

IA INTERNATIONAL ASSOCIATION FOR ENERGY ECONOMICS  
EE  
*Newsletter*

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Fall 1994

### President's Message



**A**S 1994 draws to a close, my feelings are mixed. There are so many things to do during a President's term of office, and he has time to do so few of them. This is one reason why I want to emphasize the necessity for continuous and cohesive action by the four presidents in office. Naturally, this is achieved through the close relationship that exists between them. I feel this comment is a fundamental one,

but it does not, on the contrary, exclude the other members of Council or former presidents - in short, all available IAEE good will.

It cannot be said too often that our association owes its scope and its importance to those persons who, at any given time and with or without an official title, initiate and then implement the projects that take us forward.

But 1994 has had its share of modest achievements, once again through a collective effort. In my opinion the most important thing, in all seriousness, is to leave the association in good shape, that is to have kept intact what was inherited from our predecessors. It is never easy to preserve one's heritage, particularly an intellectual one. We have tried to orient our efforts in a great many directions, all aimed at increasing the "visibility," as we say in French, of the IAEE.

Among these efforts I should like to mention the consolidation of a number of existing affiliates and the creation of two new affiliates, one in Mexico and the other in Portugal. With regard to Eastern Europe and the CIS, our efforts have been both numerous and inadequate. It will take several years of sustained effort before we can fully associate these countries that are so engulfed in economic problems. Anyway, as William of Orange said, one does not need hope to undertake nor success to persevere.

In 1994 the USAEE has involved itself fully in IAEE activities, which should result in better coordination among our American colleagues. The European Foundation, the EFCEE, is now fully operational and has proved its effective-

ness in several instances. I hope that we shall be able to establish a formula, or at least lay the foundation for one, that will enable graduate students in energy-related fields to join our association under conditions that they can afford, because they are our life blood for the future.

Our Association holds a great many conferences but it cannot survive without a strong material link. *The Energy Journal* has maintained its high level of specialized interest and scientific scope thanks to the tenacity of its editors. *The Newsletter*, in a different spirit, is developing and becoming more substantial, and if we keep up our efforts it will constitute that strong bond we need to unite us around the world.

This all goes to show that a President is no more, in time and space, than a single piece of that increasingly large and complex puzzle - the IAEE. But when I say puzzle, I mean a jigsaw puzzle and not an enigma!

I should like to express my appreciation for the work of the Executive Director and his small team, and I rely on them to continue fulfilling a roll that may appear modest but which is in fact vital. My sincere thanks to you, Dave, for all you have done. I should also like to acknowledge the courage of Fereidun Fesharaki. At Seattle in 1993 he showed us that he had regained his legendary strength and vitality, and, if you will permit the familiarity, that he was good for at least another 50 years!

Lastly, may I wish Kenichi Matsui every success as President in 1995. He is a brilliant specialist in modelling systems in particular and in energy in general and I am confident that with his sense of humor and his finesse he will bring a geographically different point of view that will prove extremely enriching for the IAEE.

I myself remain at your service and I wish to express my profound gratitude to you for all that you have given to the association, and I must admit, to me personally. Although it is a little early, please accept my warmest wishes for the approaching year's end and for satisfaction and happiness in both your personal and professional life in 1995.

*Jean Masseron*

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## Matsui to Advance to Presidency

Kenichi Matsui, President-elect during 1994, will move up to President of the Association on January 1. He succeeds Jean Masseron and will serve throughout 1995.

Matsui is Vice President, The Energy Data and Modelling Center of The Institute of Energy Economics in Japan. He holds a BA from the Faculty of General Culture, Tokyo University and was formerly Director and Chief Economist of The Energy Data and Modelling Center. Previously, he was Chief Economist of The Institute of Energy Economics.

Prior to his year as President-elect, Matsui served two years as Vice President and Secretary of the Association.

Mr. Matsui has served widely in the energy field. He formerly lectured at Tokyo University, Shizuoka Prefectural University and Chuo University. He also served as Chairman, APEC Energy Data Expert Group and was on the staff of the Secretariat for the Conference on New and Renewable Sources of Energy of the UN. He served as consultant to ESCAP's Natural Resources and Energy Division and as a consultant to the International Energy Agency's, Energy Statistics and Data Processing Division and was an Associate member of the Workshop on Alternative Energy Strategy.

## Election Results Announced

Balloting closed on November 1 for the Association's 1995 election. Ulf Hansen, Chairman of the Nominating Committee, announced the following results:

|                                          |                        |
|------------------------------------------|------------------------|
| President-elect                          | Anthony "Tony" Finizza |
| Treasurer                                | Mitchell P. Rothman    |
| Vice-President for Finance               | Richard H. Hilt        |
| Vice President for International Affairs | Guy F. Caruso          |

Tony Finizza is Chief Economist for Atlantic Richfield Company, based in Los Angeles, California. Formerly he was Regional Manager for Data Resources, Inc. and prior to that was Economist with the Northern Trust Company in Chicago, Illinois. He holds a BA and MBA from the University of California and a PhD from the University of Chicago. He is a past President of the United States Association for Energy Economics and served on the IAEE Council during 1991 and 1992. He is Program Chairman of the 1994 North American Conference. Finizza is a Director of the National Association of Business Economists, a member of the Conference of Business Economist and the National Business Issues Council and a former President of the California Council for Economic Education.

Mitchell Rothman is a Consultant Economist with Acres International, currently on assignment as Chief Economist of the Lesotho Highlands Development Authority in Lesotho. Formerly he was Chief Economist with Ontario Hydro, Senior Economist with the Canadian Imperial Bank of Commerce, Lecturer at Wordsworth College and the University of Toronto and Assistant Professor on the Faculty of Administrative Studies of York University. He holds an AB from Harvard University and an MSIA from Carnegie-

Mellon University. He has served as IAEE Treasurer during 1993 and 1994 and was President of the Canadian IAEE Chapter from 1983 to 1990. He was a member of the IAEE Nominating Committee in 1989 and 1990 and a member of the Program Committee of the Calgary and Ottawa IAEE Conferences. He is a member of the Advisory Committee, Consumer Energy Council of American/Research Foundation's Environmental Externalities Project.

Richard Hilt is Manager of Strategic Planning for the Electric Power Research Institute in Palo Alto, California. Formerly he was Assistant Director, Strategic Planning & Analysis Division of the Gas Research Institute and prior to that Energy Coordinator, FMC Corporation. He holds a BSME from the University of New Haven; an MS from the University of Denver; an MA from Temple University and a PhD from the University of Pennsylvania. He has been IAEE Vice President for Finance during 1993 and 1994 and was Program Chairman of the 1991 North American Conference. Hilt is a member of the American Society of Mechanical Engineers, American Economic Association, the National Association of Business Economists, the Research Management Committee of the Edison Electric Institute and the National Petroleum Council's Transmission & Storage Task Force, Natural Gas Study.

Guy Caruso is Director, Office of Non-Member Countries, International Energy Agency in Paris. Formerly he was Director of the Office of Oil and Natural Gas Policy, Office of Domestic and International Energy Policy, U.S. Department of Energy and prior to that Head of the Oil Industry Division, International Energy Agency and Director of the Office of Market Analysis, U.S. Department of Energy. He holds a BS and MS from the University of Connecticut and an MPA from Harvard University. He was a charter member of the IAEE and Program Chairman of the 1987 North American Conference. He is a member of the American Economic Association.

## Conference Announcement Energy Strategy for Europe

### *Sponsored by:*

Italian Association of Energy Economists (A.I.E.E.)  
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11-12 April 1995

Conference Hall of Banca di Roma  
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## In Search of the Celestial City

*Energy sage, John Mitchell, was recently named Energy Economist of the Year by the British Institute of Energy Economics. In the following interview he talks about some of the conundrums with which he wrestled in a 27 year career with the British Petroleum Company.*

"I like to think of my search for solutions to energy riddles as a sort of an economist's version of *Pilgrim's Progress*," John Mitchell says in an off-beat allusion that is typical of the Mitchell style. "I suppose, like Bunyan's Pilgrim, I have been - and still am - trying to reach the Celestial City where theory and reality agree."

