United States Association for Energy Economics

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## PRESIDENT'S MESSAGE

*Results from Albuquerque*

The 19th Annual North American Conference is now history, but not forgotten. From my perspective, and those who gave me feedback, it was a resounding success. We focused on the theme of "Technology's Critical Role in Energy and Environmental Markets" and stuck with it throughout the conference. Our keynote speaker, Paul Robinson, President, Sandia National Labs, set the tone at the outset. He elaborated on a model for developing technologies that he termed the simultaneous pursuit model, that is, pursuing both the understanding and use, or research and application at the same time. He then discussed several areas such as clean energy, long-term supply and demand for oil, resolution of contradictions in electric and environmental policy, access to fresh water, and maintenance of peace and security in the silicon world as areas where technologies can make a difference. (The full text of Dr. Robinson's presentation is included in this issue of Dialogue.) As we moved through the two and one half days of the conference, we touched on most of these themes. Mark Christensen, the Senior Vice President from Public Service Company of New Mexico was particularly cogent in his remarks in the electricity area. He left with us much to think about as the U.S. develops a policy for changing the regulation of the electric power sector.

The plenary sessions keyed off of this general theme, touching on the use of information technology in energy markets, or technological change and its impact in the development of the Gulf of Mexico. Technology also was a topic in the development of energy models, an especially challenging task given the rapid changes occurring in technology development. We held a debate on the contours of jurisdiction between the federal and state governments in the context of electricity restructuring. Given our location in New Mexico we couldn't overlook the importance of energy resource development and public lands policy. The conference occurred during the time of the 25th anniversary of the oil embargo. We held a fascinating co-plenary discussing whether there is a continuing need to manage the oil market, with views along a continuum indicating how much we presently manage the market to those who advocate a hands off policy. And of course, technology and climate change policy could not be ignored.

We also had time for fun in Albuquerque. Our receptions provided the time to network among friends and meet new people. The margarita bar at our reception just prior to our gala dinner was a great success. We held a reception at the Indian Pueblo Cultural Center. This was a great chance to see and buy many of the wonderful crafts made by local Native Americans. We enjoyed the excellent food provided by the Center. And the highlight was a demonstration of Indian dancing, often not seen by those who cannot go the ceremonies on the reservations. It was a terrific evening.

We conducted some USAEE business during the conference. We now have a new chapter in San Francisco. We selected Philadelphia for our North American meeting in 2000. We discussed and did a lot of planning for next year's conference in Orlando. We also are excited about holding the international meeting in Houston in 2001.

As I wind up my year as President, I leave with as much enthusiasm as I started. The organization is in great shape – increasing its membership, on solid financial footing, with concrete plans for meetings for the next three years. Thanks to all who made my year easier by sharing the burden and helping with the conference and all the myriad details that require official attention. I pass the baton to Mike Lynch, knowing that it is in good hands.

*Len Coburn*

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## Editor's Corner

This issue of Dialogue brings you the keynote address by Dr. C. Paul Robinson of Sandia National Laboratories at the USAEE Annual North American Conference in Albuquerque. Also included are (1) an excellent article by Dr. John Lohrenz of Louisiana Tech

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

University on the misuse of gas/oil equivalencies and (2) a summary of the recent North American Conference.

Please join me in thanking the authors for their contributions to our newsletter. My special thanks to Karl Nalepa for his assistance in summarizing the conference.

Please send new articles (or suggestions for articles) and notices for publication in Dialogue. Include news of chapter events and appropriate press releases. Items can be sent via E-mail (paul-roberts@worldnet.att.net), by Fax (713-207-9962), or by regular mail (Houston Lighting & Power Company, P.O. Box 1700, Houston TX 77251-1700). If you have questions, comments, or suggestions, I can be reached by phone at 713-207-5059.

*Paul Roberts*

## 22nd ANNUAL IAEE INTERNATIONAL CONFERENCE

*Grand Hotel Parco dei Principi, Rome, Italy, 9-12 June 1999*

**Theme**

***New Equilibria in the Energy Markets: The Role of New Regions and Areas***

This three day Conference aims at discussing new relations and agreements between North Africa and Middle East producing countries and industrialised regions in the framework of European co-operation. The Mediterranean basin and Black Sea as well as Middle East markets are showing an ongoing process of increasing energy production and capacity but with some security problems. The oil and gas reserves are vast, but are there outlets to consuming areas? What about the transit and security routes for new pipelines? What role should government, institutions and companies play in this context? How can the new free markets in oil, electricity and gas create new equilibria in Europe and Asia? What will be the impact of Kyoto follow-up on the various Regions? Which scenarios for the world energy market can be outlined?

Rome will be the best meeting point to provide a unique forum where these and related issues will be debated by experts from around the world to examine opportunities, future trends and challenges of the new and old energy areas.

## CALL FOR PAPERS

Deadline for Submission of Abstracts: 5 January 1999

Abstracts may be submitted for plenary as well as concurrent sessions. Anyone interested in organising a session should propose topics, objectives, possible speakers to the Programme Chairman well in advance of the deadline for submission of abstracts. Abstracts should be between 300 and 500 words, giving an overview of the topic to be covered. Full details, including the title of the paper, name of the author(s), address(s), telephone, fax, and e-mail numbers, should also be sent. At least one author from an accepted paper must pay the registration fee and attend the conference to present the paper. All abstracts, session proposals and related inquiries should be directed to:

Vittorio D'Ermo, Programme Chairman, 22nd Annual International Conference of the IAEE
Via Giorgio Vasari, 4 I-00196 Rome
Telephone (3906) 322 73 67; Fax (3906) 323 4921
E-mail: aiee@euronet.it or vitder@iol.it

**DEADLINES**

Abstract Submission: 5 January 1999; Notification of Abstract Acceptance: 4 February 1999
Manuscript Submission: 4 March 1999

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UNITED STATES ASSOCIATION FOR ENERGY ECONOMICS
INTERNATIONAL ASSOCIATION FOR ENERGY ECONOMICS

20th Annual North American Conference

# THE STRUCTURE OF THE ENERGY INDUSTRY: THE ONLY CONSTANT IS CHANGE

Hilton at Walt Disney World - Orlando, Florida - USA
August 29 - September 1, 1999

## Session Themes and Topics

**Energy and the Global Economy: S.E. Asia, Russia, Latin America and OECD**
**New Financial Instruments for the Energy Industries**
**Incorporating New Technologies for the Energy Industry**
**North American Energy Integration**
**The Outlook for Oil Prices**
**Alternative Transportation: Implications for the Petroleum Industry**
**Developing Countries: The Status of Energy Development**
**A New OPEC?**
**The Climate Change Debate**
**Natural Gas Markets in the New Century**
**Electricity Restructuring: Lessons from Natural Gas**
**The Oil Industry: A Changing Market Structure**
**Energy vs. Environment in the Gulf of Mexico**

## *** CALL FOR PAPERS ***

Deadline for Submission of Abstracts: April 21, 1999
(Please included your CV when submitting your abstract)

Anyone interested in organizing a session should propose topics, motivations, and possible speakers to:
Mary Lashley Barcella - 202-429-6670 / mlbarcella@msn.com
Mine K. Yucel - 214-922-5160 / mine.k.yucel@dal.frb.org

Abstracts should be between 200-1500 words and must clearly address the theme of the conference and topics above to be considered for presentation at the meeting. At least one author from an accepted paper must pay the registration fees and attend the conference to present the paper. All abstracts/proposed sessions and inquiries should be submitted to:

David Williams, Executive Director, USAEE/IAEE
28790 Chagrin Blvd., Suite 350, Cleveland, OH 44122 USA
Phone: 216-464-2785 / Fax: 216-464-2768 / E-mail: iaee@iaee.org

General Conference Chair: Michael C. Lynch
Program Co-Chairs: Mary Lashley Barcella & Mine K. Yucel
Arrangements Chair: David L. Williams

NEW THIS YEAR: USAEE Best Student Paper Award ($250.00 cash prize plus waiver of conference registration fees). If interested, please contact USAEE Headquarters for detailed application/guidelines.

