their research in front of members of the French Association for Energy Economics (AEE). It gives opportunities to students to discuss their ideas with other professors (not only their supervisor) and students, also to make them known to other professionals. During the last student conference in December of 2003, seven students presented their thesis on very different topics: electricity deregulation in Europe, new spot markets in Europe, corporate governance in the oil industry, new strategies by participants in European electric power markets, deregulation in Germany, natural gas markets in Eastern Europe, and switching costs for distribution companies. These conferences are always a very good way to meet other students that could work on a similar subject and also help students not to feel isolated in their research laboratory or firm. Members of the national association are also interested in listening to student researches and exchanging ideas with them.

The French student association is working well thanks to a student council headed by Carole Le Henaff (CGEMP Dauphine University) who is doing impressive work. She is maintaining the student data base, contacting new students, giving information about references and conferences (national and international), being in touch with different research laboratories….and, of course, in organising and managing the conferences in which students can present their research. An e-mail list has been created and also some web pages (http://www.dauphine.fr/cgemp/AEESE/PageAEESE.htm) where presentations are online and there is news about the association.

The link between the student section and the French association is assured by Sophie Meritet (CGEMP Dauphine University) who is in charge of transmitting information from both sides. The Council of the French Association for Energy Economics has decided to consider the student section a priority. The national and student councils are working together to improve the association. They know and understand that it is a way to keep alive the association: old students are now members of the French Association for Energy Economics.

Student Section in Mexico:

The Mexican affiliate of IAEE (*Asociación Mexicana para la Economía Energética* AMEE) has encouraged the student participation in its activities for many years. Currently, about 20 student members coming from different public and private universities are registered with the AMEE. They are preparing undergraduate or graduate programes; most of them are Master Degree students.

In 2001, the student section organized its 1st Student Conference with the title of "The Energy in Mexico: a Student Approach" that was held in Mexico City at the National Autonomous University of Mexico (UNAM) on September 20, 2001. This event was planned by the two 2001 IAEE student representatives: Stine Grenaa Jensen, PhD Student in Energy Economics, University of Copenhagen and Risø National Laboratory, and Alberto Elizalde Baltierra, PhD Student in Energy Economics, IFP School and University of Paris IX-Dauphine. About ten students presented full papers based on their research subjects in four sessions chaired by two professors and two professionals, respectively: 1) The Petroleum Industry, 2) The Natural Gas Industry, 3) The Electricity Industry, and 4) Energy and Environment. The abstracts of all the papers were published in a 2001 issue of the AMEE Newsletter and the full proceedings are freely available on the AMEE website (www.ameeeconomiaenergetica.com). In October 2003, a group of six volunteers from the student section helped the AMEE/IAEE to organize the concurrent sessions during the 23rd IAEE North American Conference. Following the tradition started in 2001, this year the student section organized on May 20 its 4th Annual Conference at the UNAM. Around fifteen students presented thirteen papers in front of an audience full of students, professors and professionals (proceedings will be available on the AMEE website). It is expected that speakers from this meeting will present a revised version of their articles during the 7th Annual Conference of AMEE (October 2004).

As a member of AMEE Council, Alberto Elizalde, with the support of five students, assures the link between the student section and the AMEE. It is worth mentioning that most of the old students who participated in the 1st Student Conference are now members of AMEE. Thus, the AMEE Council considers the student section as the beginning of the future of the association.

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*Sophie Meritet is Assistant Professor, CGEMP, Université Paris Dauphine (sophie.meritet@dauphine.fr) and Alberto Elizalde Baltierra is with Petróleos Mexicanos-PEMEX (aelizalde@dco.pemex.com). Sophie and Alberto were members of the French and Mexican student sections respectively, which helped them to have interesting contacts for their Ph D and now they are helping the association as professionals. They won the IAEE Best Student Paper Award in 1999 and 2002, respectively, and obtained several scholarships to attend IAEE Conferences.

