IAEE
WWW.IAEE.ORG
INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS

IAEE Energy Forum

Fourth Quarter 2009 International Association for Energy Economics

President's Message

This message comes to you shortly before the Copenhagen Conference which should develop a global climate protection strategy for the Post-Kyoto period 2013 to 2020. If many high-level political leaders meet at such an occasion, there will quite likely be some "diplomatic success," but today it remains quite uncertain whether there will be substantial international agreement on reducing Greenhouse Gas emissions (GHG emissions) for the period until 2020.

Looking back to the 1997 Kyoto protocol, its aim was to stabilize the global GHG emissions 2008-2012 and to reduce these emissions for the developing countries (so called Annex-I countries) against the year 1990. Both targets will be missed. In 2008 global CO_2 emissions were 37 percent above the level of 1990. Some OECD countries perform well and will quite likely meet their targets, but since 1990 OECD countries as a group have increased their CO_2 emissions by 15 percent. The former communist countries of Eastern Europe were able to reduce their CO_2 emissions by nearly 36 percent but this was more the consequence of the economic collapse of their economies in the 1990s than to active GHG politics. According to a recent report of the International Energy Agency, 2009 global CO_2 emissions will decline by 3 percent compared with 2008, but again primarily as a result of the global economic recession.

Regarding these developments, it is not unexpected that climate negotiations are rather sticky and effective consensus difficult to find. Energy economists have extensively analyzed the causes: The winners of ambitious GHG reductions will be the next generations, not the present voters. This makes political bargaining likely. In addition, government representatives anticipate a "double dividend" if they avoid strong national reduction targets on the accounts of other countries, because their economies may benefit from the so called leakage effects – again a case for bargaining. And regarding the governance problems in many countries of the world, it is a challenge to implement effective measurement, reporting and verification systems.

Energy experts, among them academic IAEE members, have presented bright and intelligent proposals on how to overcome these challenges and how to bring the international negotiations to a success, and some of these ideas have a visible influence on politicians. Many ideas were discussed at recent IAEE conferences. I should mention the two most recent events, the 32rd IAEE International Conference in San Francisco this June and the 10th IAEE European Conference in Vienna this August, which both offered plenary and concurrent sessions on GHG issues. By the way, these conferences were quite successful. I would like to thank the two organizing IAEE affiliates as well as the speakers, delegates and sponsors.

Our association is independent from business and other interests and our members and conference delegates are professional. Therefore, the debates at IAEE meetings give valuable insights about global and national GHG strategies. If you are regularly attending our conferences, you know what I mean: Delegates receive up-to-date assessments and inspirations about what should happen and what will likely happen at high level international climate negotiations such as the Copenhagen conference this December 2009.

A similar situation exists concerning the other hot topics of contemporary energy economics such as improving energy efficiency, securing energy, organizing wholesale and retail competition, regulating non discriminatory grid access, financing energy in-

(continued on page 2)

IAEE INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
WWW.IAEE.ORG

CONTENTS

Editor: David L. Williams

PRESIDENT'S MESSAGE *(continued from page 1)*

vestments, developing renewable power generation, eliminating energy poverty, and so forth. IAEE publications and conferences reflect the international debate and some of the most prominent economists are engaged. According to their function, academics are used to taking the lead and developing thoughtful concepts and innovative propositions, and presenting them in publications and conferences with the intention of affecting energy policy and legislation and, sooner or later, the energy business. When the political debate about one of these issues becomes hot, business associations start lobbying according to their perceived interests and try to influence the political decisions.

But in the early phases of the debate colleagues from the energy business and energy consulting are underrepresented. It is a paradox: Energy economics becomes increasingly successful in influencing energy policy, but it seems as if energy industries, their representatives and consultants are not much engaged in the debates with relevant academic mentors. I believe that our colleagues from the industry and consulting companies miss an important chance here and I am committed, together with my friend Joe Dukert, president, USAEE, to change this as far as IAEE conferences are concerned. Our idea is to organize special joint industry-academic sessions at IAEE conferences because we believe that the exchange between theoreticians and practitioners is most important and should be intensified. I count on your participation.

This is my last presidential message. I would like to particularly thank all members of the IAEE council, the IAEE conference planning committees, *The Energy Journal* editors and IAEE headquarters for their teamwork and support. There are many reasons why our association is flourishing. One is its dedicated and loyal leadership. Thanks to all of you! I had a rather easy and pleasant task in 2009. I wish all of you energy and luck for a successful 2010.

Georg Erdmann

IAEE Mission Statement

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

We facilitate:

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

We accomplish this through:

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

Editor's Note

Paul Tempest was named recipient of the IAEE 2008 Outstanding Contributions Award. We are pleased to print his remarks accepting the award made at the San Francisco International Meeting.

Once again we are privileged to have a condensed version of the BP Statistical Review. This year Christof Ruehl and Neelesh Nerukar discuss the volatility and structural changes that occurred in 2008-2009 and the lessons to be learned from them.

Gerald Westbrook posits that alternative energies will not be able to provide a replacement for fossil fuels and that we need to learn to live with oil, gas, coal and shale oil. He points out the tremendous progress that has been made in reducing emissions over the course of his life time and that instead of trying to marginalize fossil fuels we should be taking full advantage of the untapped supplies available.

Danielle Devogelaer and Dominique Gusbin discuss the influence a specific target (-15%) reduction in energy related CO_2 emissions on Belgian soil in the period after 2012 has on the Belgian power generation system. Three frameworks differing according to the absence of two energy technologies (nuclear energy and carbon capture and storage) are examined and their impact on power generation and related investments is scrutinized.

Jean Balouga discusses the impact of the global financial crisis on Nigeria noting that the reduction in demand for, and price of, oil are leading to reduced macro economic performance. He details the likely impact on the various sectors of the economy and in particular on the Nigerian States and looks at the national government's response. He concludes with some suggestions for further response.

Peter Kayode Oniemola and Gbenga Peter Sanusi discuss Nigerian bio-fuel policy which is meant to create an environment that encourages the development of the country's bio-fuels industry. This programme constitutes an attempt to integrate the agricultural sector of the economy with the downstream petroleum sector.To achieve this goal, enabling legislation is needed along the lines of that provide by the Brazilian government for the development of its bio-fuels industry.

Marcos Watanabe presents a brief discussion regarding the economic and environmental performance of different biofuel production systems around the world. Using the indices obtained from Emergy analysis, ethanol production systems in Brazil, Europe and U.S. are compared in order to observe their level of economic competitiveness and environmental impact.

DLW

Get Your IAEE Logo Merchandise!

Want to show you are a member of IAEE? IAEE has just rolled out several merchandise items that carry our logo. You'll find polo shirts and button down no-iron shirts for both men and women featuring the IAEE logo. The logo is also available on a baseball style cap, bumper sticker, computer mouse pad, window cling and key chain. Visit http://www.iaee.org/en/inside/merch.aspx and view our new online store!

The IAEE, 1979–2009

By Paul Tempest

Editor's note: Paul Tempest was named recipient of the IAEE 2008 Outstanding Contributions Award. Following are his remarks on receiving the award at the San Francisco meeting.

In preparing for this occasion, I took the precaution of looking up the IAEE on the internet. If those of you out there are members of the International Association of Elevator Engineers, or of the International Association of Exhibitions and Events or of the International Association of Earthquake Engineers, I must warn you that you are probably in the wrong place at the wrong time and may find my forthcoming remarks irrelevant to your interest. Or maybe not!

In late-1979, when I attended the first Annual International Conference of the IAEE in Washington, the world was, in many ways, in the same state as it is today. A real mess and in danger of losing heart in a turmoil of uncertainty.

Panicked by revolution in Iran and the second oil price-hike, the top economists of the day flocked to Washington in 1979 to listen to the wisdom of their elders. Morry Adelman, Sam Schurr, Bill Hogan, Jim Schlesinger spoke at length. There was a letter from the White House, sponsorship money from Rockefeller; TV coverage in abundance. As a foretaste of what was to come (or possibly following an attractive discount on the hotel rate), we were housed in the old Sheraton Hotel where demolition was already in progress. Loud were the dire warnings of inexorable limits to growth, a drying-up of venture capital, energy famine, a bloodbath in the Middle East and a nuclear holocaust. Does this not sound familiar today? How very wrong we all were in our different ways! Can we do better today?

In the piece I have written for my plenary tomorrow, I highlight five fundamental geo-political changes over the last 30 years which, for me, give a strong indication that, over the next 30 years, planet earth needs a new kind of leadership, an enhanced sense of cohesion and accelerated new technology.

As a "problem-solver" and government relations pundit, I have, of course, in my back pocket, my three alternative scenarios. The failure scenario is a disaster movie and does not bear thinking about. The muddling through scenario will clearly not work. The success scenario depends on a collective consensus focused on solving each geo-political impasse, particularly regarding Iran, Russia, China, the Middle East and Europe. Without US wisdom and leadership in these areas, we are doomed to failure. Yet just as the rest of the world had more or less despaired of US-strong-arm coercion over the last decade, we suddenly find ourselves, with Barack Obama, and an astonishing new and unexpected ditching of the old half-truths and a refreshing political openness and sensitivity. No longer are we in a trapped world of bi-polar left and right-wing dogma, locked in a conflict of the industrialised rich and the so-called "developing" or "non-developing" poor. Ahead and upward lies a much more diverse path that can provide a quantum jump into a new, prosperous and sustainable world. Take, for example, the growing impact of the internet in states where fearful totalitarian dictators and regimes have hitherto relied on brute force to consolidate their power and to isolate their subjects. Men and women of global vision, mature judgment and profound goodwill, such as Barack Obama, are on the brink of being able to engage freely with individuals worldwide, and to be able to grasp much more intensely their common but multi-varied global aspirations and needs.

So what can the IAEE claim to have really achieved over the last thirty years? Allow me to leave you with three thoughts.

1. Energy Economics Has Developed into a Vital Tool

The ability to measure much more rigorously the economic value of energy and therefore to be able to identify the most viable mix of energy supply and use has been greatly enhanced, exposing many policy weaknesses and identifying much wider ranges of opportunity worldwide.

2. The International Status of the IAEE is a Role Model

With energy still the most significant feature of international trade, energy inter-dependence demands a corps of well-informed, motivated individuals worldwide. The spread of the IAEE embracing more than sixty leading countries worldwide and a highly developed state affiliate system within the United States has provided a useful mechanism and model for similar international institutions.

3. The Membership Mix of the IAEE is its Hidden Strength

Energy economics is globally far too important to be left either to the energy industries or to the economists. It has to be all-embracing as it again rises towards the top of the global economic and political agenda. Any analysis of the membership of the IAEE demonstrates convincingly what a wide variety of professional expertise is included therein – a vital crossing point for engineers, accountants, bankers, diplomats, journalists, civil-servants, academics and market operators from very many different countries, each intent on learning from the others.

So, returning to my starting-point, and as a thank-you for this Contributions Award, I end, as always, on a provocative note. Perhaps, after all, the IAEE should now be thinking, more in geo-political terms, about:

Elevator engineering, rather than old-fashioned flights of steps
Exhibitions and events addressed to a much wider public
Earthquake engineering and other global disaster contingency management

Thank you. Shukran.

Going to the ASSA Meetings in Atlanta, GA ???

Please remember to tick off the box on your registration form indicating that you are a member of IAEE. This helps IAEE establish presence at the meeting and builds our case for having more IAEE sessions on the program.

Many thanks!!!

IAEE's Rio 2010 International Conference

Intercontinental Hotel & Resorts – Rio de Janeiro – Brazil

June 6–9, 2010

About the event

We are pleased to announce the **33rd IAEE Annual International Conference** entitled ***"The Future of Energy: Global Challenges, Diverse Solutions"*** and invite you to the wonderful city of Rio de Janeiro. The conference is scheduled for **06–09 June, 2010** at the Intercontinental Hotels & Resorts, Rio de Janeiro, Brazil.

An international energy conference in Brazil makes it a privileged forum to analyze the current world energy scenario. Latin America and Brazil have been the stage for important technological and policy changes in the energy industry. Brazil has been the scene for important technological changes in the biofuel and petroleum industries. Furthermore, new energy policies in Latin America have driven reversion in market deregulation in many countries. These aspects raise important questions for energy economists.

Rio de Janeiro – considered by many the energy capital of Brazil – will be the perfect setting for professionals from academia, business and government to debate solutions to the common global challenges in a highly uncertain energy future. The focus of the conference will be to discuss possible changes in energy policies, technologies and markets, taking a careful look of the diversity of solutions currently available.

We invite you to visit our conference website **http://ab3e.org.br/rio2010**; there you will find all the latest information on the conference along with accommodation and travel details.

We encourage you to submit your abstract early for presentation consideration. Abstracts must be submitted online – no later than **January 15, 2010** – at the conference website **http://ab3e.org.br/rio2010** in MS Word format (Adobe PDF is not accepted) using the template provided. Differently from other recent IAEE events, a short CV should NOT be included, as a blind peer review process will be used to select the abstracts. Paper acceptance will be based solely on the extended two-page abstract, covering (1) a brief overview, (2) methods, (3) results, (4) conclusions and (5) references.

We are looking forward to welcoming you for an unforgettable conference in Rio de Janeiro, the stage for the 2014 FIFA's World Cup final and the site for the 2016 Olympic Games.

Contact: rio2010@ab3e.org.br

Program (preliminary)

June 07	08:30–09:00	Opening
	09:00–09:30	Inaugural plenary session José Goldemberg
	09:30–11:00	Special plenary session. Chair: Joe Dukert **The future of energy: new energy policies and technologies** *How energy policies should deal with the advance of new energy technologies?*
	11:00–11:30	Coffee break
	11:30–13:00	Concurrent sessions 01–11
	13:00–14:30	Lunch
	14:30–16:15	Concurrent sessions 12–22
	16:15–16:30	Coffee break
	16:30–18:15	Dual plenary session. Chair: Sadek Boussena **OPEC's 50 years and the future of oil industry** *A new role for OPEC countries in a world with less fossil fuels?* Dual plenary session. Chair: Einar Hope **The challenges of energy regulation in the future** *Retail competition: yes or no?*
June 08	08:30–10:00	Concurrent sessions 23–33
	10:00–10:30	Coffee break
	10:30–12:00	Dual plenary session. Chair: Roberto Rodrigues **Bioethanol: production, use and trade** *What are the main constraints to increase the offer and the demand?* Dual plenary session. Chair: Howard Geller **Energy efficiency, electricity demand and smart grids** *What will be the role of Smart Grids to increase the energy efficiency in the next decades?*
	12:00–13:30	Lunch
	13:30–14:30	Special plenary session. Chair: Edmar L. F. de Almeida **Sub-salt oil in Brazil** *Big oil in a new exploration frontier: what are the technological and economic challenges?*
	14:30–16:00	Concurrent sessions 34–44
	16:00-16:30	Coffee break
	16:30–18:00	Dual plenary session. Chair: Vijay Vaitheeswaran **The future of energy demand in transport** *Electricity in road transport: a real technological and energy changes towards a new car?* Dual plenary session. Chair: Mine K. Yücel *Excess market speculation?* **The future of energy contracts and commercialization**
June 09	08:30–10:00	Concurrent sessions 45–55
	10:00–10:30	Coffee break
	10:30–12:00	Dual plenary session. Chair: Jonathan Stern **Geopolitics of natural gas** *Should we worry about price and gas imports?* Dual plenary session. Chair:Georg Erdmann **Energy development and poverty: key issues for energy access** *How to collect money for investments and the role of social tariffs?*
	12:00–13:30	Lunch
	13:30–14:30	Special plenary session. Chair: José Rubens Maiorino **Innovation and the economics of nuclear industry** *Trade off between technologies and costs*
	14:30–16:00	Concurrent sessions 56–66
	16:00–16:30	Coffee break
	16:30–18:15	Closing plenary session. Chair: Reinhard Haas **Energy and environment: from Rio 1992 to Copenhagen 2009** *What are the remaining barriers and economic tools to cut emissions in the next decade?*

USAEE
United States Association for Energy Economics

IAEE International Association for Energy Economics
www.iaee.org

Working Paper Series

— CALL FOR ENERGY RESEARCH PAPERS —

The USAEE and IAEE have combined efforts to created a working paper series that gives you (and all USAEE/IAEE members) a chance to increase the circulation, visibility, and impact of your research. If you have an unpublished research paper that addresses any aspect of energy economics or energy policy, we would like to feature your paper in this new series. There is no cost to you, only benefits:

- Place your work where it can be seen and used on a daily basis.
- Gain timely feedback from other researchers working on related topics.
- Create a permanent and searchable archive of your research output within the largest available Electronic Paper Collection serving the social sciences.
- Provide unlimited, hassle-free, public downloads of your work on demand.
- Raise your research profile, and that of the USAEE/IAEE, by joining with fellow members to establish a new energy research *trademark* that is unparalleled in terms of its breadth and depth of focus.

The *USAEE/IAEE Working Paper Series* is a new component of the Social Science Research Network (SSRN) *Research Paper Series*. SSRN is the leading online source of full-text research papers in the social sciences, and is accessible at the following link: http://www.ssrn.com/. SSRN is indexed by Google and all other major online search engines, ensuring that anyone who does a keyword search in your area of research will be directed to your paper, including free downloads, and provided with your contact information. SSRN tabulates the number of abstract and full-text downloads of each paper in the series and publishes various "top-ten" lists to indicate which papers are most highly demanded within individual subject areas.

To view current working papers in our series please click here

Contributor Guidelines

The *USAEE/IAEE Working Paper Series* includes only papers that present original, scholarly research related to energy economics and policy. Editorials, marketing tracts, and promotional material will not be accepted. Other than this initial screening, the working papers will be unrefereed and authors are solely responsible for their content. Authors will retain all rights to their work, including the right to submit their working papers (or subsequent versions thereof) for publication elsewhere. Neither USAEE/IAEE nor SSRN will assume or usurp any copyright privileges with respect to papers included in the series.

Each working paper included in the *USAEE/IAEE Working Paper Series* must be authored or co-authored by a member in good standing of the USAEE/IAEE, and be submitted by that member. All papers will be assigned a USAEE/IAEE Working Paper number and fitted with a distinctive cover page that identifies it as part of the USAEE/IAEE series.

To include your research paper (or papers) in the *USAEE/IAEE Working Paper Series*, please email a copy of the work (in MS Word format), including a brief abstract, to the addresses given below.

Kevin Forbes
USAEE Working Paper Series Coordinator
Catholic University
kevin.f.forbes@gmail.com

David Williams
USAEE/IAEE Executive Director
usaee@usaee.org

Volatility and Structural Change: Lessons from the 2009 BP Statistical Review of World Energy[1]

By Christof Rühl and Neelesh Nerurkar*

Introduction

2008 was a very special year.

It was a year of high volatility, in which the worst global economic contraction since World War II started. And it was the year in which non-OECD energy consumption for the first time exceeded OECD energy consumption.

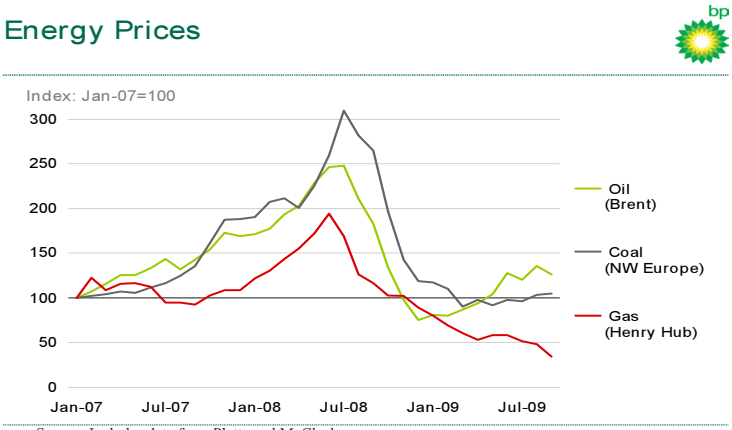
And, of course, these two big events are related. Non-OECD economies have had five years of the fastest growth ever, and they have dominated global energy demand growth since the turn of the millennium. This contributed to the rise in energy prices, which, in turn, are likely to have played a role in exacerbating the recession.

Both topics provoke doubts about our ability to sustain high economic growth and to secure sufficient energy resources. Can markets deliver enough investment to sustain energy security? Do governments have to do it? Or is more energy for more growth just becoming impossible? The following is a review of last year's world energy data, not an essay in predictions - but the numbers do give perspective. We first will review our two big themes, and then go through global energy markets by fuel.

