IAEE International Association for Energy Economics
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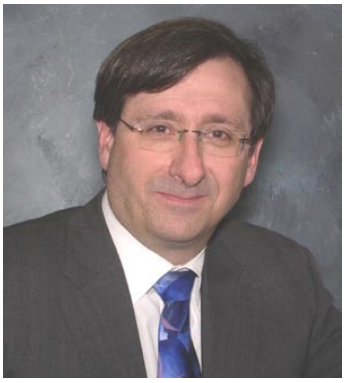
Newsletter

Published by the Energy Economics Education Foundation, Inc.

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

First Quarter 2007

President's Message



One of the key strengths of the IAEE is the diversity of its membership. A quick look at the directory suffices to confirm that our association truly is *international* in scope, drawing members from both energy producing and consuming nations, spread over six continents. Our interests in *energy economics* also reflect a wide range of perspectives, from a business focus, to public policy concerns, to more academic, research-driven pursuits. Together, we can bring to bear a unique blend of expertise and viewpoints on energy issues in these interesting, but tumultuous, times. As my term as President begins, I want to assure you that I will work to ensure that the IAEE continues to serve the interests of its diverse membership, and to offer opportunities for all of us to get together and benefit from each other's expertise, viewpoints, and interests.

Excellent examples of such opportunities are our international and regional conferences. I would invite you to mark your calendars right now, and join us at the international conference to be held in Wellington between February 18 and 21. As the year unfolds, three regional conferences will also be held: on June 10-12, the city of Florence will host the European conference; towards the end of the summer, the North American conference will be held in Houston. And in November, the first IAEE Asian conference will be held in Taipei. All four conferences promise to provide something of interest to all of us, so come along and help to make all of these memorable events. I can assure you that a lot of work goes into the planning of these conferences, so please allow me to thank the local organizers and the staff at IAEE headquarters for all of their efforts on our behalf.

Over the course of the year, I plan to direct time and effort at three specific sets of issues. *First,* in 2005 Council initiated a strategic planning process aimed, in part, at understanding and enhancing the value proposition that the IAEE offers its members. As a result, a number of initiatives have been identified in the areas of membership, publications, conferences, and operations. Over the course of the year, I want to help facilitate the implementation of these initiatives and set the stage for a more permanent process to help guide Council's efforts on behalf of the membership. *Second,* student membership has grown significantly in recent years. This has been a critical source of dynamism and renewal within the Association, and I intend to help ensure that the IAEE continues to be an attractive organization for students to join. *Third,* I want to work to broaden the global reach of the Association. The inaugural IAEE Asian conference provides an excellent opportunity to solidify our presence in that region of the world. Efforts to expand our membership in a number of Asian countries (including India, among others) would thus seem particularly appropriate in 2007.

Please allow me to use this opportunity to thank four members whose term on Council recently came to an end. *Tony Owen* (University of New South Wales, Australia) joined Council in 2004, when he served as President. Thanks, Tony for all your diligent work and leadership, both undertaken with unwavering courtesy and good humour. *Shirley Neff* (Columbia University and Association of Oil Pipe Lines, USA) was particularly busy in 2006: she was USAEE

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Editor's Notes

Peter Odell was honored with the 2006 OPEC Award. This issue includes the citation given with the award and his response in which he offers an eight point insight into the future direction of the global energy industry.

Joseph Cavicchi provides an update on developments in U.S. centralized wholesale electricity markets during the past two years. Of particular interest are the significant modifications being undertaken to overhaul existing capacity markets in the Mid-Atlantic and New England. As Cavicchi explains, there continues to be some concern as to whether these

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

President and a member of IAEE Council. Under Shirley's leadership, many initiatives were undertaken by the USAEE that also benefited all IAEE members. Thanks, Shirley for all your work and for your openness to joint ventures by the two associations. Thanks as well to *Mark Finley* (BP plc) for making time in his busy schedule to contribute to our deliberations and work. The Association as a whole and student members in particular are indebted to *Hadi Hallouche* (The City University, London UK) for all his efforts as a student intern on Council. During his two-year term, he ably represented the interests and concerns of our student members and was instrumental in the development of a number of student-focused initiatives. Thanks, Hadi and best wishes as you embark on your career. Finally, my thanks to all of you for giving me the privilege of serving as IAEE President in 2007. All the best for this New Year! I hope to see you at one (or two, or all!!) of our conferences!

Andre Plourde

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

changes will create a longer-term contracting environment that supports new generation.

Ali Hussain presents the case for an oil producers/oil consumers dialogue, arguing that security of supply and security of demand go hand-in-hand. He suggests that the recently established International Energy Forum in Saudi Arabia is the logical place for this dialogue to take place.

Alireza Tehrani and Valérie Saint-Antonin use a linear programming-based approach to evaluate the contribution of automotive fuels (i.e., gasoline and "on road" diesel) to the CO_2 emissions generated within a typical refinery. Comparing results to other allocation methods, they show that gasoline has not always been a higher CO_2 contributor than diesel within European refineries.

DLW

IAEE Mission Statement

The International Association for Energy Economics is an independent, non-profit, global organisation for business, government, academic and other professionals concerned with energy and related issues in the international community. We advance the understanding and application of economics across all aspects of energy and foster communication amongst energy concerned professionals.

We facilitate:

- Worldwide information flow and exchange of ideas on energy issues
- High quality research
- Development and education of students and energy professionals

We accomplish this through:

- Providing leading edge publications and electronic media
- Organizing international and regional conferences
- Building networks of energy concerned professionals

!! Many Thanks !!
Contributors to the IAEE Student Scholarship Fund

IAEE gratefully acknowledge the following contributors for their generous support of our student scholarship fund. The student scholarship fund is set-up to cover the cost of conference registration fees for promising students who study energy and economics and want to participate in IAEE conferences. This scholarship fund actively encourages corporate and individual support. For information on contributing to this fund, please contact to David Williams by phone/email: (p) 216-464-5365; (e) iaee@iaee.org

The individuals below have contributed to the IAEE Student Scholarship fund from January 1, 2006 – December 31, 2006.

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9th IAEE European Energy Conference

June 10-12, 2007
Florence, Italy

"Energy Markets and Sustainability in a Larger Europe"

A.I.E.E - Italian Association of Energy Economists
IAEE - International Association for Energy Economics

The conference will debate a whole range of up-to-date energy issues offering the participants a unique opportunity to see Florence cultural heritage and to visit exceptional museums and galleries.

Conference Themes and Topics

In the **plenary sessions** the conference will discuss the new energy challenges in a larger Europe:

- *Economics of Energy Efficiency*: Implications of different scenarios for energy supply and demand; Technology outlook response; Market mechanisms to promote energy efficiency; Governments' policies in implementing energy efficiency
- *Security of Supply*: Availability of oil; The role of natural gas in Europe; The scarcity of receiving infrastructure; Diversification vs. dependency: status and outlook; The security of investments; Growth of geopolitical risks
- *A wider EU Energy Market*: From Eastern Europe to the Mediterranean; Evolution in market regulation; Challenges for a larger Energy Market; Liberalisation prospects for Eastern Countries
- *Implementing renewables*: Drivers and opportunities for EU industries; Competitiveness of renewables industry; State of art of renewables technologies; Market prospects for renewables; CO2 and the renewables' role in reducing greenhouse emissions.

Among the main themes the **concurrent sessions** will debate the following topics:

- Transmission and transportation infrastructures in a liberalised environment
- Policy measures to accelerate development of RES
- Improving social acceptance of energy infrastructures
- Liberalisation and regulation of the European energy markets
- Regulatory regimes in the larger Europe
- Demand side management
- Energy, environment and emission trading
- Biofuels prospects
- Environment and the Kyoto Protocol: further development Post Kyoto
- Energy modelling and experience

Venue and Accommodation

The **Venue** is Grand Hotel Baglioni that preserves the charm and elegance typical of the Florentine tradition since 1903 and is equipped with all the modern comforts. Located in the very centre of Florence, it is 5 minutes walk from the Central Station and just near the other hotels reserved for the conference.
Accommodation have been made with four, three and two star hotels in Florence, respectively the Grand Hotel Baglioni (****), Atlantic Palace Hotel (***), Machiavelli Palace Hotel (***), Paris Hotel (***)and Hotel Corona d'Italia (***). A special block of rooms has been reserved for participants at the Grand Hotel Baglioni at rates/night from 200 to 270 Euro. In addition we are reserving rooms in other hotels close to the venue of the Conference with special rates from 100 to 175 euro/night (b/b). Early booking for the accommodation is strongly recommended: reservation must be made before May, 15th 2007 to receive the special rates indicated in the accommodation form; reservation placed after that date will be confirmed on a space-available basis.

Social Events

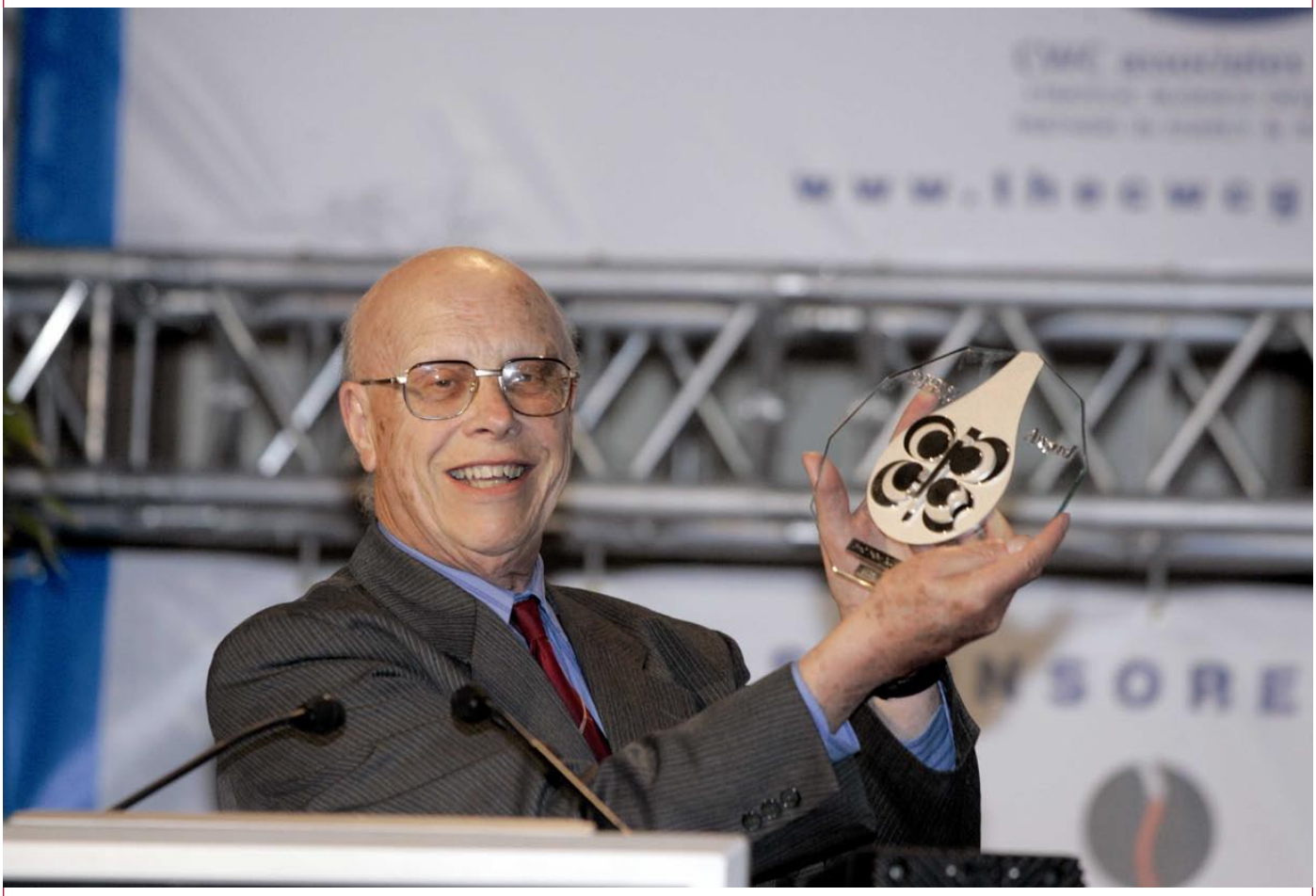
A private guided visit will be offered to all participants and guests on June 11th to the Uffizi Gallery one of the most famous museums of paintings and sculpture in the world. Its collection of Primitive and Renaissance paintings comprises several universally acclaimed masterpieces of all time.
Delegates and accompanying persons will be also invited to the Gala Dinner on June 11th organized at the Pitti Palace, the origins of which go back to 1448 and today it was transformed into a museum with various galleries and is hosting special cultural and social events.
An informative and enjoyable sightseeing tour through the city centre has been planned on Jun 11th for accompanying persons.

REGISTER NOW

Go to www.iaeeu2007.it to register online or to download the registration form.
Early Registration ends 30 April 2007.
The Grand Hotel Baglioni is the main conference hotel. For booking details visit www.iaeeu2007.it/principale.asp?Titolo=HOTELL&Lingua=En

Conference Secretariat
www.iaeeu2007.it
e-mail: **info@iaeeu2007.it**, **assaiee@aiee.it**,
Phone +39-06-3227367 , Fax 39-06-3234921

Peter Odell Wins 2006 OPEC Award



Editor's Note: Long-time IAEE member, Peter Odell, pictured above, was honored with the 2006 OPEC Award. We're pleased to reprint the citation that was carried in the OPEC newsletter together with his response.

Economist, Professor Peter Odel, was the recipient of the 2006 OPEC Award, which he was handed by Nigerian OPEC Governor, Ammuna Lawan Ali, during a special presentation at the Third OPEC International Seminar.

The award, made every two years, was in recognition of his lifetime achievement as an energy analyst.

Ms. Lawan Ali referred to Odell as a "gift to academia" and a legend of the global energy sector. She paid tribute to his "unparalleled commitment and contribution" to the energy industry with over five decades of academic and research excellence in energy economics.

"This is a man who has devoted his whole life to research in petroleum economics," she said.

Ms. Lawan Ali pointed out that Odell was a prolific writer. "He believes in sharing his thoughts and research findings with the larger academic and research community so that knowledge of the industry can be enhanced globally.

In accepting the award, Odell said he wanted to express his appreciation of the honour which OPEC had bestowed upon him in the context of the criteria employed by the Organization's Board of Governors in reaching their collective decision.