Mitchell's quest began in 1966 when he came to BP from the Rhodesian civil service. Oil was then less than \$2 a barrel and the shocks and structural changes which the next two decades would bring to the oil industry were still no more than a distant cloud on the horizon.

After moving progressively through Supply and Planning departments, and spending a year in Cambridge in Richard Eden's Energy Group in the Cavendish Laboratory, Mitchell was appointed head of BP's Policy Review Unit in 1978.

From there he made legendary presentations, first warning that the seventies would end with a massive oil price shock, then arguing that oil prices would not go on rising - a minority view when he propounded it in 1981.

After a seven-year spell as regional co-ordinator for the Western Hemisphere, he was appointed special adviser to BP's managing directors in 1990, a role especially created for him. Since his retirement from BP in 1993, Mitchell has been chairman of the Energy and Environment Programme at the Royal Institute of International Affairs in London and research adviser to Robert Mabro at the Oxford Institute of Energy Studies.

Although the Energy Economist of the Year Award is recognition that Mitchell has probably made more progress than most towards the intellectual Celestial City, he is the first to admit that the road still to be traveled looks as full of pitfalls as that so far traversed.

Three particular economic riddles have interested him along the way.

### Investing in Oilfields

The first concerns the nature of decisions about investments in upstream oil production. "In the early days of the North Sea I spent more of my life than I really wanted to on this issue," says Mitchell ruefully. But, add his fellow energy economists, his efforts have enriched the general understanding of the topic.

"Then, we were trying to make sense of discounted cash flow techniques," he says, "but is there not a better way to

put a value on an upstream investment opportunity?" Mitchell believes there is. The alternative approach is to view upstream investment as a series of options.

These give you the right, though not the obligation, to effect a deal. "An exploration investment is an option," explains Mitchell. "If the exploration is successful, if you find an oil field, you can choose to develop it or not. If you do develop it, what does building platforms and drilling production wells do? It actually gives you an option to produce oil at a particular variable cost in the future. You can say that the act of depletion and the act of production are equivalent to the exercising of that option."

Sophisticated techniques have been developed to value financial options. The challenge, Mitchell believes, is to adapt those techniques so they can be applied to real investments in upstream oil.

### International Oil Companies

On the same topic, he argues that the equity market plays a vital role in spreading the risk of exploration projects around investors: "An investor can't put money directly into a

project such as exploration in Azerbaijan because there is no liquid futures market in Azerbaijani oil exploration. But there is a liquid market in the stock of the oil companies that invest in it."

For Mitchell, these companies play a vital role as a bridge between projects that can't themselves be traded and the stock market - a role that isn't open to state-owned oil companies which can't spread their assets by putting them into the equity market.

"International oil companies must make sure they don't squander the benefits

of that unique opportunity," he emphasizes. "Government policies should promote the efficiency of these markets."

### Can Modeling Help?

Another question with which John Mitchell has been grappling is whether modeling can help economists understand how the international oil market works?

He points out that oil, unlike most other commodities, has very large 'rents'. "Rent" is the term we economists use to describe the surplus or profit that accrues to the owner of a resource," Mitchell explains.

"Because the rent from oil has traditionally been large, the investor can benefit by choosing not to buy from the abundant supplies currently available. Instead he can spend large sums on new exploration and development projects where there is a reasonable hope of recovering the investment and making a good profit."

Mitchell draws a clear conclusion from this: "When there is so much rent around from oil, people won't necessarily continue to buy from the source with the lowest cost of production. That axiom should be written in large letters

*(continued on page 4)*



John Mitchell (r) receiving the BIEE Energy Economist of the Year award from Peter Davies (l), BIEE Chairman.



**In Search...**(continued from page 3)  
above every OPEC minister's desk."

## OPEC

Finding a way to model OPEC's behavior has posed a considerable challenge to John Mitchell and other energy economists. He points to a common misconception: "OPEC is not a decision-maker; it's a useful forum for oil exporters to talk to each other. How individual countries behave is more significant in the international oil market than how OPEC acts as a whole."

Nonetheless, two features of OPEC have always interested Mitchell. One is that Middle East politics gives the oil market a propensity for major upheavals or 'shocks'. The second is that OPEC members are not joint stock companies, but governments with macroeconomic responsibilities. "They don't operate within the secure contractual framework of the U.S. constitution," says Mitchell. "Their environment is much more perilous."

These differences make it tricky for energy economists to develop models to simulate effectively the way OPEC affects the international oil market and to allow changes to be predicted. Various models have been developed, he says, but with greater or lesser degrees of success.

"After the conflict between Iraq and Kuwait, regional tension in the Middle East has been temporarily suppressed," Mitchell warns. "Low oil prices have been straining the domestic economics of every oil producer. Yet this picture doesn't fit energy economists' conventional models. So it's essential now for energy economists to build models that help us understand what is likely to happen in those countries and predict its effects on the international oil market."

## Environmental Issues

Another area that has been commanding a lot of Mitchell's attention in recent years has been the effect of industry on the environment. Of particular concern have been the targets set for reducing carbon dioxide emissions - but Mitchell cites this example only to illustrate a more general problem. This is to define, for each type of pollution and each location, the 'critical load'. How much of each pollutant can a biosystem tolerate without disturbing life, health and the climate?

John Mitchell is quite specific on what the problem is here: "The Rio convention produced what looks like a set of targets for controlling emissions, but actually it's a set of quotas," he argues.

"It says rich countries will cut their emissions, but they intend to go on emitting CO<sub>2</sub>. The developing world, on the other hand, which is not emitting much now: what will its future quotas be? This mechanism appears to me to be establishing property rights over the upper atmosphere - the right to dump carbon there - and puts the problem of CO<sub>2</sub> emissions straight into the North/South political arena."

## Can the Market Regulate Emissions?

How does this problem concern energy economists? Mitchell says economists postulate that market mechanisms such as taxes or tradable permits should control emissions. But when the critical loads of potential pollutants are local sulfur or low-level ozone, for example - rather than global, as with CO<sub>2</sub>, the whole question becomes more difficult. "A system of tradable permits wouldn't help the inhabitants of

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Los Angeles saturated with low-level ozone, if those emitting the ozone had bought permits from somewhere in the high Rockies," he points out.

Similarly, the tax rate necessary to regulate petrol consumption on German autobahns will be different from what is right for Wales or Sicily. Reconciling local emission regulations with vehicles that travel around and are traded, like their fuels, across Europe will be very difficult.

"Commerce is one of the great enablers of economic progress," Mitchell says. "If obstacles are put in its way in order to marry up environmental emissions with damage to local critical loads, a vast, untested area opens up. Any regulations put in place would either have to be adapted locally - which creates trade problems - or be universal, such as adopting Californian standards everywhere. But that is inefficient because those standards are far too severe for many countries."

Certainly, the subject of emissions raises difficult policy trade-offs. These, together with the questions of investment decisions and the difficulties of modeling the international oil market, will give energy economists like Mitchell plenty to think about in the future.

But (un)like Bunyan's Pilgrim, Mitchell is not going to allow himself to sink into the Slough of Despond if he and his fellow economists fail to come up with quick or complete answers to these conundrums.

"It's a long and winding road to the Celestial City," Mitchell quips.

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## Alaska North Slope Study

The U.S. Department of Energy released a study on *Exporting Alaska North Slope Crude Oil: Benefits and Costs* in June 1994. Present law prohibits the export of Alaska North Slope (ANS) crude oil. The Department of Energy was asked to take a fresh look at this issue in light of present circumstances. Following are highlights from this study.

Lifting the ban on exporting ANS crude oil and permitting it to be exported on U.S. flag vessels is in the best interests of this nation. The ability to export ANS crude oil improves the investment opportunities in crude oil production in both Alaska and California leading to increased production, increased jobs, not only in those states but throughout the U.S., and increased state and federal revenues, without harming national security or the environment.

These benefits flow from the Department's analysis that lifting the ban will improve investment opportunities in Alaska and California oil production. The analysis indicates that because ANS crude oil can only be sold in the U.S., its price is too low compared with other crude oils in the world market. By letting ANS crude oil participate in the world market, the price of ANS crude would increase by about \$1.20 to \$1.50 per barrel. This translates into an increase in well head values that go directly to the producing companies. California crude oil prices track ANS crude prices, so that an increase in California crude prices would be expected, although not as large as the ANS increase.