Volatility and Structural Change

The U.S. has been "officially" in recession since December 2007. But it was not until after the financial crisis that output actually fell. When it did, the decline was fast and contagious. By the fourth quarter, the global economy was shrinking. The recession spread around the globe with extraordinary speed, transmitted by a lack of credit and working capital, and then by the collapse of international trade. It is now a platitude, but the world did discover that it was more closely linked than many had expected.

The impact on energy markets was sudden and severe. The contraction in the second half of 2008 caused a strong downward movement of prices and consumption. Prices for all fossil fuels peaked in the summer, and then fell. By January of this year, dated Brent had fallen by 75%, Henry Hub gas by 58%, and North-West European coal by 62%. Inventories rose, and spare capacity emerged, as annual production exceeded annual consumption in all fossil fuels. Power generation saw the lowest growth since 1992; in the OECD it fell. Primary energy growth slowed to 1.4%: global gas consumption growth was the slowest since 2001, coal the slowest since 2002, and oil consumption fell for the first time since 1993.



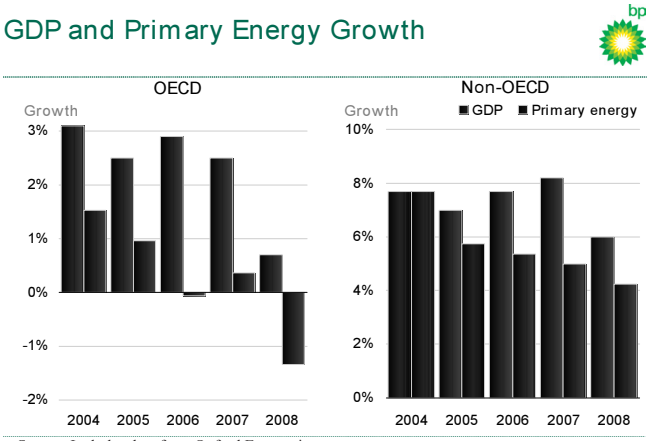
Source: Includes data from Platts and McCloskey
BP Statistical Review of World Energy June 2009 © BP 2009

On the face of it, we saw a year of two halves: Prices and consumption moved up together in the first half of the year, and then down together in the second half, because of the impact of the economic crisis. But there was more to that year.

In 2008, non-OECD primary energy consumption exceeded OECD consumption for the first time and now accounts for 51.2% of global commercial energy consumption. This has been coming for a while: the non-OECD contribution to energy consumption growth has exceeded that of the OECD since the year 2000. For the first time, in 2008 non-OECD economies used more natural gas than the OECD; in addition, China's power generation overtook that of the EU; and carbon emissions from energy use in China exceeded those of the U.S.

The structural shift we are observing is uneven across fuels. Coal demand has been dominated by the needs of industrializing economies since 1988; the non-OECD now accounts for 65% of consumption. Oil demand is converging, with non-OECD consumption growth having outpaced the OECD every year since 1999. Currently, 45% of all oil is consumed outside the OECD.

* Christof Rühl is Chief Economist and Vice President at BP plc. Neelesh Nerurkar is an economist with the firm.
See footnotes at end of text.



Source: Includes data from Oxford Economics
BP Statistical Review of World Energy June 2009 © BP 2009

How did energy markets cope with the volatility of 2008, and what links this volatility to the structural change just described?

The economy is the main driver of energy demand. For the world as a whole, primary energy demand growth slowed in line with GDP growth in 2008. In the non-OECD economies, the relationship remained broadly stable. But in the OECD, the relationship between GDP growth and primary energy growth shifted last year. Primary energy consumption fell by 1.3%, perhaps a sharper drop than the slowdown in economic growth would have suggested. Strikingly, this decline can be accounted for by one fuel in one country – namely, the biggest decline in U.S. oil consumption since 1980.

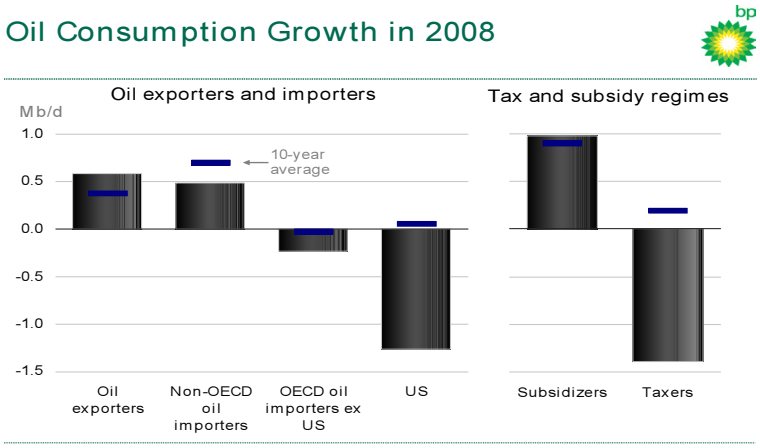
However, the OECD decline comes on the back of two years of below-average energy consumption growth relative to GDP. OECD (and U.S.) oil consumption also had started to fall as early as 2006, well before the recession. It would therefore be wrong to attribute the decline in OECD primary energy and oil demand entirely to the economic slump. The data seems to confirm what many of us have long suspected, namely that energy demand in the OECD was relatively more sensitive to rising prices; and in the non-OECD, it was more sensitive to the years of high economic growth.

To appreciate and understand better these developments, we have to look at the data fuel by fuel.

Fuel by Fuel

Oil

For the year as a whole, dated Brent averaged $75/bbl, an increase of nearly $25/bbl over 2007. This was the seventh consecutive increase in the annual oil price, something that has never happened before in the 150-year history of our industry. Of course, the annual average masks the unprecedented run-up and decline of which we are all aware: from $96/bbl on January 1st 2008 to a peak of $144/bbl in July – a record even on an inflation-adjusted basis – and then back to $34/bbl by Christmas. Prices have since bounced back to around $70/bbl.



BP Statistical Review of World Energy June 2009 © BP 2009

Global oil consumption fell by 0.6% or 420 Kb/d in 2008 – the most since 1982. OECD consumption fell for a third consecutive year, a decline for which the only explanation is the impact of high and rising prices. Non-OECD consumption growth, in contrast, remained robust until economic growth started to deteriorate.

One key event for oil demand was the magnitude of the decline in U.S. consumption: 1.3 Mb/d, as mentioned before, enough to account for almost the entire decline in OECD primary energy consumption. A second was the slowdown of non-OECD importers, concentrated in Asia, where growth halved - from 750 Kb/d in 2007 to 340 Kb/d in 2008. More broadly, 2008 was no exception to a well established pattern. All of the cumulative oil demand growth since 1999 has come from the non-OECD; and all of the global demand growth over the past five years has come from countries where oil products are subsidized.

But to explain the price trajectory described above, we need to look at the supply side as well.

Having cut oil production the year before, OPEC members started to increase production in the face of rapid price increases in early 2008. Saudi Arabia accounted for the lion's share, with significant growth also seen in Iraq, Qatar, and Kuwait. With the usual lag between wellhead and storage facility, these increases showed up as higher inventories by the summer of 2008 – just about the time that global demand collapsed. This quickly brought prices down.

In response, OPEC announced several production cuts, and by year-end it had pledged to cut more than 4 Mb/d. Relative to faltering demand this was too little, too late, to avoid a large price decline by

year end. The full impact of OPEC's cuts has only been felt in 2009, with production down by around 3 Mb/d. These OPEC cuts helped to increase prices earlier this year, in the face of still falling demand, and they support prices now.

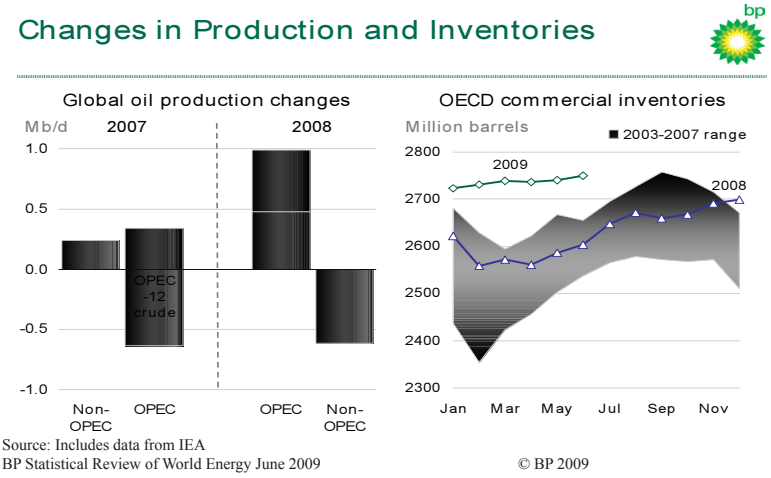
Meanwhile, non-OPEC production, falling by 610 Kb/d, suffered the largest decline since 1992. This decrease was driven by OECD countries, where decline accelerated to 750 Kb/d, with Mexican output falling by 310 Kb/d. In the face of an adverse tax system and a lack of drilling activity, Russia suffered its first annual decline in a decade (90 Kb/d). A combination of field maturity, high cost, and increasingly constrained access to investment meant that non-OPEC supply continues to struggle, despite those seven years of rising prices.

For the year as a whole, OPEC production rose by 990 Kb/d and so more than compensated for the large non-OPEC decline. Global oil production grew by 380 Kb/d, excluding biofuels. The excess of production over demand led inventories to rise substantially - OECD inventories rose by 134 Mbbls in 2008, the largest increase on record and continued to increase well into this year, leading to the deployment of floating storage to exploit the fall of spot below future prices. Needless to say, OPEC spare capacity has increased as well.

On a fundamental level, the oil market story is one of volatile price changes in a constrained market. Supply growth in regions open to investment has been anaemic, and openness to investment has itself deteriorated. This has left OPEC in the driver's seat controlling, together with other large resource holders, investment as much as production.

Refining

The refining margin environment in 2008 suffered a double blow when falling product demand met a cyclical increase in capacity. BP's global average margin of $6.52/bbl was the lowest since 2004, though still above the ten-year average. Early in the year, strong economic growth supported margins through middle distillate demand, which compensated for the price-related decline in U.S. gasoline demand. The need to produce distillate at the margin brought its price to between $25/bbl and 35/bbl above crude oil, delivering record global distillate cracks and widening light heavy spreads globally. But refining margins weakened towards the end of the year when oil demand – including for distillate – collapsed because of the recession.



Source: Includes data from IEA
BP Statistical Review of World Energy June 2009

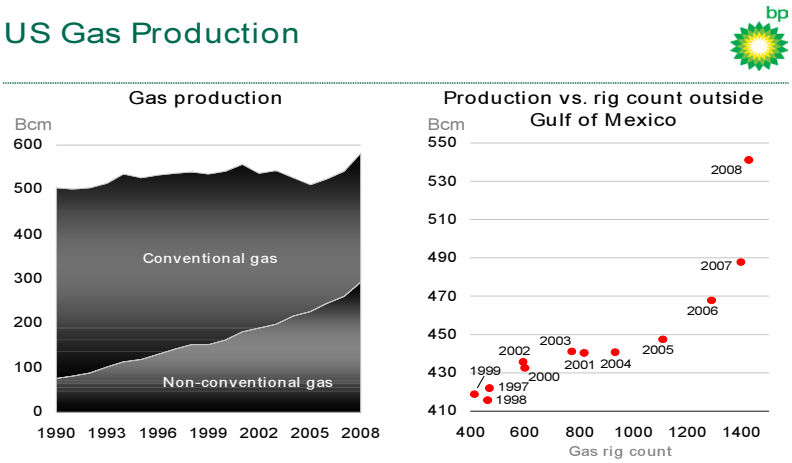
Spare refining capacity has increased as a result of new capacity, reflecting investment decisions during the "good years", exacerbated by run cuts. Global unused refining capacity grew by 1.1 Mb/d in 2008: 800 Kb/d of this was because of new capacity, and 300 Kb/d because of lower crude runs. In 2009, new capacity growth is expected to add another 2 Mb/d. New capacity and run cuts are taking their toll: in April this year, utilisation fell to about 80%, the lowest monthly level in 7 years. Yet, OECD product inventories still reached their highest seasonal levels for 19 years – a stark illustration of the scale of over-supply this part of our industry faces.

Natural Gas

Natural gas prices show a familiar pattern. All annual-average prices reached record nominal highs in 2008, with European contract gas the most expensive in the world. Prices in the liberalized U.S. Henry Hub and UK NBP markets rose sharply in the first half of 2008, but fell back as demand weakened while supply remained abundant. Oil-indexed Asian LNG and European contract prices rose for longer due to lags to oil prices, but then also fell off their peak. Prices remain depressed into 2009.

World gas production grew by 3.8%, the second strongest volumetric growth on our records. Gas consumption in the OECD grew faster than normal in the first half of 2008, but subsequently weakened and, at 2.5%, global consumption growth for the year as a whole was below the ten-year average. The non-OECD used more natural gas than the OECD for the first time ever last year and gas was the only fossil fuel for which non-OECD demand accelerated, driven by China, which recorded the world's largest volumetric increase.

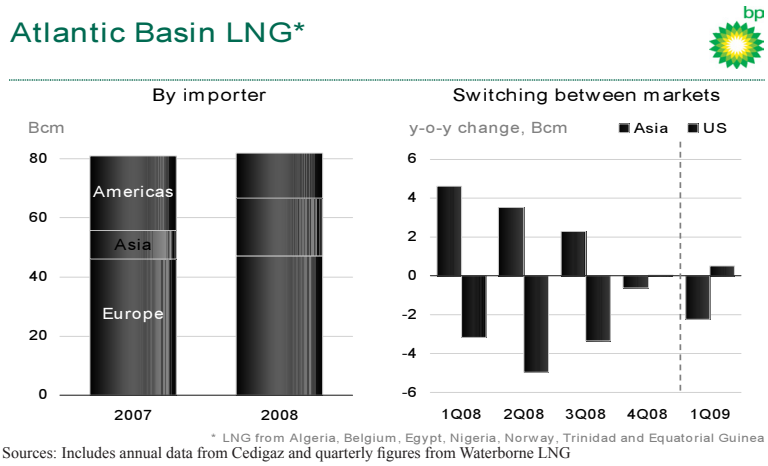
The impact of slowing demand in the second half of 2008 on prices has been exacerbated by two reac-



Sources: Includes data from U.S. DOE and Baker Hughes
BP Statistical Review of World Energy June 2009 © BP 2009

tions to past high prices: investment in 'non-conventional' gas in the U.S. and a bunching of investments in LNG.

The development of non-conventional gas such as shale, tight gas, and coalbed methane allowed the U.S. to record the world's largest production increment in 2008 (41.7 Bcm). Rising prices caused drilling for these deposits to soar and technological advances allowed output per rig employed to rise exponentially. Investment in frontier technology has increased U.S. gas reserves by 45% and nearly doubled non-conventional gas production over the last decade. As a share of total U.S. gas output, nonconventional gas went from 15% in 1990, to 28% in 1998, and to around 50% in 2008. It is, in fact, becoming conventional. Such growth caused U.S. Henry Hub gas prices to be among the lowest in the world.



* LNG from Algeria, Belgium, Egypt, Nigeria, Norway, Trinidad and Equatorial Guinea

Sources: Includes annual data from Cedigaz and quarterly figures from Waterborne LNG
BP Statistical Review of World Energy June 2009 © BP 2009

Today, 19% of global gas production is traded by pipeline and 7% by LNG. LNG continues to link regions into one globally integrated market. This demands flexibility. A record number of LNG tankers were delivered last year, expanding fleet capacity by 19%. 2008 saw the longest journey ever travelled by an LNG tanker – from Norway to Tokyo. In early 2008 a record amount of flexible LNG headed to Asia, where Japan continued to suffer nuclear outages, and other countries bought more gas because oil prices had been high. In the autumn, with demand falling, Belgium put LNG back onto a tanker and re-exported it to Asia – a first, as far as we are aware.

A good proxy for global gas market flexibility is the diversion of Atlantic Basin cargoes between regions. Atlantic Basin spot cargoes rose to 12% of total Asian imports in 2008, up from 7% in 2007, and zero in 2000. Meanwhile, abundant U.S. production caused U.S. LNG imports to fall by more than half in 2008. Asian LNG demand has turned negative this year, due to the recession, but output is growing. LNG is increasingly "looking for a home" and LNG plants are facing excess capacity. Nevertheless, the fungible share of LNG continues to rise, through good times and bad – first, before the demand and price peak in the summer of 2008, driven by consumers bidding for cargoes, and now, by producers discovering the advantages of flexible contracts when trying to place surplus LNG.

The story of gas markets into 2009 ends as one of too much supply chasing not enough demand. But behind it is the story of a supply response to high prices in the rise of non-conventional gas in the U.S.; and of accelerating global integration in response to market signals in LNG.

Coal

Coal prices also exhibit the pattern familiar from other fuels – peaking in July and then tapering off. Prices in North West Europe, a good proxy for a globally traded coal price, reached $219 per tonne in July and fell to $58 by March this year. The volatility of this marker price for traded coal exceeded that for oil and gas.

Coal remained the world's fastest-growing primary energy fuel. But at 3.1%, global consumption growth was so weak that, without the contribution from India and China, it would have fallen. Coal consumption in the OECD had the steepest decline since 1992, and in the non-OECD it grew at its slowest rate in six years.

Coal always is a China story. It meets 70% of China's energy needs; China accounted for 43% of

global coal consumption and 85% of last year's growth. Yet growth in Chinese coal consumption has been slowing since 2003, and continued to slow in 2008. Power generation growth fell in the last quarter, as the economic crisis reached China and hit its export sector.

In the OECD, coal consumption fell by 1.9%, the steepest decline since 1992. Consumption in the EU fell 5.4%, as relatively low gas prices led to inter-fuel competition early in the year. The rising price of emissions within the European Emissions Trading Scheme made electricity production from coal more costly than from gas for most of 2008. As a result, UK coal-fired power generation fell by 8.3%, while gas generation rose by 8.9% in 2008. In Germany, coal generation fell by 6.5%, and gas generation rose by 9.1%. But because coal prices have been falling more rapidly than oil-indexed gas prices and because carbon prices have fallen too, fuel switching is now reversing in those parts of Europe where pipeline gas (tied to oil prices) dominates.

Renewables

Renewables still account for only a small share of total energy consumption, and for the most part, still require government support. But from that small base they continued to grow fast, with global deployment reflecting government support as well as natural endowments. In contrast to all the other fuels, growth in renewables was led by OECD countries, where policy support is strongest. But like other fuels, 2008 saw rapid growth in the first half followed by a marked deceleration towards the end of the year, and into 2009.

Ethanol is now equivalent to 0.9% of global oil consumption. Production growth accelerated for a fourth consecutive year, rising by 31% in 2008. U.S. production rose to 600 Kb/d, as new capacity responded to tax incentives, blending mandates, and high gasoline prices. The credit crisis and falling product prices after mid-year slowed things down and left the U.S. ethanol industry with overbuilt capacity – by year-end about 15% of U.S. ethanol production capacity lay idle.

Wind power generating capacity growth accelerated to 30% in 2008, the fourth consecutive year of accelerating growth. Growth becomes a race between newly emerging big players: China recorded the fastest growth rate among the major markets and the second largest volume increment (6.2 GW, 106% growth), but the U.S. added the most new wind capacity, overtaking Germany, and with 21% has now the largest global share of global wind power capacity.

Solar power generating capacity grew even faster than wind. However, with capacity reaching 13.4 GW, solar is still a long way behind wind.

Together, wind, solar and geothermal power supply around 1.5% of global electricity.

Carbon Emissions

Carbon emissions from energy use grew by 1.6% in 2008, which is slower than last year and below the ten-year average for the first time since 2002[2].

China became the world's largest emitter of energy-related CO_2 in 2008; Asia Pacific accounted for nearly all of the world's net emissions growth. OECD emissions fell by 1.7%, mostly due to reduced oil and coal consumption, including switching from coal to gas for electricity generation in the EU.

Carbon markets grew strongly in 2008: trading volumes increased by 61%. But the recession took its toll here as well, with carbon prices behaving pro-cyclically: As energy demand and energy prices came down, carbon prices fell to €16/tonne CO_2e at year-end, from almost twice as much in July 2008.