## Critical Energy and Environmental Issues in the Next Century: Where Can Technology Make a Difference?

*By C. Paul Robinson**

### Introduction

Thank you very much for having me as your opening speaker. It's my pleasure to be here, particularly to speak on the theme of your conference, "Technology's Critical Role in Energy and Environmental Markets". I'd like to thank the people of Sandia's Energy, Information, and Infrastructure Technology Division—particularly Arnie Baker, for his contributions to this talk.

It is easy for all of us at Sandia to embrace your theme, because we think of Sandia's overall mission as, "to use science and technology to address the nation's future." Sandia develops new technology and applies both new and old technology to solve important problems facing the nation.

In our own strategic planning, we were quite taken with the model suggested in a book published last year, Donald Stokes' "Pasteur's Quadrant." He was the Dean of the School of Public Policy at Princeton, and had spent some time evaluating Vannevar Bush's monograph, Science: The Endless Frontier. He noted there was precious little data since that would affirm the view taken there, e.g. the linear model [that new science follows a path of basic research, applied research, then development and finally to the making of a product] has long since been discredited as "over simplistic." What Stokes suggests is that the optimum way for progress is to simultaneously pursue new knowledge as you are pursuing new applications to solve problems.

Together these make a powerful duo: what we call the two U's - **Understanding** and **Use**, that form the Quadrant he cites in the title. He makes a two-by-two matrix, **Use** (yes or no) and **Understanding** (yes and no). He fills in the matrix with concrete examples. For example, Thomas Edison observed what we now know to be "single electron behavior" in one of his early inventions, five years before J.J. Thompson "discovered" the electron. Yet Edison was solely focused on use and didn't take much time to seek out the extra understanding. On the opposite side, Neils Bohr, the famous theoretical physicist, just wanted to think about nature, believing that someone else would have to come along to find any use for his work. Finally, Stokes cites Pasteur, who pursued both use and understanding, and in the process made not only important scientific and humanitarian advances, but also created new industries for almost every topic he worked on. One we can all appreciate is wine-making; he found out where the oxygen comes from in fermentation (it is pulled out of the sugar) and helped perfect the French wine industry. We believe this dual approach is also the optimum way to best advance the cause of science and harness new technologies. It is, in fact, the operating philosophy we have embraced in our laboratories, and expect to emphasize it for the future.

I believe that other important things happen when you have a climate of producing and harnessing new knowledge. With the information explosion going on world-wide and the appetite of peoples everywhere for more and more knowledge, forms of government that encourage and support these processes will flourish. On the other hand, it has become increasingly hard for totalitarian states to exist, while attempting to hold back their people from new knowledge and new ideas. Thus, I believe the expansion of democracies, in concert with market economies, will continue, not only because this form of government represents the natural state for mankind, but because it will become, even more than ever, the form that can thrive in an information-rich future.

My task this morning is to talk about five areas that I believe will be key to the future of energy and environment—the very-much intertwined and interdependent themes of your conference. I will briefly mention clean energy, long-term supply/demand for oil, resolving the contradictions in US energy and environment policies, access to fresh water, and the maintenance of peace and security in "a silicon-revolutionized world."

### Clean Energy

Energy is essential for the economic growth and development of nations. The appetite for energy in underdeveloped states will grow insatiably, with only small modulation in the demands in developed states, as they all strive to be somewhat more efficient. The EIA suggests that world energy use will increase by 2/3 over the next 20 years. All must keep an eye on the need to minimize adverse impacts on human health and the environment as this increase occurs. This will require "system thinking" over the full cradle-to-grave life cycle.

Three major themes appear obvious:

- an increasing efficiency for energy use,
- a continued search for "cleaner forms of energy,"

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* C. Paul Robinson is President and Laboratories Director of Sandia National Laboratories. This is an edited version of his plenary talk at the 19th Annual North American Conference of the USAEE/IAEE, Albuquerque, NM, October 19-21, 1998.

and

- cleaning up the energy resources we are using.

In pursuing this triad, we must not try to artificially divorce economics from technology. No one wants to be forced to use higher priced forms of energy, not when competitors may not be forced to do so (and competition is rapidly becoming global). Cost effectiveness and cost competition cannot be separated easily.

Many nations of the world are just now seeing an explosive growth in their use of personal automobiles, in concert with an explosive growth in their domestic industries. Reacting to this growth, without halting it or slowing it down, will provide the greatest challenges for them.

We in the US have become the model to match for "the good life." Just imagine each of the developing nations seeking to equal our 1.8 autos per family, or more precisely, 588 passenger vehicles per 1000 people. China, for example, today has only 3 cars per thousand people! How could a 200-fold increase be handled? It is not at all likely that it can be - China already has the world's most polluted cities. There, 85 out of 88 exceed World Health Organization (WHO) guidelines for suspended particulates, and half of the cities exceed WHO guidelines for ambient sulfur dioxide. Rather than expect that they can equal US patterns anytime soon, my point is to suggest just how far away they are. Yet, I believe the derivative in growth of oil use will remain positive still, and a recent Sandia study of China's energy future projects that oil imports are likely to grow from 7 to 8 MMB per day.

Today's technology cannot provide the answer to this challenge for the Chinese or for any of us. Over the long term, all of us must have cleaner combustion in our autos, perhaps through the use of fuel cell or other electric vehicles, along with lighter weight vehicles. Perhaps we must also look to a paradigm shift in the needs for transportation, by relying more and more on telecommuting—not as the exception, but perhaps as the rule.

The challenge to all of us in the Kyoto Protocols is truly a staggering one and can hardly be taken seriously, economically or politically. Note that the Intergovernmental Panel on Climate Change suggests that just to stabilize the atmospheric concentrations of greenhouse gases will require that the whole world reduce its fossil fuel usage by some 60 to 80 percent from present levels. How this can be done, while continuing economic growth, is truly a puzzlement.

Faced with such a daunting challenge, success will have to be achieved on many fronts. Along with the directors of ten DOE multiprogram labs, I sent a report to the Secretary of Energy entitled "Technology Opportunities to Reduce US Greenhouse Gas Emissions," which documents 50 pathways for using higher efficiency energy technologies (many of which pay for themselves). We avoided jumping into the fray as to whether or not the source of such greenhouse gases is anthropomorphic or not. We also suggested that improvements in use of renewables, nuclear and improvements in fossil are both essential and likely. In any case, I think all of us can agree that the potential for serious consequences is high, and the solutions will not be easy. There is certainly no single easy answer.

We also suggested that technology for use of our present energy supplies represents a major potential for improvement—particularly in improved combustion for higher efficiency engines and electric power production. Microturbines, just making their appearance, represent a great potential for efficiency improvements and, quite naturally, would also result in far less adverse environmental impacts.

**Long-Term Supply/Demand for Oil**

Whether we like it or not, it is likely that the world will remain critically dependent on oil for the foreseeable future, and it is impossible to imagine now how demand can do anything but increase. Proven reserves (at current consumption levels) are adequate to provide about a 50-year supply, and almost all experts agree that demand will grow. Nearly 70 percent of these reserves are either in the Middle East or Commonwealth of Independent States. The market share is also expected to grow in Saudi Arabia, Kuwait, UAE, Iran, and Iraq - in the so-called "Ring of Fire" of political instability, to say nothing of the questionable stability of Russia. Thus, we should expect that political instability will be a handmaiden of the world's oil supply for some time to come, and the importance of the issues of oil supplies and military security will inevitably be similarly intertwined.