"This award to me was totally unexpected and I will endeavour to ensure that my efforts to understand the international oil and gas industry continue to meet the criteria on which the award has been made," he said.

A Professor Emeritus of the Erasmus University in Rotterdam, where he was Director of the University's Centre for International Energy Studies, his research and publications on a broad range of economic and geopolitical issues, relating to global and European energy, date back to the early 1960's.

Odell was born in 1930 in Coalville, Leicestershire, in the United Kingdom, into a family of coal-miners and railwaymen. His lifetime interest in energy emerged from that background.

Following three years with Shell International's Economic division from 1958, he returned to academia via the London School of Economics and subsequently in 1968 to a Chair in the Netherlands School of Economics, now part of Erasmus University in Rotterdam. He retired from his Directorship of the University's Centre for International Energy Studies in the 1990s and now has the status of Professor Emeritus.

In 1991, he was honoured by the International Association for Energy Economics for his "outstanding contributions to the subject and its literature" and in 1994 by the award of the Royal Scottish Geographical Society's Centennial Medal for his studies on North Sea Oil and Gas.

Over the years, he has advised many public and private bodies on energy related issues and has lectured on his research interests at many academic and professional institutions around the world.

[His publication], *Oil and World Power* ran to eight editions and 13 translations between 1970 and 1986. More recently, he has published a two-volume selected collection of 70 of his studies and commentaries, entitled *Oil and Gas: Crises and Controversies, 1961–2000;* and, in 2004, the book, *Why Carbon Fuels Will Dominate the 21st Century's Global Energy Economy.*

Odell offers eight-point insight into future direction of the global energy industry

Taking part in the final panel discussion of the OPEC International Seminar, leading economist and Professor Emeritus Peter Odell, the 2006 OPEC Award winner, set out an eight-point forecast as to what he perceives will be among the most significant elements in the long-term evolution of the energy industry.

First — the current 60 per cent contribution of oil and gas to world energy supplies will be only modestly reduced by mid-century; thereafter, hydrocarbons' contribution to energy demand will slowly decline, but will still account for over 40 per cent in 2100. By then, however, natural gas will be two-and-a-half times more important than oil, though the latter will still be an industry larger than that of 2000, albeit one which will become up to 90 per cent dependent on non-conventional oil.

Natural gas will undoubtedly become the prime energy source by the second quarter of the 21st century (well ahead of renewables) — initially through a near three-fold increase in conventional gas production by 2050 and, thereafter, through the rapid exploitation of prolific non-conventional gas supplies.

Second — the ultimate physical sufficiency of global oil and gas resources is not in doubt so that one can ignore the present-day Jeremiahs. Their predecessors in the 1960s, the 1970s and the 1980s were all quickly proved wrong and a similar fate will overcome the so-called "peak oilers" by the end of the present decade. Any under-achievement in future oil and gas production will be the result of a combination of organizational, economic, political and environmental factors, all of which can be overcome, as they always have been in the past — except for very short-term lapses.

Third — the current generally accepted wisdom favouring globalization, liberalization, market competition and dependence on speculative trading exchanges (such as the NYMEX and the IPE) for price determination will soon fall from favour as a consequence of the turmoil which they have created over the past three years.

This has been to the detriment of consumers the world over and is having adverse impacts on economic and social development in many countries, especially in the developing world. The continuing — albeit modest — expansion of the world's demand for oil now necessitates the establishment of an international oil organization whereby order can be brought to the markets.

The current unacceptability of this by policy-makers in the OECD countries will hardly be relevant beyond the middle of the next decade, in the context of the rapidly declining importance of these countries in the global oil system.

Fourth — oil from non-OECD countries already accounts for almost 80 per cent of world reserves and production, with most of this from state-owned or state-controlled exploration and production facilities. Even the remaining four largest multi-national oil corporations already appear unable to secure significant new production rights, except as minority partners in state-run systems.

This process is unlikely to be reversed, as all the large oil-consuming nations of the developing world view self-sufficiency as a prime objective and will feel assured of this only in the context of nationally owned and operated companies.

Fifth — in such potentially adverse circumstances for the oil majors, the fact that they have in recent years been pursuing policies which hardly endear them to countries in which expanding demands for energy are of the essence, is not helpful for their survival.

The companies are seen as responsible for high prices, leading to high profits, from which extortionate remuneration is paid to their executives and shares are "bought-back" to enhance their stock-markets' status, whilst they make too little investment in new upstream operations, as they cannot count on a rate of return in excess of 20 per cent.

Sixth — as with those majors that have already failed to survive, so those remaining may well be playing out their last few years. A Chinese bid for Exxon and/or Chevron and/or a Russian bid for Shell and/or BP, backed by funds provided by the wealthy Member Countries of OPEC, seem likely to be only a matter of time. With the majors gone, there will be concern in the main OECD countries for future security of supplies.

In this context, one can reasonably forecast a revival and/or the resuscitation of their own state-owned oil and gas industries. The two currently booming and expanding state oil companies in OECD countries (Statoil of Norway and ÖMV of Austria), could thus soon have new bedfellows; for

example, a new British National Oil Corporation, a revived Petro-Canada and a de-privatized Total in France/Belgium.

Seventh — above and beyond all these developments, we may anticipate the creation of a UN international energy organization designed to deal with the world's 21st century energy matters. Such an organization will, of course, include a major input from a now more-powerful-than-ever Organization of the Petroleum Exporting Countries (OPEC), given its Members' interests in tomorrow's much-expanded and ordered global oil markets.

Eighth — the world's continuing regionalized gas markets will massively expand. In Europe, the current obsession for liberalization will be inevitably abandoned, as producers wisely insist on long-term contracts to ensure security of demand in the context of importing nations' search for security of supply.

The EU's current commitments to fully liberalized gas markets, in general, and, in particular, the UK's hopelessly failed experiment with "perfect competition" for securing infrastructural developments and low pricing, will not survive the present decade.

Post-2020, an ordered gas market will emerge, with continuing long-term benefits based on the near-limitless supplies available from a range of gas-rich countries from Russia, the Caspian region, the Middle East, North Africa and Norway; and on the consuming countries' overwhelming preferences for natural gas over the high-cost alternatives of renewables and/or nuclear power and the high CO_2 emission levels from the use of oil and coal.

The establishment of a greater European strategic gas authority will be the precursor to similar developments in Latin America, sub-Saharan Africa, south-east Asia and the western Pacific Rim over the first quarter of the 21st century.

U.S. Centralized Wholesale Electricity Markets: An Update

*By Joseph Cavicchi**

Introduction

During 2005 and 2006, centrally operated U.S. wholesale electricity markets continued to evolve with the implementation and approval of significant market design modifications in several regions of the U.S. The most prominent factor driving change is the continued evidence that centralized markets do not produce price signals that will ensure future investment. In electricity markets, efficient price-setting is complex. Simultaneously balancing the need to ensure reliable system operations, the need to guard against the exercise of market power, and the need to acknowledge specific generating facility physical and financial characteristics often comes at the expense of accurate price-setting. And to the extent market structures are unlikely to generate efficient prices, the problem can be more difficult to resolve, especially when changes inevitably lead to shifts in welfare. During recent years, major changes have been made at regional wholesale electricity markets both to improve existing energy pricing, and hopefully to ensure appropriate structures are in place to value system generating capacity (whether it is provided as a physical resource or through demand response). The real test of these market changes will come during the next several years as additional system resources will be required in many parts of the U.S., and centralized wholesale markets will be relied upon as important sources of electricity prices.

Centralized wholesale electricity markets currently operating in the U.S. have become important institutions that cannot be undone. In spite of the complexity and considerable debate surrounding these market institutions, they provide transparency and open stakeholder processes.[1] Although there will always be debates associated with market operations and pressure to improve efficiencies as technology changes, these institutions have taken a previously invisible side of the electricity industry and opened it up broadly for anyone to observe. And as is the case with all commodity markets, buyers and sellers are free to hedge their requirements outside of these markets. These institutions serve as an alternative to what was often a disparate collection of vertically integrated companies often operating somewhat in isolation. There is now almost universal evidence that these markets provide benefits through increased transparency, although as is discussed herein, they must generate accurate price signals to be successful over the long run.

Notable Wholesale Market Developments

U.S. wholesale electricity markets operated through either Regional Transmission Organizations ("RTOs") or Independent System Operators ("ISOs") have seen significant changes in recent years. A brief review of the approved changes of note is as follows.

*Joseph Cavicchi is a Managing Director of Lexecon, and FTI Company. He may be reached at jcavicchi@lexecon.com
See footnotes at end of text.

California

In September of 2006, the FERC approved the California ISO's ("CAISO's") Market Redesign and Technology Upgrade ("MRTU").[2] Approval of the CAISO's MRTU proposal is the result of six years of analysis and debate focused on rectifying market inefficiencies that have existed since the CAISO began operations in April of 1998. The problems were, of course, most pronounced during the California energy crisis of 2000-2001, but had been the subject of debate even at the time the CAISO began operations. Generally speaking, the scheduled November 2007 implementation of these MRTU changes will result in the CAISO being much more like Mid-Atlantic and Northeastern U.S. RTOs/ISOs.

The primary changes resulting from the CAISO MRTU are as follows: 1) Energy will be priced locationally using a LMP system which allows for the use of a more robust system of financial transmission rights to manage congestion; 2) A financially binding day-ahead energy market will be introduced; 3) Market power mitigation will be revised and adopt some features used in the PJM Interconnection ("PJM"); 4) Security-constrained unit commitment will be introduced allowing for improved system operations; 5) A means by which demand-side resources can participate in the CAISO markets will be provided; and 6) The CAISO markets will be coordinated with the California Public Utilities Commission's ("CPUC") resource-adequacy regulatory framework while providing the CAISO the ability to procure additional capacity to ensure system reliability if needed. In addition to changes associated with the MRTU filing itself, the FERC required the CAISO to comply with its long-term firm transmission rights ruling; implement reserve-shortage scarcity pricing within 12 months of the initial MRTU implementation; and implement measures to counteract incentives for load-serving entities to under-schedule until convergence (virtual) bidding is implemented.

The CAISO changes can best be characterized as instituting various structural elements used by other U.S. centralized markets. The original California electricity marketplace included the now defunct California Power Exchange, which allowed for a day-ahead clearing of supply and demand. At the same time, the current market system reports zonal prices creating difficulties managing congestion most notably within zones. By introducing a security-constrained, financially binding day-ahead market with LMPs and enhanced financial transmission rights, the CAISO's primary structure will mirror other RTOs/ISOs with proven track records. To the extent other regions already have enhancements such as convergence (virtual) bidding and scarcity pricing, the CAISO must add these same elements in a defined time period. It is widely expected that the MRTU will vastly improve the CAISO market and result in much better pricing and generation unit dispatch.

Finally, of some interest is the fact that initially under MRTU the CAISO has a somewhat limited role in resource adequacy in California given the CPUC's important resource adequacy program. Although the CPUC program is still only getting underway, it is measurably reducing the CAISO's

need to contract reliability must-run resources out of market.[3] Going forward the CPUC continues to evaluate other potential elements to complement its resource adequacy program such as considering the potential development of a capacity-trading regime. Beyond MRTU, the role of the CAISO with respect to resource adequacy remains undetermined, although the CAISO retains the responsibility to maintain system reliability. Going forward it will be interesting to observe how California's resource adequacy framework develops given it is governed primarily by CPUC regulation, as opposed to the administered market approach used in Northeastern and Mid-Atlantic regions.

New England

ISO New England ("ISO-NE") markets have seen two significant changes during the past year: The implementation of Phase II of the Ancillary Services Market project ("ASM Phase II") and the contested settlement of its protracted locational installed capacity ("LICAP") market proposal. As described below, these changes represent significant modifications to the ISO-NE wholesale markets.

The primary elements of ASM Phase II are: 1) the addition of a locational component to ISO-NE's existing interim forward reserve market introduced in 2004; 2) the co-optimization of pricing of energy and reserves in real-time; and 3) the provision of software systems and business processes necessary to integrate demand resources into the real-time and forward operating reserves markets. Of these changes the one of most note is the introduction of a locational element in the forward reserves market. Previously ISO-NE obtained region-wide forward commitments to provide ten-minute non-spinning operating reserves and thirty-minute operating reserves for winter and summer capability periods. Starting with the 2006-2007 winter capability period (10/06-5/07), ISO-NE obtained these reserves locationally.

The practical impact of differentiating by location in the forward reserves auction is that resources located in and around Boston, Massachusetts, and in Connecticut and Southwest Connecticut that were selected in the auctions received a price for these services that was set by the auction cap of $14/kW-Month.[4] By introducing a locational component, the auction revealed that these particular regions suffer from a shortage of resources capable of providing what amount to quick-start supplies. ISO-NE has repeatedly noted that its electricity system does not contain large supplies of quick-start resources, causing it to rely on less flexible, more expensive resources for reserves. The ASM Phase II locational forward markets began operations with results that were consistent with their expected signaling of the value of quick response resources.

ISO-NE's original LICAP proposal has been modified through extensive settlement discussions and was approved as a "settlement" by the FERC in June of 2006 as the ISO-NE Forward Capacity Market ("FCM").[5] The most prominent changes to the LICAP proposal are the elimination of the "demand curve" and the introduction of a price collar that applies to existing capacity resources. ISO-NE's LICAP proposal originally sought to address the fact that ISO-NE's current short-term capacity market does not contain a locational element, and relies on a vertical demand curve set at the level of supply needed to maintain reliability. The LICAP proposal included a sloped capacity demand curve (similar to that used in New York) applied to different geographical locations in New England, and provided for capacity auctions carried out three years prior to delivery.[6] Given the structure of the approved FCM settlement, there were clearly concerns about the LICAP proposal creating clearing prices based on costs of new entry ("CONE"), but then paying existing resources this clearing price. The compromise is the FCM structure where new entry offers are allowed to clear in the auction, but payments to existing generators are collared as a function of the current ISO-NE estimated cost of new entry ($7.50/kW-Month) in the region.[7]

The FCM will rely on a descending clock auction structure where the starting price will be set at two times the estimated CONE in the region. The price will "tick down" until the Installed Capacity Requirement specified by ISO-NE is obtained. Supplies can be provided by new capacity suppliers, existing generators, and demand-side capacity offers. Various offer rules apply to the auction structure, which effectively results in existing capacity being a price-taker in the auction. The rules provide that existing capacity is paid no more than 1.4 times CONE in the event of a competitive outcome where the auction-clearing price is higher than 1.4 times CONE, and limits existing capacity payments to 1.1 times CONE in the event the auction is either uncompetitive or under-supplied. Although the FCM relies on market-monitoring review mechanisms to assess existing capacity offers, it is otherwise intentionally structured to allow new entrant offers to clear in the auction, thus sending an appropriate forward-price signal. In addition, the FCM provides that new capacity that sets the clearing price in the first year it is offered has a one-time opportunity to receive that monthly clearing price (adjusted for inflation and performance) for the following five years. The intention of the FCM structure is to generate efficient, locational forward capacity prices where there are currently none.