Conclusion

Coming back to our two main themes, it is worth keep in mind one last set of numbers. Despite their rapid growth, non-OECD economies still account for only 25% of global GDP, produced by 82% of the global population. Per capita income therefore is $2,300, compared with $32,000 in the OECD. Combined with the energy data laid out at the beginning, this also means that it takes more energy to produce one unit of GDP in the poorer countries than it takes in the OECD. To be precise, to produce $1000 worth of GDP takes 3.4 boe in the non-OECD versus 1.1 boe in the OECD - partially because of the growth of industry, but also because of inefficiencies. The scale of the challenge is easy to see.

So, what can the experience of a volatile year tell us about how to meet these longer-term challenges of adjustment?

In 2008, market reactions explain the developments we saw. In the short term, we registered huge price volatility. Where these price changes were allowed to play themselves out – which was not always the case – they drove an efficient response.

- The brunt of the OECD decline in primary energy consumption was taken by U.S. oil because it

is most exposed to crude price fluctuations.

- Globally, outside China and India, high coal prices and available gas supplies translated into falling coal and increasing gas consumption.
- In the EU, relative coal and gas prices prompted fuel switching in power generation, partially offsetting the decline in coal consumption growth.
- Intra-fuel price differentials also directed fuels to their highest valued use through trade – for example, when the EU replaced coal imports from Africa and Australia; or when low prices induced the re-contracting of LNG shipments.
- Where investment was allowed to react, high prices have translated into new supplies – witness the growth of non-conventional gas in the U.S. Where investment is constrained, this mechanism fails – witness the oil market.

But the commodity cycle has not disappeared. Refining, and to some extent also the North American gas market, bear witness to the threat of over-investment and feedback loops in capital intensive industries. Energy is a capital intensive business with long lead times; demand for its products depends on overall economic conditions. Cycles and price volatility are the norm reflecting our imperfect knowledge over long investment horizons.

The key to meeting the longer-term challenge is to manage through these ups and downs. In 2008 we saw a sharp turn in the economic cycle, and associated volatility in energy prices. Markets have served global energy security well - on the way up, and on the way down. In fact, it has been served best where markets were allowed to develop without interference.

Footnotes

[1] The Statistical Review data and a more detailed analysis of energy markets can be found at www.bp.com/statisticalreview.

[2] We derive this by applying standard conversion rates to energy consumption, so our figures are therefore not comparable to official data.

IAEE INTERNATIONAL ASSOCIATION *for* ENERGY ECONOMIC
WWW.IAEE.ORG

AMERICAN ECONOMIC ASSOCIATION

Two great associations…one great session! All IAEE & AEA members are invited to attend the joint IAEE and AEA session to be held during the Allied Social Science Associations (ASSA) annual meeting in Atlanta, Georgia.

IAEE/AEA Session

"Climate Policy for a Post-Kyoto World"
2nd Joint IAEE/AEA Session
2:30pm, January 3, Hilton Atlanta, Room 201

Presiding: **Carlo Andrea Bollino,** Dept of Economics, Finance & Stats., University of Perugia

John Weyant, Stanford University – *Global Climate Policy Scenarios: An Update*

Robert N. Stavins, John F. Kennedy School of Government, Harvard University – *Getting Serious About Global Climate Change After Copenhagen: A U.S. and International Update*

Scott Barrett, School of International & Public Affairs, Columbia University

Also, please visit the IAEE/USAEE Cocktail Party which will take place during the ASSA meetings. We invite you to attend this event!

We Can Live With a Fossil Fuel Future: Oil, Gas, Coal & Shale Oil

By Gerald T. Westbrook*

In an earlier version of this essay, an analogy was developed between our energy situation and that of 11 survivors in a movie of a plane crash in the Sahara. Both situations could be described as desperate. Both situations would exhibit entrenched opinions, zero tolerance for other views, little information and much confusion. Their crucial resource was water, ours is oil.

For the Saharan survivors, it was not until all other options proved futile that the remaining survivors—very gradually, and reluctantly—were able to coalesce around the one option that would save them, namely to re-build a plane from the wreckage. Initially most saw this as an insane idea. Our challenge is similar, to re-build our energy system.

Price Stability. When the price of crude oil sky-rocketed from $95 to $147 per barrel, it was easy to see the danger of such a situation. Less clear is the impact of a retrenchment from $147 to $35 per barrel. In this situation energy planning and implementation for areas such as alternative energy (AE) gasification becomes impossible.

Our country is still in a serious energy situation. Perhaps no one has stated it stronger than Matthew R. Simmons, a Houston investment banker. "It is sick", he concludes. This theme was continued in the *NY Times*. The writers wonder if the market is broken in some way creating a bubble of artificially expensive oil. While the price at $147 may look like such a bubble, Simmons thinks not. He notes that much of the supply is from fields that are old and getting older ─ "the era of cheap oil is over."

One can see three main pathways into the future. These widely disparate pathways or areas of concentration are AE, fleet electrification/nuclear power, and fossil fuels.

The title for this essay states that we can live with a fossil fuel future. *Warmers* and environmentalists will see this as insane. Indeed, our energy secretary, Steven Chu, has stated that "Coal is my worst nightmare." Yes, while coal has the highest level of greenhouse gas (GHG) emissions of all energy sources, I would argue we don't have the luxury to ignore coal. The key pathway to price stability is to reduce our call on global oil. What is necessary is an aggressive move to reduce this call.

Now, oil speculators are broadly accused of manipulating the market. Possibly, but all they do is simply buy and sell crude oil contracts. In order to perform this task, perhaps many times a day, they strive to read the market. Here I argue that the USA's call on global oil is an indicator to such risk takers. If the speculators can't see any progress in our ability to cut demand, or in our ability to increase supplies, they will soon start to bet again that our call on oil will go up. And, in the absence of any other inputs, they will, once again, place their bets that future prices will be a bit higher and not lower. And their next bids will also be a bit higher.

I will argue that, of the three non-perfect initiatives, the fossil fuel focus has the best odds for reducing our oil call, and the best chance at providing large amounts of additional energy.

Supply Security. This interest in supply security is in no way a pitch for energy independence. Indeed, energy independence is seen as an impossibility and an erroneous objective. Supply security can be achieved by building on a strong and reliable mix of all supply options. This includes coal, offshore oil, Alaskan oil, specifically the Arctic National Wildlife Refuge (ANWR). Now the environmentalists insist we can't touch ANWR oil. I would argue we don't have the luxury to "turn up our noses" on this resource. Many papers describe it as a pristine refuge and a cathedral of nature They inevitably show a picture with magnificent mountains in the background - the Brooks Range. But these mountains are about 50 miles from the featureless coastal plain.

George Will raises the idea that "some people use environmental causes and rhetoric not to change the political climate for the purpose of environmental improvement. Rather, for them, changing society is the end, and environmental policies are mere means to that end. The unending argument in political philosophy concerns adjusting the balance between freedom and equality." The overall good "is to enlarge government supervision of individual's lives."

Supply security also includes oil from the Mid East and syn-crude from Canada. One might ask why does it make sense for multi billion dollar investments in Canada for tar sands mining, processing and upgrading, but not an analogous effort in the U.S. on coal mining, processing and upgrading? How much difference can there be, when crude prices exceed $100?

Coal and Climate Change. It would seem that coal has become the pariah of

* Gerald T. Westbrook is President of TSBV Consultants in Houston TX. This is an abridged version of a more comprehensive piece on the same subject, including detailed references. Westbrook may be contacted at gtwtsbv@comcast.net

any energy plan. Even without the so-called global warming crisis, coal has been viewed by many activists as unacceptable, due to the criteria pollutants (sulfur oxides, nitrogen oxides, and particulate matter) and mercury emissions that. Many activists have tended to ignore that the criteria pollutants have been effectively controlled at an affordable cost, and efforts are underway on mercury emissions.

Perhaps the activists have recognized for a long time that they needed something more—to shackle coal the same way they have shackled nuclear energy—and that is where the global warming issue comes in. Hence we have had a tidal wave of publications against coal. And the conventional wisdom is that this threat of anthropogenic global warming (AGW) is worse than high level radiation from fuel rod disposal.

Many critics of coal insist we must move into a carbon constrained world, even though we are facing the most serious energy situation ever. Of course, our politicians have jumped in, many with well meaning, but terribly misguided ideas, plans and bills. For example, the Democrats have come up with such winners as suing OPEC. And these critics have come up with the phrase: *clean coal*. Any coal that doesn't meet their definition of clean coal—which is coal used in a carbon constrained plant—is dirty or ugly or filthy coal.

The climate change situation facing this country has been described as the most awesome threat our country has ever faced. Barack Obama, as a senator, has stated "The future of our planet is at stake." Harry Reid called "climate change the most important issue facing the world today." Well, not hardly, as the senate shelved this issue after only 3½ days of debate. And Nancy Pelosi has also commented that we must start cutting global warming pollution immediately, "to avoid catastrophic climate impacts."

These, and other politicians, seem to have two naive convictions and/or political positions, namely all climate alarmism is true and all alternative energy hype is true.

Emerging Strategies I: Focus on Alternative Energies

Wind Energy

• **Recent growth**. In previous writings I noted that California had over 15,000 windmills by 2000, but these produced power only 18% of the time and contributed only 1¼% of total state generation. Since then growth of this energy source in Texas has been notable, and exceeded California in 2006. By 2007, TX had 4,296 mws, CA 2,459 and the U.S. 16,596.

• **Key problems with wind energy**. Surely much of the above growth in Texas is due to government support at all levels. However, in spite of this support there are many problems.

(i) High equipment and installation costs, even with many subsidies.
(ii) Limited availability of the installed capacity and hence limited generated power.
(iii) Very remote locations frequently requiring new and long transmission lines.
(iv) Working with governments. This comes at a price. A recent commentary noted what government involvement can lead to, when it gets into market creation such as wind energy. The writer reported on a meeting on wind energy, attended by 10,000 and commented that the more the hype blows the more Robert Bradley, a former director of public policy analysis for Enron, "hears the voice of his old boss, Ken Lay." Bradley spent 16 years at Enron. He noted Enron "was a major backer of the state's 1999 mandate calling for the development of renewable energy sources, including wind generation."
Bradley further notes that "Enron lived, thrived, and perished in and through the mixed economy. Enron's artificial boom and decisive bust had more to do with government regulation than free markets. Ken Lays meteoric rise and stunning fall were not the saga of a capitalist wildcatter, they were the tragedy of a political rent-seeker in action, prominently including government intervention sought in the pretext of addressing climate change and promoting 'green' energy."
(v) System penetration. This attribute was reported on in a summary of the hype used by politicians. This case study is from the Canadian province of New Brunswick (NB). The energy minister for NB started with a claim they would add 4,500 mws of wind energy to an existing system of 4,000 mw. The neighboring state of Maine, with twice the population, had all of 42 mws. He back tracked to 1,250 to 2,000 mws. However, there is the question of system design. Even adding as little as 15 percent wind generation to an existing system requires constant monitoring and adjustment to prevent power fluctuations and grid instability.

• **Conclusions on wind energy**. With this panorama of problems it is hard to believe that this source of energy, in spite of major government support, will be the solution to our crisis.

Biofuels

There is little question that biofuels will play a role in our energy system. However, projections range from unbelievably bullish to one beset by many problems. One input comes from a key environmentalist. This scientist asked the question on the amount of electrical generation that could be achieved from wood grown on the net forest area of commercial timberland, namely 483 million acres. The answer was 17.5 percent. He concluded that the idea "that biofuels are going to end U.S. dependence on foreign energy supplies, is an illusion." Another reference reported world consumption of 10 billion gallons of biofuels in 2006, including ethanol and biodiesel. "This is 650,000 barrels/day, less than 0.8% of world oil consumption." A summary on biofuels follows.

Basic Ethanol Production

Ethanol from corn. While modestly boosting the supply of liquid fuels, this fuel may actually be increasing our overall energy demand. Many references report that this fuel requires more energy to produce than it delivers. Bloomberg reports that David Pimentel, of Cornell University of Ecology and Agriculture, argues it uses 29 percent more energy than it delivers.

Ethanol enthusiasts seem to prefer talking about the oil imports displaced. For example, one reference cited 170 to 500 million barrels of import reductions in 2006. These comments were by the Renewable Fuels Association (RFA) or its friends. However, the RFA also noted that ethanol production amounted to 4.86 billion gallons for 2006 or 116 million barrels. However, since ethanol has about two-thirds the energy content of gasoline, the116 million barrels drops to 77 million barrels or only 2¼ percent of U. S. gasoline consumption. Today, this incredibly subsidized field—corn subsidies and ethanol subsidies—has 20 separate federal laws to boost ethanol use, and 49 states offer additional support.

There are problems with this option such as impact on many food markets such as beef, cheese and milk, and related businesses. Also the energy secretary has been a staunch opponent.

Ethanol from sugar cane. Supporters conveniently ignore that Brazilian ethanol comes from a far superior feedstock - sugar cane, not corn. They also forget to mention that Brazil, in parallel with their ethanol efforts, has also become one of the giants in offshore drilling and production. The prospects for this fuel in the U.S. have been dismal, with U.S. sugar cane production less than one percent of Brazil's. And U. S. production is located only in Florida and Louisiana.

Second generation biofuels. Dr. Chu's key work at the Lawrence Berkeley National Laboatory (LBNL) was the so-called Helios Project. This included the Energy Sciences Institute, a joint effort by BP, Cal-Berkeley, Dupont, the University of Illinois and LBNL. Unlike his position on corn ethanol, Dr. Chu has been reported to be a big proponent of cellulosic ethanol. Hence one can expect an acceleration of effort in this area. Three areas show promise:

(i) Ethanol from cellulosic feedstocks.
(ii) Biodiesel.
(iii) BioButanol

An expanded version of this essay provides details on these options.

Hydrogen

Promoters of H_2 frequently claim its only emission is water vapor, from the fuel cells. This is highly duplicitous. For example, in a 2004 paper, a professor emeritus of environmental studies, noted that "given current technology switching from gasoline to H_2 powered fuel cells would greatly increase energy consumption and nearly double GHG output.

One might cite several routes to get H_2.

Direct Electrolysis. H_2 could be extracted from water via electrolysis, a 200 year old process, but it is expensive, would take a major amount of electricity and any emissions caused by this new demand for power would need to be allocated to hydrogen. About 4% of global hydrogen production is by this process.

Indirect Electrolysis by thermo-chemical cycles. In theory H_2 could be extracted from water via electrolysis by thermo-chemical cycles. For example the Hybrid Sulfur Process, derived from a Westinghouse process, uses two reactions.

A low temperature production reaction: $2H_2O + SO_2 = H_2SO_4 + H_2$.

A high temperature regeneration reaction: $H_2SO_4 = H_2O + SO_2 + ½O_2$. This high temperature reaction ~950 ºC, would use energy obtained from advanced nuclear reactors.

Steam Reforming. Almost all H_2 produced in the world today is via this process. The raw material for

this process is inevitably natural gas. It has been estimated that ~15 trillion cubic feet of gas would be needed, annually, to produce H_2 for the U.S. to power the vehicle fleet. This would boost the consumption of natural gas in the U.S. by about 66 percent. Even today gas supply requires imports from Canada, and even from the world, via specialty tankers. And any emissions caused by this new demand for gas would need to be allocated to H_2.

Solar-themal processes. A new process, but essentially unproven, could emerge. A recent reference supported "solar-thermal biomass gasification to syngas using 'rapid aerosol reactors' in a 'power tower configuration'." Sounds like a huge amount of new technology.

Summary. As noted above there are rather huge problems with hydrogen production. There are also major problems with H_2 distribution, storage and use. The current fuel cells were developed for the space program and may not be optimized for autos. There is also the issue of cost. So hydrogen is an extreme long shot as a replacement for gasoline.

Conclusion on Alternative Energy

The above is a sampling of key areas of alternative energy. In spite of its costs (and the need for subsidies); its embryonic status (and the need for major research breakthroughs); its low availability (and the need for backup generation); the remote locations (and the need for transmission capacity); and in some cases the low liquid fuel contribution; the various forms of AE can make a contribution. Can they be the solution? The above analysis would suggest not.

Emerging Strategies II: Focus on Electrified Transportation

High Energy Density Battery R & D.

Sodium Sulfur battery (NaS). One area that looks very promising is the emergence of the Sodium Sulfur battery (NaS, where Na is the chemical symbol for Sodium and S for Sulfur). Note that this approach was pioneered by Ford Motor Company for the auto application, and by the Dow Chemical Company, over 40 years ago. One key problem for this battery in autos is a very high operating temperature of 350 ºC, hence a key safety problem.

However, the NaS unit was brought to the demonstration stage for electric utility power storage, by a Japanese company and American Electric Power (AEP). Many NaS batteries are in use in Japan, and AEP has tested a 1,200 kw unit, with plans to add a unit twice that size. Another utility is planning on a 5,000 kw unit.

A slightly different application involved an installation at a major bus company. This is the first installation on the *customer side* of the power meter in the United States. This installation used electric motors to drive three compressors, used to refuel natural gas busses. This battery is capable of providing one megawatt for up to seven hours a day. It permits buying power at off peak times, plus cutting back a shift in operations.

Lithium ion battery (Li-ion). Recent developments—where the initial work is 100 years old—are encouraging. There are many major organizations active in this field, and many technical developments emerging. Two are noted here.

Plastic film separator. Exxon-Mobil, in conjunction with it's affiliate, Tonen Chemical has developed and is now producing an advanced performance film for the Li-ion battery. These separators offer enhanced permeability, higher meltdown temperature and melt integrity. This film offers major increases in the film's thermal safety and overall quality control.

Silicon nano wires. The key development is to replace the existing carbon anode. This revised battery "produces 10 times the amount of electricity of existing lithium-ion" units.

The market for Lithium-ion batteries is anticipated to grow ten fold, from 2008 to 2015, reaching $9 billion. Applications in laptops, power tools, military and space are proving the technology for the large emerging units for hybrid vehicles and full electric automobiles.

While there has been a tidal wave of news items on the Li-ion battery, there has been very little hard data on Li-ion battery costs, performance and lifetime. Until such data emerges this battery must be filed under a work in progress. Still, in spite of the lack of such information, there has almost been as many news items on new demo or prototype vehicles.

Conclusions on new batteries. These two areas surely look promising:

NaS Unit. This unit looks like a fit for standby power. It is rugged and reliable looking. It would seem that it could be built just about as large as desired. However, it does not appear to be a fit for the vehicle market, primarily due to its high operating temperature.

Li-ion Unit. This looks good for vehicles and clearly is getting all of the attention today. With the

new technologies reported above, the previous problems with fires and explosions should be a thing of the past. Indeed, optimism for this unit is now very high. At least five manufacturing plants are planned: four in Michigan and one in Kentucky. One forecast has suggested a growth from $700M in 2008 to $3.2B by 2012

Surely more hard data is needed on both of these units, particularly on cost, performance and lifetime. Also it is useful to remember historical development times for batteries in general.

Power Support

Nuclear. An acceptable battery just might see the rebirth of nuclear power. Senator McCain recently called for 45 new nuclear plants. However, as one who spent part of his career trying to get a nuclear project rolling—a half a dozen tiny assignments, plus dozens of letters, only to see it converted to a natural gas plant—a program to build 45 nuclear plants will be extremely difficult to get underway, and even more difficult, if not impossible, to implement.

Fossil Fuel based. Acceptable batteries just might have to be supported by other types of power plants than nuclear. Clearly we would need the fuels to fire such plants.

Emerging Strategies III: Focus on Fossil Fuels

Oil and Natural Gas. We can do much more to improve domestic oil and natural gas supply. *No way, the enviros/warmers scream*. Whether it is outer continental shelf (OCS) oil or the ANWR, this crowd inevitably bad-mouth such initiatives as providing only a tiny amount of energy that will never help our situation. Naturally they never see that such a problem may exist with AE. Their bad mouthing on ANWR and the OCS includes their claim that such oil development would only cut three cents off the price for a gallon at the pump. However, if one assumed an ANWR yield of 10 B barrels of oil, over 25 years, this is about 1 MBPD. There would be a cut of the same size off of our global oil call. And only three cents? Please!

While U.S. oil production peaked over thirty years ago natural gas is enjoying a bit of a boom. In 2009, gas production surged due largely to unconventional gas (UCG) resources such as the Barnett Shale, that had not been tapped in the past. This UCG resource—shale gas, tight sands gas and coal bed methane—has shown a rather surprising increase. Note that the EIA projects unconventional gas will represent about half of total U.S. production by 2012.

While this increase in UCG speaks volumes about drilling technology and geological savvy in managing these resources, it does not speak well of the state of conventional gas resources. This includes the fact that decline rates for gas wells have almost doubled over the past ten years. Perhaps more ominous is the well known dramatic decline rates for shale gas. All of these inputs suggest we will soon be looking strongly again at gas imports.