Technology directions to help in this problem are already set. Using our magnificent new 1.8 Teraflop Supercomputer here at Sandia, we have been able to develop new calculational methods for guiding the extraction of oil from old producing areas, as well as to guide the exploitation of new reserves. Computer sorting of 4D seismic interrogation patterns can more than double reserves, while also making them much cheaper to recover. Experience in the North Sea has shown a nearly 10-fold improvement in costs to obtain oil, by steadily applying a number of new technologies (smarter drilling, platforms, better drill bits, etc.). These new developments, along with some new materi-

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**Critical Issues** *(continued from page 5)*

als being developed for application to deep-water exploration, promise further gains as well.

The past few years have seen the emergence of the large-scale production of a medium density distillate liquid from natural gas. The product liquid can go directly to gasoline, diesel, or jet fuel—all cleaner and more environmentally friendly than present oils. This liquid can also greatly improve the efficiency of burning other fuels when mixing the two, and thereby lessen the environmental insult of these other fuels. The ability to more easily transport this oil-like liquid makes it ideal for utilizing stranded reserves around the world—in particular in Kazakhstan and nearby. In Russia, Iran, Qatar, Alaska, and Canada, there are major stranded gas reserves.

Over the long term, technology holds the promise to unlock and use the enormous supplies of natural gas now locked into methane hydrates, particularly deep under the oceans. And for the even longer term, it is obvious that we will need to work in more seriousness on noncarbon-based fuels, such as hydrogen, which suggest hope for completely new, potentially cleaner, fuel cycles.

**Resolving Contradictions in US Electric Energy and Environmental Policy**

Just as "charity begins at home", our push for greater energy and environmental harmony also should begin here. Even this is not easy, however.

Today, the US generates just over 50 percent of its electrical energy from coal (counting both utility and non-utility generation). For the same BTU, coal produces 80 percent more carbon dioxide than natural gas. Thus, policies that seek to drastically reduce carbon emissions (like Kyoto) will severely impact coal and, in turn, US electricity production.

The US also gets about 18 percent of its total electricity from nuclear (20 percent for just utility generation). In the present policy vacuum (and I'm being generous there) predicting what the future will be for nuclear electricity is impossible. I think we would have to agree that unless some major changes occur, nuclear power will decline as older licenses expire and no new plants are built. Yet we should not lose sight of what the replacement would mean. If we attempt to satisfy the current nuclear output by replacing it with natural gas or coal, it would increase US carbon emissions by 6 to 11 percent. If this doesn't seem large enough a problem, let me express the increased resultant carbon loading: some 95 to 165 million metric tons of carbon per year.

The one policy initiative that seems on the fast track is to restructure the electricity generating sector through deregulation - to make it more cost effective and cost competitive. Two obvious effects will be to lower the costs in many regions of the country, and also it will likely force the closing of higher cost nuclear and coal stations. If an equally likely human behavior takes place in those areas, that when the cost goes down consumption by consumers gets driven up, we would be in the position of having to replace the overall amount reduced with either natural gas or oil; and the future economics of these two fuels is certainly not a given. That the costs of electricity might eventually begin to spiral upwards, along with increased environmental regrets, must be carefully watched.

**Access to Fresh Water**

Doubtless, the next major world environmental crisis will be the demand for clean water. Anecdotal evidence is already widespread, from the depletion of the Ogallala reservoir in the Southwest United States to the running dry of the Yellow River in China. You may not be familiar with the latter. It first failed to reach the sea in 1972, primarily due to excessive pumping for agricultural areas upstream, and it has run dry each year since 1985. In 1997, it was dry for 200 days, already causing significant problems in agriculture for Shandong province. For this river and others, the result has been back seepage of sea water and contamination of fresh water supplies just upstream.

Another anecdote is the Aral Sea in Central Asia that has declined 50 percent in area and 75 percent in volume over the last 40 years. It moved from being the 4th largest lake to 8th largest. Crop problems already have arisen from salinity of rivers in the area, and the prospects for regional conflict in this area, with its large share of the world's identified energy resources, have correspondingly increased.

Technology is needed to help head off these conflicts and to alleviate the fresh water shortages worldwide, including better processes for production from sea water, along with sensors and model-based control systems to head off the worst changes in the salinity of rivers. But alas, here also, there is no silver bullet yet on the horizon.

**Maintenance of Peace and Security in a Silicon-Revolutionized World**

My fifth and last topic may seem a little out of place. Just as every new technology is a two-edged sword, the continuing silicon revolution holds perhaps the greatest possibilities for harm as well as for good in the future.

Two years ago, I attended the Microsoft CEO Summit, which they organized to coincide with the 20th anniversary of their company. Bill Gates himself noted

the revolution that had occurred over those twenty years, as a result both of Moore's law for the growth of silicon processors, and the insatiable demand for applying these marvelous devices for both information and computation. He noted that the cost for computing—in bits per second—had gone down by a full factor of a million in the twenty years since they went into business. He also announced a look into the future, in revealing the results of a study they had commissioned (and paid for), by Intel and Hewlett Packard. Their conclusion was: *Over the next twenty years they see no barriers that would prevent a further decrease in the cost of computing by another factor of a million or more.*

We at Sandia, along with the DOE and our sister labs at Los Alamos and Livermore, represent one attempt to help speed up the clock for that eventuality, through a collaborative program called ASCI (for the Accelerated SuperComputing Initiative) to more quickly achieve a computing speed of 100 Teraflops or more. The 1.8 Teraflop machine at Sandia, and which is already oversubscribed by our scientists and engineers, is the first new machine on this path. It has already raised the level of our scientific capability in significant ways and is geometrically expanding our ability to model and understand complex processes.

We have several other new revolutions in silicon - first in micromachines, tiny force generation and transmission devices, whose gears are smaller than the width of a human hair, which are being harnessed into huge arrays to accomplish useful tasks. Because of the extreme size reduction, the energy requirements to do useful tasks with micromachines are very much reduced.

Next, we are turning our model-based simulations into actual command and control devices. The potential exists with these higher fidelity controllers for much more accurate and efficient control of energy-using devices for the future. The harnessing of these better understandings and control devices is enabling smarter, smaller devices that can sense, can think, can communicate, and can act. These will undoubtedly allow us to improve not only our energy efficiency, but our environment, in years to come.

Yet, as they come on line, and we become ever so much more dependent on these silicon-based devices to control our world, the vulnerabilities they also bring must be understood and blunted. While new computer devices and control systems boost the performance of almost everything, their interconnection increases the risk of technological "domino effects" that could result in major outages and shutdowns of what we have come to call "Critical Infrastructures".

These vulnerabilities arise not only from natural causes, such as earth storms or even solar storms, but also from intentional sabotage - by those who would desire to wreak havoc on the more highly developed nations. We identify the vulnerable systems that must be considered and protected as: telecommunications systems, banking and financial systems, energy production and transportation systems, all the way to the central control systems that operate these "systems of systems."

We are developing new technological tools for both assessing the consequences, then modeling their vulnerabilities and resiliencies through what are called "agent-based simulation systems", to try to establish higher reliabilities and fault tolerances in all of these systems. Again, we will have to use the new silicon-based wonders as sensors and controls to achieve truly ensured reliability - for which we use the term SURETY.

**Conclusion**

Let me end this presentation here. I hope I have given you some food for thought. The five issues I've focused on do not represent an exhaustive list by any means. They do represent our current view of priorities.

I believe the picture in both energy and environment will be a very bleak one without new technology options and strengths, that are only likely to arise from research and development efforts. Without gains in performance in energy extraction and use across the board, people will be forced to do things they don't want to do and to live with environmental penalties they will not want to experience. And they will have to pay prices they will not want to pay.