Mid-Atlantic (PJM)

The most prominent upcoming change in PJM is also the introduction of a newly structured capacity market. Much like ISO-NE, PJM's current capacity market lacks a locational element and relies on a vertical demand curve specified at the amount of capacity projected each year as necessary to ensure reliability. Additionally, as PJM expanded its geographic reach over the past few years, the size of its capacity market grew, which, when combined with a reserve margin requirement that had been decreased since PJM had been formed, resulted in region wide depressed capacity prices. This came at a time where PJM was confronting retirement requests and responding to complaints by some generators of unjust and unreasonable remuneration in PJM's eastern region. PJM's proposed Reliability Pricing Model ("RPM") filed at the FERC in August of 2005 intended to resolve these problems.

After various rounds of debate regarding PJM's RPM proposal, the FERC issued an order in April of 2006 finding that PJM's existing capacity market resulted in unjust and unreasonable prices, and that various aspects of the RPM proposal were "features that need to be included in a just and reasonable capacity market" for the PJM region.[8] The FERC directed a so-called paper hearing on certain aspects of the RPM proposal that eventually led to the appointment of a settlement judge, and subsequently settlement discussions, which culminated in the filing at the FERC of an RPM settlement (currently still pending) at the end of September 2006. Although the resulting settlement maintains the basic features of the RPM proposal, as in the case of ISO-NE, material changes were made in order to reach settlement.

The RPM settlement maintains PJM's proposed use of a variable resource requirement (demand) curve; the assessment of capacity by local deliverability areas ("LDAs"); and the running of auctions that result in longer-term forward commitments for capacity resources. In addition, the RPM settlement also allows for load-serving entities to "opt out" of the RPM market structure as long as a commitment is made to maintain a reserve margin sufficient to ensure reliability. The differences between the RPM settlement and PJM's original RPM proposal are primarily in the shape of the demand curve, and concerns that the CONE for the PJM region has been underestimated.[9] These two factors, combined with a transition from four initial somewhat large LDAs to a reliance on 23 individual LDAs, some of which are quite small, have created concern.[10] Thus, considerable debate continues in relation to the RPM settlement's ability to ensure that investment in new capacity will result in the PJM region, and especially in smaller LDAs that face various market power mitigation rules.

The demand curve was modified to reduce the price cap from the originally proposed two times CONE to a value of 1.5 times CONE. In addition, the curve has a steeper slope in the region where capacity is excess, resulting in a more rapid decrease in capacity value when a surplus exists. The settlement also does not clearly specify that new entry offers will be allowed to clear the auction. Instead there is provision to assess new entry offers that are considered pivotal, or measurably inconsistent with other new entry offers or CONE estimates, in spite of the 1.5 times CONE price cap. Finally, new entrants receive a three-year price guarantee, which may not be suitable to support investment. These facts, coupled with what many have argued is a CONE estimate that is low compared to that estimated in other nearby regions, have caused the RPM settlement to be somewhat more contentious than the ISO-NE settlement.

New York ISO ("NYISO")

The NYISO wholesale market underwent incremental change during 2005 with the implementation of market software enhancements.[11] These enhancements have allowed ancillary service reserves and regulation to be co-optimized with energy in the real-time spot market auction. In addition, price-quantity schedules have been introduced as well to cap the costs of ancillary service procurement in real-time and to better reflect the value of ancillary services and energy in prices during scarcity conditions. An important benefit associated with these upgrades is that real-time market-clearing prices for ancillary services are equal to the marginal cost of providing the service. This results in real-time reserve-clearing prices that are equal to the opportunity cost of not providing another product. Better price signals create appropriate incentives for generators, which result in better dispatch,[12] while also more accurately signaling the value of reserves, which are vital for system reliability.

At the same time the NYISO has now been operating its locational capacity market using a demand curve for four years. Although this market lacks the longer-term forward commitment aspect of the markets that will be introduced in ISO-NE and PJM (i.e., the NYISO operates multi-month forward auctions and monthly spot auctions for capacity with delivery occurring within the next 12 months), the demand curve has affected spot prices and worked as expected.[13] There is initial evidence that longer-term contracts are being executed that serve as hedges against the NYISO multi-month and monthly capacity markets. Moreover, the NYISO successfully completed a three-year review of its CONE estimation, although not without considerable debate in relation to the accuracy of the estimate.[14] Nonetheless, the NYISO has approved CONE values through 2008 which will result in six straight years of locational short-term capacity markets that clear the monthly spot markets using a demand curve. Given the introduction of longer-term forward commitments in ISO-NE and PJM, it remains to be seen if the NYISO will move toward a longer-term forward commitment, which the FERC has clearly embraced. And finally, the NYISO's capacity market for New York City is undergoing a review focused on concerns that market power can be exercised under the current structure. Thus, it is realistic to expect adjustments to the NYISO capacity markets over the next year.

Midwest Independent System Operator ("MISO")

The major event in the Midwest has been the April 2005 start-up of the MISO's competitive wholesale electricity markets. The region introduced a day-ahead and real-time locational marginal-based pricing system and issued financial transmission rights so that revealed price differences across regions can be hedged. This market system is based upon the same principles used by ISO-NE, PJM, and the NYISO. Initial reports on its first year of operation were favorable, referencing, in particular, the benefits associated with using location prices and the ability to achieve generator re-dispatch more economically when compared with previous operations.[15] At the same time the MISO has been actively debating resource adequacy issues, and numerous parties have provided comments in relation to a recent FERC inquiry.[16] At this juncture the MISO does not have a capacity market, and members are required to maintain a specified 12% reserve margin. The intention of the MISO currently is to rely on energy-only markets and allow for price spikes during times of short supply. Because MISO is currently forecasting an ex-

cess supply condition for the next few years, there is arguably some time to debate the most suitable approach for maintaining resource adequacy. It remains to be seen if the MISO will find it necessary to introduce a capacity market.

Demand Response Initiatives

An extremely important issue facing all U.S. centralized electricity markets is the need to increase demand elasticity. Although the markets report hourly electricity prices, consumers' exposure to these prices is typically limited to those states that have introduced retail competition, and wherein retail rates and utility procurement policy specify hourly priced supply as the default (last resort) service. Thus far, this has meant that only larger commercial and industrial customers in some states have the ability to make decisions based on experience with hourly pricing. The vast majority of electricity consumers do not see hourly prices, and until metering systems and communications systems that facilitate demand response are made available to all consumers, demand response programs administered by market operators will be vital.

During the past several years there have been several programs implemented by market operators that provide opportunities for demand response to be used when clearing both energy and capacity markets. Generally there are three types of programs. First, there is real-time emergency demand response. This program typically interrupts pre-screened participating loads during emergencies and compensates them based on real-time prices and the verified amount of actual demand reduction. Second, there are day-ahead load reduction programs through which pre-screened participants capable of measurable load reductions make offers similar to generating resources in the day-ahead markets. If these load reductions are accepted in the market clearing process, then participants are paid the market clearing price and must reduce load. And third, there are programs that allow pre-qualified resources to be considered as capacity thus reducing the amount of generation necessary to ensure reliability. The implementation of these programs has resulted in demand response measured in the hundreds of megawatts in several regions. Generally, wholesale market operators hope to be able to eliminate these programs as consumers gain greater exposure to hourly pricing.

Demand response is set to play a measurable role in the new forward capacity markets, and has been of significant importance to the FERC. These demand side resources will affect the markets and may reveal that there are cost effective alternatives to building generation readily available. A significant unknown associated with the outcomes in these new markets is the ability for demand response to effectively compete with generation resources. And to the extent that effective demand response alternatives emerge, market clearing prices may be lower than currently expected.

Summary

The primary emphasis of recent wholesale market developments is on getting the prices right, and those ISOs regulated by the FERC continue to work toward achieving this goal.[17] But getting the prices right is difficult, and there is no consensus yet on what type of market structure will work best to balance the need to guard against the exercise of market power with the importance of prices increasing during times of shortage. The central theme of the current market structure debate across the U.S. is focused on ensuring that the market price signals will incent both new investment in generating facilities and demand response.

In those regions of the U.S. that have put in place centralized wholesale electricity markets this means waiting and seeing what non-utility generating plant developers and investors do as generation reserve margins diminish. And although the Northeastern and Mid-Atlantic regions are implementing forward capacity markets, there is not yet consensus on how these market structures will perform. The most pressing question that continues to be discussed in relation to the actual financial mechanics of adding capacity is what will be required to get long lead-time base-load capacity built? There does seem to be some consensus that getting a coal-fired plant built anywhere in the U.S. will require a longer-term contractual commitment than is currently observed in many of the U.S. electricity markets. Will regions that rely on centralized wholesale markets that reveal primarily short-term price signals see an appropriate mixture of generating capacity going forward?

This is clearly the major question facing those regions of the U.S. that have moved away from regulator-overseen integrated resource planning to a regime that looks to unregulated generation investment. And concerns surrounding this question define actions taken by many states in the U.S. For example, in Connecticut, Delaware, and Maine, state-led actions are underway to solicit generation resources for contract terms on the order of 10-15 years. Similar actions have been underway subject to state regulator directives in California for a few years (CPUC resource-adequacy program). The driving forces for these actions are not always the same, but they reveal the types of response that may ultimately result given that the newly restructured capacity markets will result in increased expenditures to ensure system reliability. Moreover, to the extent that no entity has a defined responsibility to meet the demands of electricity consumers for more than a few years in the future, will these state-led actions be the only way an investor can get a longer-term commitment from a buyer?[18]

These questions are not easy to answer. What is certain is that first-generation centralized wholesale markets have done an excellent job signaling the locational value of electricity and increasing transparency across vast regions. At the same time there is substantial evidence that reliability services provided by generators have not been fairly compensated. Thus, the market structures have been modified. But with current concerns often related to the recent higher-than-expected natural gas and oil prices, and with many regions relying more and more on natural gas and oil-fired resources as the marginal source of electricity supply, the realities associated with getting longer lead-time, low variable cost resources constructed has come to the forefront. And with nobody wanting to recreate stranded costs that were so pervasive in the

past, it is likely that baby steps will be the preferred approach over the next few years. That is, state regulators will take an interest in certain customers with either limited, or no, retail choice options being allowed the benefits of less volatile prices. Such a policy position may be the only response that will get longer-term buyers to sign contracts. And although there is no consensus on the contract term necessary to support investment, clearly the current market frameworks are not resulting in longer-term contracts.

Footnotes

[1] Even though locational marginal pricing ("LMP") used in practically all centralized markets has become more acceptable, there still remains some debate that the uniform pricing auctions used by centralized markets over-compensate lower-cost generators. But the U.S. Federal Energy Regulatory Commission ("FERC") has clearly signaled it will not tolerate attacks on uniform clearing price auctions (see FERC Order No. 117 FERC ¶ 61,038 (2006)). Thus, LMPs and uniform clearing prices are poised to become permanent attributes of U.S. centralized wholesale markets.

[2] C*alifornia Independent System Operator Corporation*, 116 FERC ¶ 61,274 (2006).

[3] California ISO Reduces RMR Contracts by 60 Percent, Utility Resource Adequacy Contracts Replacing RMR, California Independent System Operator Corporation, News Release, October 19, 2006.

[4] Offered supplies were less than the demand specified by ISO-NE causing the auction to clear at the cap. This does not mean that reliability is threatened, but instead that resources with quick-start features are in short supply in these regions.

[5] See *Devon Power LLC*, 115 FERC ¶ 61,340 (2006).

[6] For an explanation of the use of demand curves in capacity markets, see "Ensuring the Future Construction of Electricity Generation Plants: The Challenge of Maintaining Reliability in New U.S. Wholesale Electricity Markets," A. J. Cavicchi and A. Kolesnikov, *IAEE Newsletter*, First Quarter 2005.

[7] ISO-NE's estimated cost of new entry is $7.50/kW-Month, and existing generator payments are limited to a range of .6-1.4 times this value, or $4.50-$10.50/kW-Month in the first auction.

[8] *PJM Interconnection, L.L.C.*, 115 FERC ¶ 61,079 at P 6. These features include: 1) the introduction of locational pricing; 2) provision for establishing a forward commitment for capacity resources; 3) the use of a demand curve (called a variable resource requirement schedule by PJM); and 4) the integration of generation, transmission, and demand-response alternatives.

[9] The settlement also eliminated a feature that PJM originally had proposed that would have provided additional financial incentives for providing flexible, responsive generation resources. In contrast to other ISOs, PJM's markets currently do not use a market approach to value these ancillary services.

[10] Four large LDAs are used for the first three years: 1) the former Mid-Atlantic Area Council ("MAAC") region plus the Allegheny Power zone; 2) all other transmission zones recently integrated into PJM, i.e., American Electric Power, Com-ed, Dayton Power & Light, Duquesne, and Dominion-Virginia Power; 3) Eastern MAAC, which consists of Public Service Electric and Gas, Jersey Central Power & Light, Atlantic City Electric, Rockland Electric, Philadelphia Electric Company, and Delmarva Power & Light; and 4) Southwestern MAAC, which consists of Potomac Electric Power and Baltimore Gas & Electric. After four years the number of LDAs increases to 23 (based on the existing PJM reliability analysis framework), which represent transmission systems operated by individual utilities within the PJM footprint.

[11] See, generally, *2005 State of the Market Report New York ISO*, Potomac Economics, Ltd., Independent Market Advisor to the New York ISO, August 2006.

[12] In particular, the real-time commitment of combustion turbines, which is always a complicated problem for system operators given start-up costs and minimum run-time constraints, improved considerably with the new software.

[13] The demand curve is only used when clearing the monthly spot market for capacity run just prior to the beginning of a month. The NYISO's multi-month forward capacity auctions clear by balancing supply and demand offers and bids.