With increased well head prices, producing companies have an increased incentive to invest more money in production. The analysis concludes that between \$600 million and \$1.1 billion in potential oil investments would be generated between 1994 and 2000. Furthermore, the analysis indicates that this increased investment would translate into increased oil reserves and increased production by about a total of 80,000 to 120,000 barrels per day (combining both California and Alaska.)

Increased well head prices mean more state and federal revenues because taxes are based upon the value of crude oil at the well head. Alaska would benefit between \$700 million and \$1.6 billion; California would benefit between \$180 and \$230 million; and the federal government would benefit between \$100 and \$180 million.

All of this activity means more jobs for U.S. workers. The analysis found the potential to increase direct and indirect employment in oil-related investments and oil production in the range of 5,400 to 13,900 jobs. Induced employment, that

is, employment that occurs due to the expenditures by direct and indirect employees, would range from 4,700 to 11,500 jobs. The total net gain in U.S. jobs ranges from about 10,000 to as many as 25,000 jobs. This does not mean that we do not lose a small number of jobs in the maritime sector; however, the loss is quite small when compared with the gains in all sectors.

The analysis indicates no impact on consumers in higher prices for gasoline or other refined products because the increased price of crude oil would be absorbed by refiners, who now enjoy the largest refining margins of any region in the U.S. There would be no measurable impact on the environment from the ability to export ANS crude oil.

The Department indicates that there would be no adverse impact upon national security. While imports would increase to make up for the amount exported, the net import balance would remain the same in the short run and actually would improve in the long run as domestic production increases. The import situation is judged on a net basis, that is, the amount of imports less the amount of exports. If imports increase by the amount exported, on an oil basis the impact is zero. On a dollar basis, the import bill may increase slightly depending upon the kind of oil imported to replace the ANS crude oil. Overall, however, the United States is no worse off than before from the perspective of national security.

Len Coburn

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Energy professionals interested in reviewing economics books (in any language) for *The Energy Journal* are invited to send a one page CV together with a letter listing their research interests to:

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Publishers, academic presses and authors are invited to submit energy economic books in any language for review and annotation.

## Conference Proceedings 17th IAEE International Conference Stavanger, Norway, May 25-27, 1994

A limited number (100 sets) of the Proceedings from the Stavanger International Conference are now available for **member only** purchase from IAEE Headquarters; (one set only to a member.) Entitled *Energy Markets in Transition* (a three volume set), the proceedings are available to members for \$10.00. This includes surface mail to all locations. Payment must be made in U.S. dollars with checks drawn on U.S. banks. To order copies, please complete the form below and mail together with your check to: Order Department, IAEE Headquarters, 28790 Chagrin Blvd., Suite 210 Cleveland, OH 44122, USA.

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## Obituary Notice for Old-Style Economics\*

By Will Hutton

Economists are increasingly discontented with economics. They are embarrassed by its forecasting failures. They are uncomfortable that its theories seem less and less able to describe the real world.

They regret that quite modest mathematical prowess has become more important than original economic thinking. Things, they know, need to change.

The discontent is spreading. The OECD, reviewing the results of five years of economic forecasts from leading governments and multinational institutions including itself, concluded that as reliable a benchmark would be simply to assume that next year will be the same as this — and ignore the forecasts. It is difficult to find a reflective economist who is happy with matters as they are.

Professor Paul Ormerod has gone one step further. In *The Death of Economics*, published today by Faber, he brings together the simmering discontents of economists over the past quarter of a century, and launches a comprehensive attack.

Economics' core axioms do not and cannot correspond to any known reality, he says: economists know this but nonetheless close their eyes because of the intellectual elegance of their theories if they did work.

It is a book of its times — reflecting the new scientific and philosophic preoccupations just as the founding fathers of economics did theirs.

For them, the point of intellectual reference was the Newtonian conception that the natural laws of nature ineluctably produced a natural harmony. They looked for natural laws of economics to produce a parallel economic harmony.

But faith in natural laws and harmony has been a casualty of the 20th century. There has been an intellectual revolution, culminating in the new theories of the natural world showing it to be ordered chaos.

Across the natural sciences, new computing power has permitted investigation into actual physical behavior, demonstrating that any order in nature is the result of very complex interactions, is very easily destabilised and need not be harmonious at all.

The natural world — from the weather to the animal population — can seem to have settled into a self-regulating equilibrium; but then it can suddenly change direction so that there are violent storms or an explosion in a particular species' numbers.

These outcomes seem inexplicable if you apply the old rules that relationships are governed by simple, permanent, natural laws: but the new power of computers can discern patterns even in what seems to be unpredictable or chaotic behavior.

Instead of stable relationships based on laws that hold good at any time or place, relationships are unstable — but even this unpredictability can have patterns.

Science is departing in new directions. Having spent this century breaking down physical phenomena into ever smaller parts it has finally arrived at the quark — the ultimate tiny foundation of physical life that can be reduced no further.

The new discoveries lie not in unveiling the properties of ever smaller particles but in discovering the properties of

systems.

Reductionism is giving way to studies of complexity; a belief in stable universal laws is being superseded by a new preoccupation with the stably unstable laws of ordered chaos.

Yet economics, as the mathematician Paul Ormerod complains, remains locked in the decaying paradigm. It is firmly reductionist in its scope; it insists on universal laws; it assumes predictable behavior. Yet this neither corresponds to the economic world as it is, nor to the way real scientists are beginning to think of the natural world.

Economics will need to transform itself before this challenge.

His prime target is the intellectual tools that economics have developed in order to permit mathematical rigour. To make the laws of supply and demand produce predictable outcomes, economists suppose a point of stable balance where the marginal gain from some branch of activity is exactly cancelled out by an equivalent marginal loss. At the cusp of these marginal computations lie points of unimprovable balance; mathematics can then state where markets, governed by such trade-offs, should end up.

Prof. Ormerod lays into "marginalism" with relish. His charge is that it supposes a trajectory of costs and rewards that does not exist in the real world as extensively as economists need to make their theories work. That, in any case, economic actors do not carry the mental equipment to make such fine trade-offs rationally. And that, even if they did, it would be impossible for any population of economic actors, armed with just the information supplied by price signals, to reach a state in which each one's position was unimprovable — what economists call a general competitive equilibrium.

The first problem has been known to economists since the advent of mass production; that the marginal costs of increasing output can fall continually so that there is no limit to firms' expansion. In other words, there need not be a point where, necessarily, marginal costs exceed any marginal gain.

Prof. Ormerod cites Alfred Chandler's magnum opus, *The Scale And Scope Of Industrial Capitalism*, which demonstrated how that once large companies had achieved a lead over their competitors they generally retained it — and costs continually fell. Quaker Oats, Campbell Soup, Heinz, Procter and Gamble, Eastman Kodak, Union Carbide and a host of other companies defied the laws of economics by making huge investments in product-specific marketing, distribution and purchasing networks, and establishing unassailable positions which allowed their costs to carry on falling.

Nor need gains fall at the margin, either. A third car, for example, will add little to the mobility of most families, or a fourth television set to their viewing habits.

Yet, what drives such consumption is not a careful calculus of the marginal usefulness of additional purchases, but, as Thorstein Veblen argued in *The Theory Of The Leisure Class*, by more human impulses — the more one has, the more one wants, and the greater the satisfaction obtained from getting it.

A world of conspicuous consumption and increasing returns to companies has no fine points of balance at all.

But this is only the beginning. Can economic agents be rational in the sense that economists need them to be?

Prof. Ormerod attacks the idea that consumers can rationally order their preferences for different goods, so that



if they prefer A to B, and B to C then necessarily they prefer A to C. Not so.

Empirical studies show that consumers simply do not transfer their preferences in this way; the rationality needed by economists is far too patchy upon which to rest an entire theory.

The biggest problem is using cost and price data alone to find optimal levels of production and consumption for an economic system.

It is clear that the task would overwhelm any individual participant in a market because prices and costs, as we have seen, need not force them ever to stop producing or buying — so theorists fall back on the idea of an independent auctioneer who performs the task on the participants' behalf.

Yet the task is impossible. Prof. Ormerod draws an analogy between searching for equilibrium using only price signals and finding a crater in a field blindfold.