The harnessing of science and technology in the ever-enduring advances that come from combining understanding and use must be given an opportunity to help fashion a better world. The right technology solutions will be the ones that are the most harmonious with both of the major themes of life on earth today: democracy and market economies. The challenges are large, and the opportunities are larger.

Before closing let me suggest some references you might want to keep in mind to explore further the topics I've mentioned here:

- the *Encyclopedia Britannica 1999 Yearbook of Science and the Future* (summary of article on Energy), which I co-authored with Joan Woodard.
- Fall issue of *Issues in Science and Technology*, "Critical Infrastructures: Interlinked and Vulnerable," which I co-authored with Joan Woodard and Sam Varnado.
- Sandia's web page at *www.sandia.gov*, where particular coverage is given to micromachines, advanced computing, and energy and environmental research.

## *In Situ* Gas To Oil Equivalence 6 MCF/Barrel? Aw C'mon!

*By Dr. John Lohrenz**

**Foreword**

*The small boy who said that the Emperor had no clothes on was probably spanked and sent to bed. Campbell Watkins and myself (1) were merely ignored; witness the continuing flood of publications and studies, private and government, measuring "barrels of oil equivalent" or capital expenditures per "barrel of oil equivalent", etc.*

*John Lohrenz now explains why it makes no physical/engineering sense. Everybody ought to read his paper carefully. And those who won't listen to either economists or engineers may listen to John Browne, the CEO of British Petroleum: "We don't help ourselves as an industry by talking about barrels of oil equivalent. No such thing exists." (2)*

***M.A. Adelman***

I once again perused one of those 4-color, slick paper booklets promulgated to "educate" the public, hopefully with money to invest, in companies with oil and gas assets in-the-ground, i.e., *in situ*. Summarizing those assets, the booklet intoned that the "standard" equivalence of 6 MCF of gas per barrel of oil was used.

I can't argue with that if the descriptor, "standard", merely implies many others committing the same foolishness. However, it fails any standards of economics, of thermodynamics, and even, of common sense.

Further, we are not talking here about a subtle difference from a gas to oil equivalence of 6 MCF of gas per barrel of oil. USDOE (and analogous agencies of other nations, too) reports often fixate on a value of 5.6 MCF/barrel. That's wrong, too.

In fact, what is wrong is fixating on any, single quantitative value of the gas to oil equivalence.

For a humbug notion so widely used, one is at peril seeking who to blame. So we shall here bypass detection of the original culprit. First, we shall articulate the foolishness and then consider the questions: (1) What is/are "correct" *in situ* gas to oil equivalence(s)? (2) How might these "correct" *in situ* gas to oil equivalencies be measured?

We start with a truism, obvious to be sure, but either not understood, misunderstood, or not recognized by those committing the "standard" foolishness.

All Oil and Gas Started *In Situ* and Later Became *Ex Situ*. Physically, *in situ* oil exists *in situ* abodes only conjointly with *in situ* gas; *in situ* gas can exist in those abodes without its partner; *in situ* oil not so. Instances occur where there is so little *in situ* gas physically existing conjointly with *in situ* oil that the amount of such gas which can be sold *ex situ* would still be zilch even if the market value of *ex situ* gas zooms up orders of magnitude.

The physical settings and the relative amounts of *in situ* oil and gas in their abodes have no direct connection, however, with the gas to oil equivalence. True, one can posit some macroeconomic supply-demand forces from the *ex situ* markets trickling down to the hugely variegated *in situ* abodes.

But no economic values from *in situ* oil and gas would occur without transformation to the *ex situ* form. There is no new positive cash flow in the oil business until some *in situ* oil is converted to *ex situ* oil and sold to be used up - usually as a chemical reactant, mostly as a fuel for combustion. And that, no doubt, provides the rationale for the specious logic that led and still leads to the ludicrous assertion that an always OK approximation is 6 MCF is equivalent to 1 barrel of oil.

Where Does the Ruse, Gas to Oil Equivalence ≅6 MCF/Barrel, Come From? If the use of oil and gas is combustion, then a fair and reasonable gas to oil equivalence would follow as the ratio of the heat one obtains from their combustion. Make sense? Certainly must do so with many. Utter and demonstrable nonsense aver all who passed[1] a course in elementary thermodynamics. (As a matter of fact, some economists who may or may not have had the course join the nonsense chorus to this ruse.)

Here let us first pursue the specious logic that *in situ* gas to oil equivalence should be driven by combustion heats and follow same to its ludicrous demise.

Pursuing that specious logic, one can resort to any standard[2] thermodynamic text.

You will find a heating value for methane, i.e., pure, dry natural gas of 1,030 Btu/SCF. SCF stands for Standard Cubic Feet. Here, the descriptor "standard" implies a specific temperature and pressure decreed to be "standard". In fact, the heating value seen will be slightly different in different texts (and other sources) depending on precisely which temperature and pressure are deemed to be "standard".

Let your finger slide down the table (for hydrocarbons) where you read 1,030 for natural gas, to isooctane,

* John Lohrenz is in the Department of Chemical Engineering at Louisiana Tech University, Ruston, Louisiana.

[1] See endnotes at end of text.

shift right or left to another column, and you may read a heating value of 5.014 million Btu per barrel[3]. Take that 5.014 million Btu per barrel and divide by 1,030 times 1000 (to convert SCF to MCF, 1 MCF = 1000 SCF) and you obtain a gas to oil equivalence of 4.87 MCF/barrel. Isooctane is, in fact, the pure hydrocarbon for which the ASTM octane number for motor gasoline (and other fuels) is defined equal to 100. Had we selected pure n-octane, not isooctane, the equivalence computed would be 4.95 MCF/barrel; with pure n-heptane, 4.84 MCF/barrel.

To be sure, gasoline is a complex mixture in which isooctane, n-heptane, and n-octane are constituents. One standard source gives a heating value for motor gasoline (without further specifications) such that the natural gas to motor gasoline equivalence is 5.1 MCF/barrel. The same source also lists a heating value for natural gasoline[4] such that the equivalence is 4.5 MCF/barrel.

Crude petroleum oils are even more complex mixtures than any gasoline. The *Oil & Gas Journal* routinely lists 13 different U.S. and 9 world crude prices (along with 18 different "receipt points" for U.S. natural gas). But those 13+9=22 oils are really 22 different specifications for a commodity - like corn, wheat, oats, or rye - being traded in a market[5]. The chemical fact is, however, that no two wells producing crude petroleum oil yield the same complex mixture; in fact, the oil from any well is a changing complex mixture through time. Thus, the gas to oil equivalence based on heating values, too, must differ for each source of oil as well as time produced from a source.

Some produced petroleum oils are highly asphaltic with heating value gas to oil equivalences about 6.4 MCF/barrel. At the other extreme, some produced oils are so "light" they could be used without processing as motor gasoline[6] with equivalences ≅4.5 MCF/barrel.

Now, if one wishes to consider any mishmash of oils between those two extremes, one can naturally expect to find some intermediate equivalence depending on <u>which</u> particular mishmash is chosen as standard. Pick 5.6 MCF/barrel; that'll do. Pick 6 MCF/barrel; that'll do, too. Who cares when we're picking a mishmash-number from a mishmash - and then calling it "standard"?

<u>But Then What Do We Really Have?</u> We have a ratio based on heating values. But what are these heating values? If we take a petroleum oil or a dry[7] natural gas and mix it with the exact amount, no more and no less, of pure oxygen to burn it completely, all at a specified standard pressure and temperature, often 1 atm. and 60 F, then burn all the hydrocarbons so that all the combustion products are carbon dioxide and water in a steady state[8] process, then return the mixture of combustion products back to the standard pressure and temperature such that the water produced is liquid[9], then the net heat obtained will be the heating value.