Coal. This fuel is undergoing massive expansion in China, India and elsewhere. We can do much more with coal, not only for power, but for gaseous and liquid fuels too. For coal, the resource base is almost unlimited. The U.S. has been called the "Saudi Arabia of coal." We need a program here on coal, analogous to the Canadian effort on the Athabasca Tar Sands.

Some will think such a pathway is absolutely insane. However, the hope is that, in the future, they will come to the conclusion that it is the only way out of our situation. Here we would boost our conventional supplies of domestic oil and gas, we would increase our use of coal generation and we would start to utilize coal gasification, coal liquefaction and shale oil.

One cannot expect the *warmers* and the environmentalists to salute the fossil fuel focus plan. As with nuclear, opposition will be loud, massive and entrenched. Indeed this could well be the fight of the century. However, we don't have a century, probably less than a decade.

Climate Change

I have followed and written on global warming (GW) for 20 years. My recent inputs have focused on what I call the key witnesses for the defense of the skeptical perspective, including:

- key non scientists, such as Vaclav Klaus, Michael Crichton and George Will.
- *Distinguished Veterans(DVs)*, mostly scientists, mostly retired, with incredible accomplishments (These are veterans from the research community, some with emeritus in their title. I have developed a listing of over 60 such scientists. In a recent paper the views of four DVs on hurricanes, three on physics and four on various aspects of food production were noted. In a more recent paper the views of 17 physicists, all skeptical on GW, are noted.).
- other witnesses, include active scientists, TV weathermen and State Climatologists.

Conclusions on the Climate Change Situation. In a recent paper the views of the above witnesses have been noted. Their lifetime publications and comments give the nature of their views on the GW issue: all skeptical. There are simply too many highly educated, high horsepower individuals—that are concerned that we have not diagnosed the climate scene completely or correctly—to ignore their views.

Today the proponents of this issue are a mixed bag. This includes the behind the scene organizers; those who are intimidated by the fear of job or funding loss; the many fellow travelers who are riding the political winds; and many who have been brainwashed on this issue, or who endorse the global warming issue as it makes their lives easier.

The very best one can say about the GW issue, and the need to move to a carbon constrained world, is that it is premature. The very worst is that it is a fraud.

The Environmental Situation in General

I have followed environmental issues in general for over 40 years, and for the coal area, in particular, for over 30 years. My position in this area is that we can live with this fuel. One might ask what are my credentials to take such a position. This position has been based on inputs from three areas: emissions control improvements; individual exposure to coal, oil and key chemicals; and experience obtained via The National Coal Policy Project from 1977 to 1979.

Emissions Control Improvements. As noted above, the key pollutants from coal fired power plants have been controlled. "On balance we've achieved much 'cleaner' generation of electricity from coal since the Clean Air Act of 1970." With such improvement in the environment in general and coal units in particular, a key question is why then do we hear so much bad news about the environment? Could it be that environmentalists often lie? Indeed, Lomborg has shown the ways in which professional environmentalists play loose with the truth.

Individual Exposure to Coal, Heavy Oil and Critical Chemicals. The public is concerned about such a reliance on coal. As a means to soften such concerns I will offer a view of my trip through life, as it has been involved with coal, heavy oil and other potential environmental problems. Yes, this represents only a sample of one, and yes, this is not proof that these commodities have never had problems in the past. Rather I present this input to raise the possibility that coal just might not be the pariah it has been painted to be.

Saskatchewan. I will start this trip in the city of Saskatoon.

Home heating. I was born into a coal fired home, and spent my first dozen years living with coal. We had a coal bin and had periodic coal deliveries. And there was a certain amount of coal dust. Over this period we converted initially to a coal stoker, then fuel oil and finally gas.

Coal fired trains. For my first six years our home was one block from the Canadian National Railroad tracks heading to the downtown station, and other destinations. The engines, perhaps a dozen or more a day, slowed down as they entered downtown, or speeded up, as they left.

Source of electricity. I was also born into a city with a coal fired electric system and spent my first 22 years living with this system. The local utility had two large coal fired steam-electric stations. One of these was ~ ⅓ of a mile away, the newer unit was about five miles southwest.

Local refinery. This refinery was about as small as a refinery could get, but one knew it was around. We lived about five miles east of it, yet when the west wind blew, which was most of the time, the aromas would be very noticeable. And one could also see the plant flare at work.

What does one do with a used coal bin? When I was 18 I took a summer job in construction. The first task was on a project where a building was being renovated, and a coal bin had to be torn down. This room had plaster walls and ceilings and coal dust was everywhere. It took a week to complete, and each day I came home totally black. I had to strip to my briefs, and be hosed down extensively. I could clean the outside of my body, but doubtful on the inside.

Local asphalt plant. For two summers, I was an inspector at the city's asphalt plant. There were two environmental problems at this plant: fine dust from the hot gravel and tar oil vapors.

Ontario. After graduating I went to work in Ontario, with a major oil company.

Refinery Design. This included work for refineries in Calgary, Vancouver and Norman Wells. Clean work, but our offices were across the street from the largest refinery in Canada.

Petrochemical Plant Startups. The first startup was on a detergent-alkylate plant. Everything that could go wrong with a new plant did and I was involved in this startup, for almost a year. It used benzene as one of its raw materials, a known toxic substance. Several precautions were taken, but there were bound to have been some trace benzene leaks all during this startup. The next startup was a heavy oil

steam cracker for ethylene, propylene and butadiene production.

Michigan. Next, I worked for a huge chemical company in Michigan.

Steam and power system. Coal fueled this plant, and the first environmental problem was coal dust. We had moved into an apartment in 1960, when we discovered our car and our window sills would frequently turn black, ditto for the inside window sill. This plant needed electricity for motors and for chlorine production. However, the power plants were old, with no stack-gas treatment. When I complained, I was told be patient. It took about a year of patience.

Chemical exposure. This included brief times in a glycol ether - brake fluids complex, a polystyrene plastics plant, a styrene butadiene latex system, and a herbicide plant. In 1962 the DOD asked Dow to make Agent Orange, a mixture of two herbicides: 24D and 245T. One of the herbicides, if it was not made properly, could contain an impurity, dioxin, The company scientists developed analytical tools that could measure dioxin in the parts per trillion level. Because of this rather incredible new capability they found that dioxins were all over our society, wherever any burning occurred . They were found in auto mufflers, cigarette smoke, wood soot and many other places, including chemical plants and paper mills.

Summary on personal exposure to coal dust, tar and critical chemicals. I believe one can conclude that I have had more than my share of exposure to coal dust, tar and critical chemicals. I am now 76, and going strong. Again I realize this is only a sample of one, but it is food for thought. Can the hideous problems painted about coal just be a bit over-stated?

The National Coal Policy Project (NCPP) - 1977 to 1979

There were also environmental concerns, back in the 1970s, on the further use of coal. As a result, the NCPP, under the auspices of Georgetown University, was initiated. Here meetings between environmentalists and industrialists were held to try to define a future pathway for coal that would be acceptable to both camps. This was a difficult project to progress. Indeed, it was decided early on "to leave the task of making projections to others." However, some 200 recommendations were made. I will note my impressions of this activity, primarily from the perspective of the coal transportation sub-committee.

My first impression was that the environmentalists were better prepared. In contrast all the members of the industrial side would seem to have very little time to do any homework. My second impression was that we could never get these environmentalists to make a list of the problems and define their priorities. I came to the conclusion they would never do this. My final impression was that the attitude of some members of the environmental movement "scared the devil out of me." They were so intense, so certain of their cause and so socialistically oriented, that they seemed to be saying "get us elected and get out of the way."

Today I hear what all the activists and the politicians have to say about coal and I'd swear they are the same people that I met 30 years ago. They are so intense, so certain and so socialistically oriented, they seem to be saying "get us elected and get out of the way."

Conclusions

Today, our country is in the most serious energy situation it has ever faced. Here, I have argued, directly or indirectly, that:

- while the various forms of AE can make a contribution they will not be the solution to our current crisis - we will be using fossil fuels for decades to come;
- the pathway to price security is to reduce our call on global oil via a substantial boost in our conventional supplies of domestic oil and gas, via an expanded and broader use of coal, via a start on shale oil, via a dramatic improvement in electric vehicles and the power system to support such a move and via a boost in AE and on energy efficiency and conservation;
- the most positive area is the development of high energy density batteries, while the most negative area is the incredible support and subsidies for corn based ethanol;
- the climate change situation, in regards to fossil fuel use, is manageable, and the need to move to a carbon constrained society is premature at best;
- the environmental situation with coal is manageable, a judgment based in part on my lifetime exposure to coal, and in part on the improvements in emissions control over the past 40 years.

CONFERENCE OVERVIEW

Energy is a key driver of economic growth, something the world is desperately looking for in the current crisis. At the same time, traditional energy supply is reaching its limits. Many energy sources have to be developed to meet the 21st century environmental, social and economic challenges.

How can unconventional hydrocarbons (oil sands, shale gas and others) and carbon sequestration help bridge the gap between conventional oil, gas, coal and nuclear power and the most promising renewable energy sources – biomass, hydro, wind, geothermal, and solar? Furthermore, how can market reforms promote more energy efficiency?

This conference will bring together key players in the North American energy sector to address these questions and many others in plenary and concurrent sessions.

Those interested in organizing sessions should propose a topic and possible speakers to Pierre-Olivier Pineau, Concurrent Session Chair (p) +1 514-340-6922, (e) *pierre-olivier.pineau@hec.ca*

This conference will also provide networking opportunities through workshops, public outreach and student recruitment.

HOSTED BY: CAEE

WITH SUPPORT FROM: USAEE, IAEE, AMZEE

TOPICS TO BE ADDRESSED INCLUDE:

Conventional Oil and Gas Issues
- Reserves and access to reserves
- Production and drilling activity
- Fiscal issues: incentive taxation and royalty regimes
- Enhanced recovery with CO_2 injection
- Estimating and forecasting project costs

Unconventional Oil and Gas Issues
- Reserves, resources and possible recovery
- Oil sands production costs
- Heavy oil prospects
- Coalbed methane and shale gas production
- Environmental footprint

Infrastructure Investments
- New pipelines
- LNG terminals, import/export
- Refining and moving 21st century liquid fuels
- Financing after the credit crisis

Carbon Capture and Sequestration
- Experiences to date
- Links with enhanced oil & gas recovery
- Potential to limit GHG
- Cost and the role of subsidies in CCS

Electricity Generation
- Supply adequacy
- New nuclear developments
- State/provincial regulation and economic distortions
- Ownership and cost of hydropower

Electricity Networks
- Market integration and reforms
- Transmission upgrades and pricing
- Distributed generation
- Smart grids and smart metering innovations

Energy Efficiency
- Measurement and verification
- Link to energy pricing
- Information and other market failures

Climate Change
- GHG emission reduction targets and costs
- Impacts of a cap-and-trade system or a carbon tax
- Developments in carbon-mitigation technologies
- International agreements post-Kyoto
- Cost effectiveness: reduction, sequestration or adaptation

Biofuels
- Regulatory incentives
- Life-cycle energy and economic assessments
- Linkages and competition with the food chain

Renewables in Electricity
- Renewable Portfolio Standards and regulatory approaches
- Wind development: growth and challenges
- Hydropower contribution
- Solar and geothermal technology updates

Energy and Transportation
- Transportation policy and efficiency
- Impact of the automobile crisis on energy demand
- Fuel efficiency standards

Geopolitics
- North American energy inter-dependence
- The future of OPEC
- Natural gas politics
- Persian Gulf security
- Renewable energy and energy security

Energy Poverty
- Access to modern energy services
- Energy prospects for developing countries

Visit our conference website at: http://www.usaee.org/usaee2010/

CALL FOR PAPERS

We are pleased to announce the Call for Papers for the 29th USAEE/IAEE North American Conference to be held October 14-16, 2010 at the Hyatt Regency Calgary hotel, in Calgary, Alberta, Canada. The Deadline for receipt of abstracts is May 21, 2010.

Paper abstracts, giving a concise overview of the topic to be covered and the method of analysis, should be ***one to two pages***. Abstracts should include the following brief sections: (1) overview, (2) methods, (3) results, (4) conclusions, and (5) references.

Please visit http://www.usaee.org/usaee2010/ to download a sample abstract template. NOTE: All abstracts must conform to the format structure outlined in sample abstract template. At least one author of an accepted paper must pay the registration fees and attend the conference to present the paper. The corresponding author submitting the abstract must provide complete contact details – mailing address, phone, fax, e-mail, etc. Authors will be notified by July 9, 2010 of their paper status.

Authors whose abstracts are accepted will have until September 3, 2010, to submit their full papers for publication in the conference proceedings. While multiple submissions by individuals or groups of authors are welcome, the abstract selection process will seek to ensure as broad participation as possible: each speaker is to present only one paper in the conference.

No author should submit more than one abstract as its single author. If multiple submissions are accepted, then a different co-author will be required to pay the reduced registration fee and present each paper. Otherwise, authors will be contacted and asked to drop one or more paper(s) for presentation.

Abstracts **must be submitted online** to http://usaee.org/USAEE2010/submissions.aspx Abstracts submitted by email will not be processed. Please use the online abstract submission form.

STUDENTS

Students may submit an abstract for the concurrent sessions. The deadline for abstracts is May 21, 2010. Also, you may submit a paper for consideration in the USAEE Student Paper Award Competition (cash prizes plus waiver of conference registration fees). The paper submission has different requirements and a different deadline.

The deadline for submitting a paper for the Student Paper Awards is July 8, 2010. Visit http://www.usaee.org/USAEE2010/paperawards.html for full details. Students may also inquire about our scholarships for conference attendance. Visit http://www.usaee.org/USAEE2010/students.html for full details.

TRAVEL DOCUMENTS

All international delegates to the 29th USAEE/IAEE North American Conference are urged to contact their respective consulate, embassy or travel agent regarding the necessity of obtaining a visa for entry into Canada. If you need a letter of invitation to attend the conference, contact USAEE with an email request to usaee@usaee.org.

The Conference strongly suggests that you allow plenty of time for processing these documents.

Note: U.S. citizens attending the 29th USAEE/IAEE North American Conference will need to present a passport upon entry to Canada.

The Impact of the Energy/Climate Package on the Development of Renewable Energy Sources in Belgium: Some Insights

By Danielle Devogelaer and Dominique Gusbin*

Introduction

Renewable energy sources (RES) are becoming more and more indispensable in the current global energy landscape. According to the IEA report on Deploying renewables (2008), they are already the third largest contributor to global electricity production today, only marginally behind natural gas. Worldwide, they represented 18% of electricity generation in 2005, and have expanded further since. Focusing on the EU27, the share of renewables in Gross Final Energy Demand reached 8.5% in 2005 and is targeted to go up to 20% by 2020 as part of the *Energy/Climate Package* adopted by the European Parliament in December 2008. The electricity sector in particular experiences a substantial increase in the market penetration of renewables, reaching a share of 15% in EU27 gross electricity generation in 2005. Hydropower takes up the major slice (almost two thirds in 2005) of electricity generation based on renewables, biomass and waste account for 21%, and although spectacularly growing, the share of other renewables like wind, solar and geothermal only represents 2.4% in 2005 EU27 power production. The latter is projected to climb to 11% by 2020 in case of full realisation of the Energy/Climate Package.

Most renewable energy sources make use of technologies that ultimately derive energy from natural phenomena like wind, wave, tidal, sun, water, … Renewable electricity can be generated from wind power, wave, solar photovoltaics (PV), hydro, geothermal and biomass (energy from crops or forestry).

Advantages of most RES are that, once in operation, they have no fuel costs, they exhibit very few unexpected outages and in several cases, less maintenance is needed to keep them functioning (IEA, 2005). However, it is also worth noting that most RES today need subsidies to compete with other technologies. These subsidies should nonetheless steadily decrease over time because of the "learning by doing" process and economics of scale. RES can also play an important role in reducing carbon dioxide (CO2) emissions[1], they can help to enhance sustainability and make a significant contribution towards improving the security of energy supply by reducing Europe's growing dependence on imported fossil energy sources.

Why RES in Europe?

The European Commission has set out a strategy in its Directive 2001/77/EG that by 2010 aims to double the share of renewable energies in gross domestic energy consumption in the European Union (to 12%) and to boost the share of renewables' based electricity in total electricity consumption to 22%. In its Energy/Climate Package (December 2008), the European Parliament further stepped up this effort through adopting a twin target to combat climate change and to develop renewables[2], thereby acknowledging the renewables' benefits in tackling climate change. The definition of this twin target (GHG together with RES) gives way to several desired interactions.

First, as renewables reduce carbon dioxide emissions, climate policy will benefit from installing RES. In specifying the RES development objective, RES become an even more important component of climate policy because the RES objective leads to higher RES deployment than climate policy alone (FPB, 2008). This is so because giving an extra incentive to RES development will postpone the use of other carbon low/free technologies like nuclear or CCS. Second, climate policy also influences the level of RES deployment through the carbon value mechanism (proxy for emission permits' price). Since the RES target is a relative target, two action domains are open: developing RES and/or decreasing final energy demand. The carbon value mechanism then influences both nominator and denominator: it stimulates the use of RES by making fossil fuels more expensive (relative to their carbon content) and it lowers the energy demand through relative price increases.

On top of that, the RES objective prevents the "dash for gas" phenomenon (FPB, 2007) and gives room to a more balanced fuel mix in the power sector than climate policy alone. This is due to the fact that by specifying the RES objective, the accompanying carbon value can be lower, and so polluting fuels like coal do not completely vanish from the power sector scene, which gives rise to a more diversified energy mix (hence, an improvement in security of energy supply).

* Danielle Devogelaer is a commercial engineer, She is part of the Energy-Transport team in the Sectoral Direction of the Federal Planning Bureau. Dominique Gusbin manages the Energy-Transport team in the Sectoral Direction of the Federal Planning Bureau. The opinions expressed in this paper are those of the authors and do not necessarily reflect those of the Federal Planning Bureau.
See footnotes at end of text.

Above that, RES also give rise to the creation of new industries and new functions within the existing economy. Whole new industries can be conceived through the manufacturing and operating of RES, as well as creating completely new jobs and tasks within established sectors, e.g., finance (green investment bankers), research, administrations (monitoring), …

European RES Objectives

The E/C Package then stipulates an increase in the share of renewable energy in gross final energy demand at EU27 level up to 20% by 2020 (starting from 8.5% in 2005). In order to arrive at that 11.5 percentage points leap, a European effort sharing scheme based on equity, cost efficiency and national circumstances is adopted in which all Member States share a part of the burden. This scheme takes flexibility into account, hence admitting that the use of "flexmechs" is needed in order to efficiently arrive at the proposed national targets.

Although every Member State has to live up to its own particular renewables' target, one thing is common: a 10% RES objective in the transport sector, meaning that each Member State has to reach a 10% renewables' share in its gasoline and diesel transport consumption by the year 2020. Renewables used in transport can originate from first and second generation biofuels, green hydrogen and green electricity.

Three sectors for RES use are defined which cumulatively have to contribute to the national target: the electricity sector (RES-E), transport (RES-T) and heating and cooling (RES-H). Besides the 10% mandatory target in the transport sector, no specific sector objective is defined and a country, therefore, is free to allocate its objective amongst the three sectors.

Impact of the E/C Package on the Belgian Energy System

In order to obtain a good grasp of the impact the E/C Package is likely to have on the European and Belgian energy systems, several quantitative analyses were realised with the aid of the PRIMES model (EC, 2008, Capros, 2008, FPB, 2008). PRIMES is a partial equilibrium model that integrates energy supply and demand on a national or European level. Since it is a partial equilibrium model, the energy system alone is modelled and not the rest of the economy. It is principally conceived to build energy projections for the long term (up to 2030), to analyse scenarios and to study the impact of policies and measures that potentially can influence the energy system. Although numerous aspects of the energy system can be analysed with PRIMES, this article only focuses on a selection of indicators within the Belgian context. In what follows, gross inland consumption, final energy demand and power generation will pass the scene, with major focus on RES deployment.

As a starting point, a baseline is run. The baseline that is used for this analysis is similar to the one published in April 2008 by DG TREN of the European Commission (EC, 2008). In the PRIMES baseline, energy developments are simulated on the basis of assumptions concerning, e.g., economic and social development, world energy markets and implemented policies. Starting from these assumptions, developments are driven by market forces so that efficient energy solutions are chosen whenever this is economic taking into account subjective discount rates including risk premiums.