If all the economists' artificial assumptions hold, there is only one crater and all the auctioneer has to do is walk down it to get to the bottom. This can be done blindfold because the slope will inevitably guide him or her downward — the way price signals would guide an auctioneer to the best outcome. But, in fact, the field is pitted with many craters, given what we know about rationality and the shape of marginal costs and revenues. There can be lots of possible points of balance — multiple equilibria.

The blindfolded auctioneer is left groping about, climbing in and out of craters and running the risk of being trapped in some.

It is only by assuming these difficulties away that economists can construct the equations that will produce the required result. The idea is absurd. It does not exist.

Yet the perfectibility of market equilibria is the guiding beacon of economics. It is to approach this ideal that the financial markets have been deregulated and trade unions weakened. It is why taxes have been cut and public investment emasculated.

The former Soviet Union and eastern Europe have been urged to build their economies around this theory's nostrums. Economic impossibilism rules.

Prof. Ormerod urges us to return to the roots of economics — political economy: to recognize that there are many possible outcomes to market behavior, depending on culture, the shape of institutions and history; that markets have no inherent tendency to stability or best outcomes; that perforce social institutions can and do shape economic outcomes with greater or less efficiency; that profits and the priorities of the financial system are prime determinants of employment and output rather than the efficiency and flexibility of market price signals; that we should drop absurd and unattainable benchmarks of economic efficiency such as competitive equilibrium.

It is a controversial and impassioned call; but it chimes with the direction of intellectual life generally.

Economics is beginning to move the way Prof. Ormerod wants; it has much, much further to go.

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## Manantali Dam: Energy Plan in Embryo for Ten Years

As a sub-regional agency for cooperation created in 1972, The Organization for the Exploitation of the Senegal River (OMVS) links some of the poorest countries in the world. The GDP per capita is less than U.S. \$600 for the countries of Mali, Mauritania and Senegal.

In spite of a small population density (18 million scattered over 3,236,000 km<sup>2</sup>), these countries offer a very difficult energy situation:

- most energy needs are provided by biomass since these countries are located in the Sahelian region with a dry climate and threatened by a relentless encroachment of the desert.
- the energy independence rate (noncommercial energy excluded) is nearly nil. Hydrocarbon production is virtually non-existent. There is just a little natural gas production in Senegal. The crude oil processed by the two area refineries (1.2 mt/year each in Mauritania and Senegal) is imported as well as are other oil products needed for the market.
- the hydroelectric potential, which is very great (1,400 mw), is largely unexploited. Apart from Mali, where hydroelectricity satisfies 78% of demand, what generation there is entirely thermal.

In order to capitalize on the Senegal River's potential for irrigation, energy and inland navigation, the three states joined forces through OMVS to build two dams; the first one, near the Diama delta, was commissioned in 1986, and the second one, the Manantali, was commissioned in 1987. Commissioning is not the same as implementation, however. It is only the beginning of the planning and negotiating process.

It was recognized early that the irrigation plans for the area would take a long time to develop. And so far this has been the case. And the inland navigation aspects of the project are, today, still at only the conception and feasibility study stage. Neither the agriculture nor the inland navigation parts of the project are expected to make a significant contribution to offsetting the costs of the project, however.

The energy part of the project is thought capable of generating significant profits. This has led to expectations of less dependence on oil, a low KWh price, an expansion of electrification, particularly in areas close to the river, and an impetus to industrial and agricultural development. The project will include a 5 x 20 mw power station and a 1,200 km, 225 kv transmission line.

Unfortunately, energy production, originally scheduled to begin in 1988, will not begin until 1998.

The main reason for the delay has been the lengthy negotiations over the many details of the project, especially the choice of the transmission line which will serve Senegal and Mauritania. It has been especially difficult to reconcile the views of the various ministries responsible for energy, agriculture, finance and so on, and those of OMVS and the National Energy Corporations.

It has taken ten years of negotiations and compromise, to reach a stage where the financing can go forward, but today this is almost complete for a total of \$483 million.

Problems still remain, of course, but it would appear that finally the realities of OMVS are near at hand.

*Alioune Fall*

## Reports from Stavanger

Editor's note: The 17th IAEE International Conference in Stavanger, Norway from May 25 to 27 was a huge success, both intellectually, socially and from a networking standpoint. Following are some of the reports from the conference.

### A Note from the Conference Chairman

It was a great pleasure to welcome nearly 300 delegates to the 17th Annual Conference of the International Association for Energy Economics. I was especially pleased to recognize that more than 40 countries were represented, a record number in the history of the IAEE.

The theme of the conference was *Energy Markets in Transition*, with a focus on the rapid changes taking place in these markets all over the world. Deregulation, privatization and developments of market-based systems are dominant features of this transitional period. At the same time, a strong environmental movement and stricter environmental controls create challenges and opportunities for the energy industry, and for the formulation of national energy policies.

The energy market dynamic is a tug of war between perceptions and reality. An illustration of this can be found in the oil market, with the developments in the paper markets versus market fundamentals. At some stage the physical realities correct the paper markets and market perceptions.

Initially, the conference was a paper market - driven by perceptions. And, not as a surprise, there was an enormous amount of paper transactions and papers involved.

The perceptions related to this conference must have been very positive given the number of papers submitted, speakers and delegates registered and support received prior to the conference.

In the energy world, market perceptions and scenario building seem to have a stronger impact on capacity developments and supply potential than on demand.

Based on perceptions and paper transactions - capacity was built and demand scenarios developed. Starting the conference, the fundamentals and market realities ruled.

The success of the 17th Annual IAEE Conference was then entirely in the hands of the participants, the result being the concerted efforts of all of them during three wonderful days in Stavanger. Their active participation cleared the marketplace.

It was an honor to be the General Conference Chair. I was, however, not alone and it would not have been possible without the very strong support from many individuals and organizations.

My grateful appreciation to the Norwegian Association for Energy Economics and its Chairman, Bjorn Brochmann. Without their strong support and Bjorn Brochmann's personal dedication this conference would not have been possible.

A special thanks also to the Council of the International Association for Energy Economics - they accepted our application for this conference under the presidency of Ulf Hansen in 1992 and were very supportive all the way. Our President this year, Jean Masseron, was very active in the direct promotion of this conference, and I was grateful for having him as my Co-Chair.

The excellent professional agenda was made possible by a strong program committee under the dedicated leadership of Einar Hope. We owe him a special thanks!

The organizational aspects were well taken care of by the Organizing Committee under the efficient leadership of Anne-Grete Ellingsen and with the management of the Secretariat by Eli Rosberg from Bennett.

Finally, the financial and professional support of several organizations was instrumental in securing the right framework for the conference to be a successful event - logistically as well as financially.

The stage was then left to the delegates - our good friends of the International Association for Energy Economics. We all gathered to discuss the various aspects related to the general conference theme *Energy Markets in Transition*, with the focus on key issues and driving forces setting the scene for energy supply and demand into the next century. I would like to thank all participants whose active participation made this conference a great success - both professionally and socially.

*Odd Hassel*  
General Conference Chairman

### The Stavanger Conference Programme

Organizing the programme for an international conference is an interesting exercise or experiment from a market perspective. The theme of the IAEE Stavanger conference was *Energy Markets in Transition*. Is the "market" for papers and professional contributions to IAEE international conferences itself in transition? In particular, will there be a sufficient supply of interesting and high quality papers and contributions, with a balanced regional and sectoral representation, to meet the standards and fulfill the expectations of the Association and the conference participants?

We were fortunate enough to have an excess of papers of some 30% for the concurrent sessions. This meant that we could make a selection of good quality papers. Approximately 100 papers were presented at the conference, representing more than 40 countries. I think that we obtained a fairly well balanced regional representation in the final programme, even though we could have hoped for more papers from the LDCs and from Eastern Europe.

With respect to sectoral representation, some might object that there was an overrepresentation of papers about the electricity industry and to some extent also about the gas industry. Personally, I think that this is basically a reflection of present research interests and preoccupation of energy economists rather than an overrepresentation, simply because it is in those industries where the transition process towards market reorganization and deregulation has been most rapid and dramatic.

In addition to the papers we received in response to the Call for Papers, we organized a number of invited papers sessions. My impression is that those sessions were well attended and positively received by the conference participants.