Scarcity and Growth Considering Oil and Energy: An Alternative Neo-Classical View

By Douglas B. Reynolds, 2002
The Edwin Mellen Press, $110.00.
ISBN 0-7734-7234-7

This book is very apt right now given the arguments raging in the energy literature between the Neo-Malthusians and the Optimists or as I prefer to call them the "Realists versus Optimists" regarding the depletion of oil resources. The chapters included in the monograph, which are based on previously published and unpublished articles by the author, would put him and also myself in the "Realists" camp.

The thrust of the author's monograph seems to project a declining oil reserve base, increasing oil prices, and potential negative economic affects resulting from a future transition from a higher-grade energy resource such as oil to lower-grade oil alternative resources. The author's analysis seems to indicate the possibility of a world oil price shock in the next five to ten years or even sooner. Whilst I may agree with some of the premises the author has propounded in his chapters, I find myself unable to support some of the conclusions. A review of these chapters will, therefore, enable me to expound an alternative view.

In order to understand where this book fits in with the overall energy literature, a little background is in order. There is a division between the realist camp and the optimist camp which is caused by the Realists' view on oil depletion. Given that the world's prosperity over most of the past Century was fuelled by cheap oil-based energy, it is not surprising that there are many "Optimists" (or rather many vested interests) seeking to obscure and deny the obvious conclusion that peak oil production is nigh. After peak comes decline. Why this is obvious? for the simple reason that you have to find oil before you can produce it. Accordingly the peak of oil discovery in the 1960's imposes a corresponding peak of production. Admittedly, different regions peak at different times, the United States did so long ago. The North Sea is now at peak and set to decline at about 6% a year. Inevitably as the world peak approaches oil prices predictably soar.

The first three chapters of the book: "**The Mineral Economy,**" "**Determining The Power of Prices to Change Oil Discovery and Production,**" and "**Oil Exploration Game with Incomplete Information**," deal with this idea of depletion. They show how and why an oil production decline will happen. However, the book does not go far enough in dealing with the arguments against such a decline. For example the Optimists practice their denial and obfuscation of the inevitable oil production decline by the well known technique of myth creation including such myths as:

- Reserve growth reflects advances in technology.
- Technology will extract more from old fields.
- Higher prices will lead to more discovery.
- The oil resource is so large that for practical purposes, it can be taken as "infinite".

The Optimists have been singing the praises of technology by peddling the theory that thanks to such things as seismic imaging and horizontal drilling, higher recovery percentages from oil deposits can be increased from the current world average of 32% to 60%. They also maintain that if oil recovery percentage could be increased from the current world average of 32% to only 40%, the concern about the reserve–production ratio and the work of M. King Hubbert might be irrelevant. The interesting thing is that the average recovery percentage has hardly moved during the last 20 years from 32%.

The thrust of the first three chapters then deals with the interrelationship between the scarcity of the oil reserve base and price and the impact of technology. I tend to share the author's view that while technology is capable of reducing extraction and production costs and also expanding the reserve base, the decline in oil prices can only last until demand grows faster than technological innovation. And since the true size of a resource is never known, we are unable to determine as to whether technology is actually overcoming scarcity or not until demand from a resource outstrips supply. In such a situation, the scarcity of the resource will push the price up. Furthermore, the author rightly focuses on the interdependence between information and the rate of success of exploration and oil discovery and also exploration costs. The logical sequence is that good information pushes down exploration costs and improves discovery rate and production until depletion sets in pushing costs back up again and discovery down. This is the case of most exploration and discovery efforts.

In the two chapters entitled: "**Modeling OPEC Behavior**," and "**World Oil Supply Forecast and The Reserve/Production Ratio Assumption**," the author promotes a very interesting risk aversion theory to explain why many OPEC members and some non-OPEC members such as Mexico have very high reserve-production ratios. Most of these countries should be able to increase production by 2 or 3 times current production if they had competitive market environments similar to the United States. The explanation is that government-owned National Oil Companies (monopolies), have a natural aversion to taking risks being political bodies and therefore do not invest enough in oil exploration and development as well as capacity expansion.