The PRIMES baseline depicts the Belgian economy under current trends and policies taking into account the policies implemented up to the end of 2006. This baseline may come up with energy forecasts that do not lead to the realisation of agreed targets (e.g., Kyoto target). In PRIMES, the indicators on CO_2 emissions or the share of RES are model results that inform the policy process about the effects of policies or their absence. This approach enables the baseline to illustrate the gap between policy ambitions and what is already underway for delivering on these policy aspirations. This approach allows the baseline to be a valid reference case for the subsequent evaluation of the effects of energy and climate policies and measures. Such measures are modelled in the policy scenarios irrespective of their state of implementation (answering "what if" questions).

The policy scenario studied in this article originates from the work the Federal Planning Bureau performed on the quantitative analysis of the impact of the combined GHG and RES targets on the Belgian energy and economic system (FPB, 2008). In PRIMES, the installation of a constraint (be it on emissions or renewables) is equivalent to the introduction of a variable that reflects the economic cost imposed by this constraint. In the case of GHG emissions, this variable is the marginal abatement cost (also called carbon value) associated with this constraint; it represents the cost to reduce the last unit of emissions that needs to be eliminated in order to reach the set emission target. The marginal abatement cost can also be seen as the emission permits' price determined on a perfect market and of which the quantity corresponds to the constraint. The carbon value (CV) by hypothesis is unique for all sectors; it initiates changes in the relative prices of the different energy forms, reflecting by this the differences in the

carbon content of fuels. These changes induce technological modifications/innovations and behavioural adaptations of producers and consumers of energy.

When a constraint is put on RES, things are a bit different. Instead of imposing directly an overall target for renewables, it is assumed that a certain positive monetary value is associated with any unit of energy produced by a renewable energy source. Such a monetary value does not involve payments but its presence alters the economic optimality of calculations of the agents. This monetary value could be interpreted as a "virtual" subsidy and enters in the model calculations as a negative unit cost (a benefit), which is called a renewables value (RV). Being a virtual subsidy, the renewables value does not make energy cheaper but just influences the optimal fuel mix as considered by each economic agent.

Evolution of the Belgian Energy System under Unchanged Policy

Starting from a projection of the Belgian energy system under unchanged policy (baseline), a selection of energy indicators is presented. The final year studied is 2020 since this is the horizon stated in the E/C Policy Package. The same indicators are afterwards scrutinized for the policy scenario.

Gross Inland Consumption

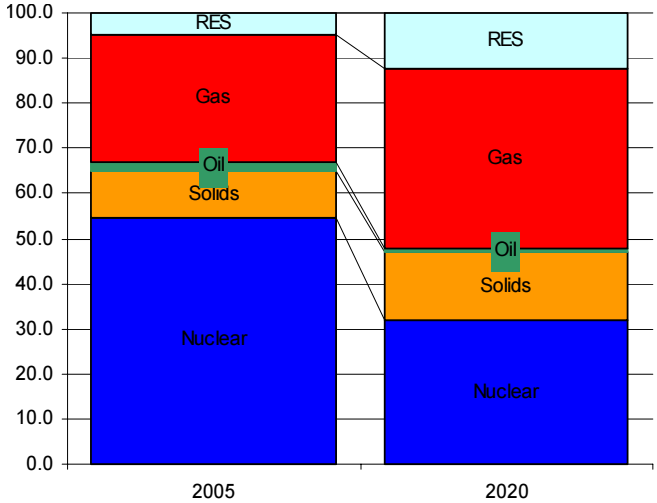
The first indicator is the Gross Inland Consumption (GIC) or Primary Energy Demand. The GIC is an indicator that describes a nation's total energy consumption and that consists of primary production (energy sources that are exploited on the nation's soil, e.g., wind and hydro) and net import (energy sources that are imported by the country, e.g., oil). The baseline GIC for Belgium follows a growth pattern: from 55 Mtoe in 2005[3] to 59 Mtoe by 2020. The share (and absolute amount) of renewables follows this increase: from 3.7% in 2005, it climbs to 6.3% by 2020.

Final Energy Demand

Zooming in on the FED (Final Energy Demand, i.e., the energy consumption of industry, households, the tertiary sector (including agriculture) and transport), we see that between 2005 and 2020, the FED increases by 13.9% (or an average annual growth rate of 0.9%). All energy forms seem to grow, with the exception of oil which stabilizes. Renewable energy sources like biomass and solar thermal develop strongly (annually by 3.8% on average), but represent the smallest share in 2020 (8.2%).

Power Generation

The evolution of net electricity generation between 2005 and 2020 is depicted in Figure 1. A significant change in shares can be noticed: more gas and RES are used in 2020, the share of solid fuels increases somewhat, while both oil and nuclear energy[4] decline.



Source: PRIMES, FPB (2008)

Figure 1
Net Electricity Generation (%), Baseline, Year 2005 and 2020

Zooming in on power generation based on renewable energy sources, Table 1 summarizes net power generation and installed capacity for the 4 RES (hydro, wind, biomass & waste[5] and solar PV). With the currently implemented or approved policies (green certificates, investment subsidies, etc.) and the evolution of fossil fuel prices, the net installed RES power capacity grows from a rather low 800 MW in 2005 to approximately 4000 MW installed in 2020; subsequent RES based electricity generation grows from 3900 GWh in 2005 to 13200 GWh in 2020. This means that the share of RES in total electricity production increases from 4.7% in 2005 to 12.4% in 2020. The power capacity grows a bit faster than the production due to the intermittent nature of (some of) the renewables. In 2020, the largest capacity will be provided by wind energy, with total wind capacity estimated to be 2228 MW.

RES in Gross Final Energy Demand

The E/C Policy Package subscribes to a 20% share of renewable energy in Gross Final Energy Demand by 2020 for the EU as a whole. For Belgium, this boils down to a 13% share. In the baseline, nonetheless, without the adoption or implementation of any additional incentives or actions by the end of 2006, we see that we are still a long way from reaching this objective. Starting from an absolute amount of 778 ktoe of RES in 2005, we arrive at 3167 ktoe by the year 2020. Expressed in percentage of Gross

Final Energy Demand, this amounts to 7.5% in 2020.

The expansion in the share of biofuels (RES-T) is remarkable: it rises from non-existent (0% in 2005) to 6.9% in 2020. However, this sharp rise does not suffice to meet either the 2010 target (5.75%) or the 2020 target (10%).

	Net power capacity (MW)		Net electricity generation (GWh)	
	2005	2020	2005	2020
Hydro	102	108	280	362
Wind	167	2228	227	5334
Biomass and waste	551	1547	3375	7403
Solar PV	2	93	1	71
Total	822	3976	3883	13169

Source: PRIMES, FPB (2008)

Table 1
RES Power Capacity (MW) and Electricity Generation (GWh), Baseline, Year 2005 and 2020

The E/C Package for Belgium in 2020

A next step then is to look at the same indicators in a policy driven scenario in which the E/C Package for Belgium is mimicked as close as possible[6], this means including resort to flexibility mechanisms for the GHG reductions (JI/CDM) as well as for RES (trading) (FPB, 2008). Figures are reported compared to the baseline in the year 2020.

Gross Inland Consumption

In 2020 under the influence of the twin target, the energy system undergoes a dual effect: energy savings on the one hand (total GIC declines by 5.3% or 3162 Mtoe) and a significant jump in RES deployment on the other (increase with 44.7% or 1655 Mtoe). The RES share now boils down to 9.6% (compared to 6.3% in the baseline).

Final Energy Demand

In the FED, we also notice this double effect: the total FED in 2020 decreases by 5.7%, the RES deployment augments further.

Power Generation

The power generation also bears the influence of the Package. As seen earlier, a first reaction of the system is to lower its energy demand, including its electricity consumption (basically because of the rise in energy prices). Next, the power mix changes due to substitutions: the shares of solids and gas decrease considerably (respectively, from 15 to 10% and from 37 to 34%), whilst the renewables' based electricity is able to expand its part to 19.2% (up from 12.4% in the baseline). Net installed RES power capacity then jumps to 6101 MW (+46% compared to baseline), net RES electricity production reaches 19503 GWh in 2020 (+48% compared to baseline).

Res in Gross Final Energy Demand

Belgium should reach a 13% share in Gross FED by 2020. In the baseline, we saw that a 7.5% share or 3167 ktoe is obtained with current trends and policies. The policy scenario with the aid of the renewable value then is able to step up this effort and reaches 12.3% of RES in a cost efficient way. This boils down to an absolute amount of renewables in Gross FED of 4904 ktoe. The deficit of 0.7 percentage points can be remedied through the use of flexibility mechanisms.

The share of biofuels in transport reaches 9.5%[7]. In other words, this means that the incentive systems in place to reach the GHG and the RES target would normally suffice to reach the set goal of 10% renewable energy in transport.

Conclusion

In a nutshell, this article describes some reasons why a specific RES target was added to the adopted European E/C Package (instead of a single GHG emission reduction objective). The benefits of this twin target are outlined.

Next, a Belgian baseline up to the year 2020 is presented in which current policy, ongoing trends and structural changes endure, without any specific efforts or additional policies to constrain damaging greenhouse gases or develop renewables other than those already implemented by the end of 2006. Zooming in on renewables, we see that by 2020 the share of RES mounts in GIC as well as in FED, but that it stays rather modest (6 to 8%). Power generation will count on RES for 12.4% in 2020, basically through wind and biomass.

In a second step, the impact of the E/C Package as adopted by the European Parliament is investigated on the Belgian energy system, with focus on RES. First observation is that the energy system switches to energy savings: the three indicators all point to a decrease in energy consumption. Next, the deployment and share of RES increases. The proposed 13% share that was appointed to Belgium seems to be within

reach. Condition is that Belgium starts to act as soon and as swift as possible on the implementation of this Package in terms of policy measures and awareness campaigns. There is no time to waste.

Footnotes

[1] As is the case for any equipment, there are indirect CO2 emissions associated to RES technologies. These emissions are taken into account in the country where RES technologies are produced or in the emissions of industry if they are being produced domestically.

[2]GHG reduction objective of 20% (possibly 30%) in 2020 with respect to 1990 at European level and RES development objective of 20% of Gross Final European Energy Demand in 2020.

[3] 2005 is the last year of observed statistics available from Eurostat.

[4] The reader is brought to memory that Belgium did decide on a nuclear phase out: the nuclear installed capacity is gradually decommissioned to have completely vanished by the year 2025, following the Belgian law of 2003 on the nuclear phase out (Belgian Monitor, February 28, 2003, pp. 9879-9880).

[5] The designation 'biomass and waste' is the generic term for a set of different sources, being biogas, solid biomass and waste of all sorts (bio and non-biological waste).

[6] Given best available knowledge at the time of publication.

[7] 9.5% stands for the biofuels' contribution being produced domestically (in Belgium). The deficit (remaining 0.5%) can be purchased through a mechanism of intra-community trade, since the mandatory target of 10% renewable energy in transport on EU ground is honoured

References

Bossier F., D. Devogelaer, D. Gusbin and F. Verschueren (2008), *Impact of the EU Energy and Climate Package on the Belgian energy system and economy,* Federal Planning Bureau, Working Paper 21-08.

Capros et al. (2008), *Model based Analysis of the 2008 EU Policy Package on Climate Change and Renewables*, Report to the European Commission, DG ENV.

Devogelaer D. and D. Gusbin (2007), *Energievooruitzichten voor België tegen 2030 in een tijdperk van klimaatverandering*, Federal Planning Bureau, Planning Paper 102.

European Commission (2007), *Limiting Global Climate Change to 2 degrees Celsius, The way ahead for 2020 and beyond*, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions.

European Commission (2008), *Annex to the Impact Assessment*, Commission Staff Working document.

European Commission, Directorate-General for Energy and Transport (2008), *European Energy and Transport, Trends to 2030 – Update 2007*, prepared by NTUA with the PRIMES model.

European Commission (2008), *Clarifications regarding the definition of final energy consumption in Article 2(c) of the RES directive*, Non-paper.

Federal Planning Bureau (2006), *La politique climatique post-2012: analyse de scénarios de réductions d'émissions aux horizons 2020 et 2050*, *Het klimaatbeleid na 2012: Analyse van scenario's voor emissiereductie tegen 2020 en 2050*.

Federal Planning Bureau (2006), *Long term energy and emissions' projections for Belgium with the PRIMES model*, report addressed to the Commission Energy 2030.

IEA (2005), *Variability of wind power and other renewables, Management options and strate*gies.

IEA (2008), *Deploying Renewables, Principles for Effective Policies*.

Careers, Energy Education and Scholarships Online Databases

IAEE is pleased to highlight our online careers database, with special focus on graduate positions. Please visit http://www.iaee.org/en/students/student_careers.asp for a listing of employment opportunities.

Employers are invited to use this database, at no cost, to advertise their graduate, senior graduate or seasoned professional positions to the IAEE membership and visitors to the IAEE website seeking employment assistance.

The IAEE is also pleased to highlight the Energy Economics Education database available at http://www.iaee.org/en/students/eee.aspx Members from academia are kindly invited to list, at no cost, graduate, postgraduate and research programs as well as their university and research centers in this online database. For students and interested individuals looking to enhance their knowledge within the field of energy and economics, this is a valuable database to reference.

Further, IAEE has also launched a Scholarship Database, open at no cost to different grants and scholarship providers in Energy Economics and related fields. This is available at http://www.iaee.org/en/students/ListScholarships.aspx

We look forward to your participation in these new initiatives.

INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
WWW.IAEE.ORG

Member-Get-A-Member Campaign

IAEE Members:

We are pleased to announce the continuation of IAEE's Member-Get-A-Member campaign. IAEE believes you know quite well the value of membership in our organization. Furthermore, membership growth is one of the Association's top strategic initiatives. With your knowledge of our organization's products/services, publications and conferences, we know that you are in the ideal position to help us grow. The process to win rewards for your self is quick and easy!

Here's How the Program Works:

- For each new IAEE member you recruit, you receive THREE months of membership free of charge.
- New Members must complete the online IAEE membership application form at https://www.iaee.org/en/membership/application.aspx Make sure the member(s) you refer mentions your name in the "Referred By" box located on the online membership application form.
- The more new members you recruit the more free months of membership you will receive. There is no limit to the number of new members you may refer.

Membership Recruitment Period and Additional Incentive:

- This special program will run from September 1 – December 31, 2009.
- The Member that refers the most new members to IAEE during this timeframe will receive a complimentary registration to attend the Rio IAEE International Conference (this prize may be assigned by the winner to another member).

IAEE Tips for Success:

- Promote the benefits of IAEE membership - Share your IAEE passion with others! Visit https://www.iaee.org/en/inside/index.aspx for a brief overview of IAEE.
- Connect with colleagues – Invite your co-workers, colleagues and friends to IAEE conferences.
- Keep IAEE membership applications at your fingertips - Please contact David Williams at iaee@iaee.org and request that membership applications be mailed to your attention. Feel free to hand these out on your travels.
- Let IAEE do the work for you – Send us an email at iaee@iaee.org letting us know who should be invited to join IAEE (we need full name and email address) and we will contact who you refer to see if they have an interest in joining IAEE. If the member joins during the timeframe above you will be given three months of membership free per member you recruit!

We encourage all members to help our organization grow. At the same time, you will be rewarded with free membership months and an opportunity to have your conference registration fees waived at coming IAEE Conferences.

Please forward this letter today to members you believe should join IAEE. We encourage them to visit https://www.iaee.org/en/membership/application.aspx to join!

The Global Financial Crisis and the Oil and Gas Sector of the Nigerian Economy

By Jean Balouga*

Some of the channels through which the global financial crisis are affecting Nigeria are the reduction in volume of, and price of oil, low commodity prices, exit and reduction in capital flows, cut in tourism, cut in foreign credit lines and low remittances. Reduction in the demand for, and price of, oil in particular is providing a platform for reduced macro-economic performance through its usual channel of government revenue and foreign exchange earnings. In budget terms, the average price of oil hovered just above US $ 40, less than the benchmark for the 2009 budget.

Impact on Nigeria

In Nigeria, the budgetary crisis caused by steadily dwindling oil revenue, may make it difficult for the government to put into joint venture operation the US$5 billion it allocated for the purpose in the 2009 federal budget of N3.1 trillion. Although the Nigerian National Petroleum Corporation (NNPC) claims it has, in collaboration with the Federal Ministry of Finance, secured all the financial instruments necessary to raise the balance of US$5.87 billion required to meet government equity commitment to joint-venture projects in 2009, the global financial climate makes it doubtful if such funding can be successfully accessed.

As we go through early 2009, operators will likely take a restrained approach to E&P activities. Though most projects are evaluated and based on long-term horizons, the on-going crisis could cause postponement of projects and delays in the completion of on-going ones. Both National Oil Companies and International Oil Companies may adopt a wait-and-see attitude as they evaluate the stability of the world economy and the prospects for oil prices. Some small international companies and state-owned operators may also be hamstrung by tightness in the credit markets. Overall, oil companies in the international arena will be less aggressive in the first half of 2009 than they were in the same period in 2008.

Global service companies are unlikely to continue their investment in infrastructure and hiring, especially in emerging markets. Certain segments of the oil service industry are expected to slow down more than others, with production-oriented products and services likely to remain in low demand. With the continuing downturn and the slow pace of activity likely in the E&P sector, prospects do not look particularly bright for the Nigerian oilfield service sector in 2009. Just as it happened last year, oilfield service companies, some of which are already trimming their workforce may not have much to do this year unless there is a turnaround.

The fear among indigenous companies in the service sector is that if this trend continues, gains made in government's Nigerian-content drive may be lost. Experience and skills acquired by indigenous firms through opportunities for the handling of contracts, which the Nigerian-content policy opened up for them may be lost, if there are no further avenues to put them to test.

The Federal Government's delay in producing a new, comprehensive economic programme reflects the fact that the country stands at a crossroads between implementing tough, unpopular market reforms and pandering to nationalistic and pro-subsidy interest groups. In addition, the challenges presented by the crisis combined with lower oil prices have caused uncertainty among Nigeria's policymakers. For his part, President Yar'Adua has listed seven priorities for reforms. Of these, arguably the greatest challenge will be to find a solution to the country's electricity supply problems. The government expects the private sector to play a key role, although private companies look set to take a cautious approach, given the challenging operating environment. Until they become fully involved, the government has committed itself to large subsidy payments to keep electricity prices low for end users.

Economic Growth

The troubles in the Niger Delta, which have intensified since April 2008, are likely to depress oil production further. The reason is that despite increased production from new offshore fields, the creation of the Ministry for the Niger Delta and a general amnesty declared by the Federal Government, no solution to the region's troubles is in sight, and the rebel militias are likely to continue their campaign. In addition, the OPEC quota cut introduced in December 2008 will put pressure on the authorities to reduce production. As a result, economic growth in Nigeria will come to depend much on the performance of the non-oil sec-

* Jean Balouga is in the Economics Department of the University of Lagos, Lagos, Nigeria. He may be reached at jebalouga@hotmail.com

tor, particularly solid minerals and agriculture as has been the case in the past three years or so. Although growth in this sector should remain comparatively robust, it is likely to slow markedly in 2009. Less access to finance will restrict investment and constrain previously buoyant sectors such as banking and construction. Growth in Nigeria's resurgent banking sector is also likely to slow. Although not directly exposed to toxic assets, the country's financial institutions will suffer from worsening investor sentiment and lower consumer confidence.

External Sector

The slump in oil prices in 2009 has caused a large contraction in the value of Nigeria's exports to US$28.2bn, from US$76.3bn in 2008. Import growth will also slow, owing to falling international prices for many commodities and lower domestic demand, but the traditional trade surplus is forecast to turn to deficit. Meanwhile, the services and income accounts will remain firmly in deficit, although the income deficit will shrink in line with the fall in oil prices and concomitant lower profit remittances from the international oil companies operating in Nigeria.

States

The oil revenue accruable to all tiers of government is on the decline: N30.894 billion in May 1999, N196.383 billion in May 2004, N746.745 billion in May 2008, and N435.40 billion in January 2009, to the lowly amount of N285.58 billion distributed in February 2009. Also, the value of the 13 percent derivation fund accruable to oil-producing states was N23.64 billion in January, 2009, much less than the sum of N35.08 billion that accrued to the concerned states in December, 2008. (The sharp reduction observed in the February 2009 allocations would have been more drastic but for the depreciated exchange rate applied in the conversion of the oil proceeds).