All the professional contributions, both in plenary sessions and in concurrent sessions, have been published in three



volumes of Conference Proceedings, with a total number of some 1200 pages. I hope that members of the Association will find the Conference Proceedings a valuable source of information and that they will be used as an important reference work for energy economists for some time to come.

*Einar Hope*  
*Chairman of the Programme Committee*

## Energy in Economies in Transition

One of the concurrent sessions at the Stavanger conference was dedicated to the highly dynamic energy developments in Central and Eastern Europe. Ulf Hansen, chairman of the European Foundation for Cooperation in Energy Economics and former president of IAEE, chaired the session.

IAEE representatives from Poland, Hungary, Russia and the three Baltic states (Estonia, Lithuania and Latvia) presented their views on the development of the energy sector after the breakdown of the "command economy" and the Soviet Union. They gave us inside reports on one of the most spectacular events in modern history in terms of economic transition. Following is a personal interpretation of this very interesting session.

### Restructuring

A significant decline in energy consumption has been observed over the last 5 years in all these countries. The most important reasons behind this development are the economic depression and restructuring which the former communist block is now going through. Energy price reform, which in many cases has led to more than a tenfold increase in real energy prices, is also a significant contributor to reduced energy use.

The energy importing countries, especially, are feeling the pain of having adapted to - during decades of "central planning" - an energy consumption many times too high in relation to what they can afford under world market prices. This will be the situation both if they continue to rely on Russian sources or if they turn to the world market.

Diversification of energy supplies and less dependence on Russia is an important objective, especially for the Baltic nations.

### The Debt Problem

One important feature of energy price reform in all these countries, including Russia, is the debt problem. Under existing economic conditions, neither households nor industry can afford to pay market prices. On the other hand, electricity and gas companies cannot simply cut off deliveries to large cities and basic industries upon which a whole region depends. Instead debt is accumulating. As a consequence, the energy companies lack money to make investments.

In many cases, where energy consumption and production capacity were far too high in the first place, the problem is not open to short term solutions. The debt problem is also affecting production of energy for export. Russia is the prominent case, where falling oil production, to a large extent due to lack of finance, is adding to its economic problems and scarcity of foreign currency.

As Andrei Konoplyanik from Russia expressed it: "There is a mutual dependency between the energy complex and the rest of the economy. You cannot, therefore, expect a solution to energy problems before the economy and society as a whole is functioning more effectively and is more healthy."

It may, therefore, be encouraging, also in terms of energy, that the economies in these countries seem to have passed the bottom and are on the road to recovery.

### A Bonus for Russia?

The breakdown of the Soviet system and a transition to sound energy pricing can, in my view, turn out to be a big advantage for Russia and especially for her energy industry:

- world market prices for energy export to previous allies and former Soviet republics will boost the foreign currency earnings.
- an energy price reform in Russia may release huge amounts of otherwise domestically consumed energy for export purposes.
- their huge energy resources can be exhausted in a more cost and resource efficient way.

The conference owes thanks to the sponsors of this special session: Norsk Hydro, a Norwegian energy based industrial company with a broad range of activity also in Eastern Europe, and the European Foundation for Cooperation in Energy Economics.

*Bjorn Brochmann*

## Learning About Electricity in Stavanger

The IAEE's 17th Annual International Energy Conference was replete with the unexpected. The setting was entirely appropriate for an energy group, and attendees were prepared to learn about crude oil and to experience first hand the rigors of the North Sea. The first surprise was that the leading topic in Stavanger was not oil, although it was not hinted in the program, but electricity deregulation about which, it turns out, Norway has a lot to offer the rest of the world. The second surprise was that the North Sea rewarded attendees with three beautiful, sunny and mild days.

The Norwegian hosts organized a conference that captured the best of what the IAEE has to offer. Einar Hope and his program committee achieved just the right balance among the three constituent elements of the IAEE: industry, academia and government. Each was well and fully represented in attendance as well as in a program that contained both relevance and rigor. The full integration into the program of the IAEE's annual awards - this year, to Walter Mead and Walid Khadduri - was a very nice touch, and a feature of the conference that deserves to be continued.

Like others before, the 17th International Conference of the IAEE offered a unique opportunity to meet old friends and to make new acquaintances from around the world and to experience the unique local touches that have become such a tradition for the less serious part of the meeting. But the best is always that unexpected insight and new perspective that

*(continued on page 10)*

## Electricity in Stavanger (continued from page 9)

makes attendance both professionally imperative and personally rewarding. In this, the General Conference Chairman, Odd Hassel, and Bjorn Brochmann, president of the Norwegian affiliate, and their colleagues did not disappoint. Those who had the good fortune to attend, as well as those who value a vibrant and strong IAEE, owe our Norwegian hosts a strong vote of thanks.

A. Denny Ellerman  
Past President

## The Social Side of Stavanger

The social events organized by our Norwegian hosts in Stavanger were truly marvelous. The council dinner hosted by the Mayor of Stavanger was held in a quaint old mansion — a truly wonderful evening. Another memorable evening was the voyage of a flotilla of boats through charming skerries around Stavanger to the island of Sjernaroy (see pictures below.) Finally, the elegant conference dinner at the Atlantic Reso Hotel marked another event we will not forget.

Outside of all the good food, scenery and wines, the IAEE Conference in Stavanger gave us a feeling of warmth, friendship and sense of being welcomed every moment of our stay. The conference atmosphere was relaxed, while serious. Our Norwegian host did an excellent job.

Fereidun Fesharaki  
Past President



Top: Past Presidents Denny Ellerman and Ulf Hansen and other guests enjoying the social evening on the island of Sjernaroy. Bottom: Other conferees enjoying the dinner on Sjernaroy with a bit of local music in the background.

## Japan Revises Long Term Energy Outlook

On 21 June, the Advisory Committee for Energy of the Japanese Government published its *Long Term Energy Outlook*, a revision of the one published two years ago.

The new *Outlook* has two cases: (1) a "Current Policy Case" assuming only ongoing policy measures and (2) an "Enhanced Policy Case" assuming additional policy measures especially aimed to improve energy efficiency, including measures to change the social and transportation systems.

Primary energy demand in 2000 is lowered from the 597 M.Kl.o.e., of the previous *Outlook*, by 6 M.Kl.o.e. to 591 M.t.o.e in the "Current Policy Case" and decreased by 15 M.Kl.o.e. to 582 M.Kl.o.e. in the "Enhanced Policy Case." For 2010, primary energy demand is lowered by 4 M.Kl.o.e. from 666 M.Kl.o.e. to 662 M.Kl.o.e. in the "Current Policy Case" and by 31 M.Kl.o.e. to 635 M.Kl.o.e. in the "Enhanced Policy Case."

The difference between the two cases is thus fairly small, and it is unrealistic to assume no additional policy measures.

In this outlook, primary energy demand is estimated to grow 0.9% per annum for the period from 1992 to 2000, and a like amount per annum from 2000 to 2010. Meanwhile, GNP is expected to grow 3.0% per year from 1992 to 2000 and 2.5% per year for 2000 to 2010. Energy GNP/elasticity is thus estimated at 0.3 for 1992 - 2000, and 0.36 for 2000 - 2010.

This very large improvement in projected energy efficiency is comparable to the one achieved in the volatile period following the first oil shock. Given the expected relatively stable, low price and ample supply of fossil fuel, repetition of such a large improvement in energy efficiency is difficult to visualize.

On the supply side, the capacity of nuclear power is expected to grow from 34.4 million kW in 1992 to 45.6 million kW in 2000 and to 70.5 million kW in 2010. Dependency on oil is expected to fall from the current 58.2% to 52.9% in 2000 and 47.7% in 2010. These projections have been raised slightly from the previous ones. Use of LNG is expected to grow from 40 million tons in 1992 to 53 million tons in 2000 and to 58 million tons in 2010. Coal usage is expected to rise from 116.3 million tons in 1992 to 130 million tons in 2000 and 134 million tons in 2010.

If this energy outlook is realized, CO<sub>2</sub> emission per capita will flatten out after 2000 at the level of 1990.

Question: Are the enhanced policy measures enhanced enough?