Because of this risk aversion theory, the author disagrees with the US Energy Information Administration's (EIA 2000) forecast that the world oil production will not peak until at least 2030 and beyond and with EIA's estimates of ultimately recoverable reserves (URR) of about 3 trillion barrels of oil as based on an incorrect assumption. The assumption of the EIA's world oil supply is that the world will be able to attain a ten to one proven oil reserve to oil production ratio similar to that of the United States. But the author's theory of risk aversion means the OPEC's gulf members with 65% of the global proven oil reserve cannot achieve the ratio and therefore global oil production may never attain as high a level as the EIA forecasts. Using this analysis the author concludes that a global oil price shock could occur within the next five years. This is a view I happen to share and have recently expounded in a paper entitled: "**Anatomy of An Impending Third Oil Crises,**" which I presented to the 24th

IAEE international conference in Houston on 26 April, 2001.

A common thread weaves through the chapters entitled: "**Energy Grades and Economic Growth**," "**Entropy Subsidies**," "**The Energy Utilization Chain**," "**The Economics of Alternative Energy Resources**," and "**Entropy and Diminishing Elasticity of Substitution**." These chapters focus primarily on the impact on economic growth of a future transition from a higher-grade energy resource like conventional oil to lower-grade unconventional oil alternatives and also on the entropy subsides. Whilst I may agree with the author that the greatest economic eras in history have been punctuated by energy transition from low-grade energy resources to high-grade energy resources, I cannot accept his conclusions that a future transition from the higher-grade oil resource to the lower-grade unconventional alternatives such as tar sands, shale oil, and heavy oil, could lead to lower economic growth.

Therefore, I will adopt the second scenario proposed by the author for future energy transition with some qualification. Technology will offset any economic slowdown because it would have cut the extraction and production costs of the unconventional oil resources to conventional oil levels. This along with a transition from the lower-grade natural gas to the higher-grade solar energy (mass produced) for electricity generation and less pollution, would provide a bonus to the economy and would enhance economic growth. Furthermore, future advances in technology would more than compensate for the loss of entropy subsidy and would, therefore, preclude a rise in energy price above expected levels.

As for the last chapter entitled: "**Soviet Economic Decline: Did an Oil Crisis Cause The Transition in The Soviet Union**," it is too simplistic, in my opinion, for the author to conclude that an oil crisis caused by scarcity may have contributed to the break up of the Soviet Union and pushed these planned economies toward a more efficient system, namely, free market and political democracy. If this is so, then how do we explain the Russian Federation's continued decline of oil production and consumption in the current free market environment. While oil revenue was important to the ex-Soviet Union, it can not on its own lead to the collapse of the country as much as a radical decline in oil revenue might lead to the break up of Saudi Arabia which depends almost totally on oil revenue. Other factors mainly the burdensome arms race with the US during the Reagan administration and the mismanagement of the half baked experimenting with transition to democracy and market economy by Mikhail Gorbachev, led to the collapse of the Soviet Union. Therefore, I disagree with this chapter and its conclusions. It does not sit comfortably with the theme of the monograph.

In conclusion, I believe that this is a useful monograph to be read by the energy profession as it will stimulate a lot of discussion among energy experts on the future of energy and the sensitive issue of depletion. Of particular interest to energy practitioners is the article entitled: "**World Oil Supply Forecast and The Reserve/Production Ratio Assumption**."

Mamdouh G. Salameh
Director Oil Market Consultancy Service

News On *The Energy Journal*

The Energy Journal (EJ) held an Editorial Board meeting at the IAEE North American conference in Washington in July. About a third of our international editorial board members were able to attend. Activities in 2003 were reviewed and future developments discussed. Among these was the desirability of increased publication of policy related papers in order to attract broader readership.

During 2003 we received a record-high total of 140 papers, a 40 per cent increase over quite stable levels in recent years. This did not, however, seem to signify a new trend since submissions in the first half of 2004 have reverted to more normal levels of 50.

The *Journal's* print run for each of the four issues is 2,650 copies; outside circulation is to about 450 institutional subscribers.

The main topics were: energy and the environment, economic modelling and analysis, electricity markets, and policy regulation and government. A total of 19 refereed papers and 10 book reviews were published in Volume 24 (2003).

The geographical breakdown of submissions in 2003 was:

40% - North America (US, Canada, Mexico)
35% - Europe
15% - Asia-Pacific
10% - Rest of World.

The main shift in 2003 compared with 2002 was towards Europe, at the expense of North America.