The challenges are glaring. How realistically can these states finance their budget deficits? Would they cut their budgets as some are already considering? They are already considering borrowing either from the banks or from the public through bonds. To what extent will such intent be fulfilled without jeopardizing the proper execution of the budgets especially their recurrent expenditure segments? How would the states respond effectively to the teachers' demands for a salary increase as agreed to with the Governors last year?

Government's Response

Although there was a delay in the formulation of policies that could have shielded the economy from the effects of the crisis in the belief that it would not affect Nigeria, Nigeria is slowly coming to terms with its effects. The Yar'Adua administration is re-working the 2009 budget in line with global realities. With oil prices now in a free fall, the government is set to drop its projected crude oil benchmark down. As part of cost-cutting measures, government plans to remove some items of expenditure from the budget while recurrent overheads and capital expenditure would be pruned. Important changes in the 2009 budget include the cancellation of overseas training, a 20% cut in the emoluments of all top federal government functionaries (from the President to the Permanent secretaries), a ban on the purchase of new cars for government functionaries and agencies, and no vote for new capital projects for ministries, departments and agencies. On the other hand, the federal government has set aside N200 billion for big-time farmers and planned a social security net so that job losers, displaced Nigerians and other indigents may be given allowances to cushion the effect of the meltdown. Government has started using part of the funds in the Excess Crude Account to supplement revenue allocation to the three tiers of government in months when available revenue falls short of the budgetary provision; it is laying emphasis on priority areas such as power, health, the Niger Delta and dredging of the Niger River. It has drawn up plans to defend the country's banking system amidst fears that bad loans, racked up during a frenzy of stock market speculation, could put some lenders in danger and is contemplating the creation of an assets management company, backed by state and private funds, that could offer to buy bad debts.

The CBN has embarked on "emergency" measures to bolster the liquidity of the system by easing the monetary policy rate from 9.75% to 8 percent. It has cut the cash reserve requirement for banks by half, from 2% to one percent and banks' minimum liquidity ratios by 5% to 25 percent. These emergency measures are aimed at improving liquidity conditions in the domestic economy as well as responding to the complex mix of external and domestic financial developments affecting Nigeria.

However, Sebastian Spio-Gebrah faulted CBN's moves, saying that they are inflationary (Nigeria's core inflation rose from 2.5% in January 2008 to 8 percent in January 2009) adding that, this policy might lead to agitation by civil servants for an increase in wages, which the government may not be able

to do. Moreover, according to him, these measures do not address the growing worry by many Nigerian savers who may lose substantial sums of money to some of the middle-tier banks who may be facing an "insolvent" crisis in addition to the more generalized financial sector "liquidity" problem. For example, over the past six months the non-performing loan ratios of many banks have risen. In response, some of the most stressed ones have dramatically increased the interest rates they pay to depositors, while also dramatically cutting back on lending. This deeply-worrying phenomenon may have necessitated the adoption of the unprecedented policy of interest-rate controls on both deposits (max.15%) and credit (max.22%). Regrettably the loosening of liquidity has not done anything structurally to address the underlying bank-toxic-loan problem which triggered the liquidity problem in the first place.

Major capital projects highlighted in the 2009 budgets of the 36 states of the federation may suffer a severe setback if revenue accruing to them continues to dwindle. Capital projects are expected to be the first casualty as expenditure on investment is expected to be cut in the states.

Many states have already begun the process of reviewing their expenditures with projects to boost infrastructure at the top of the chop block: roads, urban renewal and water-supply projects are being suspended, as states grapple with the challenges of lean resources. Urban renewal projects in some states – dualisation of existing roads and electricity projects using solar energy may be hardest hit by the capital projects rationalization.

Traditionally, internally-generated revenue (IGR) is a marginal revenue area for the states. Only 14 states generate more than 10 percent of their total revenue from IGR, with the exception of Lagos, whose IGR is 60% of its total revenue. Yet a bloated retinue of personal aides for governors, weak structure for accountable governance to curb corruption, and the seemingly intractable problem of ghost workers, have made states maintain huge recurrent costs, which often account for more than 60 percent of their yearly budgets. This is being looked into.

Now, following the decline in allocation to states, the drive for IGR is escalating in all of them. Hitherto overlooked sources of funds are now being resurrected. (The statutory areas states can derive revenue remain income tax, levies on land, fees etc.). The tax base is broadening. In spite of all their efforts, it looks increasingly likely that many states will continue to experience revenue shortfalls that will put many of their programmes at risk.

Conclusion

The Nigerian oil and gas sector is perhaps the flank through which the global financial crisis has hit Nigeria hardest. The reason is that the Nigerian economy is so tied to oil revenue that oil shocks immediately impact on virtually all economic prices in significant magnitudes. What is required now is to ensure that the government reform progamme is expedited. The restructuring of the oil and gas sector, in particular, will streamline the operations in the oil industry such that major tasks of policy, (de)regulation, commercial operations and national assets management, etc., are carried out by separate public entities. For now deregulation of the downstream sector should be put on hold. Priority attention should be given to efficiency in resource use and accountability, provision of infrastructure and reinvigoration of the peace process in the Niger Delta. In addition good planning should ensure that government spending and its financing do not result in economic instability, that requisite diversification of the economic base is allowed to take place – particularly in the areas of power supply, agriculture, petroleum refining, petrochemicals, information and communications technology, iron and steel, manufacturing - and people's empowerment through small and medium enterprises. Government should close the $100billion infrastructural gap now 80% GDP without delay and speed up the public-private partnership arrangement, whose benefits include project efficiency, appropriate risk allocation and sharing, the privilege of leveraging on private sector strengths and tapping on the pool of private sector funds. Because the CBN's interest rates have not yet translated into increased spending on interest-sensitive investment and consumption, there is no alternative to fiscal policy if government wants to reverse the current downturn. The resulting increase in the national debt is the price that we, and future generations, have to pay for the mistakes that created the current economic situation. When the crisis is over Nigeria will have a substantially higher debt-to-GDP ratio. At that point it will be necessary to develop policies to gradually reduce the relative level of government spending in order to shift the fiscal surpluses and reduce the debt burden. The ideas are there. It is just the will and sincerity that may be lacking. According to Price (2009), if we rein in corruption, rein in unnecessary expenditures, follow simple cannons of political and economic governance, work at our infrastructure, and diversify our economy we shall overcome.

References

Bassey, J. (2009): "Financial Crisis: FG plans social security policy", BusinessDay, 4 February, pp.1, 4.

---------- (2009): "Response to financial crisis"; BusinessDay, 30 January to 1 February, p.10.

Dodd, R.(2007): "Subprime: Tentacles of a Crisis"; Finance and Development, December, pp.15-19.

Egwoniso, O.: "Carving out survival strategy for the economy in meltdown"; BusinessDay, 15 April, p.17.

Fagule I, Obi I and K. Ajumobi (2009): "PPP can be a panacea to Nigeria's infrastructure deficit"; BusinessDay, 10-12 April, pp.1, 4.

Feldstein, M.(2009): "The case for fiscal stimulus"; BusinessDay, 28 January April, p.52.

---------- (2009): "Outlook for 2009-10: Plummeting of oil price translate into a tricky political scene for the Nigerian president"; BusinessDay, 9 March, p.53.

Green, M.(2009): "Nigeria prepares plan to buy bad loans"; BusinessDay, 9 March, p.57.

---------- (2009): "Dwindling oil revenue: Options before states"; Editorial, BusinessDay, 9 March, p.12.

---------- (2009): "State governments and financial crisis"; Editorial, BusinessDay, 10 March, p.12.

Momoh, S., J. Omachonu, B. Anaro, S. Michael and A. Imhonlele (2009): "'Less corruption, more prudent management key to states' survival'", BusinessDay, 12 March, pp.1, 54.

Momoh, S. (2009): "Stakeholders chide CBN over N200bn agric fund"; BusinessDay, 22 April, p.49.

Nwachukwu, I. (2009): "Global economic crisis: Impact, challenges in Nigeria", BusinessDay, 11February, p.38.

Nwachukwu, I. (2009): "Global Crisis: Is Government mindful of long-term implications of policy responses?" BusinessDay,4 February, p.42.

Nwachukwu, I. (2009): "$100bn infrastructural gap now 80% of GDP-Rewane"; BusinessDay, 15 April, p.16.

Nwachukwu, I.(2009): "Global Crisis: X-raying challenges before policy-makers"; BusinessDay, 11 March, p.17.

Obasa R. (2008): "Effects of the global credit crunch on the oil industry"; Nigeria's oil and gas monthly, October, pp.16-18.

Okiti, O., J. Omachonu, M. Amuche and A. Ajakaiye (2009): "States scale down capital projects" BusinessDay, 10 March, pp.1, 51.

Okiti, O and I. Obi (2009): "States' drive to boost internal revenue escalates"; BusinessDay, 11 March, pp.1, 46.

Okiti, O. and I. Obi (2009): "Crisis looms in states over declining revenue"; BusinessDay, 11 March, pp.1, 4.

Okiti, O. (2009): "How is it going?" BusinessDay, 13 April, p. 55.

---------- (2009):"IMF raises concern on Nigeria, other developing countries' economies"; BusinessDay, 5 March, p. 4.

Omachonu, J. and O. Egwuoniso (2009): "CBN's monetary policy may derail Yar'Adua's second term bid"; BusinessDay, 13 April, pp.1, 4.

Price, C.(2009): "Nigeria's compass in the tide of economic meltdown", BusinessDay, 30 March, pp.30, 50.

Stiglitz, J. E. (2009): "Developing countries and the financial crisis", BusinessDay, 16 April, p.48.

---------- (2009): "Yar'Adua mulls N73bn economic stimulus plan"; BusinessDay, April p.50.

IAEE Institutional Membership

IAEE is very grateful for the support and involvement of our Institutional Members listed below. Institutional membership carries with it many special benefits. For a full listing of benefits and services please visit http://www.iaee.org/en/membership/institutional.aspx

Aramco Services Co., USA
BKW FMB Energie AG
BP Plc., UK
CityPlan spol. S.r.o., Czech Republic
ConocoPhillips, USA
CRA International, USA
Curtin Business School, Perth, Australia
Energy Information Administration, USA
GSE S.p.A., Italy
Institut Francais Du Petrole, France
Institute of Energy Economics, Tokyo
National Energy Board, Alberta, Canada
Platts, USA
Rice University, Baker Institute, USA
Shell International, Ltd., The Netherlands
Talisman Energy, Canada
UCL SERAus, Australia
University of Alberta, Canada
University of Auckland, New Zealand
University of Perugia, Italy
University of Stavanger, Norway

The Nigerian Bio-fuel Policy and Incentives (2007): A Need To Follow the Brazilian Pathway

By Peter Kayode Oniemola and Gbenga Sanusi*

Introduction

Fossil fuel sources[1] are the fulcrum upon which industrialization and globalization have rested over the years. Oil provides over 90 percent of Nigeria's foreign exchange earnings, even though the oil sector of the economy contributes only 30 percent to the GDP in comparison to 40 percent from agriculture. The country benefits from the rise in oil prices and the strategic importance of being one of the world's largest producers of a vital product.[2] Nigeria's oil has not guaranteed ecologically and socially acceptable development in Nigeria.[3] At present, there are over 11 oil companies operating 1,481 wells from 159 oil fields in the Niger Delta producing 2.7 million barrels of crude oil each day and flaring about 17 billion cubic metres of associated gas, spewing 2,700 tons of particulates, 160 tons of sulphur oxides, 5,400 tons of carbon monoxide, 12 and 3.5 million tons of methane and carbon dioxide, respectively, in the process.[4]

The current trajectory of fossil fuel use and its related emission of greenhouse gases[5] are unsustainable.[6] The environment is in threat by exploration of oil. With the rise in oil prices and the adverse effects of global climate change, Sub-Saharan Africa has an unprecedented opportunity: choosing a cleaner development pathway via low-carbon energy alternatives that can reduce greenhouse gas (GHG) emissions and, at the same time, meeting current suppressed energy demand and future needs more efficiently and affordably.[7] Bio-fuels[8] are becoming an increasingly important alternative source of energy. The use of bio-fuels will reduce the use of fossil fuels, thereby minimising the emission of green house gases. Increased use of bio-fuels will enhance the quality of the environment. The use of bio-fuels will lead to environmentally friendly, sustainable and viable sources of energy to reduce the dependency on depleting fossil fuels. Increasing attention is being focused on the production of bio-fuels especially ethanol and bio-diesel as the alternatives that will contribute to global reduction in greenhouse gas emissions.

According to the International Energy Agency bio-fuels presently account for 10 percent of global Total Primary Energy Demand (TPED), far more than all the other sources of renewable energy. In developing countries it provides 20 percent of Total Primary Energy Demand and reliance on bio-fuels in Africa is put at 47 percent, largely from wood.[9] Bio-fuels are drawing increasing attention worldwide as substitutes for petroleum-derived transportation fuels to help address energy costs, energy security and global warming concerns associated with liquid fossil fuels.[10]

Bio-fuels may emit some pollutants when combusted, but they generally burn cleaner than corresponding fuels used in similar applications. The environmental case for other renewable energy technologies stresses the lack or absence of air-pollutant emissions during their normal operation.[11]

Nigerian Bio-Fuel Policy and Incentives (2007)

Nigeria presently has a policy on bio-fuels entitled Nigerian Bio-fuel Policy and Incentives (2007). The Policy Document was approved by the Federal Executive Council on June 20th, 2007 and gazetted as a national bio-fuels policy at the same time. The Nigeria National Petroleum Corporation was given the mandate to create an environment for the take-off of a domestic ethanol fuel industry. The aim is to gradually reduce the nation's dependence on imported gasoline, reduce environmental pollution while at the same time creating a commercially viable industry that can precipitate sustainable domestic jobs.

The framework of the policy and the incentives is meant to create an enabling environment that is expected to sensitize and catalyze the development of the country's bio-fuels industry.[12] The bio-fuel programme constitutes a major and unique attempt to integrate the agricultural sector of the economy with the downstream petroleum sector, while fostering the use of other renewable energy sources.

To make the project a realizable objective; the federal government through the Nigeria National Petroleum Corporation, (NNPC) created the Renewable Energy Division (RED), to champion the implementation of the programme. The NNPC, by mandate of the former President, Olusegun Obasanjo, inaugurated the Renewable Energy Division in August, 2005, and charged it with the responsibility of developing the bio-fuel industry in Nigeria.[13] RED shall provide a consistent, steady supply of alternative fuel to the utmost satisfaction of customers and continuously seek to improve the quality of its management systems.

* Peter Kayode Oniemola is a McArthur Foundation Graduate Intern in the Faculty of Law, University of Ibadan, Nigeria. He may be reached at petermola@yahoo.com Gbenga Sanusi is a student at the University of Ibadan, Nigeria.

See footnotes at end of text.

The implementation plan includes initial market seeding (E-10), a bio-fuel production programme (PPP) to achieve 100% domestic production by 2020, a complete bio-fuel uptake arrangement, and joint-venture distilleries. This is anchored on agricultural productivity and competitiveness. The policy is intended to create market demand for bio-fuel products. Already, US$4 billion has been committed to a sugar-cane sourced ethanol project in the northern states of Jigawa and Benue while cassava-sourced ethanol projects are earmarked for the southern Anambra and Ondo states.[14]

For the purposes of implementing the provisions of the Policy, a Bio-fuels Energy Commission shall be established. The Bio-fuels Energy Commission is charged with responsibility for implementing the strategies for bio-fuels in the country. It shall specifically exercise the following responsibilities:

1. Register all bio-fuel plants/projects in the country.
2. Issue license to bio-fuel operators for the production of fuel ethanol or/and bio-diesel in Nigeria.
3. Formulate and recommend fiscal, financial and other incentive policies for the bio-fuel industry, as well as protection measures if required.
4. Periodically, review and assess the economic, technical, environmental and social impact of the use of bio-fuels, and determine changes in policies required when necessary.
5. Monitor the supply and utilization of bio-fuels and bio-fuel blends and recommend appropriate measures to the Department of Petroleum Resources in case of shortages in the supply of bio-fuels or feedstock.
6. Review and adjust the minimum mandated bio-fuel blends as it deems appropriate.
7. Determine and put in place industry stabilization mechanisms.
8. Designate and oversee the activities of the investment bank appointed to manage the Bio-fuel Industry Equity Fund.
9. Establish and support the Bio-fuels Research Agency to be established under the Bio-fuels Programme.
10. Monitor intra-industry commerce, in particular relationships between out growers and bio-fuel producers. Present quarterly reports and briefings on the status of the bio-fuel industry to the National Assembly.
11. Present quarterly reports and briefings on the status of the bio-fuel industry to the National Assembly.
12. Disseminate and share information with investors and other interested members of the public.
13. Liaise with the Energy Commission of Nigeria in the formulation, revision and implementation of the National Energy Policy.
14. Liaise with the National Sugar Development Council as may be required.
15. Liaise with government ministries, agencies, parastatals, research institutes.

Provisions for incentives in the biofuel industries have also been made. For instance, there exist provisions for application for waivers granting Pioneer Status for an initial 10-year period with the possibility of additional 5 years extension since biofuel is not listed as one of the companies benefiting from such under the Industrial Development (Income Tax Relief) Act. The Policy explores the various provisions of the tax laws[15] in Nigeria in order to create a wide range of incentives to the bio-fuels market. It, therefore, becomes necessary for the amendment of the tax laws in the country to bring them in consonance with the intent and purpose of the policy.

A research agency to be known as the Bio-fuels Research Agency shall be established to act as the central coordination body for bio-fuel research in the country. The policy stresses a collaborative efforts with local research institutes in feasibility studies namely, International Institute of Tropical Agriculture (IITA), National Cereal Research Institute (NCRI), National Root Crops Research Institute (NRCRI), Nigerian Institute for Oil Palm Research Council (NIFOR), Forestry Research Institute Nigeria (FRIN), Nigerian Stored Products Research Institute (NSPRI), Institute for Agricultural Research and Extension Services (IARES), Agricultural Research Council of Nigeria (ARCN), National Biotechnology Development Agency (NABDA), SHEDA Science and Technology Complex (SHESTCO) Federal Soil Conservation School (FSCS), National Centre for Agricultural Mechanisation (NCAM), National Agricultural Seeds Council (NASC), Nigerian Automotive Council, Raw Materials Research and Development Council (RMRDC) and Federal Institute of Industrial Research Oshodi (FIIRO) and other relevant agencies.There is also collaboration with Government agencies and parastatals in bio-fuels policy development.

The Bio-fuels Research Agency shall collaborate with the Ministry of Agriculture and Ministry of Science and Technology to provide direction for research in crop production, industry technology and

processes pertaining to the production of bio-fuels.

The International Energy Agency presents two scenarios in its World Energy Outlook, and discussions of these two scenarios show how policies affect the global energy market, energy security and energy-related climate change concerns. The Outlook contains two energy scenarios: a reference or baseline scenario, which depicts how global energy markets would evolve in the absence of new government policies; and an alternative policy scenario which depicts global energy markets as impacted by additional government interventions and policies.[16] This calls for rapid adoption of policies that are favourable to bio-fuels and other renewable sources in Nigeria. A legal regime favourable to development of bio-fuels must also be created following the path of Brazil.

Biofuel Policies in Brazil

Brazil has exhibited a high level of commitment to the development of renewable energy through a series of measures like the New Hydropower Policy, aimed at building large hydro schemes; the Biodiesel Policy, which seeks to increase national biodiesel use; the Luz para Todos Program (Lights for All), which targeted 2.5 million new connections by 2008—of which 200,000 will be supplied by renewable energy; and an Ethanol Policy aimed at increasing domestic application of ethanol (1 million flex fuel vehicles in 2005) and exports.[17]

The most popular is the Brazilian National Alcohol Programme (Programa Nancional do A'lcool-PROALCOOL) to reduce the need for oil imports and provide a market for Brazilian sugar. This was launched in 1975 and included the promotion of ethanol as motor fuel through, credit guarantees and low interest loans for the construction of new refineries, purchasing ethanol at favourable prices by the state through a trading enterprise, granting of subsidies for ethanol, large marketing campaigns with the state oil company, Petrobras, becaming involved in ethanol distribution in the whole of Brazil.[18] These would not have been possible without a combination of policy, mass enlightenment, and a legislative and administrative framework. The result was an increase in ethanol production by 500%.[19]

Brazil produces the lowest cost ethanol worldwide, owing to genetic R&D, which has led to a more robust sugar cane variety that is also richer in saccharose. The country is expected to produce another 16 billion liters of ethanol in 2008.[20] The legal framework for the programme was created by Decree 76.593/1975.[21] The investments and expenses related to the program were financed by the National Bank for Economic Develpoment (Banco Nacional and Desenvolvimento Economito) and other banks.[22] Though the program experienced crises due to the fall in oil prices and the rise in sugar prices, the program is noteworthy for the effect it had in the development of ethanol in the Brazilian energy mix.