[14] ISO-NE's FCM provides for CONE adjustment based on observed FCM clearing prices. PJM's RPM settlement also proposes an adjustment mechanism for CONE that will take into account observed auction clearing prices. These adjustment mechanisms used to define future CONE values are referred to as empirical CONE. The NYISO CONE is based on three-year reviews of actual engineering cost estimates for the CONE.

[15] *2005 State of the Market Report, The Midwest ISO*, Independent Market Monitor of the Midwest ISO, July 2006.

[16] See, generally, *Midwest Independent System Operator, Inc.*, FERC Docket No. ER06-1112-000.

[17] Texas also operates a centralized market ("ERCOT"), although it is state-regulated and was not reviewed as part of this paper.

[18] In many states in restructured regions current procurement structures focus on providing consumers only short-term, last-resort service. But the originally expected retail providers have not emerged for smaller consumers and thus no entity is currently anticipating these consumers' longer-term demands, at least not as far as anyone can observe given those entities that do commonly supply these services to utilities.

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Security of Oil Supply and Demand and the Importance of the "Producer-Consumer" Dialogue

By Ali Hussain*

This study addresses one of the most important issues facing the international oil industry namely the security of oil for both consumers and producers.

To highlight the importance of this matter one has to understand:

- how oil was created;
- how long it took to make; and
- its vital role in the world economy.

In order to tackle the oil security issues both consumers and producers have to discuss them and agree upon solutions that are mutually beneficial.

What is Oil?

> "Oil is a fossil fuel, which was formed millions of years ago. Some scientists say that tiny diatoms are the source of oil. Diatoms are sea creatures the size of a pinhead. They can convert sunlight into stored energy.
>
> As the diatoms died they fell to the sea floor. Here they were buried under sediment and other rock. The rock squeezed the diatoms and the energy in their bodies could not escape. The carbon eventually turned into oil under great pressure and heat. As the earth changed and moved and folded, pockets where oil and natural gas can be found were formed."

The above definition clearly shows the unique characteristics of oil, namely how it was formed, the long period it took to materialize and as a result of such formation, that it is limited in quantity. Consequently oil can not be reproduced. It can only be replaced with another discovery, exploration and development. Therefore, once oil reserves are finished an oil producer can no longer produce oil. This is simply a significant sacrifice to oil producers and it is at the same time a warning to oil consumers to use oil efficiently and stop wasting this noble commodity. It is estimated that so far the world has already produced 400 billion barrels compared with existing proven oil reserves of 1200 billion barrels. By the end of 2005 Saudi Arabia had produced 111 billion barrels (b/b), Iran 78 b/b, Kuwait 37 b/b, Iraq 32 b/b and the U.A.E. 25 b/b.

The Importance of Oil

Oil plays an important role in the economic development of the world. It provides all the energy for transportation such as cars, trucks, airplanes, etc. It also provides energy inputs such as heating to domestic and industrial buildings as well as lubrication for engines and machines. In addition, oil is a raw material product for plastics, paints, fertilizers, pharmaceuticals, etc. In other words, oil is vital for many industries and modern economies rely heavily on goods and services that contain oil and oil products' elements. According to BP data, in 2005 the share of oil as a source of energy in the total world energy mix was about 36.4%. This is compared with other alternative sources of energy such as gas 23.5%, nuclear and coal each respectively 6%. With regard to renewable sources of energy, hydroelectricity contributed 6% while others such as solar and wind still played a very minor role in the total global energy mix. Furthermore, the use of these renewable sources as well as nuclear is restricted to power generation.

To compare oil with other alternative sources of energy, it can be mentioned, presently and in certain cases, oil is not a commodity that can be easily replaced by these alternative sources. Natural gas and nuclear power cannot compete fully with oil. For example, oil lubricants can only be obtained from oil, and natural gas cannot easily be transported like oil. As for nuclear energy, it continues to suffer from certain safety matters including nuclear waste. As far as renewable sources of energy are concerned, they have a long way to go before they can significantly compete with oil.

As mentioned earlier, oil is a depletable asset (i.e., it is finite) and, therefore, it is possible that one day in the future the world will be without oil. According to BP statistics, in 2005 the reserves- to- production (R/P) ratio was 40.6 years.

Moreover, due to the importance of oil, all countries in the world and especially the industrial ones pay particular attention to the international oil industry and try to encourage their oil and non-oil companies to be involved in the construction and operations of this industry in two ways:

i. Oil companies, which are engaged in the production of oil and oil products; and
ii. Companies, which supply the oil industry with its requirements such as machines, tools, equipment, etc.

World Oil Reserves

Although oil reserves can be found in many parts of the world, a large proportion of them is concentrated in the Middle East area. According to BP data, in 2005 world proven oil reserves were 1200 billion barrels. In the same year OPEC proven oil reserves were 902 billion barrels or 75 % of the world oil reserves. Furthermore, within the Middle East, in 2005, the Gulf had reserves amounting to 743 billion barrels, accounting for 62% of world oil reserves. This region also enjoys the lowest cost of oil production in the world. For example, in Iraq the cost of oil production is about $1-2 per barrel.

Security of Oil Supply

Due to the importance of oil, one of the most important issues of concern to oil consuming countries is the security of oil supplies from the major oil producing countries namely OPEC countries. If the right conditions are provided, these countries can meet the expected growth in world oil demand. Currently OPEC meets about 40% of world oil demand and as 75% of the world proven oil reserves are located in OPEC countries, OPEC can expand oil production to meet the anticipated future increase in the global demand for oil.

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* Ali Hussain is an Oil Consultant and former OPEC Officer. He can be reached at alihussain27@gmail.com

However, in order for OPEC to expand its oil production, it needs to be certain that the oil industry will remain profitable. The oil industry is capital intensive and OPEC would require to billions of dollars of investment in exploration, development, storage, etc., and simultaneously wait 3-10 years to locate and develop these new oil fields before they can become profitable. For example, Mr. Khaled Al-Falih, a senior vice president in Aramco, stated at a recent conference in London, that Saudi Arabia plans to invest $80 billion in the next five years to increase production to 12 m. b/d, expand gas processing facilities and increase refining capacity at home and abroad.

It must be remembered that as OPEC is not the only supplier of oil in the international market, it can not guarantee oil price stability or the availability of oil supplies to all oil consumers at all times.

To enable OPEC to provide enough investments to increase capacity to meet the expected growth in oil demand, two hurdles must be tackled. They are:

a) Reasonable oil prices in real terms i.e., taking account of imported inflation and changes of the U.S. dollar exchange rate.

According to OPEC data, if 1973 is taken as a base year, due to imported inflation into OPEC countries and the devaluation of the U.S. dollar vis-à-vis other major currencies, the real price of OPEC oil in 2005 was only $10.42 per barrel compared with its nominal price of $50.64 per barrel.

b) Taxation in the major oil consuming countries.

Taxation in major oil consuming countries limits the growth in oil demand and thus reduces the incomes of oil producing countries and consequently limits their ability to invest in the growth of their respective production capacities.

Many major industrial countries have introduced heavy taxes on some oil products. In some industrial countries, the price that motorists pay for gasoline is three or four times higher than the price of the original crude oil. In some of these countries, taxes account for more than 70% of the final price of oil products. In fact, these industrial countries receive much more income from oil taxation than the oil revenues generated by OPEC. According to OPEC data, during the period 2000-2004, the G7 countries made a total of $1.6 trillion from oil taxation. This compares with oil revenues of just $1.3 trillion for OPEC countries over the same five -year period. In addition, while the $1.6 trillion in oil tax revenues by the G7 is pure 'profit' this is not the case for the OPEC countries, as the cost of exploring, developing and transporting that oil must be deducted from these oil revenues.

In addition, such taxation can be considered a transfer of income from oil exporting to some oil importing countries. Such income can be used by oil producing countries in oil exploration and development in order to address the need to increase the current production capacity as demand rises in the future. If there is not sufficient investment to increase oil production capacity before it is needed, the international oil market may suffer sudden price shocks. This is essentially what has happened during the last few years. During the last three decades the real price of oil in the international market has been relatively low, as shown earlier, which discouraged major oil producers, namely OPEC, to increase production capacity. This in turn led, during this period, to the stagnation in this capacity to around 31 m. b/d and was consequently unable to match the recent significant increase in global oil demand particularly of light crude, consequently leading to the significant rise in oil prices.

Security of Oil Demand

Major oil producers such as the OPEC countries need security of demand for their oil. These countries are developing countries and they rely heavily on the income they get from oil exports (i.e., oil revenues) that they receive in foreign currencies, which they use to import the necessary goods and services they require for their development. In some oil producing countries oil exports account for more than 90% of total exports. Thus, any drastic reduction in the demand for oil and hence oil exports and consequently oil revenues, may have significant economic as well as political impact on these countries.

Oil producing countries will be reluctant to embark on major oil production capacity expansion when oil consumers intend in the future to substitute oil with other sources of energy and plan to increase taxation on oil products. In its recent report World Energy Outlook 2006, the IEA stated, for environmental and political security reasons, "the world is on a course that will lead it "from crisis to crisis" unless governments act immediately to save energy and invest in nuclear and bio fuels". In addition, in major industrial countries some writers advocate a further increase in taxation on oil products. For example, in a recent article in the Los Angeles Times, Steven Mufson recommended that "A sharp hike in energy taxes on petrol and other fossil fuels would not only help improve the government's balance sheet, but it would also be a way to start addressing global warming." Furthermore, every now and then, and mainly for political reasons, some reports are published in some major oil consuming countries particularly the U.S.A. advocating an "Independent Energy Policy" which usually recommend reducing these countries dependence on Middle East oil. Such reports and statements can not and will not encourage major oil producers in the Middle East to increase oil production capacity significantly. Such important issues must not be left to the issuance of reports and statements. They must be discussed thoroughly in a direct dialogue between consumers and producers.

As aforementioned, the oil industry is capital intensive and it requires a considerable amount of investment to explore, develop and produce oil, as well as to maintain oil production capacity and facilities. Therefore, oil producers like OPEC countries have to earn a reasonable return on their investments in order to be able to continue to pursue these operations. It has been estimated that in the past it cost Saudi Arabia $2 billion annually to keep its surplus production capacity.

A reduction in oil demand will force oil production to slow down or even stop. This in turn may damage some oil fields and may also reduce the amount of oil that can be re-

covered from them in the future.

A reduction in oil demand and a decline in oil producing countries' oil exports and revenues may force these countries to reduce their investments in the oil industry itself for two reasons:

a) Due to the reduction in the money available for investment; and
b) There will be fewer incentives to expand future production capacity.

Under such conditions the world may face a shortage in oil supplies in the future, which will have negative effects on the global economy.

To avoid these problems oil producing countries must be assured of reasonable oil prices in real terms (i.e., taking imported inflation and the devaluation of the U.S. dollar into consideration) and stable growth in oil demand. This will help these countries to maintain their production levels and provide enough investment for future growth in oil production capacity to meet future growth in world demand. Due to the relatively low real price of OPEC oil during the last two decades, new and existing oil fields have faced lower levels of investment resulting in OPEC's production capacity, particularly in Saudi Arabia, remaining static. Given that the majority of OPEC countries are currently producing at or near full capacity levels to meet the recent increase in oil demand, the surplus production capacity in these countries, especially in Saudi Arabia, has declined to only 1.5 million b/d mostly of heavy crude oil. Thus, the ability of OPEC countries to meet the anticipated on-going growth in oil demand is limited unless more money is invested in their oil industries.

It goes without saying the security of oil supplies depends heavily on the security of oil demand. To ensure the security of both supply and demand, oil producers and oil consumers must work together.

Oil Producers-Oil Consumers Dialogue

According to the IEA, the global demand for oil is expected to increase from the present level of 84 m. b/d to 116 m. b/d in 2030. With their large oil reserves some countries in the Middle East and particularly in the Gulf region will be able to meet such extra demand. These countries include Iraq, Saudi Arabia, Iran, Kuwait and the U.A.E. These are the future "Mini OPEC" countries. Oil consumer countries must be prepared to negotiate with these countries from "now" on future oil supplies. To leave it too late will be "too late".

As oil is an important strategic global commodity and affects daily life everywhere, major oil producing countries must take the lead in organizing an effective and useful dialogue with oil consumers. Such dialogue should also include minor oil consumers and oil producers' countries as well as international oil companies who play a major role in the international oil industry.

This dialogue must concentrate its efforts on the discussion of important matters related to oil, which affect the lives of all people worldwide. Subjects to be discussed can include:

1. International oil prices and their effect on the world economy.
2. The effect of oil usage on the environment.
3. Present and future investment in the international oil industry.
4. The purchasing power of oil revenues of oil exports.
5. Taxation on certain oil products in major oil consuming countries.
6. Security of oil supply and security of oil demand.

There have been some international conferences and seminars covering oil producers-oil consumers' dialogue. Furthermore an institute named the International Energy Forum (IEF) has recently been established in Saudi Arabia to deal with this issue. This institute is the right forum where consumers and producers can meet to discuss above matters and must, therefore, be supported. However, so far the dialogue issue is not being taken seriously enough and unless there are comprehensive discussions and scientific studies of all the subjects mentioned above and unless an effective mechanism to implement the findings of these discussions and studies and possible agreements has been established, then all valuable efforts, unfortunately, will be wasted.

The establishment of the International Energy Forum in Saudi Arabia is a good example to show the interest of major oil producing countries to play a vital role in this dialogue and to tackle all issues related to this dialogue. Oil producers have not only an economic but also a moral obligation to provide enough oil supplies to oil consumers. It is also in their interests to increase oil production and hence oil exports to increase their oil revenues which they can use to develop their developing economies. It is also in the interest of all oil producers, oil consumers, international oil companies and future generations to see that oil is produced, priced and used in a scientific and efficient way for the benefit of all.

Finally, major oil producers and consumers must remember that oil is a strategic commodity, its quantity is limited and at the same time it is so vital for the daily life everywhere and thus must consider above policies very seriously. It is their obligation and duty as well as it is in their own interest; they must be very active in the international oil scene to adopt certain policies that will bring benefits not only to their nations but also to the international community at large. It is high time oil consumers and producers stop adopting short-term policies and start following and implementing long-term ones.