Kenichi Matsui

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## Council Makes Proceedings Available at Reduced Cost

The IAEE Council has voted to make a limited number (100 sets) of the Proceedings from the Stavanger International Meeting available to members at the cost of mailing and shipping. The cost is \$10.00 which includes surface mail to all locations. The Stavanger proceedings are a three volume set. Please use the order form on page 5.

## Cassedy Joins King Publishing Group

John Walsh Cassedy, Executive Director of IAEE from 1984 to 1992, has left the association management field and joined King Publishing Group in Washington, DC. In her new capacity as Associate Publisher, Joan is responsible for the non-editorial side of the company including marketing, new business development and conference organization.

King Publishing is a large newsletter publishing and conference management firm. King publishes *The Energy Daily*, *Defense Week*, *New Technology Week* and *Nuclear Remediation Report*, among other newsletters.

## NEWS FROM THE AFFILIATES

(Affiliates and Chapters are Urged to Keep the Editor Informed of Their Activities)

### Singapore Affiliate News

The Singapore affiliate was established in September 1993, and now has over 60 members. Marking its first full year of existence, the affiliate recently had its third public lecture. Dr. Fereidun Fesharaki, Director, Program on Resources, East-West Center, and Past President of the IAEE, addressed a special luncheon on "China: Oil Product Trade Flows" co-hosted by the Singapore affiliate of the IAEE and the French oil company, Total, on Friday September 16th.

"Given China's move to centralize the oil and refining sector, the chances of new refinery ventures are very slim whilst China's import requirements are looming larger and larger. The import requirements are largely in refined products particularly diesel and gasoline. Without adequate refinery construction, China's product imports will reach 850,000 b/d by the year 2000 and 1.4 mn b/d by 2005, of which more than two-thirds will be diesel fuel. China single-handedly is likely to raise product prices and affect refinery margins all across the region. At the same time, China will penalize itself by having to pay the higher prices created by its own actions. China's refining policy is approaching the critical stage not only for China but also for the Singapore market as well as the whole Asia-Pacific region" said Dr. Fesharaki in his comments on the recent reforms.

The talk was well attended with over 50 people representing most of the larger companies in Singapore. Almost all the wire services were present, with journalist-members representing Reuters, Platt's, Petroleum Argus, Knight-Ridder, and Petroleum Intelligence Weekly. The speech was reported in the *Straits Times* and *Business Times*, both being local dailies. Guests from Total included Mr. H. de Mestier, Chief Representative, Northeast Asia, who gave a brief speech on Total's joint-venture refinery in Dalian, China.

The Singapore affiliate hopes to be able to carry out its second year of existence with a series of equally interesting public lectures in the coming year.

*Tilak Doshi*

### AIEE has Active First Half

During the first half of 1994, the Italian affiliate, AIEE, organized a number of domestic conferences and seminars on energy, oil and the environment. The most important of these was held in Rome in June at the Ambasciatori Hotel and had the theme *The Energy Policy in Italy: Notes and Proposals for the New Legislature*. This was sponsored jointly with the Istituto dell'Economia delle Fonti di Energia of Bocconi University in Milan and had the support of Banca Nazionale del Lavoro (Rome.)

With over 200 participants, including many journalists, the seminar focused on the main problems of the energy sector in Italy, specifically the privatization of the large energy agencies (ENEL and ENI), creation of an Authority to regulate services and tariffs, the impact of the EEC rules and directives and the effect of environmental rules and policies on output and consumption.

The meeting discussed and analyzed various aspects of Italian energy policy as presented in papers by Dr. Curcio, president of the AIEE; Prof. Gatti, General Director of Energy Sources of the Ministry of Industry; Prof. De Paoli, Deputy Director of IEFE (Bocconi University); Prof. Clo, Bologna University and Prof. Garriba, Director of the Energy Department of ENEA. Subsequently, representatives of the largest agencies and companies, ENI, ENEL, Edison, Unione Petrolifera and public energy utilities presented their views on privatization and regulation problems as they related to the electrical and oil sectors. A round table discussion also ensued involving representatives of several political groups including North League, Forza Italia, Italian Popular Party and Left Democratic Party.

*Edgardo Curcio*

### Workshop on the Future of the Refining Industry

On June 9th the Centre for Economics and Management of the Ecole Nationale Supérieure du Pétrole et des Moteurs organized a one-day workshop on the "Future of the Refining Industry." What is the outlook for the industry at a time when

*(continued on page 15)*



## Tomorrow's Engines and Fuels

In the domain of transport and fuel technologies, it makes sense to forecast a strategy of evolution rather than revolution. Small advances that can be widely applied to current technology will be much more effective than any hypothetical order-of-magnitude gains, which would require building up new technology from zero.

However, the "revolutionary" strategy should still be carried out in answer to special situations which require drastic solutions. For example, "zero emission" cars might be the best answer to highly polluted and traffic-overloaded city centers.

After reviewing the global automotive fleets and their fuel consumption, this article will address the major advances that can be expected in fuel and engine technology over the coming decade. Alternative fuels and engine strategies will also be covered.

### Vehicles and Their Fuels: Global Views and Trends

The total number of engine-powered vehicles is approximately 600 million, with more than two-thirds in the OECD countries. In these countries, a moderate increase will be seen until 2010. The sharpest growth of vehicles is expected in most of the developing countries, as a result of their economic development.

In an optimistic scenario, the fleets of the developing countries could reach 300 million vehicles.

The overall consumption of fuel for transport was approximately 1750 million tons for the year 1993.

It is expected that in the coming 15 years the demand for transport fuel will remain steady in the USA, but will increase in all other regions of the world. In the most industrialized countries, the slow increase in demand is due to the saturation of space and needs, combined with gradual progress in vehicle fuel efficiency.

The sharpest increases in fuel demand are expected in the developing countries, i.e., 90% between 1993 and 2010. This raises a number of important questions, particularly that of the ability of these countries to raise the extra funds required to develop transport.

Both consumers and national authorities began to be more aware of car fuel consumption during the oil crisis in the seventies. Since that time, consumption has continued to drop. In the USA, average fuel economy of standard cars progressed from a high 20 liters per 100 kilometers in 1970, to less than 10 liters/100 km in 1990. In Europe, consumption fell from 12 to 8 liters/100 km.

### The Next Step in Lowering Consumption Will Be Stimulated By CO<sub>2</sub> Emission Limits

It has taken thirty years to develop high citizen sensitivity to pollution, and to develop the technical solutions to bring car emissions from a "no control" situation to a very acceptable cost-efficient status (at least for the 3 main gaseous pollutants, i.e., CO, HC and NO<sub>x</sub>). Between 1972 and 2000, reduction by a factor of between 10 and 100 will have been achieved.

It is clear that further improvement cannot be made with only the continued reduction of these three main pollutants. New approaches, based on air quality control, should replace simple emission control. For instance, ozone is becoming a major factor in air quality in cities. Detailed analysis of

reactive hydrocarbons is necessary to control ozone formation in the lower atmosphere, because their reactivity varies from 1 for methane to more than 700 for butadiene.

There is a significant correlation between the chemical composition of fuel and its evaporated or unburned hydrocarbons. This is why fuel formulation is recognized more and more often as an effective approach to improving air quality.

Toxicity of emissions is also being studied. Today, CO and five HC species are under consideration: benzene, butadiene, formaldehyde, acetaldehyde and PNA (polynuclear aromatics). The concentration of these HC's in exhaust emissions is also clearly correlated with fuel composition.

To summarize the challenge of better air quality for the future, three technologies will have to progress in a coordinated manner:

- much cleaner combustion in engines
- advance catalytic conversion of the exhaust gas
- fuel formulation

### New Engine and Fuel Technology for Low Consumption and Emission

#### New Engine Technology

Today, 3-way catalyst technology eliminates both CO and unburned hydrocarbons by oxidation into CO<sub>2</sub> and water. Simultaneously, NO<sub>x</sub> is reduced to N<sub>2</sub>. Elimination of these three pollutants is possible only if the combustion has been achieved within a very accurate window of fuel/air ratio centered at stoichiometry. This requires very precise electronic control of the air-to-fuel mixture. Ideally, more than 90% of the CO, HC and NO<sub>x</sub> is eliminated when the catalyst has reached the proper operating temperature.