Thus well over half our papers are contributed from countries outside of North America. Our overall acceptance rate was 15 per cent.

The work of our referees is vital. In 2003 we received over 400 referee reports, an average of about three per paper. The referees were drawn from people located in some 50 countries. We use a 'double blind' system: the referees don't know the identity of the authors; the authors don't know the identity of the referees.

The average time for receipt of referee reports on a new submission is six to eight weeks. On average, accepted papers are published within a year of their original submission.

In terms of new activities, plans are well underway to publish a special issue devoted mainly to European electricity. We expect to publish that issue next year. Plans are also underway to publish a sequel to the special issue on the Kyoto protocol which appeared in 1999. Special issues are provided at no cost to IAEE members.

Several people are involved in bringing the Journal to members, including Dave Williams (IAEE executive director), Dick Gordon (book review editor), Carol Dahl (assistant book review editor) and of course our publishers, Edward Brothers. But what is essential above all to the smooth functioning of *The Journal* is the outstanding contribution made by our associate editor, Geoff Pearce at the University of Toronto. We especially acknowledge his administrative work during a year when the increase in the number of submissions put such an additional burden on him.

Campbell Watkins and Adonis Yatchew, Joint Editors
September, 2004.

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The IAEE currently meets the professional needs of over 3300 energy economists in many areas: private industry, non-profit and trade organizations, consulting, government and academe. Below is a listing of the publications and services the Association offers its membership.

- **Professional Journal:** The Energy Journal is the Association's distinguished quarterly publication published by the Energy Economics Education Foundation, the IAEE's educational affiliate. The journal contains articles on a wide range of energy economic issues, as well as book reviews, notes and special notices to members. Topics regularly addressed include the following:

Alternative Transportation Fuels	Hydrocarbons Issues
Conservation of Energy	International Energy Issues
Electricity and Coal	Markets for Crude Oil
Energy & Economic Development	Natural Gas Topics
Energy Management	Nuclear Power Issues
Energy Policy Issues	Renewable Energy Issues
Environmental Issues & Concerns	Forecasting Techniques

- **Newsletter:** The IAEE Newsletter, published four times a year, contains articles dealing with applied energy economics throughout the world. The Newsletter also contains announcements of coming events, such as conferences and workshops; gives detail of IAEE international affiliate activities; and provides special reports and information of international interest.
- **Directory:** The Annual Membership Directory lists members around the world, their affiliation, areas of specialization, address and telephone/fax numbers. A most valuable networking resource.
- **Conferences:** IAEE Conferences attract delegates who represent some of the most influential government, corporate and academic energy decision-making institutions. Conference programs address critical issues of vital concern and importance to governments and industry and provide a forum where policy issues can be presented, considered and discussed at both formal sessions and informal social functions. Major conferences held each year include the North American Conference and the International Conference. IAEE members attend a reduced rates.
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United States Association for Energy Economics International Association for Energy Economics

Denver Chapter, USAEE

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Concurrent Session Chair: Wumi Iledare

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Renewable Energy: Back to the Future?
Electricity Reliability: Boom to Bust & Back Again
Energy: International Commodities
Non-Conventional Energies: Probable to Proven

Possible Concurrent Session Topics

Concurrent sessions will be developed from the papers selected for the program. Among the possible topics are: Electricity markets; geopolitics of energy; international energy markets; global LNG; Kyoto Protocol revisited & emissions trading policies; transport sector challenges; forecasting, modelling & scenario developments; energy efficiency & renewables; avoiding bottlenecks & blackouts; nuclear power revisited; sustainable development; private vs. public ownership & use; energy supply & demand; energy policy discontinuities and the climate change debate.