As at January, 2008 there are sixteen ethanol plants in Brazil.[23] Beyond the use of ethanol for vehicles, Brazil is also a leader in the generation of electricity from renewable sources. Over 80% of Brazil's electricity is produced via sustainable technology, mainly through the harnessing of hydroelectric power (77% of all generation).[24]

The Brazilian Program of Technological Development for Biodiesel envisions exporting biodiesel, depending on production levels and on the growth and consolidation of an international market.[25] The idea is to encourage the cultivation of castor beans and palm by family farmers and in the less developed regions of the country.[26] The government will confer social certificates on producers who encourage the participation of family farmers in the biofuel production process.[27] Brazil has more recently begun to target the increased use of biodiesel fuels, derived primarily from domestically produced soybean oil, with recent legislation allowing for blends of 2% biodiesel in diesel fuels (B2), which may be increased to 5% (B5) in the near future if the market responds favourably.[28]

Brazil's bio-fuel program was successful because its research and technology was adapted to the needs of the citizens.

Therefore, there is need for innovation through research and development. Private sector companies with the ability for joint ventures and government agency participation are necessary for bio-fuel technology to be adapted successfully.

An example of Brazilian government support or participation in bio-fuel initiatives is the establishment of regulatory agencies responsible for the launching of bio-fuel industries. These agencies also provide grants for research, development and demonstration purposes. These are coupled with the provision of financial incentives (e.g., bio-fuel price subsidies), and 'sunset' provisions for the policies supportive of technology joint ventures as appropriate.[29,30]

It is now well established that to achieve this potential energy, efficient policies and legislation must be put into place that make it possible for firms to profit by suppling energy services through efficient investments. Legislation and policies must be adopted that will promote bio-fuel subsidies. Also, policies

must be adopted that help remove the many barriers that efficiency investments must overcome. These include informational, institutional, behavioural, financial, and legal barriers.

Conclusion

In conclusion, the present Nigerian government needs to formulate policies that have legislative support, as is the case in Brazil. There is need for a new legal framework that will enable the process of complementing traditional sources of energy with renewable energies like bio-fuel.

The lack of enabling legislation in the Nigeria energy sector has retarded the implementation of clean energy policies. Technical information on bio-fuels has also been hindered. Besides, there have been logistics bottlenecks. Moreover, the government has not encouraged the research and development required to enable the use of bio-fuels and other renewable sources of energy to achieve full efficiency and sustainability. Multi-sectoral coordination and support is equally lacking. In addition, no effort has been made toward the development of local expertise and institutional procedures to facilitate project finance and provision of appropriate fiscal and economic incentives, hence the call for enabling legislation that will fill these regulatory gaps in the energy sector.

There is a need for a public-private partnership in the development of bio-fuels in the country. The proposed partnership should optimize benefits amongst parties, either public or private, by allocating responsibilities to the party that is best positioned to control the activity that will produce a desired result. Clear and transparent legislation to develop the industry is critical and must be put in place at the right time.

Footnotes

[1] The common examples include coal, oil and natural gas.

[2] The top most oil producing countries include Saudi Arabia 264.3; Canada 178.8; Iran 132.5; Iraq 115.0; Kuwait 101.5; United Arab Emirates 97.8; Venezuela 79.7; Russia 60.0; Libya 39.1; Nigeria 35.9; United States 21.4 ; China 18.3; Qatar 15.2; Mexico 12.9; Algeria 11.4; Brazil 11.2 Kazakhstan 9.0; Norway 7.7; Azerbaijan 7.0; India 5.8 barrels, constituting 95% of the world total.(Source: Oil & Gas Journal, Vol. 103, No. 47 (Dec. 19, 2005). From: U.S. Energy Information Administration. http://www.eia.doe.gov/emeu/international/petroleu.html.

[3] Olaniyi, A.''Biofuels Opportunities and Development of Renewable Energies Markets in Africa: A Case of Nigeria''. A paper presented during the Biofuels Market Africa 2007 Conference, in Cape Town, South Africa, on November 5-7,2007.

[4] Ibid.

[5] Six greenhouse gases have been identified under the Kyoto Protocol to include Carbon dioxide (C02), Methane (CH4), Nitrous oxide (N20), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF6), as listed in Annex A of the Koyoto Protocol.

[6] International Energy Agency (2008). World Energy Outlook (2007 Edition), Paris: IEA-OECD.

[7] Christophe de Gouvello, Dayo, F. B. and Thioye, M. (2008) ''Low-carbon Energy Projects for Development in Sub-Saharan Africa Unveiling the Potential, Addressing the Barrier''.Wahington DC: The International Bank for Reconstruction and Development / The World Bank, P.1.

[8] Biofuels are products that can be processed into liquid fuels for either transport or heating purposes. Bioethanol and biodiesel are two of the most common forms of biofuels. Others include biomethanol, biodimethylether and biogas. Bioethanol is produced from crops such as sugarcane, corn, beet, wheat and sorghum. A new generation of 'lignocellulosic' bioethanol also includes a range of forestry products such as short rotation coppices and energy grasses. Biodiesel is made from seeds such as rapeseed, sunflower, soy, palm, coconut or Jatropha. New biodiesel technologies synthesize diesel fuels from wood and straw to a gasification stage (see Bart de Steenhuijsen Piters, ''How sustainable are biofuels? Between common curiosity and confronting interests''. Available on http://knowledge.cta.int/en/Dossiers/S-T-Issues-in-Perspective/Biofuels/Articles/How-sustainable-are-biofuels-Between-common-curiosity-and-confronting-interests assessed 29th October, 2008.

[9] International Energy Agency (2008). World Energy Outlook 2007 Edition, Paris, IEA-OECD.

[10] United Nations Conference on Trade and Development (2008) Biofuel production technologies: status, prospects and implications for trade and development UNCTAD/DITC/TED/2007/10.

[11] R. Steenblik (2005) ''Liberalisation of Trade in Renewable-Energy Products and Associated Goods: Charcoal, Solar Photovoltaic Systems, and Wind Pumps and Turbines''. OECD Trade and Environment Working Paper No. 2005-07.

[12] Dayo, F. B. (2008) ''Clean Energy Investment in Nigeria: The domestic context, Manitoba, International Institute for Sustainable Development''. p.59.

[13] ''Africa's First Ethanol Refinery Flagged off in Ekiti''. Available at http://www.tribune.com.ng/16092008/

biznes.html.

[14] Azih, I. ''Biofuels Demand: Opportunities for Rural Development in Africa (Nigerian case-study)'', A paper presented at the 2nd European Forum on Sustainable Development, Berlin Germany, June 18-21, 2007.

[15] Companies Income Tax Act A (Cap C 21, Laws of Federation of Nigeria, 2004)Value Added Tax Act (Cap V 1, Laws of Federation of Nigeria, 2004), Petroleum Profit Tax Act (Cap P 13, Laws of Federation of Nigeria, 2004).

[16] International Energy Agency, World Energy Outlook, 2006.

[17] Report of proceedings of the International Grid-Connected Renewable Energy Policy Forum held on February 1-3, 2006 in Mexico City, Mexico. Available at http://www.gridre.org/images/Grid_Proceedings_Final_May_3.pdf

[18] Omorogbe, Y. O. ''Promoting Sustainable Development through the Use of Renewable Energy: the Role of the Law'' in Zillman, D. N., Redgwell, C. Omorogbe, Y. O. and Barrera-Hernandez, L. K. (eds.) (2008). Beyond the Carbon Economy: Energy Law in Transition. New York: Oxford University pp. 54-55.

[19] Ibid. 55.

[20] Ru¨ther, R. ''Renewable Energy Policies in Brazil''. Kreith, F. and Goswami D. Y. (eds.) (2007) Hand Book of Energy Efficiency and Renewable Energy, Taylor & Francis Group, Roca Raton. p2-3.

[21] Yanko Marcius de Alencar Xavier, ''Energy Policy for the Future: Brazilian Law and Policy''Zillman, D. N. et al. Op. cit. 405

[22] Ibid. 405.

[23] ''World Biofuels Map''. 2008 Edition, London: Petroleum Economist Ltd.

[24] ''Biofuel Industry in Brazil'', Available at http://www.researchandmarkets.com/reportinfo.asp?report_id=591868

[25] World Resources Institute, ''Brazilian Program of Technological Development for Biodiesel'' http://projects.wri.org/sd-pams-database/brazil/probiodiesel-brazilian-program-technological-development-biodiesel.

[26] Ibid.

[27] Ibid

[28] See www.procana.com.br, www.bioenergy-lamnet.org

[29] United Nations Conference on Trade and Development (2008) ''Biofuel production technologies: Status, Prospects and Implications for Trade and Development'' UNCTAD/DITC/TED/2007/10.

[30] Ibid.

!!! Congratulations!!!

Congratulations to Can Erbil! He is our winner from the IAEE Exit Survey Campaign. Mr. Erbil renewed his membership during our Exit Survey Questionnaire period. His renewal was entered in a raffle for receipt of a three year complimentary membership in IAEE, and he is our grand winner!

Congratulations and thank you to everyone who participated in our Exit Survey Campaign and for renewing their membership in the IAEE!

FIRST ANNOUNCEMENT AND CALL FOR PAPERS

Dramatic events of last few years: very fast energy demand growth in developing countries, artificially stimulated economics in developed countries and related with that banking crisis, the largest energy price shock in modern history and following global recession, growing evidence of global warming and looming difficulties in production of primary energy resources presents a unique environment for activities and businesses of energy economists and policy makers. All of that creates a vast medium of thoughts for researchers active in energy economics and great challenges for politicians responsible for energy policies.

The 11th IAEE European Conference "Energy Economy, Policies and Supply Security: Surviving the Global Economic Crisis" will provide excellent opportunity to present and discuss the results of newest studies preformed in such exceptional circumstances. The conference will bring together wide spectrum of scientists, policy makers, professionals from all energy sectors, governmental and public institutions. This conference for the first time will take place in Vilnius - the capital of Lithuania, at the year when Lithuania will celebrate 20th anniversary of regained independence.

That opens good opportunity for participants of the conference to learn more about the specifics and problems of energy sector's development in the Baltic States and the wider region around them. The problems of the integration of that region to the future PanEuropean energy market should be one of most important topics of Vilnius conference.

We are looking forward seeing you in Vilnius.

Prof. Jurgis Vilemas
General Conference Chair

Conference topics

- ☐ Energy supply security (political, economical and technical)
- ☐ Sustainability of energy systems, mitigation of global warming
- ☐ Role of renewable energy sources and biofules
- ☐ Energy demand forecasting
- ☐ Energy sector analysis and modeling
- ☐ Energy policy
- ☐ Geopolitics of energy supply (gas, oil, nuclear and etc.). Price of security
- ☐ Road map for energy efficiency
- ☐ Market integration and liberalization
- ☐ Energy sector risk analysis
- ☐ Specific energy sector problems of CEE countries
- ☐ Nuclear energy: hopes and realities
- ☐ Environment

Call for Papers

Abstract Submission Deadline: 9 April 2010

We are pleased to announce the Call for Papers for the 11th IAEE European Conference to be held on 25-28 August 2010. You are cordially invited to submit proposals for presentations at the concurrent sessions on a range of topics highlighted but not limit to above.

Please submit abstracts of maximum two pages in length, comprising: overview, methods, results, conclusions. Please attach a short CV. The lead author submitting the abstract must provide complete contact details: mailing address, phone, fax, e-mail etc. Accepted abstracts will be published in the printed abstract volume. At least one author for each accepted paper must pay a registration fee and attend the conference.

Authors will be notified by 9 May 2010 of their paper status. Authors, whose abstracts are accepted, will have to submit their full-length papers (up to 10-12 pages limit suggested) by 9 July 2010 for publication in CDROM conference proceedings. While multiple submissions by individual or groups of authors are welcome, the abstract selection process will seek to ensure as broad participation as possible: each speaker delivers only one presentation in the conference. If multiple submissions are accepted, then a different co-author will be required to pay the speaker registration fee and present the paper.

Abstracts must be submitted electronically as a text document (doc; NO pdf) via the following link:

http://www.iaee2010.org

Conference Venue

Vilnius is the capital of Lithuania since 1323. About 554 000 people of various nationalities and different religions are living there. Despite wars, occupations and destruction, the architectural ensemble of Vilnius remains unique. It is the largest Baroque city in North-East Europe. Nearly all styles of European architecture from Gothic to Classicism are present in Vilnius. Contemporary Vilnius is a modern, forward looking and dynamic city, which attracts people and charms them.

For long ages the picturesque Old Town and National Museum of Lithuania could tell a lot about honorable past of this city and the whole country, which in 2009 celebrates solid 1000 years anniversary of being for the first time mentioned in historical annals. Because of its unique and openness the Old Tow of Vilnius is enrolled into the list of UNESCO World's Cultural Heritage.

The conference venue is Reval Hotel Lietuva, Konstitucijos av. 20, located at the administrative center of the city within walking distance to Old Town, major museums, other cultural sights, restaurants and many hotels.

Registration fees

Participants	Early registration, EUR	Late registration, EUR
Speakers/Chairpersons	450	475
IAEE members	500	550
Non-members	650	700
Students	250	275
Accompanying persons	225	250

Cancellation/Refund policy: A refund (less 100 EUR administration fee) is available until 19 July 2010. From 19 July, there will be no refund given, but a delegate from the same organisation may be substituted.

Organizing by:

Welcome New Members!