Now let's ask a series of questions. First, to what extent does this hypothesized process duplicate how oil and gas are actually consumed physically? Answer: Never wholly and, often, really not at all (for example, when used as feedstock for petrochemical production). Second, to what extent are these heating values of oils and gases mirrored in their market behavior? Answer: Absolutely no correlation between the two is mandated; even if the hypothesized combustion process were the actual and only use for oil and gas, which is of course not so, the market need not be bound to assigning equal values to Btu's (or kJ's) irrespective of the fuel, oil or gas, from which they were concocted.

Third and last question: To what extent, then, can heating value derived gas to oil equivalences describe relative economic values of searchable (but not yet located), developable (located, but without an installed capacity to produce), or producible (could be produced with existing facilities, but are not yet produced) *in situ* oil and gas.

Answer: To suppose any discipline based on relative heating values exerted in the market behavior for *in situ* oil and gas assets must rank right up their with tooth fairies and holiday benefactors caroming down chimneys. C'mon! That's for children. But not for sophisticated analysts on or around Wall Street, giving government pronouncements, or anywhere.

**The Relationship Between the *Ex Situ* and the *In Situ* Oil and Gas Markets.**

Nominated for, at least, an Oscar in the category of flagrant understatement, we have:

Ever since the birth of the modern oil and gas business in about the middle of the 19th century, the market values of *ex situ* oil and gas have fluctuated.

Gas to oil equivalences computed by dividing prevailing *ex situ* market oil by gas prices have varied, too. In 1950, market *ex situ* gas to oil equivalences were around 40 MCF/barrel; in 1970, around 20. In the 1990's, these equivalences have been lazing between 12 and 8.

Clearly, the *ex situ* oil and gas market hasn't been quantitatively influenced by any of the machinations with oil/gas heating values. Those *ex situ* markets are, however, distinguished from the *in situ* markets which feed them by how the units bought and sold can be counted. *Ex situ* oil and gas bought and sold can be measured within ordinary engineering accuracy; one

*(continued on page 10)*

***In Situ* Gas** *(continued from page 9)*

can continuously inventory *ex situ* barrels of oil and MCF of gas; an addition of 1 unit increases the inventory by 1; a diminution of 1 decreases the inventory by 1; any deviation from that algebra is an error. For *ex situ* oil and gas, what some have called the zeroth law of thermodynamics, to wit:

Old Inventory + New Input - New Output = New Inventory

must work. For *in situ* oil and gas inventories, that need not and does not work. The law doesn't work for any - searchable, developable, or producible - *in situ* oil and gas inventories. (One must not be gulled by the syntax used to describe *in situ* oil and gas inventories such as "proved" and "proven" reserves. Using the context of that syntax, the difference between one's current age and the expected death in the actuarial tables is one's "proved" reserves of life. Conducting one's affairs presuming death at the end of the "proved" reserves of life would be silly; presuming that an inventory of *in situ* oil and gas is "0" when the proved reserves are produced is equally silly. In fact, as one lives and grows older, the actuarily predicted demise increases, too. One can observe the same effect with geriatric oil and gas fields' remaining "proven", still producible *in situ* reserves.)

In fact, the markets for any of the 3 kinds of *in situ* markets certainly need not march in step with the *ex situ* market, itself not phlegmatic. True, a normative force can reasonably be imagined such that a higher market *ex situ* gas price compared to the market *ex situ* oil price should induce lower gas to oil equivalences in the markets for *in situ* oil and gas. But this normative force is likely a lightweight compared to other physical and economic forces affecting the various *in situ* oil and gas markets. Operating and processing costs per unit of revenue from sales for gas are usually lower; development costs vary for gas compared to oil from location to location; searching, i.e., conducting an exploration program, costs for gas targets characteristically differ from that for oil targets.

In summary, the *ex situ* oil and gas markets have not obeyed ≅6 MCF/barrel. There is no basis for assuming any of variegated *in situ* oil and gas markets are in tandem with the *ex situ* markets let alone an equivalence ≅6 MCF/barrel.

The Gas to Oil Equivalence and the Second Law of Thermodynamics. Any undergraduate student of thermodynamics will tell you (or should be able to tell you) that the use of heating values to determine an equivalence is based only on the first law of thermodynamics and that such misuses well-deserve the failing grades given.

That most preeminent and profound second law needs to be invoked. From the second law, one should consider the available energy that can be obtained from each fuel. Briefly, the available energy is the amount of energy that would be obtained if the fuel were combusted and energy harvested in the most efficient way possible. The idea is not new. Dodge (3) articulated the notion and some applications over 50 years ago; the notion is embedded in the exquisite preachments of Georgescu-Roegen (4). As per Dodge (3), available energy computations can be and are used today, for example, to prorate steam generation costs to users; users pay a fraction based on the available energy diminution of the steam leaving to that entering. If one user uses his/her steam more efficiently than another, that user is, in effect, "rewarded" with cheaper steam and deservedly so.

But how shall we compare the second law of thermodynamics available energy of gas compared to oil? To do so, we would have to concoct a gedanken experiment consisting of Carnot turbomachinery and chemical reactions carried out reversibly which allow us to make gas from oil or oil from gas. In the terminology of Georgescu-Roegen, we don't have the recipe to do so - in fact or even in hypothesis.

Centuries ago alchemists sought a recipe to make gold from base materials. Their futile search wasn't contradicted by the laws of thermodynamics. They couldn't find the right recipe. And we modern scientists haven't found a recipe to apply the sound, quantitative second law of thermodynamics available energy to the ratio of the inherent "value" of gas compared to oil.

Using Science When It Can Be Used, But Only Then. The discipline of science, over 3 centuries old, rests on the foundation of experimental measurements unaffected by conspiracies, contretemps, bad hair days, etc., in what is being measured. Oil and gas molecules don't suddenly or even over the long-term decide to burn less so, to refuse to react with another kind of molecule once adored, get the government to give them subsidy, or (fill in your own ludicrous impossibility). The discipline of science, thus, allows the computation of the heat that one obtains from the combustion of any fuel, oil or gas, that enters at a certain temperature and pressure, combines with specified oxygen and carrier gases at certain temperatures and pressures, and with the products ending up at a specified temperature and pressure under a specified process. Any single set of all those specifications will lead to one and only one amount of heat evolved anywhere - in a furnace or on Wall Street.

But what, pray tell, does that wonderful morsel of science have to do with the hubbub on Wall Street or any active market? Or specifically, the disparate markets for

searchable *in situ* oil and gas, developable *in situ* oil and gas, and producible *in situ* oil and gas? Who believes the discipline of science can be applied to these markets just like it can to calculating heats from combustions processes? Aw, c'mon!

In the market, gas is gas and oil is oil and any *in situ* equivalence between them is a whim of that market that can change with time, the category of the asset - searchable, developable, or producible, and, in fact, the character of the individual asset. The market can "say" a gas to oil equivalence ≅6 MCF/barrel at one time for particular *in situ* oil and gas assets. Then higher. Then lower. But not only is an equivalence ≅6 MCF/barrel not an immutable law, it isn't even a common sense, long-term central tendency. Aw, c'mon!

The only "correct" *in situ* gas to oil equivalence is that determined in and signaled in the market for the gas and the oil. Do markets change? Do markets fluctuate? If so, so must gas to oil equivalences.

**REFERENCES CITED**

(1) M.A. Adelman & G.C. Watkins, "The Value of United States Oil and Gass Reserves: Estimation and Application", *Advances in the Economics of Energy & Resources*, vol. 10, pp. 131-184 (1997); and citations there to previous work.