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1. BP Statistical Review of World Energy- different issues.
2. OPEC Annual Statistical Bulletin- different issues.
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Allocation of CO_2 Emissions in Petroleum Refineries to Petroleum Joint Products: A Case Study

*By Alireza Tehrani Nejad M. and Valérie Saint-Antonin**

1. Introduction

Life Cycle Assessment (LCA) is one of the engineering methods that has increasingly gained attention and is regarded today as an important tool for environmental policy and strategic decision making. According to the Society of Environmental Toxicology and Chemistry (SETAC, 1993), this method aims at evaluating the environmental burdens associated with a product, process or activity throughout its life cycle from the extraction of raw materials through processing, transport, use, disposal and recycling. By relating environmental issues to the whole production chain, this method is regarded to have a holistic system-level approach which is well suited for assessment of complex systems.

Well-to-Wheel (WTW) studies are similar to LCAs but they cover a narrower system boundary by only focusing on the transport applications. They calculate the energy consumption and the associated greenhouse gas emissions along fuel chains and consist of two parts. The first part assesses the stage from the extraction of feedstock until the delivery of automotive fuels to the vehicle tank and is usually referred to as Well-to-Tank (WTT) analysis. The second part corresponds to Tank-to-Wheel (TTW) studies and aim at evaluating the performance of automotive fuels in the engine.

By analogy to LCAs, WTW studies can be also categorised in retrospective and prospective approaches (e.g., Ekvall et al., 2005). Retrospective studies look back at historic environmental impacts and use plant-specific or average data to illustrate the environmental burdens (e.g., CO_2 emissions) associated with the average production of a given automotive fuel. These kind of studies are useful for environmental accounting purposes. On the other hand, prospective or change-oriented studies look forward and consider the effects of different decisions. They are based on marginal data and attempt to explore the environmental effects associated with the marginal production of a given automotive fuel. As mentioned by EUCAR et al., (2004), when the ultimate purpose of a study is to guide the policy makers, prospective or marginal approach should be considered. In this study, we focus on both retrospective and prospective WTT analysis.

Since in WTT studies the main difference among the CO_2 content of automotive fuels are exclusively due to the refining process (EUCAR et al., 2004), especial care should be taken on this component. Oil refining is a joint production system with a very complex technical structure and a vast number of outputs that are strongly correlated. Therefore a key methodological problem which inevitably arises is how to correctly identify and quantify the real cause-effect chains that should be considered in estimating the marginal and average CO_2 content of automotive fuels at the gate of the refinery[1]. Neither the traditional WTT approaches, nor the existing databases can be useful because they fail to capture the complex interdependencies and synergies which exist among the refinery oil products and process units.

This paper attempts to illustrate that a practical way to perform such an analysis is to use Linear Programming (LP) models. In contrast to the traditional WTT methods, the information created through the duality in LP incorporates the complete interdependency and economic effects associated with any marginal variation in the refinery; this information can be directly used for prospective WTT studies but need some more computations for retrospective analysis. The proposed methodology is then applied to a real-type refinery model in order to estimated the CO_2 content associated with the marginal and average production of the automotive fuels. Three simulations for years 2005, 2008 and 2010 are performed to evaluate the impact of the sulfur tightening policy on the CO_2 content of automotive fuels at the gate of the refinery. This question is of importance because the reduction of the environmental impacts of automotive fuels constitutes one of the prime objectives of European environmental policies.

2. General linear model of the refinery and the CO_2 emissions

The use of LP in the refining industry spans a period of well over 50 years. The blending of gasoline was among the first popular applications of LP in refineries (Charnes et al., 1952). Today, designing new units, fixing the operating conditions, making a choice of feedstocks, improving the operations planning, oil product costing, policy analysis and forecasting are among the routine utilization of LP in oil refineries.

Refineries are very large complex industrial plants converting crude oil to a large number of petroleum products. Here, we develop the following static single-refinery LP model which operates in a competitive environment.

$$\begin{cases} \min \ c^T x \\ s.t. \quad Ax \geq b \\ \qquad Dx = 0 \\ \qquad Ex - \varepsilon = 0 \\ \qquad Fx \leq f \\ \qquad x \geq 0, \varepsilon \geq 0. \end{cases} \tag{1}$$

The main variables of our model are non negative physical rows xj ($j = 1, 2, \ldots, n$) between refining units from crude oils to end-use oil products along with intermediate products, utility consumptions, exchange products and pollutant emissions. The term c is the given n-vector of acquisition input costs and includes the cost of crude oils, feedstock, operating variable cost (e.g., cost of catalysts, solvents and chemicals)

*Alireza Tehrani Nejad M. and Valérie Saint-Antonin and with the Institut Français du Pétrole, Rueil-Malmaison, France. They may be reached at alireza.tehrani@ifp.fr or valerie.saint-antoni@ifp.fr
An expanded version of this paper was presented at the 9th Annual USAEE/IAEE/ASSA meeting session on *Current Issues in Energy Economics and Energy Modelling*, January 2007, Chicago, USA.
See footnotes at end of text.

and the exchange cost of finished products. In a cost minimizing framework, the refiner's objective is to satisfy demand for a product (in terms of both quantity and quality), denoted by the *m*-vector *b*, at minimum cost subject to the prevailing technology, input costs and availability. The oil product categories considered in this model are liquefied petroleum products (propane and butane), naphtha, gasoline, middle distillates (jet fuel, diesel and heating oils), heavy fuel oils with 1% and 3.5% mass sulfur contents and bitumen.

The linear technology used is represented by the fixed coefficient matrix *A*. The most common types of other constraints are the material balance and product quality constraints. The latter guarantee the expected quality and technical requirement of finished products in blending problems such as octane number (for gasoline), cetane number[2] (for diesel), viscosity (for fuel oil) and sulfur content (for all the above products). The material balance constraints represent the fact that the sum total of quantities going into some unit process or blending pool equals the sum total coming out.

We have also defined an emission balance equation, *Ex*, capturing the numerous source of CO_2 emissions in the refinery. In general, a refinery's emissions depend on the crude oil's weight and the conversion degree required for achieving the oil production target b: a high share of more valuable products (i.e., gasoline and diesel) requires higher processing and more CO_2 emissions. Modern and more complex refineries that are equipped to process heavier crude slates and produce lighter products record higher CO_2 emissions. Different types of fuels are burnt to provide the required energy for refining processes. In our LP model, the total carbon dioxide emissions ε are generated from burning fuel gas (ethane and propane), liquefied fuel (e.g., vacuum residue) and the coke of the catalytic cracker, each of which being assigned a specific CO_2 emission coefficient *E*.

Finally, since our study concerns the short and medium term the availability of some process units is limited to their installed capacity in the short term. That is, no investment occurs in new technology and no capital investment is depreciated or retired. For the medium term simulations, however, some realistic investments could occur.

3. Prospective LP-based approach

The exposition of our approach differs from the existing literature known as the marginal allocation methodology (see Azapagic and Clift, 1998, 1999; Babusiaux, 2003). Following the definition of a primal feasible basic variable,

$$\varepsilon = \sum_i \alpha_i b_i + \sum_j \gamma_j f_j \qquad (2)$$

where ξ_i and ξ_j correspond to the blocs which relate ε respectively to the demand and capacity slack variables in the final simplex tableau. In economic words, relation (2) implies that the attribution of the carbon dioxide emissions to primal constraints (i.e., oil products and limiting unit processes) according to their marginal contributions (i.e., ξ_i and ξ_j) is exactly equal to the whole CO_2 emissions generated within the refinery. The partitioned emissions reflect the underlying technical interdependencies embodied in the refinery model and are not necessary in proportion to physical measures (e.g., mass or energy content, etc.). In other words, these product-related coefficients ξ_i, as opposed to the ones in traditional methods, include all consequences of the desired change on the operation of the refinery as well as compositional changes of the oil products. Therefore, these simplex-based substitution coefficients are well suited for assessment of the marginal CO_2 content of automotive fuels for prospective WTT studies.

4. Retrospective LP-based Approach

Retrospective WTT studies aim to assess the environmental burdens (specially the CO_2 emissions) associated with the average production of a given automotive fuel within the refinery. As opposed to the prospective approach, retrospective WTT studies require the allocation of the total CO_2 emissions of the refinery over the petroleum products. As mentioned before, oil refining is a joint production system and due to the complex nature of the process involved and the vast number of joint product outputs that are strongly correlated, it is very difficult to establish any non-controversial allocation scheme for oil products.

According to the ISO 14041 recommendations, the allocation procedure should respect the following points (Frischknecht 2000):

1. Where allocation cannot be avoided, the system inputs and outputs should be partitioned between its different products or functions in a way which reflects the *underlying physical relationships* between them;
2. Where physical relationships alone cannot be established or used as the basis for allocation the inputs should be allocated between the outputs and functions in a way which reflects other relationships between them (e.g., physical measures or economic relations).

In practice, most of the allocation rules used so far for the petroleum-based fuel are traditionally based on two fundamental approaches: physical measures (mass, volume, energy or exergy[3] contents, molecular mass or other relevant parameters) or market value (gross sale value) or expected economic gain of individual oil products from a given refinery. Both of these approaches inevitably involve the use of arbitrary allocation rules and correspond to the second recommendation of ISO 14041. Furthermore, these approaches provide an incomplete picture of the whole system as they ignore the complex interactions, interdependencies and synergies which exist among the refinery oil products and process units.

In (Tehrani Nejad M., 2007) the author provides an original two-stage approach to yield some LP-based coefficients in such a way that it best satisfies the desired characteristics of a non-arbitrary allocation method as well as the ISO 14041 recommendations. The final allocation relation can be summarized as follows:

$$\varepsilon = \sum_i (\alpha_i + \sum_j E_B^T \delta_{ij} + \theta \vartheta_i) b_i \qquad (3)$$

In relation (3), the expression which is between the pa-

rentheses represents the net contribution of the *i*th oil product to the process-related carbon dioxide emissions in relation (2). These net contributions are based on the production elasticity of the unit processes involved in the production plan and vary following the optimal technology of the multi-product refinery. Let us re-state the meaning of relation (3) as follows: in a competitive situation and within a linear production technology, the whole CO_2 emissions of the refinery can be fully assigned to the oil products through some LP-based "average allocation" coefficients. These latter include the direct and the indirect contribution of each oil product to the refinery's CO_2 emissions. The direct contribution ε_i corresponds to the marginal CO_2 content of the *i*th oil product and is directly obtainable from the final Simplex tableau. The indirect contribution, depends upon the production elasticity of unit processes and should be calculated, ex-post, at the optimal solution of the LP model. Note that both the direct and indirect contributions, 1) are based on the same cost efficient equilibrium (i.e., they are extracted from the same final simplex tableau) and are perfectly coherent with each other; and, 2) they depend totally upon the technical and physical relationships that define the operating state of the refinery and are perfectly consistent with the ISO 14041 recommendations.

5. General framework and data of the refinery LP model

The refinery model retained here is based on the LP model presented in (1) and corresponds to a typical European Fluid Catalytic Cracking (FCC) refinery developed by *Institut Français du Pétrole*. It contains 650 constraints and more than 1800 variables. Its general framework can be summarized as follows.

5.1 Crude oil supply

In this study, the number of crude oils is reduced to Brent (generic name for North Sea sweet crude oil), Arabian Light and Arabian Heavy crudes. These are considered to be typical of the quality of crudes currently available in European refineries (Saint-Antonin, 1998). However, due to aggregation problems and the lack of complete technical information, the optimal crude structure deduced from the LP model could not reflect the given European oil market structure. For this reason, the crude oil shares have been fixed in the model (see Table 1).

Table 1: Typical Crude Oil in the LP Model

Crude oils	%mass	API°	Sulfur content
Brent	40	37	0.32
Arabian light	40	33	1.86
Arabian heavy	20	27	2.69

Source: Favennec, 1998

5.2 Crude oil prices

The selling price of crude oils is a Custom-Insurance-Fret (CIF) price which is deduced from the Free-On-Board (FOB) price in two steps. First, a freight cost calculated according to a reference scale is added to the FOB price. Then the obtained price is multiplied by an insurance and commission rate. Here, we used the average CIF prices for year 2005 (see Table 2).

Table 2: Crude oil prices for year 2005

Crude oils	Conversion factors	$/b	$/t
Brent	7.50	53.3	400
Arabian light	7.32	49.2	360
Arabian heavy	7.10	45.9	326

Source: Platt's 2005.
Conversion factors from ton to barrel.

5.3 Petroleum products specifications

European and U.S. refineries are subject to environmental specifications. Specially, gasoline and "on-road" diesel sulfur contents were significantly reduced to 50 ppm in 2005 and will be set to 10 ppm by January 2009. In addition, the total aromatic content is reduced from 42 vol% to 35 vol% in 2005. Since 2000, the olefins and benzene contents have been limited to 18 vol% and 1 vol% respectively. A review of European Union diesel specifications is scheduled for 2006 (Houdek, 2005).

Between Europe and the rest of the world, trade of oil products can only take place if the sulfur levels of petroleum products comply with the European regulations. This point is of importance because most countries in Asia, Africa and South America adopt sulfur specifications that set levels far above European standards. For instance, the national specifications for sulfur levels in gasoline and diesel in China are respectively 800 ppm and 2000 ppm, or 16 and 40 times higher than European specifications. For our base case study (year 2005), we considered the European specifications of the year 2005 for automotive fuels (Table 3).

Table 3: Specifications of gasoline and diesel in Europe

Quality	Gasoline	Diesel
Sulfur, max. (\% m)	50 ppm	50 ppm
Cetane, min. (number)	--	51
RON, min. (point)	95	--
MON, min. (point)	85	--
Aromatics, max. (\% vol.)	35	--
Benzene, max. (\% vol.)	1.0	--

Source: Panorama IFP, 2005

6. Scenarios and results

6.1 Scenarios specifications

The objective of our simulations is to evaluate the impact of the sulfur reduction policy on the marginal and average CO_2 content of automotive fuels at the gate of a European-type refinery. Three sulfur specification scenarios based on 2005 (the base case), 2008 and 2010 have been defined (see Table 4). For simplicity purposes, we suppose that there is no distinction between product specifications and the actual levels required at the refinery gate to cover for possible contamination in the distribution systems. Within these scenarios, oil products' demand, crude oil supplies and all other input and output prices (such as crudes and petroleum products) are supposed to be the same as the base case. For the medium term scenarios (2008 and 2010), only some realistic investments could occur in the reforming and hydro-cracking units.