All topic ideas are welcome and anyone interested in organizing a session should propose the topic and possible speakers to:
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U.S. Pipeline Study. (2004). Price: $545.00. Contact: PennWell Corporation, 1421 South Sheridan Road, Tulsa, OK 74112, USA. Phone: 1-918-832-9256/1-800-633-1656. URL: www.ogjresearch.com

Modelling Prices in Competitive Electricity Markets. Derek Bunn (2004). 338 pages. Price: £60.00. Contact: Customer Services Dept., John Wiley & Sons Ltd., 1 Oldlands Way, Bognor Regis, West Sussex, PO22 9SA, England. Phone: 44-1243-843294. Fax: 44-1243-843296. Email: cs-books@wiley.co.uk URL: www.wileyeurope.com

Climate Policy. Michael Grubb, Ed. (2004). 4 Issues. Price: £85.00. Contact: James & James/Earthscan, 8 – 12 Camden High Street, London NW1 0JH, United Kingdom. Phone: 44-20-7387-8558. Fax: 44-20-7387-8998. Email: earthinfo@earthscan.co.uk URL: www.jxj.com

FUTURE USAEE / IAEE EVENTS

Annual Conferences

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August 28-30, 2005	8th Annual European Conference Bergen, Norway
September 18-21, 2005	25th North American Conference Denver, Colorado, USA Omni Interlocken Resort
June 7-10, 2006	29th IAEE International Conference Potsdam, Germany Kongresshotel am Templiner See

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IAEE Affiliate members are reminded that dues parity goes into effect in 2005. All Affiliate members will receive both *The Energy Journal* and the *IAEE Newsletter*. Annual Affiliate member dues to IAEE will be $55.00.

Calendar

8-9 November 2004, North American Gas Strategies Conferences at Calgary, AB. Contact: Conference Registration, Ziff Energy Group, 1117 Macleod Trail SE, Calgary, AB, T2G 5M8, Canada. Phone: 1-800-853-6252. Fax: 403-237-8489 Email: paula.arnold@ziffenergy.com URL: www.ziffenergyconferences.com

8-10 November 2004, Foreign Exchange at New York City. Contact: Rachel Zagaro, Marketing manager, Euromoney Training-Americas, 225 Park Avenue South, 6th Floor, New York, NY, 10003-1604, United States. Phone: 212-843-5229. Fax: 212-361-3499 Email: rzagaro@euromoneyny.com URL: http://www.euromoneytraining.com/databasedriven/coursedetail.asp?busareaid=3&CourseID=303&LS=energyweb

10-11 November 2004, 3rd National Oil Companies Summit 2004 at Le Meridien Piccadilly, 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

15-19 November 2004, International Project Finance at New York City. Contact: Rachel Zagaro, Marketing manager, Euromoney Training-Americas, 225 Park Avenue South, 6th Floor, New York, NY, 10003-1604, United States. Phone: 212-843-5229. Fax: 212-361-3499 Email: rzagaro@euromoneyny.com URL: http://www.euromoneytraining.com/databasedriven/coursedetail.asp?busareaid=3&CourseID=160&LS=energyweb

15-18 November 2004, International Trade and Pre-Export Finance at Miami. Contact: Rachel Zagaro, Marketing manager, Euromoney Training-Americas, 225 Park Avenue South, 6th Floor, New York, NY, 10003-1604, United States. Phone: 212-843-5229. Fax: 212-361-3499 Email: rzagaro@euromoneyny.com URL: http://www.euromoneytraining.com/databasedriven/coursedetail.asp?busareaid=3&CourseID=309&LS=energyweb

16-17 November 2004, International Conference on Security of Global Energy Supplies at Vienna, Austria. Contact: Yulia Khoroshilova, Conference Producer, C5, London, UK. Phone: +44 (0)20 7878 69 24. Fax: +44 (0)20 7878 69 35 Email: yulia@C5-Online.com URL: http://www.C5-Online.com

16-19 November 2004, Sand Control & Management Europe 2004 at Aberdeen, United Kingdom. Contact: Olivia Brown, Conference Producer, Oil and Gas IQ, a division of IQPC, Anchor House, 15-19 Britten Street, London, United Kingdom, SW3 3QL, United Kingdom. Phone: +44 (0)20 7368 9511. Fax: +44 (0) 20 7368 9511 Email: olivia.brown@iqpc.co.uk URL: http://www.oilandgasiq.com/GB-2287/diary

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17 November 2004, Deloitte's 2004 Oil & Gas Conference at Houston, Texas. Contact: Ms. Mickey Appel. Phone: 713.982.3301. Fax: 713.427.4300 Email: dt_oil&gasconf@deloitte.com