(2) Interview in *Petroleum Intelligence Weekly*, March 23, 1998, p. 6

(3) Dodge, Barnett F., *Chemical Engineering Thermodynamics*, First Edition, McGraw-Hill Book Company, Inc., New York, 1944.

(4) Georgescu-Roegen, Nicholas, *The Entropy Laws and the Economic Process*, Harvard University Press, Cambridge, 1971.

**Endnotes**

[1] Or they should have failed the course.

[2] Here again, "standard" merely implies nearly-all-the-texts-are-doing-it.

[3] Again, the precise value will vary minimally depending on the exact temperature and pressure decreed to be standard.

[4] Natural gasoline is a product obtained by fractionation of a wet (with hydrocarbons other than methane) natural gas stream.

[5] The specifications include, in fact, algorithms for "correcting" prices for certain allowable departures from the said specifications.

[6] Actually doing so would, of course, violate State and Federal gasoline tax laws.

[7] Here the descriptor, dry, specified a natural gas free of water vapor. A gas to oil equivalence based on a natural gas saturated with water vapor would be about 7% lower.

[8] Combustion in a piston-driven engine is not a steady state process, but a batch process. Gas to oil equivalences based on heating values for analogous batch process combustions would be slightly higher or lower than steady state depending on the carbon-hydrogen content of the oil.

[9] If the water obtained upon combustion is not liquefied, but remains a vapor, the gas to oil equivalences will be higher. A 10% higher equivalence would be an extreme, but plausible increase.

## Report from the 1998 USAEE North American Conference

Those who attended the Annual North American Conference enjoyed an excellent meeting which provided much more than any individual could take in. Attendees at the conference were welcomed by the USAEE President and General Conference Chair, **Len Coburn**. Len expressed his appreciation for the efforts of **Michelle Foss** and **Arnie Baker** in organizing the presentations for the conference. He also expressed the appreciation of the participants for the corporate sponsors for various functions.

New Mexico Senator **Joe Guererro**, a member of the National Energy Council, welcomed the participants to Albuquerque and described some of the technological capabilities in New Mexico.

**Charles Spierer** of the Universite de Geneve and President of the IAEE expressed the appreciation of the IAEE for the North American Conference.

### Critical Energy and Environmental Issues in the Next Century: Where Can Technology Make a Difference?

**Dr. Paul Robinson**, President, Sandia National Laboratories, discussed five potential energy/environmental policy concerns. (See the full text of Dr. Robinson's presentation elsewhere in this issue.)

### A Competitive Advantage in the New Millennium: Use of IT in the Energy Market

**Ian K. Miller**, President, Energy Business Group, EDS, Presiding. Mr. Miller noted that technology saved the oil and gas industry in the last crisis and asked if technology could be the savior of the industry again. He said that the key issues are flat or declining prices, uncertain demand, curtailed or postponed investments, and a slide in profits. Some industries have harnessed IT more effectively and the focus should be on reducing costs through IT.

**Jeff Wacker**, Vice President and Delivery Officer, Energy Business Group, EDS, addressed business uses of IT, including electronic commerce and electronic collaboration. He noted that Internet traffic is doubling every 100 days and commented on Metcalf's law which indicates that utility is measured by the square of the number of users.

**James S. Crompton**, Principal Technical Advisor, Chevron Information Technology Company, addressed the move from "iT" to "IT" and the scope of knowledge-based enterprises. He noted that the knowledge intensity of processes must decline as the knowledge intensity of products increases.

**Richard Standaert** described the Eastern Trough Area Project and the use of IT to share critical information among project participants.

### Technological Change and Government Policy: Experience in the U.S. Gulf of Mexico

**Michelle Michot Foss**, Director, CBA Energy Institute, University of Houston, Presiding

**James Regg**, Chief, Technological Assessment & Operations Support, U.S. Minerals Management Service (MMS), presented an overview of MMS initiatives in the Gulf of Mexico Outer Continental Shelf (OCS) area. He noted that deepwater technologies are different and advanced, and that technology is evolving so quickly that it is not practical to develop new regulations because they become obsolete before they can be implemented. The MMS is addressing deepwater E&P activities through implementation of performance-based regulations and more generic rules. The MMS is working with industry to develop a Deepwater Operations Plan (DWOP) and is using risk assessment analysis as a regulatory tool.

**Paul Hays**, "Deep Star" Project Manager, Texaco, discussed the "Deep Star" project, which is an industry-wide cooperative effort to develop technologies for deepwater E&P. The effort involves 22 oil companies and 35 service companies. Different subcommittees focus on separate technology issues. The project will seek to commercialize the new technologies it develops (such as composite risers). The regulatory committee is holding discussions with the U.S. Coast Guard and MMS to identify regulatory gaps and overlaps, and to act as an information exchange with the agencies. One goal is to jointly develop a generic environmental impact statement (EIS) for deepwater operations. The next phase of the project is to develop a deepwater field using the new technology.

**Phil Wilbourn**, Offshore Technology Research Center, Texas A&M University, described the work of the Offshore Technology Research Center. It is a National Science Foundation Engineering Research Center, with participation by many industry organizations. The goals of the center are research, educational opportunities, and service to the industry. The center tests all Gulf of Mexico facilities using wind, wave, and current simulations, for water depths up to 10,000 feet. The focus of the next 10 year research plan will be reliability and materials/structural integrity, with an emphasis on technology transfer.

**Scott Farrow**, Director, Center for the Study & Improvement of Regulation, Carnegie Mellon University, cautioned against performance-based regulation and noted the conflict between economic (monetary) regulation and social (environmental, health, and safety) regulation. He asked that if performance-based regulation is adopted, what should the performance measures be, and how should they be measured? He stated that deepwater regulatory design must be carefully devel-

oped and observed that the MMS has been granting exceptions to its standard regulations for deepwater E&P. He reminded the audience that past regulation has been in response to "significant" events such as the Santa Barbara blowout and the Exxon Valdez oil spill.

**Monday Luncheon**

The Paul Frankel Award was presented to **Professor Allan Manne** from Stanford University. Senior Fellow Awards were presented to **Carol Dahl**, Colorado School of Mines, **David DeAngelo**, Pennsylvania Power & Light, and **Dorothea El Mallakh,** International Resource Center for Energy & Economic Development.

**25 Years After the First Oil Shock: Are Oil Markets Managed and Will They Need to Be?**

**Herman Franssen**, Director, Petroleum Economics Limited, Presiding

**David Knapp**, Senior Analyst, International Energy Agency, observed that oil prices are the same now as in 1972 (in real terms). He said that it is difficult to control the oil market, and that markets are not being managed well today. But, he believes that oil markets should not be managed at all. He pointed out that the oil market is different now as compared to then.

**Edward Morse**, Publisher & President, Energy Intelligence Group, offered that oil markets have always been managed, and are in fact managed today. He pointed to the U.S. Strategic Petroleum Reserve (SPR) as an example of market management, as well as OPEC meetings to set production quotas. He also discussed Saudi Arabia's role as a swing producer to set the floor for oil prices. He said that the Saudi goal is to mange the price of oil so that it is kept low enough to keep out alternatives to oil and keep the world dependent on oil for as long as possible. Its goal of moderate oil prices is also aimed at remaining on positive terms with the U.S.

**Bijan Mossavar-Rahmani**, Chairman, Mondoil Corporation, sees a target oil price of around $18 per barrel. He talked of the balance between the main parties: producers, consumers, and oil companies, and pointed out that the oil companies look at their margins, not necessarily the absolute price of oil.

**Roger Diwan**, Director, Petroleum Finance Company, agreed that oil markets are managed now. He said that OPEC has the ability, but not the will, to effectively manage the oil market. The capability to increase production exists, but political problems interfere with it happening.