Table 4: Sulfur scenarios for years 2005, 2008 and 2010

Oil products	Base year 2005	Scenario 2008	Scenario 2010
Gasoline	50	30	10
Diesel	50	30	10
Heating oil	2000	1000	1000

Unites: ppm

6.2 Marginal CO_2 contributions of automotive fuels: a prospective study

The results per automotive fuels featured in Table 5 correspond to the marginal CO_2 contribution of gasoline and diesel at the gate of the refinery. They show that the gap between the marginal CO_2 contribution of gasoline and diesel will be enlarged until 2010. This important conclusion can be explained as follows. By 2005, European refineries have already expanded the diesel fraction from oil refining beyond its optimum balance with gasoline yield to meet the diesel-oriented market demand. Technically, this imbalanced production ratio has most probably resulted in higher production cost and energy consumption for diesel, as compared to gasoline (for technical details, see Kavalov and Peteves, 2004). Table 4 shows that, adding the ultra-low sulfur specifications into the current imbalanced production situation will further increase the marginal energy consumption and the resultant CO_2 emissions associated with diesel.

On the other hand, the marginal CO_2 content associated with gasoline continues to decrease and becomes even negative from 2008. This unconventional result is mainly due to the catalytic reforming unit, whose major function is to contribute to the gasoline blend but also provides hydrogen as a by product. Meeting the ultra-low sulfur diesel from 2008 would require using more intensively the hydrodesulfurisation and hydro-cracking units for which hydrogen is a crucial input. For cost reasons, it happens that the catalytic reforming unit would operate at full capacity not in order to meet the gasoline demand (which is decreasing in Europe) but to meet the increasing hydrogen requirement of the refinery. This unusual situation would inverse the major function of the reforming unit and would push gasoline to become more and more as a "by-product" of this unit as compared to hydrogen. Since the optimal solution of LP accounts for all the interdependencies among process units, it does not wrongly penalize the reforming unit for its intensive operation; and, therefore, the gasoline pool receives a much lesser CO_2 emissions than diesel. The negative CO_2 content of gasoline could confirm the "by-product" nature of this product in European refineries in the near future.

Table 5: Evolution of the marginal CO_2 contents

Oil products	2005	2008	2010
Gasoline	0.205	-2.483	-1.010
Diesel	0.357	0.690	0.800

Unites: tCO2/t

Note, however, the emission coefficients in Table 5 must be interpreted with great care as they only correspond to the marginal production of automotive fuels in the refinery. As far as the total CO_2 emissions are not fully allocated over oil products (because of the "non product" active constraints), these marginal coefficients are only useful for prospective WTT analysis.

6.3 Marginal CO_2 contributions of automotive fuels: a retrospective study

An optimal departure[4] from the marginal CO_2 content to average CO_2 content associated with automotive fuels requires using the allocation relation presented in Section 4. The results per automotive fuels featured in Table 6 are now comparable to those which are based on traditional accounting WTT studies. Most of these latter overestimate the energy use and CO_2 emissions of gasoline, as compared to diesel, due to the higher number of gasoline processing units in European refineries. In our LP model, the average CO_2 content associated with automotive fuels are totally in line with their respective marginal CO_2 contents. That is, since the equilibrium extent of gasoline-to-diesel conversion has been reached, adjusting the a European-type refinery's output to meet the new ultra-low diesel demand, would be on average more energy-and CO_2-intensive for diesel as compared to gasoline. Moreover, the gap between diesel and gasoline average CO_2 contribution would also widen further, because of the more expensive adjustment of diesel properties to the new European standard requirements.

Table 6: Evolution of the marginal CO_2 contents

Oil products	2005	2008	2010
Gasoline	0.302	-1.189	-0.931
Diesel	0.567	0.752	1.503

Unites: tCO2/t

7. Conclusion

In this paper we distinguished between prospective (marginal) and retrospective (accounting) WTT analysis. We argued that prospective analysis should be considered when the objective is to explore the environmental effects associated with the marginal production of a given automotive fuel. On the other hand, retrospective analysis is of interest when the main objective is to evaluate the average environmental impacts of a given automotive fuel in transportation studies. It was also explained that, an exact prospective/retrospective study for the production of automotive fuels requires assessing the marginal/average contribution of gasoline and diesel to the total CO_2 emissions generated within the refinery. Oil refining is one of the most complex joint production system, and traditional WTT methods fail to account for the complete interaction and substitution effects among the process units.

In order to compute the marginal/average contribution of automotive fuels at the gate of refineries, a practical method based on linear programming was developed. We illustrated that the marginal/average LP-based emission coefficients which emerge from the optimal solution, as opposed to the ones computed by traditional methods, include all consequences of the desired change on the operation of the refinery as well as compositional changes of the oil products. In other words, these emission coefficients embody the physical and process relationships in the refinery system and provide more

realistic estimates of the environmental impacts of automotive fuels.

Using the LP methods summarized in Sections 3 and 4, we estimated the marginal/average CO_2 contribution of the petroleum products for a typical European refinery. Then, three simulations for years 2005, 2008 and 2010 were performed to evaluate the impact of the sulfur reduction policy on the CO_2 content of automotive fuels at the gate of the refinery. Based on the obtained numerical results, the following core conclusions can be highlighted. Due to the transport and fiscal policies in most of the European countries, the demand for automotive diesel, at the expense of gasoline, has been drastically increased from the past 10 years. Since the equilibrium extent of gasoline-to-diesel conversion has been reached, adjusting the European refineries output to meet the new oil product quantities, would be more energy-and CO_2-intensive for diesel. Moreover, our estimates follow the general conclusions driven by Kavalov and Peteves (2004) who claimed that the gap between diesel and gasoline CO_2 contribution would widen further, because of the more expensive adjustment of diesel properties to the new European standard requirements.

A surprising result was the negative marginal/average CO_2 contribution of gasoline at the gate of the refinery from 2008. This fact, however, could be perfectly explained by the continuously declining demand of gasoline, on the one hand and, on the other hand by the increasing hydrogen requirement in the refineries due to the new quality specifications. This imbalanced situation would inverse the major function of the catalytic reforming unit and, would cause gasoline to become more and more a "by-product" of this unit and the whole refining system. Hence, the negative CO_2 content of gasoline should be interpreted rather as a confirmation of the "by-product" nature of this oil product in Europe in the near future.

Footnotes

[1] Throughout this paper, by marginal (average) CO_2 content of a given oil product we mean the additional CO_2 emissions associated with the marginal (average) production of that oil product within the refinery.

[2] The cetane number measures the speed at which diesel burns in an engine when subjected to high temperature and pressure (Favennec, 1998).

[3] The exergy content of a system indicates its distance from the thermodynamic equilibrium. The higher the exergy content, the farther from the thermodynamic equilibrium (definition from, http://www.holon.se/folke).

[4] Here, an optimal departure means to preserve the cost efficient equilibrium of the refinery.

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Norwegian Association for Energy Economics (NAEE)

NAEE www.naee.no was formally established in 1984 and today has a membership of around 120 individual members with background from energy companies, government, consulting, policy research and academic organisations in Norway. In its earlier years, NAEE membership was mainly from the oil and gas sector however more recently the organisation has attracted members from the electricity industry as well. Since its establishment, the NAEE has worked actively to provide an interdisciplinary forum for the exchange of ideas, experience and issues among professionals interested in energy economics in Norway.

Conferences and Seminars

NAEE regularly holds workshops, seminars and conferences for the benefit of its members and public at large. Most of the NAEE seminars and workshops are organised in cooperation with Norwegian organisations with interest in the energy sector. The seminars and workshops organised during 2005-2006 illustrates this approach. During this period, NAEE organised following national seminars:

- "Utilisation of gas in Norway: Opportunities and Challenges", organised in collaboration with Statistics Norway, Oslo, 30. March, 2006
- "Security of supply in the Norwegian power market", organised in collaboration with Statnett, Oslo, 15. November 2005.
- "Norwegian participation in Energy projects in the South: Challenges and dilemmas", organised in collaboration with Norwegian Petroleum Directorate, Stavanger, 11.May 2005.

The association has also actively pursued regional cooperation with its peer chapters in Europe. In August 2005, NAEE hosted the Annual European Energy Conference in Bergen. This conference attracted over 120 presentations from delegates and speakers from government, corporate and academic circles from over 30 countries. This European event was organised for the second time by NAEE, the first time being in 2000. Both conferences were organised in cooperation with Institute for Research in Economics and Business Administration, SNF, Bergen. NAEE was also host for the IAEE International Conference that was held in Stavanger in 1994.

Opportunities and priorities

Norway is endowed with abundant non-renewable and renewable energy resources. The oil and gas activity in the North Sea is already well established and so is the utilisation of the hydropower resources in the country. However the Norwegian energy wealth goes beyond the currently developed resources. Exploitation of offshore oil and gas resources in the Arctic region is currently in its infancy stage. So is the exploitation of renewable sources, mainly wind power, along the Norwegian coast.

On the demand side, utilisation of natural gas in Norway, particularly for power production is one of the issues on the contemporary agenda. The main challenge facing the industry and the policy makers is to find a commercially viable alternative for handling CO_2 emissions from gas power production. Other issues on the policy agenda include: security of supplies in the Norwegian power system which is almost exclusively dependant on hydropower, and competitive supplies of power inputs to the energy intensive industries as current preferential contracts held by these industries expire by 2010. NAEE is addressing this latter issue at its forthcoming seminar:

- "Power intensive industries and the regional power and network situation in Norway: A power system perspective", to be organised in collaboration with SNF, Bergen, 9th Nov.2006.

The welfare of the Norwegian society is closely coupled to the efficient and equitable management of its energy resources. Resource endowments are determined in heaven, however resource management takes place on the earth. The quality of the human capital employed in the management of the resources is crucial in this context. NAEE is committed to providing a forum for professionals interested in the energy sector, and the challenges in Norway in the coming years will be no less than what they have been during the past.

The current position of the NAEE is due to its distinguished members, and the voluntary efforts of the group of enthusiasts that have constituted the board of NAEE from time to time since its establishment in 1984. NAEE shall continue to create value by providing updated information and networking opportunities for its members and the public at large.

Balbir Singh, President NAEE

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We look forward to your participation in these new initiatives.

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United States Association for Energy Economics International Association for Energy Economics

Conference Structure

This year we have chosen plenary session themes that reflect key policy challenges and uncertainties for developing necessary energy infrastructure in North America and elsewhere. The concurrent sessions will expand on the themes outlined below, and we are actively soliciting papers that address the suggested bullet points. Papers on other topic ideas are, of course, welcome, and anyone interested in organizing a session should propose the topic and possible speakers to: Wumi Iledare, Concurrent Session Chair (p) 225-578-4552 (f) 225-578-4541 (e) wumi@lsu.edu. The conference will also feature workshops, public outreach and student recruitment sessions.

LNG • Upstream access and supply • Downstream infrastructure development • Shipping capacity and costs • Contracts, project financing, gas market integration, risk management	**Electricity Market Design** • Importance of market design • Market design policy evolution in the USA • Comparison of different market structures • Efficiency of regulatory versus market structures
Supply and Access • Oil – conventional & unconventional resources, geopolitics • Refining – capacity, technology • Natural gas – access and geopolitics • Role of National Oil Companies	**Electricity Infrastructure** • Building transmission – who? how? New technologies? • Managing grids: Independent system operators, traditional utilities • Smart grid and other IT applications • Building new generation including alternative energy sources
Legal and Regulatory Considerations • Siting energy facilities • Increasing regulatory efficiency • Managing legal uncertainties • EPAct 2005: an evaluation	**Energy Trading** • Oversight – veracity of price data • Volatility – impact, management • Oil, gas, coal, electricity price linkages • Impact of market structure
Alternative Energy & Efficiency • Mass-scale solar power, wind power • Coal gasification • Biofuels – amount, timing, delivery infrastructure • Energy efficiency	**Human Capital** • Trends in skills needed • Impact of demographics and societal trends on career choice • Role of educational institutions • Role of media and reporting on perceptions of the energy sector
Science and Technology • Role of IT (upstream oil & gas, demand-side management, smartgrid) • Frontier technologies: nanotechnology, biotechnology, material sciences • Energy storage and energy efficiency • Science of climate change and carbon sequestration	**Other Energy Delivery Infrastructure** • Refining capacity • Petrochemicals • LNG regasification terminals • Pipelines

**** CALL FOR PAPERS ****

Abstract Submission Deadline: April 27, 2007

(Please include a short CV when submitting your abstract)

Abstracts for papers should be between one to two paragraphs (***no longer than one page***), giving a concise overview of the topic to be covered. At least one author from an accepted paper must pay the registration fees and attend the conference to present the paper. The lead author submitting the abstract must provide complete contact details - mailing address, phone, fax, e-mail, etc. Authors will be notified by June 1, 2007, of their paper status. Authors whose abstracts are accepted will have until August 4, 2007, to return their papers for publication in the conference proceedings. While multiple submissions by individuals or groups of authors are welcome, the abstract selection process will seek to ensure as broad participation as possible: each speaker is to present only one paper in the conference. No author should submit more than one abstract as its single author. If multiple submissions are accepted, then a different co-author will be required to pay the reduced registration fee and present each paper. Otherwise, authors will be contacted and asked to drop one or more paper(s) for presentation. Abstracts should be submitted to:

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Students: Submit your paper for consideration of the USAEE Student Paper Awards (cash prizes plus waiver of conference registration fees). Students may also inquire about our scholarships for conference attendance. Visit http://www.usaee.org/USAEE2007/paperawards.html for full details.

Travel Documents: All international delegates to the 27th USAEE/IAEE North American Conference are urged to contact their consulate, embassy or travel agent regarding the necessity of obtaining a visa for entry into the U.S. If you need a letter of invitation to attend the conference, contact USAEE with an email request to usaee@usaee.org The Conference strongly suggests that you allow plenty of time for processing these documents.

Visit our conference website at: http://www.usaee.org/usaee2007/

Hybrid Modeling of Energy-Environment Policies: Reconciling Bottom-up and Top-down

Guest Editors: Jean-Charles Hourcade, Mark Jaccard, Chris Bataille and Frédéric Ghersi

Over the last two decades, energy-economy modelers of all stripes have begun to realize that energy and climate change policy cannot be approached solely with either a financially denominated macroeconomic 'top-down' approach, be it CGE or otherwise, or a purely technologically denominated 'bottom-up' approach. Large scale shifts in the energy system, like those that effective climate policy may require, will involve similarly large changes in technology and the micro- and macrostructure of the economy, demanding realistic modeling of all these dynamics.