18-19 November 2004, 5th Annual Forum Solarpraxis 2004 at Berlin, Germany. Contact: Luis Verdejo Rodriguez, Project Manager, Halo Energy Ltd, London, United Kingdom. Phone: 44-0-870-74425-91 Email: info@halo-energy.com URL: www.halo-energy.com

21-22 November 2004, 1st Annual CZAEE International Conference 2004 at Prague, Czech Republic. Contact: Ivan Benes, Program Chair, Czech Association for Energy Economics, Odboru 4, Prague 2, 120 00, Czech Republic. Fax: 420-2-2492-2072 Email: ivan.benes@cityplan.cz URL: www.abf.cz/kie

22-25 November 2004, 2004 EWEC - European Wind Energy Conference & Exhibition at London, United Kingdom. Contact: Silke Schlinnertz, Marketing Manager, European Wind Energy Association - EWEA, Renewable Energy House, Rue du Trône 26, Brussels, 1000, Belgium. Phone: +32 2 546 1940. Fax: +32 2 546 1944 Email: info@ewea.org URL: www.ewec.info

27-28 November 2004, Refining Economics at Dubai, UAE**.** Contact: Conference Secretariat, Conference Connection Administrators Pte Ltd, 105 Cecil St #07-02, The Octagon, Singapore, 069534, Singapore. Phone: 65-6222-0230. Fax: 65-6222-0121 Email: info@cconnection.org URL: www.cconnection.org

November 30, 2004 - December 2, 2004, 2004 Environmental Performance Summit at Washington, DC. Contact: Melvin Hall, Associate Director, The Performance Institute, 1515 N. Courthouse Rd., Arlington, VA, 22201, United States. Phone: 703-894-0481. Fax: 703-894-0482 Email: hall@performanceweb.org URL: http://www.performanceweb.org

November 30, 2004 - December 2, 2004, Power-Gen International at Orlando, FL. Contact: Lisa Gasaway, Conference Organizor, Power-Gen Intl 2004, PO Box 973059, Dallas, TX, 75397-3059, USA. Fax: 1-918-831-9161 URL: www.power-gen.com

6-7 December 2004, CERI 2004 Electricity Conference: The Future of Electric Power in North America at Calgary, AB. Contact: Dave Donald, Conference Division, Canadian Energy Research Institute, 150, 3512 - 33 St. NW, Calgary, AB, T2L 2A6, Canada. Phone: 403-220-2380. Fax: 403-289-2344 Email: conference@ceri.ca URL: www.ceri.ca

6-7 December 2004, Iran and Middle East Oil and Gas Investment Forum: Addressing New Investment Challenges, Analysing New Project Opportunities at Tehran, Iran. Contact: Morteza Sabetghadam, Director, Institute for International Energy Studies, IIES, 125, Zafar - Dastjerdi Ave, Tehran, 19167, Iran. Phone: 9821-225-8092-5. Fax: 9821-222-1793 Email: sabet@iies.org URL: www.ibcgulf.com/iranforum

6-7 December 2004, EOR 2004 - Strategic Enhanced Oil Recovery at London, UK. Contact: Jonathan Neale, Marketing Manager, CWC Associates, 3 Tyers Gate, London, SE1 3HX, England. Phone: +44 207 089 4188. Fax: +44 207 089 4201 Email: jneale@thecwcgroup.com URL: www.thecwcgroup.com

6-7 December 2004, Condensate & Naphtha Forum 2004 at Singapore. Contact: Conference Secretariat, Conference Connection Administrators Pte Ltd, 105 Cecil St #07-02, The Octagon, Singapore, 069534, Singapore. Phone: 65-6222-0230. Fax: 65-6222-0121 Email: info@cconnection.org URL: www.cconnection.org

9-10 December 2004, Pacific Gas Insiders 2004 at Singapore. Contact: Conference Secretariat, Conference Connection Administrators Pte Ltd, 105 Cecil St #07-02, The Octagon, Singapore, 069534, Singapore. Phone: 65-6222-0230. Fax: 65-6222-0121 Email: info@cconnection.org URL: www.cconnection.org

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