However, 3-way catalyst technology has two drawbacks: 1) its efficiency is poor under cold conditions - until a temperature in the range of 250 degrees C is reached; 2) it requires engine settings that increase fuel consumption by 7 to 12%.

Moreover, under cold conditions the unburned hydrocarbon composition is strongly correlated with the fuel composition, while this correlation is nearly eliminated with an active catalyst. R&D is being carried out on a catalyst heated by engine control or by electrical devices that will eliminate the cold operation problem.

The 4-stroke and the 2-stroke lean burn, gasoline or diesel engines are today alternative solutions which offer better fuel economy than the conventional 4-stroke gasoline engine with a 3-way catalyst.

The diesel automotive engine is widely developed in Europe and recognized as a valuable solution for fuel economy and low emissions. Its benefit in average fleet consumption has been proven at between 15 and 25%. These gains are even higher with the new automotive direct injection (DI) engines, which are beginning to be marketed.

The diesel engine belongs to the family of lean burn engines. Its high efficiency combustion principle is obtained by an overall fuel/air ratio below stoichiometry (lean). The same approach can be applied to gasoline engines. But for good control of diluted combustion, it is necessary to achieve advanced engine design and control.

A new generation of 2-stroke direct injection gasoline engines represents the most promising future for new en-

gines. They combine the advantage of the best fuel economy with a significant advantage in power-to-weight ratio and sizing.

Three advanced after-treatment technologies should be mentioned, because their success could significantly lower the pressure on fuel reformulation. These technologies are:

- 3-way catalyst heated directly by electric power or by engine control;
- diesel particulate filters with an appropriate regeneration strategy;
- NO reduction catalyst for diesel and lean-burn gasoline engines.

Extremely low emission levels can be expected from these technologies. They might require adequate fuel specifications, but they will be less stringent than deep reformulation. Once the technical questions have been reasonably developed, the debate to implement such technology should address the matter of cost-to-benefit between the car, the after treatment and the oil industry, probably under the control of policy makers.

### Clean and Efficient Fuels

Today, fuel reformulation for the sake of environmental protection is probably one of the "hottest" topics debated by industry, policy makers and citizens.

#### Reformulated Gasoline in the USA

The most complete set of results on gasoline reformulation has been published by the American Auto-OPil program. Table 1 summarizes the results, which are of general interest when relating fuel composition to pollution. Pollution is divided into three categories:

- direct gaseous emissions CO, HC, NOx, which are subject to regulations;
- ozone formation potential resulting from the HC composition;
- emission of 4 toxic species: benzene, butadiene, formaldehyde and acetaldehyde.

Table 1  
Gasoline Reformulation

| Parameter                       | CO   | HC   | NOx | Ozone | Toxic* |
|---------------------------------|------|------|-----|-------|--------|
| Aromatic<br>45 to 20 %          | -13% | -6%  | =   | =     | --++   |
| Olefin<br>20 to 5%              | =    | 6%   | -6% | -10%  | ==     |
| MTBE<br>0 to 15%                | -11% | -5%  | =   | =     | ==++   |
| T90%<br>182 to 138 <sup>o</sup> | =    | -22% | 5%  | -10%  | ----   |

\* benzene, butadiene, formaldehyde, acetaldehyde

From this table, it is clear that reformulation is a complex subject and that no one can expect a "miracle" fuel composition that will lower all sources of pollution. If HCs must be reduced, then aromatics reduction and MTBE and T90% reduction have a positive effect.

Unfortunately, MTBE, which is widely used to maintain the octane level when aromatics are reduced, tends to increase aldehyde emissions. Furthermore, gasoline reformulation tends to increase consumption.

#### Gasoline Quality in Europe

The European Community has defined a standard quality

for unleaded premium, often called "Eurosuper," with RON > 95 and MON > 85. Oxygen, benzene and sulfur are subject to limits.

The French car manufacturers are promoting a quality standard for fuel. Fuels can obtain this label if they give advanced performance, guaranteed by a set of engine and vehicle tests.

This strategy, which does not impose detailed composition limits but performance levels, can be considered as an alternative to the "reformulation" approach. It brings benefits to the consumer while probably imposing fewer constraints on the oil industry. However, it should be noted that the required performance level can hardly be reached without an efficient additive package.

#### Reformulation of Diesel Fuels and the "City Fuels" Tax Incentive

Because Europe has various diesel powered vehicles, special attention is given to supply quantities and to the quality of diesel fuel. Cetane numbers remain high throughout Europe, with a significant number of survey samples above 50-52. Sulfur content stands at an average of about 0.15 wt%. Much effort is still needed to meet the European Community requirement of 0.05 wt% in 1996. This value is considered by car manufacturers as the first step toward allowing the use of oxidation exhaust catalysts without the drawback of excessive sulfate formation.

The diesel engine's good fuel economy and the correlated CO<sub>2</sub> emission is recognized more and more often. For this reason, it could be encouraged if its main drawback, i.e., high NOx emission, can be controlled. Fuel reformulation can contribute to solving this problem.

Under standard operating conditions, deeply reformulated fuel reduces particulates by 30%. If the engine is designed to achieve low NOx emissions, then the benefit of the reformulated fuel is much greater. Thus, advanced combustion and fuel can combine their benefits to reduce NOx by 50% and particulates by 60%. It is clear that car manufacturers are greatly interested in reformulated diesel fuels in Europe.

Today, the oil industry cannot produce adequate volumes of deeply reformulated diesel fuel, but is encouraged by tax incentives - U.S.\$100/m<sup>3</sup> for producing "city fuel" in Northern Europe.

#### New Fuels and Their Dedicated Engines for Specialized Markets

What is the best substitute for the conventional piston engine? Most of the specialists consider that it is still - and will be for an unlimited period of time - the piston engine.

What is the best substitute for oil? It is certainly oil, but for a limited number of years. Simply, because fossil energy is limited, it is clear that alternative fuels must be considered.

#### Conclusion

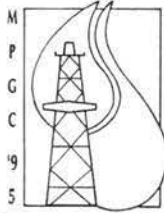
For the next 10 years, although the overall appearance of engine technology will remain the same, engines will have to progress in terms of fuel economy. Indeed, fuel economy, closely coupled with CO<sub>2</sub> emission control, is likely to become a greater priority.

Clean and efficient fuels can efficiently meet advanced emission control and fuel economy goals. However, it should

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- Peter Wildblood, Chief Executive, International Petroleum Exchange of London
- Ferdinand Berger, Director, Middle East, Francophone Africa and South Asia; Shell International Petroleum Company London, London
- Keith Hamm, Managing Director, PEL, London
- Dr R. K. Pachauri, Director, Tata Energy Research Institute, New Delhi
- Kevin Leydon, Head of Division, Analyses & Forecasts, Commission of the European Communities, Director-General, Energy, Belgium
- Hossein Razavi, Chief, Oil & Gas Division, The World Bank, USA
- Vahan Zanojan, Senior Director, The Petroleum Finance Company Ltd, USA
- Dr Samir Malaty, Vice President, Overseas Bechief Incorporated, Muscat

- H. Drucker, Associate Laboratory Director, Energy & Environmental Science & Technology Division, Argonne National Directory, USA
  - Essam Trabulsi, President, ET Petroleum, USA
  - Bijan Mossavar-Rahmani, Apache International Inc, USA\*
  - Herman Franssen, Economic Advisor to H. E. The Minister of Petroleum & Minerals, Oman
  - Dennis O'Brien, Chief Economist, Caltex Petroleum Corporation, USA
  - M.S. Robinson, Chairman of the Energy & Environmental Steering Committee, Royal Institute of International Affairs, UK
  - Cyrus H. Tahmassebi, Chief Economist, Ashland Oil Inc., USA
  - Fereidun Fesharaki, Director Program on Resources, East-West Center, USA
- Other Ministerial speakers and additional speakers will be included in the final programme

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### DELEGATE PROFILE

- Senior upstream and downstream energy executives • Oil trades and industry analysts • Senior government representatives • Financiers and bankers in oil and gas • Engineering and contracting firms • port authorities and shippers.