This is the 'hybridization' challenge, to bring technological explicitness and micro- and macroeconomic realism together in one integrated policy analysis package, and it has given rise to several distinct hybrid modeling approaches. Yet, while individual publications over the past decade have described efforts at hybrid modeling, there has not yet been a systematic assessment of their prospects and challenges. To this end, several research teams held a workshop in Paris on April 20, 2005 to compare and share their hybrid modeling strategies and techniques.

This 177-page special issue, edited by Jean-Charles Hourcade, Mark Jaccard, Chris Bataille and Frédéric Ghersi, is composed of an introductory editorial, which summarizes the various modeling approaches represented in the issue and speculates on future methodological advances, and detailed articles from each of the participating modeling teams (WITCH, IMACLIM-S/POLES, ObjECTS MINICAM, CIMS, E3MG, an MCP CGE, AMIGA, and EPPA-MARKAL). By presenting the state of the hybridization art in one easily accessible package, this issue is a unique and useful tool to the wider modeling community grappling with the world's energy and environmental policy issues.

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The French Affiliate

The Association of Energy Economists (AEE) was founded in 1985 with the support of French energy firms (Electricité de France, Gaz de France, Elf Aquitaine, Total), l'Agence de la Maîtrise de l'Energie et de l'Environnement, research centers (Institut français du Pétrole, Commissariat à l'Energie Atomique) and some governmental administrations. The academic community has joined the AEE through individual membership. The AEE now has ten institutional members (enterprises and administrations) and 165 individual members, 45 of which are students. Since 2000 the AEE supports the development of a very active chapter of students in energy economics.

Traditional and past activites

Through its activities (an annual meeting and conferences), the AEE has become a national platform for companies, institutions and academics. Its goal is to encourage debate in energy economics and energy policy by bringing together individuals with a wide range of energy expertise and encouraging the exchange of ideas and information. On the international scene, the AEE organized, in 1992, the 15th Annual International Conference of the IAEE "*Coping with the energy future : markets and regulation"* in Tours and in 1999, the European Conference "*Energy and Technology*" in Paris.

In addition to AEE's activities, academic institutes in different universities (CGEMP in Paris Dauphine University, CERNA in the Paris School of Mines, CREDEN in Montpellier University, GRJM in Paris-Sud University, the Institut Français des Relations Internationales, IFP) are also very active in organizing events in energy economics between academics, companies and institutions. Professional associations (AFTP in oil activities, ATG in gas activities, SFEN in the nuclear field) also propose such activities. Part of the AEE's activities, over the years, has been to work in partnership with these other associations.

The AEE also encourages its members to participate in the IAEE International and European conferences. In particular it supports young economists by helping them with travel expenses.

Specialized seminars

Recently, the AEE has taken new initiatives to raise the level of dialog between professionals and academic economists. Since 2005 the main activity of the AEE has been the organization of a series of presentations and debates with representatives from the academic and business worlds on theoretical approaches applied to relevant strategic and political issues. This initiative for improving reflection through specialized events receives the support of the Conseil Français de l'Energie, the French affiliate of the World Energy Council, which co-organizes this series of quarterly seminars with the AEE.

Seminars are organized on a regular basis throughout the year (quarterly) so as to give the opportunity to a maximum of AEE members to participate. The first one was held on the issue of "Energy investment up against market and regulatory risks" (June 15, 2005). It focused on the relevance and limits of decision-making methods under uncertainties from the newly liberalized markets and public policies. It highlighted the difficulties of managing different types of risks in the strategic decisions of companies and in the long-term policies for climate protection and energy security. Guest speaker was Christian Gollier, professor at Toulouse University and MIT, a very well-known specialist of decision theory under risk.

These quarterly seminars which attract around 70 participants include a theoretical presentation on the issue by a professor together with comments on applications to the business world from a professional economist. The following topics were discussed in the first four seminars:

- "Economics of Technical Change and Environmental Policy", with presentations by Claude Henry, Professor at the Ecole Polytechnique and Cédric Philibert, International Energy Agency (May 18, 2006)
- "Risk aversion and economic decision" with Louis Eeckhoudt, Professor at Mons University (Belgium) and CORE (Leuwen University) and Sandrine Spaeter (Professor, BETA, Strasbourg University). June 28, 2006)
- "The oil price as indicator of future rarefaction: the relevance of the exhaustible natural resources theory" by Pierre-Noël Giraud, Professor, Ecole des Mines de Paris and Denis Babusiaux, professor, Institut Français du Pétrole (September 28, 2006)
- "The efficiency of economic instruments for sustainable development : from theory to practical designs" by Olivier Godard, professor at the Ecole Polytechnique and Jean-Michel Trochet, EDF Senior economist (January 23, 2007)

Student Chapter

The AEE created and maintains a very active students' chapter which now serves as a benchmark to incite other national affiliates to create similar sections. It includes 45 members doing doctoral theses in the field of energy economics on a range of subjects such as energy-economy links, energy efficiency policy, renewable energy sources, CO2 policy instruments, industrial strategies on electricity and gas markets, efficiency of new market regulations.

The main objectives of the Student Chapter are two-fold. Firstly it provides space for networking between students from various academic research centers in France who are involved in PhD research in energy economics. Secondly, it gives them the opportunity to exchange views on their research work with professional economists and academic researchers. The AEE student chapter organizes twice yearly workshops where ten members present a progress report on their research to a panel of professors and professionals. During these meetings, the students benefit from their comments and advice for their research.

Website

More information about the French chapter of the IAEE and the presentation of its activities is available at www.aee-france.fr/. This web site, which was initially created in 2006 by the Student Chapter to support its various initiatives and to circulate information, has now become a valuable platform for the whole association.

Dominique FINON, President of AEE

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"2001: An Energy Odyssey?"

24th IAEE International Conference, Houston, Texas, USA, April 25-27, 2001
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- Natural Gas Industry Restructuring
- Energy Demand, Efficiency and the Economy
- Electricity Restructuring
- Energy Asset Optimization
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- California Power Industry
- Real Time Pricing
- Natural Gas Expansion in China
- Electricity Losses in Mexico
- Cost Structure in Natural Gas Distribution

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- Taxation Issues in the Energy Sector
- Renewable Energy Sources
- Electricity & Natural Gas Capacity Issues
- Price Volatility in Energy Markets
- Technology and Energy Efficiency
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- Energy Demand Analysis

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Climate Policy Uncertainty	Electricity Reliability in the States
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Energy Pricing, Taxation, and Subsidy	Energy Planning and Policy Options
Renewable Energy and New Energy	Conservation Know-how and R&D
Oil and Coal: Today and Tomorrow	Distributive Energy Systems and New Fuels

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Multi-Greenhouse Gas Mitigation and Climate Policy

Guest Editors: Francisco C. de la Chesnay and John P. Weyant

This Special Issue of *The Energy Journal*, entitled Multigas Mitigation and Climate Policy, presents the results of the most recently completed study organized by Stanford University's Energy Modeling Forum (EMF), commonly referred to as EMF-21. Edited by John Weyant, Stanford Univ., and Francisco de la Chesnaye, U.S. EPA, the 520-page volume is the largest and most comprehensive international, coordinated study on greenhouse gas (GHG) scenarios to date.

This Special Issue provides a complete report on a comparative set of analyses of the economic and energy sector impacts of multigas mitigation of anthropogenic GHGs, including carbon dioxide (CO_2) and the more potent non-CO_2 GHGs including methane (CH_4), nitrous oxide (N_2O) and a set of fluorinated gases (PFCs, HFCs and SF_6). In 2000, energy-related CO_2 emissions accounted for about three-quarters of global emissions, with the combination of non-CO_2 gases making up the rest on a CO_2-equivalent basis.

The objectives of this study were to: (1) conduct a multigas policy assessment to improve the understanding of the affects of including non-CO_2 GHGs and terrestrial sequestration into short and long-term mitigation policies; and (2) advance the state-of-the-art in integrated assessment and climate economic modeling. Nineteen energy-economic modeling teams from Asia, Europe, and the U.S. along with international experts on non-CO_2 GHGs and forestry participated in the study. Many of the modelers who participated in EMF-21 have now formed a new international consortium (supported by the new EMF-22 study) to develop the next round of global economy, energy, and GHG scenarios.

Results from EMF-21 provide reference projections of all GHGs to 2100 and also estimate the economic effects of meeting a stabilization target of 4.5 Wm-2 (watts per square meter) relative to pre-industrial times, which corresponds to an equilibrium temperature increase of 3.0°C. Although the models project that CO_2 emissions grow throughout the century, the range of reference case projections is quite large, with projections from some models showing slightly more than a doubling and others showing an approximate five-fold increase over the century. The reference emissions for CH_4, the second most important GHG, show about a doubling of emissions over the century. For the climate stabilization case, all models show that climate mitigation under a multigas policy leads to an appreciable reduction in both marginal costs and effects on global GDP.

The two principal insights from the study are: (1) the range of economic sectors from which non-CO_2 GHGs originate is far larger and more diverse than for CO_2; and (2) the mitigation costs for these sectors and their associated gases can be lower than for energy-related CO_2 alone. Taken together, these two factors result in a more diverse portfolio of potential mitigation options, and thus the potential for reduced costs, for a given climate policy objective.

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Shirley Neff Leads Pipe Line Group

Shirley Neff, USAEE Past President, has been named President and CEO of the Association of Oil Pipe Lines (AOPL) based in Washington, DC.

Prior to her new position Ms. Neff was Adjunct Lecturer and Research Scholar at the Center for Energy, Marine Transportation and Public Policy (CEMTPP) in the School of International and Public Affairs at Columbia University in New York and an advisor to Goldwyn International Strategies in Washington, DC. She was also Executive Director of The Energy Forum in New York, the New York affiliate of the USAEE, a group she helped reorganize and reenergize.

Ms. Neff was economist for the U.S. Senate Committee on Energy and Natural Resources from 1993-1996 and from 1999-2003. While on the staff of the Committee, she was responsible for oil and gas policy, international energy security, renewable energy, climate change and energy tax matters.

In addition to her Senate career she has extensive private and public energy sector experience having been senior governmental affairs director for Royal Dutch Shell and held a similar position at the Interstate Natural Gas Association of America.

Ms. Neff also serves on the advisory board of the Center for Energy Economics at the Bureau of Economic Geology, University of Texas at Austin. She holds a BS in economics from Iowa State University and an MS in economics from the University of Wisconsin-Madison and is a Senior Fellow of the USAEE.

Mark Schwartz Replaces Retiring Lawrence J. Goldstein as President of PIRA Energy Group

After 30 years as President of PIRA Energy Group, a leading international energy consulting company that he co-founded in 1976, Lawrence J. Goldstein has announced his retirement, effective December 31, 2006. A member of the National Petroleum Council, Larry also served as president of Petroleum Industry Research Foundation (PIRINC), from which he is also retiring. He will remain on PIRINC's board and help in the relocation of the foundation from New York City to Washington DC under new management and name, Energy Policy Research Foundation.

Dr. Mark A. Schwartz replaces Larry as President of PIRA Energy Group. Prior to joining PIRA in 2002 as Managing Director of the Scenario Planning Service, Mark was Chief Economist of ExxonMobil Corporation, where he was responsible for developing the company's long-range economic and energy outlook. During his 25 years at Exxon he also had assignments in Upstream Planning, Treasurers, International Gas and Corporate Planning. Mark holds a PhD in economics from the University of Pennsylvania.

Mark joins PIRA's Executive Management Team, which is led by Chief Executive Officer Dr. Gary N. Ross (Global Oil Consulting) and includes Executive Directors Gregory Shuttlesworth (Natural Gas), Allan Stewart (Electric Power), Ira Joseph (International Gas), and Chief Operating Officer A.J. Conley (Sales and Administration).

German IAEE Affiliate *Gesellschaft für Energiewissenschaft und Energiepolitik (GEE) e.V.*

In 2009 the German Affiliate will celebrate is 30th anniversary. The organization was founded in the midst of the debate on nuclear energy in Germany. At that time it was the aim to move the debate from military manifestations between antinuclear groups and the police to places such as energy dinners, seminars and conferences where the different positions could be discussed in a controversial but friendly manner. To implement this concept it was necessary to elect some representatives from ecologist groups into the GEE board, but in the beginning some members from the energy industry had some problems with this.

In the mean time the concept of an independent organization is well accepted. GEE meetings have a broader scope. Market liberalization and regulation, the new trade with electricity, natural gas and greenhouse gas emissions, energy prices and the prospects for energy investments are regular topics for our meetings which are famous for their stimulating discussions and source for new ideas. In the rather competitive market for energy conferences, the German affiliate is known as regularly presenting new speakers which are later invited by other conference organizers.

This is possible through the important role the academia has in our organization, in addition to business people from industry, consulting and administration. The GEE is not a mere energy economic association. Many of our 250 members have their academic roots in disciplines such as Engineering, Legal and Political Sciences. Therefore the first "E" in our name does not stand for "Economics" but for "Energy Sciences" while the second "E" stands for "Energy Policy".

The energy markets in Germany and Europe are subject to fundamental changes. The market dynamics requires more young professionals to join the scene. GEE is actively involved in this process, among others by sponsoring a "best student award" which becomes more and more popular. As the German energy industry globalizes, *GEE* is well positioned by its affiliation with the IAEE which is another important asset for our organization to flourish in the future.

Georg Erdmann
President of the GEE

Endogenous Technological Change and the Economics of Atmospheric Stabilisation

Guest Editors: Ottmar Edenhofer, Carlo Carraro, Jonathan Köhler and Michael Grubb

Few dispute that technology innovation will be central to tackling the diverse energy challenges of this Century – but the economics of innovation remain poorly understood and inadequately represented in most economic models.

Nevertheless, empirical and theoretical developments in the field of "endogenous technological change" (ETC) are increasingly being incorporated in energy-economy models, which are rapidly gaining complexity and salience in the global debate. In both 'top-down' and 'bottom up' lines of analysis, a much richer menu of technologies and innovation processes are being modeled, for example with introduction of strategic R&D investments and R&D spillovers, crowding out effects between different R&D investments, joint modeling of learning by researching and learning by doing, and endogenizing dynamics of a backstop technology.