**Dorothea El Mallakh**, Director, International Resource Center for Energy & Economic Development, remarked on the acceptance of a long-term price range for oil. She pointed out that the current Middle Eastern rulers have been in place for a long time, 20 to 40 years, and are getting older. Those that ultimately replace the current rulers would bring a different perspective to the government. She also observed that there is a difference between "intervention" and "management" of the oil market.

**Herman Franssen** observed that from a U.S. consumer's perspective, the SPR, taxation policies, and conservation are "good" intervention, while OPEC quotas are "bad" intervention. He argued that some form of management of oil prices is necessary and in the best long term interests of both producers and consumers.

**Tuesday Luncheon: Technology's Impact on a Utility in Transition**

**Mark Christensen**, Senior Vice President for Retail Services, Public Service Company of New Mexico (PNM), noted that technology and technological innovation drives the economy. He differentiated between hard technology and information technology and commented on the advances in gas-fired power generation technology and the resultant agitation for customer choice. He discussed the impact on PNM of transitioning to a competitive market and noted that the key piece which is missing is the acquisition and maintenance of customers. He commented that utilities need to be incented to sell services in an open market and questioned whether or not there will be savings for residential customers. He noted that technology is moving faster than public policy can accommodate.

**Energy Resource Development and Public Lands Policy**

**Bonn J. Macy**, Special Assistant to the Director, Minerals Management Service, Presiding

**Tom Fry**, Deputy Director, Bureau of Land Management, U.S. Department of the Interior, noted that ¼ of the U.S. is public lands and commented on the debate among the Federal government, the states, and the tenants over rights relative to the land. The questions are: Who should be managing the land? What portion of the land should be available for extraction? How should revenues be divided? Should tribal lands be managed differently? Should the Federal government be paid in kind?

**Stephen Reynolds**, Director, State Lands & Investment, State of Wyoming, stated that, in Wyoming, public land issues are among the three most important issues for the state. The Federal government controls 50% of the surface and 70% of the subsurface. He said that demands from various interest groups are incessant.

**David Harrison**, Consultant, Council of Energy Resource Tribes, noted that the issues are similar on Indian lands which are administered by Federal agencies for the benefit of the Indian people. He questioned the competence and motivation of the federal agencies and noted that Indians are now participating in exploration,

*(continued on page 14)*

**1998 Conference Report** *(continued from page 13)*

development, and production.

**Mark Murphy**, President, Strata Production Company, noted the lack of unified Federal policy and commented that the Federal lands with the greatest potential are increasingly inaccessible. He noted the pressures for additional gas supply and stated that much of that gas will have to come from Federal lands.

**Debate: Federal / State Jurisdictions for Electricity Restructuring**

**Mark Jaccard**, Associate Professor, Simon Fraser University, Presiding

**Donald Santa**, Vice President and Deputy General Counsel, LG&E Energy Corporation, and former FERC Commissioner, presented an overview of the evolution of electric policy at FERC, touching on PURPA, PUHCA, EPAct, and Order 888. He sees FERC currently concentrating on merger policy issues, and wondered if FERC will issue an electric restructuring order like Order 636 in the gas industry. He said that some areas which Congress should address are to mandate a date certain for retail access, enhance FERC authority under the Federal Power Act, repeal or amend PUHCA, and define the role of Federal Public Power Agencies (BPA, TVA) in a competitive market. He said that there was a good policy and economic case for retail choice, and a competitive market will do a better job than a regulated one, but that most states undergoing restructuring have had to make a political deal to get it done. The problem with mandated rate cuts is that it takes out the margin a marketer may be able to meet. Therefore, the number of customers signed up by a third party may not be a good measure of the success of competition.

He observed that it takes either a crisis or consensus to pass legislation, so we should get what we can even if it means not getting all we want in legislation. He believes that Congress is leaning towards enacting Federal legislation to take away impediments to competition, without getting involved in deregulation itself. Committee leadership will be changing, which may ease passage of some sort of modest legislation. He suggested that reliability concerns can be addressed through transmission planning at the Federal (rather than state) level, and that consumer protection will be the focus of state commissions in the future.

**Kathleen Magruder**, Vice President, State Government Affairs, Enron Corporation, described Enron as the largest gas marketer and electric wholesaler in the country (even bigger than BPA and TVA). She observed that most gas restructuring has occurred at the state PUCs, while electric restructuring has occurred at the state legislatures. She believes that stranded cost recovery is appropriate, and noted the tax impacts when generating facilities are written down will adversely affect school districts and local governments dependent on the tax revenues. Consumer issues will continue to grow in importance. She agreed that Congress should be involved in easing Federal impediments to competition, but stranded cost recovery is a local issue that should be addressed by the states. Federal legislation does not necessarily have to mean that states cannot structure their own legislation to serve customers needs.

She observed that if political decisions make restructuring uneconomic, competition will not come. She observed that we need retail competition, not just wholesale competition, to allow individual customers to pick the services that best fit their needs. Finally, with a competitive retail market, rules should be adopted to require electric marketers to perform, in order to ensure a reliable marketplace.

**Innovations in Risk Management: The Impact of Weather Derivatives and Other Advanced Financial Products on Energy Trading and Marketing**

**Fereidoon "Perry" Sioshansi,** Partner, Convector Consulting, Inc., Presiding

**Stephen Warwick,** Senior Vice President, Koch Energy Services, talked about using risk management techniques to protect against volume variations associated with temperature fluctuation, and which can complement price management tools. He showed that the price of natural gas versus heating degree days (HDDs) was not well correlated, but gas volumes versus HDDs were. He described a heating degree day swap to manage volume risk associated with weather that is colder or warmer than normal. He also pointed out that price risk hedging is only effective if gas volumes meet projections, so ideally one needs both price and volume hedging to maximize protection.

**Peter Lamb**, Director, CIMMS, University of Oklahoma, discussed his work in analyzing El Niño, and its companion weather event, La Niña. He described the ocean forces that create these events, and provided historical data to support general trends in the expectation of weather patterns in North America as a result. He showed that different regions will experience different impacts from El Niño and La Niña events. He also explained his work in Africa with regards to projecting economic impacts from predicted weather events.

**Sam Hakim**, Risk Control Manager, Williams Energy, and **Kamal Hamdan**, Director of Analytics/ Power, PG&E Energy Trading, also spoke.

*Karl J. Nalepa and J. Paul Roberts*

**Scenes from the Annual Conference**

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## Student Scholarships: A Call for Support

USAEE was pleased to once again offer student scholarships for students to attend the North American Conference in Albuquerque, New Mexico. At this year's conference, 9 students qualified under the guidelines for scholarship requests. Inviting student participation at our conferences is one of the best mechanisms for recruiting new members to the USAEE.

Of the 9 scholarship students, several presented papers at the conference in Albuquerque. Student speakers in Albuquerque included the following:

Dhananjaya "Jay" Arekere, Texas A&M University
*Energy Use and Sustainability: Issues of Spatial and Temporal Equity*

Christopher Bataille and Mark Jaccard, Simon Fraser University
*New Evidence on Capital for Energy, Interfuel, Capital for Carbon and Own Price Carbon Elasticities: Results and Implications from a Disaggregated Technology Simulation Model*

Chien-Ping Chen, University of Houston
*Consumer Self-Generation and Monopoly Limit-Pricing Under Timing Uncertainty of Deregulation in the Electricity Market*

Amy Craft, Stanford University
*Capacity Expansion in an Unbundled Electric Utility Industry*

Nancy Feng, University of Houston and Karl J. Nalepa, Railroad Commission of Texas
*A Texas Natural Gas Model*

P.H. Kobos & J.D. Erickson, Rensselaer Polytechnic Institute & Thomas E. Drennen, Sandia National Laboratories
*Fueling China's Cars: Growth in Passenger Vehicle Ownership, Oil Demand and Carbon Emissions*

Robert M. Margolis, Princeton University
*Addressing the Emerging Crisis in Energy Technology R&D*

M. Zhang and J.D. Erickson, Rensselaer Polytechnic Institute and Thomas E. Drennen, Sandia National Laboratories
*The Kyoto Protocol and International Trade: The Carbon Loophole*

Other students participating in the conference included:

Venkatesh Sundararaman

At the Albuquerque conference a student scholarship breakfast was held to network those receiving scholarship funds to attend the conference with supporters of the fund and USAEE Council members. This event was a success and will be continued at future conferences.