### ENQUIRIES & REGISTRATIONS

MPGC '95 Secretariat:

Conference Connection Administrators, Pte Ltd. 220 Orchard Road, #05-01 MidPoint Orchard, Singapore 0923. Tel: 65+256-9341 Fax: 65+254-5628

### AGENDA & TOPICS

- Regional economic outlook • OPEC and prices, production and supply • Natural Gas and LNG prospects • Prospects for Middle East export refineries • US Energy Policy Issues • Middle East oil trading scenarios • Upstream development scenarios • Upstream downstream integration • Competition for capital from Asia, Japan and the CIS oil producing republics • International Oil company presidents review

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The International Association  
for Energy Economics

### REPLY COUPON

The Third Annual Middle East Petroleum & Gas Conference  
January 15-17, 1995, Muscat, Sultanate of Oman

#### Conference Fees:

US\$1295 per person which includes attendance at conference, lunches coffee breaks, one folder of papers and invitations to all hosted functions.

For IAEE members the fee is reduced to US\$1265 per person.

Fees are payable in advance and will be refunded less US\$175, administration charges for any cancellations received in writing on or before December 16 1994. After this date no refunds can be made although substitutions are allowed.

To register for the Conference, please complete the form below and send to 220 Orchard Road, #05-01 Midpoint Orchard, Singapore 0923 or fax 65+254-5628.

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**Contact Person**

For more information please contact Melissa James at telephone 214-767-1691 or fax 214-767-5534. Equal Opportunity Employer.

**Tomorrow's Engines and Fuels** (continued from page 13)

be kept in mind that goals must be set in terms of performance, and not in terms of fuel composition. The fuel "reformulation" strategy does not appear to be the most efficient one.

The question of alternative fuels from biomass is justified on a long-range basis, in phase with the shrinking of conventional fossil fuels. Their short-term use responds mainly to questions connected with economic problems in relation to the agricultural world.

Gaseous fuels, CNG and LPG, demonstrate very high anti-pollution performance, especially at low temperatures. However, they require special engines in order to supply their best potential. They are well suited for niche applications, such as taxis (LPG), or city buses (CNG). Their "nearly zero emission" potential makes these engines the real economic challengers to electric cars.

Finally, fuels - which are basically energy vectors - have a number of other functions to fulfill, such as tax collection or local problem solution. These "external" justifications may be of paramount importance in certain special situations. The multiple dimensions of the fuel domain should be assumed and should be managed by all the players: industry, government and consumers.

*A. Douaud, Institut Français du Pétrole*

**Workshop** (continued from page 12)

margins are low and environmental constraints call for ever-increasing capital investment in order to improve product quality and reduce pollutant emissions from refineries?

Several presentations provided material for discussion:

- J.P. Favennec (ENSPM-FI) outlined recent developments, gave an indication of costs and margins and estimated the capital investment required.
- J.C. Company (Total) attempted to determine the form of conversion that could provide an answer to the growing need for light products. But the problem is how to invest in capital-intensive conversion units when there is such a small gap between the prices of light and heavy products.
- P. Guerard (Elf France) analyzed the consequences of environmental regulations and indicated the investments and costs that could be required as a result of more and more stringent quality specifications for the various products.
- E. Freund (IFP) summed up the status of research and the perspectives for refining processes. Most of the technology required to meet the qualitative and quantitative needs of the year 2000 already exists but it involves extremely high refining costs. Consequently, this calls for an enormous research effort.
- In the afternoon, D. O'Brien (Caltex) and P. Obe (Esso) examined the status of refining in Asia and the United States, pointing out the differences in attitude between the two areas. In Asia, cooperation based on mutual trust is developing between refining companies and governments in order to meet growing demand, whereas in the United States the situation is more complicated, and some refineries are seriously threatened with closure.
- G. Montanier (BP) concluded the day's session by outlining BP's strategy in Europe for the downstream sector. He was neither pessimistic nor optimistic, and emphasized the opportunities for cost cutting cost, which are vital if refiners are to survive.

Simultaneous interpretation from French to English and English to French was provided, enabling around 50 persons, including representatives from several companies outside France, to hear the presentations and take part in the discussion.

*Jean Masseron*

**Calendar**

**13-16 November 1994, Nuclear Energy Forum.** Washington, DC, USA. Contact: Conference Office, US Council for Energy Awareness, 1776 I Street NW, Ste 400, Washington, DC 20006. Phone 202-293-0770. Fax 202-466-0246.

**16 November 1994, U.S. Environmental Policies: Are We Barking Up the Wrong Tree?** Washington, DC, USA. Contact: ACCF Center for Policy Research, 1750 K Street, NW Ste. 400, Washington, DC 20006-2300 USA. Phone: 202-293-5811. Fax: 202-785-8165.

**29 November - 2 December 1994, National Actions for International Commitment: Evaluating Climate Change Action Plans.** Washington, DC, USA. Contact: Wendy H.

*(continued on page 16)*

**Calendar** (continued from page 15)

Petry, Conference Coordinator, Center for Environmental Information, 50 Main Street West, Rochester, NY 14614-1218 USA. Phone: 716-262-2870. Fax: 716-262-4156.

**6-9 December 1994, Refining, LNG & Petrochem-Asia 94.** World Trade Centre Singapore. Contact: Yvonne Low, Marketing Services Executive, Singapore Exhibition Services Pte, Ltd., 11 Dhoby Ghaut #15-09, Cathay Building, Singapore 0922. Phone: 65-338-4747. Fax: 65-339-5651.

**15-17 January 1995, Third Annual Middle East Petroleum & Gas Conference (MPGC '95).** Al-Bustan Palace Hotel, Muscat, Sultanate of Oman. Contact: Vimla Mulchand, The Conference Connection, Inc., P.O. Box 1726 Raffles City Post Office, Singapore 9117. Phone 65-256-9341. Fax: 65-254-5628.

**7-8 February 1995, 1995 Energy Efficiency & the Global Environment Conference.** Newport Beach, CA, USA. Contact: June Appel, Synergic Resources Corp., 111 Presidential Blvd., Bala Cynwyd, PA 19004 USA. Phone: 215-667-2160. Fax: 215-667-5593.

**11-12 April 1995, Energy Strategy for Europe,** sponsored by the AIEE (Associazione Italiana Economisti dell'Energia). Hotel Sheraton Rome. Contact: AIEE, Via Giorgio Vasari, 4, 00196 - Roma - ITALY. Phone: 39-6-3227367. Fax: 39-6-3234921.

**8-10 May 1995, 1995 International Conference on Energy & Environment.** Shanghai China. Contact: Prof. Zhi-Hang Chen, Conference Chairman SIME, PO Box 482,

516 Jun Gong Rd., Shanghai 200093 P.R. China. Phone: 86-21-5435883. Fax: 86-21-5431258.

**28-30 June 1995, 7th National Demand-Side Management Conference.** Dallas, Texas, USA. Contact: Pam Turner, Electric Power Research Institute, 3412 Hillview Ave., Palo Alto, CA 94304 USA. Phone: 415-855-8900.

**5-8 July 1995, 18th IAEE International Conference.** "Into the Twenty-First Century: Harmonizing Energy Policy, Environment, and Sustainable Economic Growth." Washington, DC, USA. Contact: IAEE Headquarters, 28790 Chagrin Blvd., Ste. 210, Cleveland, OH 44122 USA. Phone/Fax: 216-464-5365.

**18-20 July 1995, Energy Models for Policy and Planning.** An IFORS special conference at the London Business School. Contact: Professor Derek W. Bunn, London Business School, Sussex Place, Regents Park, London NW1 4SA, England. Fax: 44-71-724-7875. Email: energy@lbs.lon.ac.uk.

**8-13 October 1995, 16th World Energy Council Congress, "Energy for Our Common World: What Will the Future Ask of Us?"** Tokyo, Japan. Contact: Organizing Committee, Shuwa Kamiyacho Bldg., 4-3-13 Toranomon, Minato-ku, Tokyo 105, Japan. Phone: 81-3-3437-4727. Fax: 81-3-3437-4678.

**9-12 October 1995, International R&D Conference, "Water & Energy 2001: Needs, Development, Utilization"**. New Delhi, India. Contact: C.V.J. Varma, Member Secretary, Central Board of Irrigation and Power, Malcha Marg, Chanakyapuri, New Delhi-110021, INDIA. Phone: 3015984. Fax: 91-11-3016347.

**IAEE Newsletter**

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