It is time to assess the state of the art, with a comparative study traversing both 'bottom-up' and 'top-down' perspectives in relation to the most over-arching, long-term and global policy question in the field: the implications of trying to stabilize atmospheric CO_2 concentrations. This Special Issue brings together the results from the Innovation Comparison Modeling Project, representing early and extensive efforts to do just that. Edited by Ottmar Edenhofer, Carlo Carraro, Jonathan Köhler and Michael Grubb, the 284-page volume contains a Synthesis Report that examines and compares the influence and dynamics of ETC in ten different global models (ENTICE-BR, FEEM-RICE, AIM/Dynamic-Global, DEMETER-1CCS, MIND, DNE21+, GET-LFL, MESSAGE, IMACLIM-R and E3MG), applied to assess the economics of stabilising atmospheric CO_2 concentrations.

These, together with an Introductory Overview and a Technical Overview of the theoretical and empirical state of play, presents a unique collection and contribution to the wider economic debate on technology, innovation and policy towards our global energy challenges.

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10th Annual Energy Economics Meeting
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Hot Topics in Energy Modeling

If you are interested in presenting please send electronically an abstract of 200-400 words and a short bio to the program chair Carol Dahl at the Colorado School of Mines (cdahl@mines.edu) by May 25, 2007. Decisions on papers presented and discussants will be made by July 1. The program including abstracts will be posted at iaee@iaee.org by September 1, 2007. The session will be published in an online IAEE/ASSA Papers and Proceedings.

Alternatively, if you are interested in being a discussant please send a short bio and a list of research areas you would feel qualified to discuss. Discussants and at least one member of each paper must be a member of IAEE to be included in the session.

Calendar

18-21 February 2007, 30th IAEE International Conference: Restructuring to Sustainability: at Wellington, New Zealand. Contact: Conference Manager, Victoria University of Wellington, PO Box 600, Wellington, New Zealand. Phone: 64-4-463-6556 Email: iaee-registrations@vuw.ac.nz URL: http://www.vuw.ac.nz/iaee07/index.html

20-21 February 2007, Financing Clean Fuels at London, UK. Contact: Conference Coordinator, The Bookings Department, IBC Gobal Conferences, Informa UK Ltd, PO Box 406, West Byfleet, KT14 6NN, United Kingdom. Phone: 44-0-20-7017-5518. Fax: 44-0-20-7017-4745 Email: energycustserv@informa.com URL: www.ibcenergy.com/ez1205

22-23 February 2007, Cap and Trade as a Tool for Climate Change Policy at Berkeley, CA. Contact: Mary Elliott, Center Administrator, University of California, Berkeley, California Center for Environmental Law & Policy, School of Law (Boalt Hall), Room 362, Berkeley, CA, 94720, USA. Phone: 510-642-7235. Fax: 510-643-2672 Email: melliott@law.berkeley.edu URL: http://www.ccelp.berkeley.edu

23-25 February 2007, Eastern Economic Association 33rd Annual Conference at New York City, NY. Contact: Dr. Mary Lesser, Conference Secretariat, Eastern Economics Association, c/o Iona College, 715 North Avenue, New Rochelle, NY, 10801, USA. Phone: 914-633-2088. Fax: 914-633-2549 URL: www.iona.edu/eea

February 26, 2007 - March 2, 2007, Natural Gas Strategy Course part 1 at Groningen, The Netherlands. Contact: Evanya Breuer, Manager Customer Relations, Drs., Energy Delta Institute, P.O. Box 11073, Laan Corpus den Hoorn 300, Groningen, Groningen, 9700 CB, The Netherlands. Phone: +31 50 524 83 12. Fax: +31 50 524 83 01 Email: breuer@energydelta.nl URL: www.energydelta.org

27-28 February 2007, 5th Annual Shared Services & Outsourcing for HR at Grand Copthorne Waterfront, Singapore. Contact: +65 67229388, IQPC Worldwide, 61 Robinson Rd, Singapore, Singapore. Phone: +65 67229388. Fax: +65 6720 3804 Email: enquiry@iqpc.com.sg URL: www.iqpc.com.sg

27-28 February 2007, Asia Pacific Drilling Fluids and Cuttings Management Summit 2007 at Swissotel Le Concorde, Bangkok, Thailand. Contact: Philip Parba. Phone: +65 6722 9388 Email: enquiry@iqpc.com.sg URL: www.iqpc.com.sg/as-3469/2020

27-28 February 2007, Information, Knowledge and Process Integration for Upstream Oil & Gas at London. Contact: Romain Ollichon, Mr., IQPC Ltd., Anchor House, 15-19 Britten Street, London, SW33QL, United Kingdom. Phone: 00 44 (0) 7368 9300. Fax: 00 44 (0) 7368 9511 Email: romain.ollichon@iqpc.co.uk URL: www.iqpc.com/uk/infoknowledge/ediary

27-28 February 2007, Advanced International Boundary Dispute Resolution at London. Contact: Romain Ollichon, Mr., IQPC Ltd., Anchor House, 15-19 Britten Street, London, SW33QL, United Kingdom. Phone: 00 44 (0) 7368 9300. Fax: 00 44 (0) 7368 9511 Email: romain.ollichon@iqpc.co.uk URL: www.iqpc.com/uk/ibd/ediary

February 27, 2007 - March 2, 2007, FPSO Design Conference 2007 at Marriott Hotel West, Beijing, China. Contact: Louis Peng, Marketing Executive, IQPC China, 8F, Majesty Building, 138 Pudong Avenue, Shanghai, 200120, China. Phone: 86 21 5063 4538. Fax: 86 21 6859 0666 Email: enquiry@iqpc.com.cn URL: www.iqpc.com.cn/cn-1830

February 28, 2007 - March 2, 2007, World Sustainable Energy Days at Austria. Contact: Conference Secretariat, O.O. Energiesparverband, Landstrasse 45, Linz, 4020, Austria. Phone: 43-732-7720-14386. Fax: 43-732-7720-14383 Email: office@esv.or.at URL: www.wsed.at

5-9 March 2007, World Fiscal Systems for Oil & Gas at Singapore. Contact: Victoria Jolly, CWC School for Energy Limited. Phone: +44 20 7978 0074. Fax: +44 20 7978 0099 Email: vjolly@thecwcgroup.com URL: http://www.thecwcgroup.com/train_detail_home.asp?TID=7

5-6 March 2007, CERI 2007 Natural Gas Conference at Calgary, Alberta, Canada. Contact: Julie Staple, Administrative Assistant, Canadian Energy Research Institute, 150, 3512-33rd Street NW, Calgary, Alberta, T2L 2A6, Canada. Phone: 403-220-2380. Fax: 403-289-2344 Email: conference@ceri.ca URL: http://www.ceri.ca/Conferences/conferences=north_american_natural_gas.asp

5-6 March 2007, 12th Annual Middle East Gas Summit (MEGAS) 2007 at Qatar. Contact: Marketing Department, IBC Gulf Conferences. Phone: 971-4-336-9992. Fax: 971-4-336-0116 Email: marketing@ibc-gulf.com URL: www.ibcgulfconferences.com

6-8 March 2007, Transmission & Distribution Europe 2007 at Prague, Czech Republic. Contact: Elisabeth Brusse, Conference Manager, Synergy, The Netherlands. Phone: +31 346 590901. Fax: +31 346 590601 Email: elisabeth@synergy-events.com URL: www.td-europe.eu

6-8 March 2007, Power Gen Renewable Energy and Fuels at Las Vegas, NV. Contact: Jan Simpson, Conference Manager, PowerGen, 1421 S Sheridan Rd, Tulsa, OK, 74112, USA. Phone: 918-831-9736. Fax: 918-831-9875 Email: pgreconference@pennwell.com URL: www.power-gengreen.com

13-15 March 2007, NESEA's Building Energy 07 Conference at Boston Seaport World Trade Center. Contact: Jan Nokes, Business Manager, Northeast Sustainable Energy Association, 50 Miles Street, Greenfield, MA, 01301, USA. Phone: 413-774-6051 x16. Fax: 413-774-6053 Email: jnokes@nesea.org URL: http://www.buildingenergy.nesea.org

19-30 March 2007, Oil & Gas Mini MBA - 10 day Management School at London, UK. Contact: Victoria Jolly, CWC School for Energy Limited. Phone: +44 20 7978 0074. Fax: +44 20 7978 0099 Email: vjolly@thecwcgroup.com URL: http://www.thecwcgroup.com/train_detail_home.asp?TID=25

19-30 March 2007, Master of Gas Business Management, module 1 at Groningen, The Netherlands. Contact: Evanya Breuer, Manager Customer Relations, Drs., Energy Delta Institute, P.O. Box 11073, Laan Corpus den Hoorn 300, Groningen, Groningen, 9700 CB, The Netherlands. Phone: +31 50 524 83 12. Fax: +31 50 524 83 01 Email: breuer@energydelta.nl URL: www.energydelta.org

20-21 March 2007, Advanced Acquisition And Divestiture In Oil & Gas 2007 at London. Contact: Romain Ollichon, Mr., IQPC Ltd., Anchor House, 15-19 Britten Street, London, SW33QL, United Kingdom. Phone: 00 44 (0) 7368 9300. Fax: 00 44 (0) 7368

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9511 Email: romain.ollichon@iqpc.co.uk URL: www.iqpc.com/uk/AandD/ediary

20-23 March 2007, Asia Power & Energy Congress at Singapore. Contact: Conference Secretariat, Terrapinn Pte Ltd, 1 Harbourfront Place #18-01, Harbourfront Tower 1, Singapore, 098633, Singapore. Phone: 65-6322-2770. Fax: 65-6223-3554 URL: www.terrapinn.com/2007/asiapower

20-21 March 2007, Shared Services & Outsourcing: 2007 Global Conclave at Hyderabad International Convention Centre, India. Contact: Abhaey Singh, IQPC Worldwide, 61 Robinson Rd, Singapore, Singapore. Phone: +65 6722 9388. Fax: + 65 6720 3804 Email: enquire@iqpc.in URL: www.iqpc.com.sg

26-27 March 2007, China Alternative Energy 2007 at Beijing. Contact: Lynette Han, INC Global Conferences, Singapore. Phone: 65 6220 2577. Fax: 65 6337 4169 Email: lynette@inc-global.com URL: www.inc-global.com

27-28 March 2007, HSE Risk Management in Asian Oil & Gas at Prince Hotel, Kuala Lumpur, Malaysia. Contact: +6722 9388, IQPC Worldwide. Phone: +6722 9388 Email: enquiry@iqpc.com.sg URL: http://www.oilandgasiq.com/AS-3517/2020

27-28 March 2007, Smart Metering Central & Eastern Europe at Budapest, Hungary. Contact: Corien den Ouden, The Netherlands. Phone: +31 346 590901. Fax: +31 346 590601 Email: corien@synergy-events.com URL: www.synergy-events.com

27-27 March 2007, International Boundary Disputes and Unitisation in E&P 2007 at The Prince Hotel, Kuala Lumpur, Malaysia. Contact: Edsel Alvarez Mercado Jr, Producer, IQPC Worldwide, 61 Robinson Rd, Singapore, Singapore. Phone: +65 6722 9388 Email: enquiry@iqpc.com.sg URL: www.iqpc.com.sg/as-3526/2020

27-28 March 2007, Integrity Summit 2007: Well & Production Integrity & Asset Integrity Management Stream at Prince Hotel & Residence , Kuala Lumpur, Malaysia. Contact: Seema Hari Kumar, Producer, IQPC Worldwide, Singapore, Singapore. Phone: (65) 6722 9388 Email: enquiry@iqpc.com.sg URL: www.oilandgasiq.com/AS3547

28-30 March 2007, Sustainable Transport Fuels '07 at Beijing. Contact: Lynette Han, INC Global Conferences, 420 North Bridge Road, #05-27 North Bridge Centre, 188727, Singapore. Phone: 65 6220 2577. Fax: 65 6337 4169 Email: lynette@inc-global.com URL: www.inc-global.com

15-18 April 2007, 34th International Energy Conference and 28th International Area Conference at Boulder, CO. Contact: Dr. Dorothea H. El Mallakh, Director, ICEED, 850 Willowbrook Road, Boulder, CO, 80302, USA. Phone: 303-442-4014. Fax: 303-442-5042 Email: iceed@colorado.edu URL: www.iceed.org

16-20 April 2007, Natural Gas Strategy Course part 2 at Moscow, Russia. Contact: Evanya Breuer, Manager Customer Relations, Drs., Energy Delta Institute, P.O. Box 11073, Laan Corpus den Hoorn 300, Groningen, Groningen, 9700 CB, The Netherlands. Phone: +31 50 524 83 12. Fax: +31 50 524 83 01 Email: breuer@energydelta.nl URL: www.energydelta.org

16-18 April 2007, LNG Contracts at Dubai. Contact: Victoria Jolly, CWC School for Energy Limited. Phone: +44 20 7978 0074. Fax: +44 20 7978 0099 Email: vjolly@thecwcgroup.com URL: http://www.thecwcgroup.com/train_detail_home.asp?TID=24

23-27 April 2007, International Gas Value Chain at Groningen, The Netherlands. Contact: Evanya Breuer, Manager Customer Relations, Drs., Energy Delta Institute, P.O. Box 11073, Laan Corpus den Hoorn 300, Groningen, Groningen, 9700 CB, The Netherlands. Phone: +31 50 524 83 12. Fax: +31 50 524 83 01 Email: breuer@energydelta.nl URL: www.energydelta.org

23-25 April 2007, 7th Intl Exhibition on Nuclear Power Industry 2007 at Shanghai, China. Contact: Organizer, Coastal International Exhibition Co Ltd, Rm 2106, China Resources Bldg, 26 Harbour Rd, Wanchai, Hong Kong. Phone: 852-2827-6766. Fax: 852-2827-6870 Email: general@coastal.com.hk URL: www.coastal.com.hk

IAEE Newsletter

Volume 16, First Quarter 2007

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

Contributing Editors: *Paul McArdle* (North America), Economist, US Department of Energy, Office of Policy, Planning and Analysis, PE-50, Washington, DC 20585, USA. *Tel*: 202-586-4445; *Fax* 202-586-4447. *Tony Scanlan* (Eastern Europe), 37 Woodville Gardens, London W5 2LL, UK. *Tel* 44-81 997 3707; *Fax* 44-81 566 7674. *Marshall Thomas* (Industry) 3 Ortley Avenue, Lavallette, NJ 08735, USA *Tel* 908-793-1122; *Fax:* 908-793-3103.

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