Corporate supporters for this year's student scholarship fund were as follows:

American Petroleum Institute
Atlantic Richfield Company
Conoco, Inc.
Exxon Company

Recognizing the need for interested and qualified graduates, many sponsors of the student scholarship fund consider the program as supporting education as well as recruitment. Next year, at the 1999 conference in Orlando, we will continue the student scholarship program. To firmly establish the program in 1999 we need the active financial support of the membership. For those of you who can, please try to plan in your budgets for a corporate or organization sponsorship of $500 - $1000. If you have any questions regarding this program, please do not hesitate to contact David Williams at USAEE/IAEE Conference Headquarters: (p) 216-464-2785 / (f) 216-464-2768 / (e) iaee@iaee.org

## New Members of USAEE

The follow individuals recently joined the USAEE. Welcome!!

**Dean Abrahamson**

**Peggy Abrahamson**
Senior Editorial Manager
US Department of Energy

**Neal Allen**
Market Specialist
Alabama Power Company

**Dan Arvizu**
VP Energy Envir & Systems Group
CH2M Hill

**Ralph Avellanet**
Program Manager
US Department of Energy

**Fabian Bachtiar**
Student
University of Oklahoma

**Dennis Banasiak**
Middle East Gas Projects Manager
Phillips Petroleum Company

**Linda Curry Bartholomew**
Vice President Public Affairs
PP&L Inc.

**Richard Berard Jr.**
Senior Consultant
Arthur Andersen

**Mark Bononi**
Analyst
Paine Webber

**Damon Bresenham**
Student
Univ of Wisconsin-Milwaukee

**Jack Bridges**
Senior Forecaster
Duke Energy

**Kenneth Brown**
Senior Advisor
National Science Foundation

**J. Kendall Cable**
Vice President
CH2M Hill

**Janis Carey**
Assistant Professor
Colorado School of Mines

**Roland Clarke**

**David Clement**
Director of Strategic Planning
PacifiCorp

**Robert Cope III**
Assistant Professor
Southeastern Louisiana University

**Patricia Costello**
Senior Research Analyst
Potomac Electric Power Company

**Gregory Cowles**
Manager Information Systems
Enron Energy Services

**Jim Crompton**
Principal Technical Advisor
Chevron Information Technology Co.

**Steven Crookshank**
Economist
American Petroleum Institute

**Scott Davis**
Senior Commercial Analyst
Triton Energy Limited

**Robin Duquette**
Louis Dreyfus Energy

**Neal Elliott**
Senior Associate
ACEEE

**Marit Engebretsen**
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**Miranda Ferrell**
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**Jean Wallace Frazier**
Senior Olin Research Fellow
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**Robert Gardner**
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**Michael Hurley**
Senior Tax Advisor
Arco Alaska Inc.

**Toshtya Imada**
Visiting Scholar CIS
MIT

**Shawn Intorcio**
Manager Electricity Practice
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Lawrence Berkeley National Lab

**Andrew Kleit**
Associate Professor
Penn State University

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## Calendar

**2-4 December 1998, Successful Load Profiling: How to Make Retail Access Work for Distribution Companies, Suppliers and Customers.** Grand Hyatt, San Francisco, CA. Contact: IBC USA Conferences, Inc., 225 Turnpike Road, Southborough, MA 01772-1749. Phone: 508-481-6400. Fax: 508-481-7911. E-mail: reg@ibcusa.com

**3-4 December 1998, Private Energy in Turkey**. Washington, DC, USA. Contact: Registration Dept. The Center for Business Intelligence, LLC, 500 W Cummings Park, Ste. 5100, Woburn, MA 01801. Phone: 781-939-2438. Fax: 781-939-2490. E-mail: registrar@cbinet.com

**9-11 December 1998, Power-Gen '98.** Orlando, Florida. Phone: 918-831-9160.

**4-6 May 1999, IEA International Workshop on Technologies to Reduce Greenhouse Gas Emissions: Engineering-Economic Analyses of Conserved Energy and Carbon**. Washington, DC, USA. Contact: John Newman, IEA, Phone: 33-1-40-57-67-15. Fax: 33-1-40-57-67-49. E-mail: johnnewman@iea.org or Jeffery Dowd, US DOE, Phone: 202-586-7258. Fax: 202-586-4447. E-mail: jeff.dowd@hq.doe.gov

**11-22 January 1999, 5th International Training Program on Utility Regulation and Strategy**. Gainesville, Florida. Contact: Pascale Parker, Program Manager, PURC, 205 Matherly Hall, University of Florida, Gainesville, FL 32611. Phone: 352-392-6148. Fax: 352-392-7796. E-mail: purcecon@dale.cba.ufl.edu URL: http://www.cba.ufl.edu/eco/purc/

**3-5 February 1999, PowerFair '99**. Houston, Texas, USA. Contact: Enerdata Ltd. Phone: 905-470-0117. Fax: 905-479-2515. E-mail: enerdata@inforamp.net

**14-18 February 1999, DistribuTECH '99**. San Diego, CA. Contact: Nancy Wilson, Conference Manager, PennWell Conferences & Exhibitors, 1421 S. Sheridan Road, Tulsa, OK 74112-6600. Phone: 918-831-9438. Fax: 918-831-9834. e-mail: nancyw@pennwell.com

**3-4 March 1999, Electrifying Africa '99.** Lost City Convention Center, Sun City Resort, South Africa. Contact: PennWell, 1421 South Sheridan Road, Tulsa, OK 74112. Phone: 918-831-9160. Fax: 918-831-9161.

**20-22 April, 1999, Electric Power '99 - Conference & Exhibition**, Baltimore, Maryland, USA. Contact: Electric Power '99, c/o The TradeFair Group, Inc. 1220 Blalock, Suite 310, Houston, TX 77055. Phone: 713-463-9595. Fax: 713-463-9997. E-mail: event@electricpowerexpo.com

**9-12 June 1999, 22nd IAEE International Conference**. Rome, Italy. Contact: IAEE Headquarters, 28790 Chagrin Blvd., Ste. 350, Cleveland, OH 44122. Phone: 216-464-5365. Fax: 216-464-2737. E-Mail: iaee@iaee.org URL: www.iaee.org

**August 29 - September 1, 1999, 20th USAEE/IAEE Annual North American Conference - "The Structure of the Energy Industry: The Only Constant is Change."** Orlando, Florida, USA. Contact: USAEE/IAEE Headquarters, 28790 Chagrin Blvd., Ste. 350, Cleveland, OH 44122. Phone: 216-464-5365. Fax: 216-464-2737. E-Mail: iaee@iaee.org URL: www.iaee.org

**23-28 July 2000, ENERGEX '2000 Conference**, Las Vegas, USA. Contact: Dr. Chenn Zhou at fax: 219-989-2898, e-mail: qzhou@calumet.purdue.edu or Dr. Brian Golchert at fax: 630-252-5210. E-mail: brian_glochert@qmgate.anl.gov

## Conference Proceedings
## 17th North American Conference
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