The following individuals joined IAEE from 7/1/09 to 9/30/09

Ovo Adagha
United Kingdom

Marek Adamec
CTU in Prague
Czech Republic

Abiola Rahman Adeworan
Esscom Petroleum Oil and Gas Ltd
Nigeria

Anna Aeloiza
Mi Swaco
USA

Aluebube Agada
Nigeria

Fernando Antonio Aguilar Morales
UNAM
Mexico

Muhammad Waqar Ahmad
GC University Lahore
Pakistan

Abdulaziz Ahmed
Saudi Arabian Oil Company
Saudi Arabia

Jacob Aho
University of New Hampshire
USA

Andrew Aideloje
Arkhangeisk State Technical Univ
Russia

Ngwi Akem
Aim Group Book Shop Int Ltd
Cameroon

Evren Akkaya
Chevron Ltd
United Kingdom

Abdulaziz Al Rugaib
Bain & Company
Saudi Arabia

Imad Alam Al-Deen
Iraqi Ministry of Oil
USA

Muhammad Aldawood
Stanford University
USA

Rafat Aldhuhayan
Saudi Aramco
Saudi Arabia

Yamen Al-Hajjar
Saudi Aramco
Saudi Arabia

Nadhmi Alkhamis
USA

Muhammad Al-Tayyeb
Saudi Aramco
Saudi Arabia

Petra Amrusch
University of Vienna
Austria

Karim Anaya
University of Cambridge
United Kingdom

Jorgen Andersen
BI Norwegian School of Management
Norway

Konstantinos Andriosopoulos
Cass Business School
United Kingdom

Ding Li Ang
Hart Energy Consulting
Singapore

Armand Angah
USA

Abigail Anthony
ENE
USA

Nkolika Anyaoku
Nigeria

Cecelia Araujo
Universidad Pontificia Comillas
Spain

Can Arslan
Turkey

Yusuf Arslan
Turkey

Thomas Askew
Kalamazoo College
USA

Ahmed Bajunaid
Saudi Aramco
Saudi Arabia

Philip Baker
UKERC
United Kingdom

Bjorn Bakken
SINTEFF Energy Research
Norway

Sergio Barrientos
Surenergia SA
Chile

Nir Becker
Tel Hai College
Israel

Ernest Sanyare Warmann Beinpuo
Ghana

Michael Belsnes
SINTEF Energy Research AS
Norway

Joachim Benatzky
University of Duisburg Essen
Germany

Gunther Bensch
RWI
Germany

Izzet Bensusan
Karbone
USA

Joachim Berner
Norway

Paolo Bianchi
Italy

Raphael Bointner
Vienna Univ of Tech
Austria

April Boyko
Canada

Ralph Braccio
Booz Allen Hamilton
USA

Frauke Gabriele Braun
German Inst for Economic Research
Germany

Don Bredin
University College Dublin
Ireland

R J Briggs
Penn State University
USA

Allen Brooks
Parks Paton Hoepfl and Brown
USA

Emily Brown
Total
Canada

Florence Brzakowski
EDF RD
France

Ingo Bunzeck
Energy Research Ctr Netherlands
Netherlands

Heimo Burbaumer
Austrian Energy Agency
Austria

Gary Burns
Chilecentral.cl
Chile

Brita Bye
Statistics Norway
Norway

Medardo Cadena
MEER
Ecuador

Jesus Calderon
Bank of Nova Scotia
Canada

Matthew Campbell
SunPower Corporation
USA

Erendu Canice
University of Ibadan
Nigeria

Amelie Carlton
University of Houston
USA

Edwin Castro
CNEE Guatemala
Guatemala

Angel Caviedes
Coasin Chile
Chile

Jean-Michel Cayla
Mines Paris Tech
France

Izge Cengiz
USA

Srichattra Chaivongvilan
Australia

Varun Chandran
University of British Columbia
Canada

Cheng Chang
USA

Chun Ti Chen
ITRI
Taiwan

Paul Cheruvathur
University of Alberta
Canada

Edward Christie
Austria

Ebuzoeme Chukwu
United Kingdom

Matthew Church
Canada

Andrew Clark
USA

Albert Codinach
France

Vance Colin
RWI
Germany

Simone Corbo
Enel
Italy

Nick Corcoran
Petro Andina
Canada

Scarlett Crockatt
Canada

Vivien Csapi
University of Pecs
Hungary

Maxine Cunningham
University of Alberta
Canada

Aselebe Dauda
Peter and Royal Brother Ltd
Nigeria

Elizabeth Davis
Ipam Univ of Sierra Leone
Sierra Leone

Guilherme De Biasi
Univ Pontificia Comillas
Spain

Cederic De Jonghe
KU Leuven
Belgium

Carlos De Miguel
University of Vigo
Spain

Erik Delarue
University of Leuven
Belgium

Ryan Dick
Canada

Mary Dickerson
USA

Grusbin Dominique
Federal Planning Bureau
Belgium

Anthony Downward
University of Auckland
New Zealand

Kathryn Dpuuis
University of Calgary
Canada

Bert Droste Franke
Europaische Akademie zur Erdorschun
Germany

Mathilde Drouineau
Mines Paris Tech
France

Timon Dubbeling
Netherlands

Sam Duck
Sky Plus Investment
USA

Pablo Duenas
Universidad Pontificia Comillas
Spain

Francisco Ebeling
UFRJ
Brazil

Uzochukwu Ebirim
Federal Univ of Technology
Nigeria

Jonas Egerer
TU Dresden
Germany

Jeff Escarra
USA

M M Estiaquzzaman
Germany

Patrick Uchenna Eze
Eze Green Energy Company Ltd
West Indies

Trevor Ference
ISES
Canada

Valter Ferrarini
Gas Plus SpA
Italy

Klaus Fischer
Austria

Patricia Fortes
Universidade Nova de Lisboa
Portugal

Lars Olav Fosse
Point Carbon
Norway

Craig Froome
The University of Queensland
Australia

Virginia Fuller
USA

Gianluca Fulli
JRC Institute for Energy
Netherlands

David Gaskin
USA

Nishtha Ghosh
USA

Ute Gigler
AIT
Austria

Jose Alberto Goicochea-Calderon
Thames Valley University
United Kingdom

Andreas Goldthau
Central European University
Hungary

Daniel Gonzalez
Chile

Hisanori Goto
Central Resarch Inst of EPI
Japan

Varun Gowda
EGI University of Utah
USA

Wina Graus
Ecofys Netherlands bv
Netherlands

Alex Greenstein
US Department of State
USA

Morten Grevstad
Norway

Kenneth Grobeck
USA

Poul Erik Grohnheit
Risoe DTU
Denmark

Angelamaria Groppi
Politecnico de Milano
Italy

Katharina Gruenberg
Shell Global Solutions
Netherlands

Shane Gryzko
Canada

Gilles Guerassimoff
Ecole des Mines de Paris
France

Daniel Guerrero Lopez
National Electrical Council
Ecuador

Jonathan Haerer
EnBW Trading GmbH
Germany

Manfred Hafner
FEEM
Italy

Arsim Hamiti
BIRD
Serbia

Henrik Hammar
Swedish Ministry of Finance
Sweden

Tom Olaf Hammervold
Nordea
Norway

Nina Hampl
Univ of St Gallen Inst F Econ Env
Switzerland

Alexander Hazbun
Chile

Brenden Heidrich
Pennsylvania State University
USA

Maria Heinczinger
KTI Transport Research Institute
Hungary

Eva Henriksson
Lulea Univ of Technology
Sweden

Christian Hermansen
ACTIC Consultants
Chile

Johannes Herold
TU Dresden
Germany

Edward Hirs
USA

Hedda Hoyer
Canada

Claus Huber
EGL
Austria

Abada Ibrahim
IFP
France

Innocenti Degli
Italy

Ugur Ipek
Norwegian School of Economics
Norway

Stine Jensen
Danish Energy Association
Denmark

Tejaswinee Jhunjhunwala
Shell Canada
Canada

Blair Johnson
Canada

Scott Johnston
Canada

Jill Jones
Bnbkennel
USA

Jonathan Jones
University of Liberia
Liberia

Birte Holst Jorgensen
Risoe DTU
Denmark

Sondes Kahouli
Univ of Nantes
France

Seppo Karkkainen
VTT Technical Rsch Ctr of Finland
Finland

Gokson Kavlak
Turkey

Olamilekan Paul Kayode
Energy Resources Management td
Nigeria

Mads Keller
Danish District Heating Assoc
Denmark

Janina Ketterer
Ifo Institut
Germany

Idir Khiar
University of Zurich
Switzerland

Jaroslav Kanpek
Czech Technical University Prague
Czech Republic

Richard Knowlton
USA

Christos Kolokathis
Energy Resch Ctr of the Netherlands
Netherlands

Attila Kovacs
Univ of West Hungary
Hungary

Alois Kraussler
Univ of Applied Sciences Joanneum
Austria

Ralf Kuder
Univ of Stuttgart IER
Germany

Daniel Lafferty
Canada

Joshua La Forge
ECERF University of Alberta
Canada

Gina Elisa Lagunes Diaz
Mexico

Victoria Lalonde
Alberta Energy
Canada

Richard Boltinus Larsen
DI
Denmark

Julia Lechner
WU Wien
Austria

Joanne Lee
Canada

Woo Yul Lee
Lahmeyer International GmbH
Germany

Clinton Levitt
Copenhagen Business School
Denmark

Miriam Levy
USA

Jun Li
Ecoles des Mines
France

Ning David Li
Saudi Aramco
Saudi Arabia

Ariel Liebman
Energy Users Assn of Australia
Australia

Martin Lienert
R2B Energy Consulting GmbH
Germany

Kristin Linnerud
CICERO
Norway

Carol Litwin
Asian Development Bank
Sweden

Chiara Lo Prete
Johns Hopkins University
USA

Enrique Lobato
Univ Pontificia Comillas
Spain

Guillaume Loeillet
France

Richard Lohwasser
RWTH Aachen University
Germany

Nicolas Lopez
Universidad Catolica de Chile
Chile

Nuria Lopez-Mielgo
Universidad de Oviedo
Spain

Alvaro Lopez-Pena
Universidad Pontificia Comillas
Spain

Roderick Macintosh
Canada

Gustavo Malaguti
France

Ramiz Mammadov
AGIP KCO
Azerbaijan

Aynsley Manning
Alberta Energy
Canada

Alex Marach
USA

Thomas Martinsen
Norway

Carmen Maslowski
Canada

Alberto Massano
Italy

Kara May
Canada

Cameron McLeod
Australia

Megan McNeill
Government of Alberta
Canada

Lori Medlen
FRA
USA

Mohammad Mehrabani-Yeganeh
Canada

Katia Metan
USA

Chresten Meulengracht
Meulen Energy
Denmark

Zia Mian
Office of Utility Regulation
Jamaica

David Minor
Chevron
USA

Amitav Misra
USA

Juan David Molina Castro
Pontificia Univ Catolica de Chile
Chile

Chris Moody
EnCana
Canada

Aleem Muhammad
Switzerland

Raghavan Narayanan
API
USA

Derek Nesmith
USA

Richard Newell
Department of Energy
USA

Thierry Nguema-Affane
USA

Melea Nicholson
Nexen Inc
Canada

Christopher Omololu Obisesan
Nigeria

Diana Ognjan
HEP Obnovljivi Izvori Energije
Croatia

Olle Olsson
SLU
Sweden

Adeya Oluwaseun Omojesu
Nigeria

Innocent Onah
University of Bonn
Germany

Amanda Onwuka
USA

Jose Antonio Orosa Garcia
University of A coruna
Spain

Peter Otersen
USA

Michael Angel Panas
Poten and Partners UK Ltd
United Kingdom

Javier Parrilla
Inst for Industrial Production
Germany

Jonathan Parry
CERA
USA

Albert Passy
Genscape
USA

Amol Phadke
Lawrence Berkeley National Lab
USA

Stephen Plume
Accept Software
USA

Alexander Poghossian
Alpha Plus Consulting
Armenia

Jason Polen
Washington State Dept of Comm
USA

Panagiotis Pouliasis
United Kingdom

Tomas Pranckevicius
Lithuania

Anthony Price
Canada

Artan Profiri
Temple University
USA

Jessica Pusz
USA

Hanqi Qiu
Canada

Nathan Reich
USA

Merlyn Rennie-Browne
National Energy Corporation
Trinidad & Tobago

Rusbeth Rezania
Vienna Univ of Technology
Austria

Sabrina Ricci
Italy

Brian Rice
USA

Charles Riesenberg
USA

Sam Roach
CNRL
Canada

Slavica Robic
University of Zagrebu
Croatia

Joshua Rogers
NERA Inc
USA

Andrew Rollo
USA

Ewa Romaniuk-Calkowska
USA

Danielle Rourke
Federal Energy Regulatory Comm
USA

Joshua Rowley
NYU POLY
USA

Isabella Ruble
American University of Beirut
Lebanon

Benjamin Russell
Canada

Carlos Salamanca
MPX Energia de Chile
Chile

Estefana Salazar
LRI
Mexico

Thina Saltvedt
Nordea Markets
Norway

Javier Sandoval
Chilquinta Energia SA
Chile

Enzo Sauma
Chile

Caitlin Schulz
Canada

Cenk Sevim
World Energy Council Turkish Comm
Turkey

Vera Sevrouk
USA

New Members (continued)

Hitesh Sharma
Canada
Ritesh Sharma
Turner Construction Company
USA
Edwin Allan Simpson Espinosa
CIPSSA Consultants
Mexico
Matthew Singletary
Statoil Hydro
USA
Tristan Skolrud
University of Washington
USA
Ruchi Soni
The World Bank
India
Christine Stadnyk
University of Saskatchewan
Canada
Steven Stalany
ERCB
Canada
Ryan Stasynec
University of Alberta
Canada
Helle Stisen
Dansk Energi
Denmark
Sabrina Sullivan
Canada
Emily Sun
NYU Poly
USA
Demet Suna
TU Wien Energy Economics Grp
Austria
Shruti Syal
Canada
Oyinkansola Tasie
United Kingdom
Kali Taylor
University of Calgary
Canada
Seyoum Teshome Akele
Swedish Univ of Agricultural Science
Sweden
Michael Thomas
University of Alberta
Canada
Scott Towsley
Canada
Daniel Vagasky
USA
Jaron Van Dijken
University of Alberta
Canada
Mats van Kleef
DDACE Power Systems
Canada
Leonid Varshavsky
CEMI RAS
Russia
Yuliya Wawrykowicz
Canada
Manuel Wiechers
Mexico
Craig Windram
E3 International
France
Joshua Wylie
EnCana Corp
Canada
Pamela Yee
Canada
Denny Yeung
Black & Veatch
USA
Karl Zach
Vienna Univ of Technology
Austria
Victor Zamani Shidok
Petroleum Products Reg Agency
Nigeria

Announcement
12th Annual IAEE/USAEE Session at ASSA Meeting

Atlanta, Georgia – January 3, 2010
10:15am, January 3, Hilton Atlanta, Room 208

"Energy Security for Renewables and Non-renewables"

Presiding: **Mine Yucel**, Federal Reserve Bank of Dallas

Gail Cohen, US Congress Joint Economic Committee, Frederick Joutz, George Washington University, and Prakash Loungani, International Monetary Fund – *The Determinants of Energy Vulnerability and Security: An Empirical Analysis*

Stephen P.A. Brown, Resources for the Future and Hillard G. Huntington, Energy Modeling Forum, Stanford University – *Reassessing the Oil Security Premium*

Christian Winzer, Karsten Neuhoff, and Daniel Ralph, University of Cambridge – *Measuring Security of Supply*

Kevin F. Forbes, Catholic University of American, Marco Stampini, African Development Bank, and Ernest M. Zampelli, Catholic University of America – *Do Higher Wind Power Penetration Levels Pose a Challenge to Electric Power Security?: Evidence from the ERCOT Power Grid in Texas*

Discussants: **Andre Plourde**, University of Alberta
Ken Medlock, Rice University
Xiaoyi Mu, University of Dundee
Wumi Iledare, Louisiana State University

Abstracts are posted at http://www.iaee.org/documents/2010/assa_cfp.pdf

The meeting is part of the Allied Social Science Association meetings (ASSA).

For complete program information please visit http://www.vanderbilt.edu/AEA/Annual_Meeting/index.htm

Also, please watch for the IAEE/USAEE Cocktail Party.

Ethanol Production in Brazil: Bridging its Economic and Environmental Aspects

By Marcos Watanabe*

Overview

Global discussions involving the enhancement of renewable energy use frequently highlight the European Union "Triple 20" deal as the main large-scale effort aimed at changing the worldwide pattern of fossil fuel consumption to power economic activities. Actually, the targets of carbon emissions reduction and increase in the use of renewable energy before 2020 symbolize an extraordinary attempt to achieve more sustainable energy production in the European Union. Fortunately, reactions like this are also being noticed in Asian, African and American countries where the development of new technologies are incrementing the competitiveness of some ventures focused on renewable energy production. In order to understand the potential of renewable energy use outside the European Union, this article will focus on Brazilian biofuel production. Moreover, a few indices derived from Emergy methodology comparing the environmental and economic performances of some biofuel and fossil fuel options observed in some case studies around the world, will also be shown.

Ethanol Production in Brazil

Among biofuels used in the transport sector, Brazilian ethanol is the one that is currently in the spotlight because it's already produced in large quantities and presents competitive prices when compared with gasoline. In 2008, the Brazilian Sugarcane Association stated that ethanol internal demand was of 20 billion liters, the value of which, remarkably, surpassed gasoline consumption in Brazilian light-vehicles (UNICA, 2008). According to the Brazilian Bank for Economical and Social Development (BNDES, 2008), the low price of ethanol production is responsible for this successful achievement. Many studies estimate that costs are between US$ 0.25/liter and US$ 0.30/liter (including all inputs and factors), which would correspond to an oil price of between US$ 36/barrel and US$ 43/barrel. This estimate assumes gasoline prices are 10% higher than crude oil prices in terms of volume and that substitution with anhydrous ethanol is done on a one-to-one volume. Under such conditions, substitution of gasoline with bioethanol is patently viable, but a more complete confirmation of the advantage of this biofuel can be seen by comparing plant prices prior to taxation (BNDES, 2008).

The fortunate experience of ethanol use in Brazil may also be coupled with a superior sucrose yield and a higher potential of biomass production of sugarcane – an average of 87 tons per hectare in South Central Brazil – than observed in other crops. As Figure 1 shows, only beets can be compared with sugarcane in terms of ethanol production per cultivated hectare. However, the industrial process of ethanol production from beets depends on an external power input (electricity and fuel) while sugarcane electricity is provided by bagasse burning at the mill. Moreover, as biotechnology of enzymes is improved, ethanol from sugarcane cellulosic residue probably could increase average productivity to 9,000 liters per hectare (BNDES, 2008).

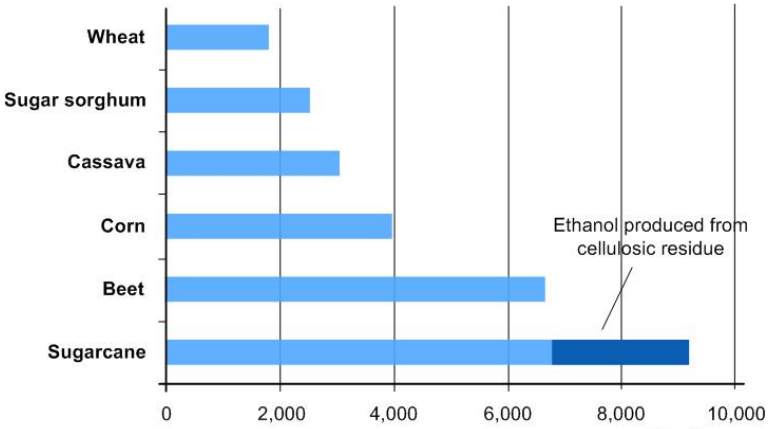


Figure 1. Average ethanol productivity per area for different crops. Source: BNDES (2008)

Ethanol Benefits: Less Greenhouse Gases and Improved Energy Ratio

Among the possible benefits derived from ethanol use in the replacement of gasoline consumption, researchers highlight the reduction of carbon dioxide emissions. According to Macedo et al. (2008), ethanol production is responsible for an average emission of 440 kg of CO_2 equivalents per cubic meter of ethanol, when it is blended with gasoline (usually 25 % in Brazil). Net avoided emis-

* Marcos Watanabe is the IAEE Student Council Representative for 2009 and 2010. As PhD student at University of Campinas, Brazil, his research focuses on the assessment of the environmental and economical impacts of sugarcane ethanol production.

sions can reach 1,900 kg CO_2 equivalents per cubic meter of ethanol used. Considering such production simultaneously with electricity generation by residue burning, it is estimated that every 100 million tons of sugarcane avoids 12.6 million tons of CO_2, and this represents an important greenhouse gas emissions reduction (BNDES, 2008; UNICA, 2007). Such performance (see Table 1) disregards land-use change in the case of cropland area expansion overtaking ecosystem areas. According to Searchinger et al. (2008), if rainforests were converted to cropland, a pay-back time of 45 years would probably be necessary to neutralize all emissions generated by such ecosystem destruction.

Another strong aspect of Brazilian ethanol is the energy ratio. Including production of chemical and materials, feedstock growth, transportation and processing, Macedo et al. (2008) have quantified that for 1 ton of sugarcane, a total fossil input of 233 MJ produces 2185 MJ of ethanol, bagasse surplus and electricity. In this case the energy balance would be approximately 9. Table 1 shows energy ratios obtained for different feedstock.

Feedstock	Energy Ratio	CO_{2eq} avoided
Sugarcane	9.3	89%
Corn	0.6-2.0	-30% to 38%
Wheat	0.9-1.1	19% to 47%
Beet	1.2-1.8	35% to 45%
Cassava	1.6-1.7	83%
Lignocellulosic residues	8.3-8.4	66% to 73%

Table 1. Comparison of different feedstock for biofuel production

Source: BNDES (2008).* Theoretical estimate, process under development.

In spite of the innumerous economic and environmental benefits derived from ethanol consumption, biofuel production can also generate undesirable effects depending on its agricultural model of production. Using economic language, modern agricultural production can also generate negative externalities, usually related to soil erosion, damage to wildlife, air and water pollution and others (Pretty et al. 2000). Considering that these tradeoffs can give rise to financial and environmental costs, more accurate assessment is sometimes required to ensure that biofuel production is feasible in economic and environmental aspects. In order to quantify such performance, the Emergy approach can be considered a useful tool because it puts economic and environmental systems on the same basis.

Emergy Approach to Connect Environmental and Economic Systems

All systems, natural or man-made, depend on inputs to produce something. All products or services produced by systems have "emergy". Emergy means "energy memory" or "the available required energy used up directly and indirectly to make a service or product" (Odum, 1996). The Emergy approach converts all energy, mass and money flows of a certain production system into a same energy basis. Instead of tons of oil equivalent (toe), this methodology uses the solar energy equivalent joules (seJ) as standard. In summary, every product or service can be quantified in terms of seJ. Although it is universal, this methodology is particularly important to deal with renewable energy systems because it has the capacity of including the natural contributions such as sunlight, rain, wind, geothermal energy and others in order to generate biomass.

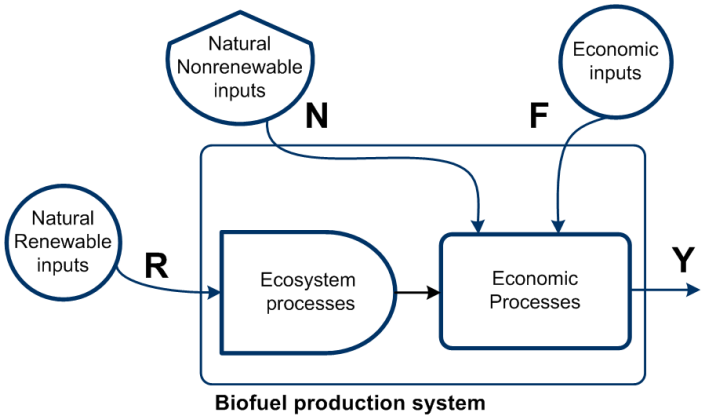


Figure 2. Simplified view of a production system according to the Emergy approach.

The Emergy approach distinguishes three main input categories: Environmental Renewable inputs (R) such as sunlight, wind, rain, etc.; Environmental Non-Renewable Inputs (N) such as soil, groundwater, fossil fuels, etc.; and Material and Services from the economy (F) such as human labor, electricity, construction and others. The output can be a product or service which contains the total Emergy (Y). Such considerations makes the Emergy approach a great tool to measure and compare the economic and environmental indices of different systems.

Four indices derived from the Emergy approach are important to assess biofuel production:

• **Transformity (Tr)** is equal to the emergy content (Y in solar equivalent joules) divided by total energy content (given in joules or calories). The higher the value, the lower the system's efficiency.

- **Renewability (%R)** is equal to the Renewable Input (R) divided by total emergy (Y). This index quantifies the percentage of renewable energy (sun, wind, rain, etc.) used up in the production process. The higher the value, the greater the sustainability of the production system.
- **Emergy Yield Ratio (EYR)** is equal to the total emergy (Y) divided by total economic inputs (F) such as human labor, machinery, fertilizers and others. It reflects the ability of a certain system to deliver energy to the economy by amplifying its investment. The higher the value, the lower the

system's dependence on economic investment and the higher the enterprise competitiveness.
- Emergy Loading Ratio (ELR) is equal to Non-renewable resources from the economy and environment (F+N) divided by Renewable Input (R). It is a general measure of the environmental impact of a production system. The lower the value, the lower the environmental stress.

Emergy Indices to Compare Different Fuel Alternatives

Considering Brazilian ethanol, Transformity indices have ranged from 50,000 to 100,000 sej/J, while gasoline values have ranged from 65,000 sej/J to 110,000 sej/J. As Table 2 shows, Brazilian ethanol has presented the same Transformity magnitude of fossil fuels in these cases, which means the same level of efficiency in terms of emergy invested to the amount of emergy delivered. However, other biofuel options have presented higher Transformity indices, which means lower efficiency processes.

Energy Source	Transformity (sej/J)	Reference
Natual gas, world average	8.04 E+04	Odum (1996)
Oil, world average	9.05 E+04	Odum (1996)
Gasoline, world average	1.11 E+05	Odum (1996)
Gasoline, Italy	6.60 E+04	Bastianoni et al. (2009)
Sugarcane ethanol, Brazil	5.30 E+04	Pereira(2008)
Corn ethanol, U.S.	1.00 E+05	Ulgiati (2001)
Sugarcane ethanol, U.S.	1.40 E+05	Bastianoni & Marchetini (1996)

Table 2. Transformity indices among various energy sources.

Fossil fuels (oil, natural gas and gasoline) have better Transformity indices because such natural stocks were produced millions of years ago by natural processes. If ventures have abundant and well-positioned storage, relatively lower effort is necessary to extract and refine them compared with other sources of energy. In the case of biofuel production, crops are produced and processed in just one year and demand relatively more emergy investment per emergy delivered. Moreover, factors like high diesel use in machines, increasing fertilizer inputs and loss of topsoil in the agricultural stage can negatively affect the efficiency of other biofuel production alternatives.

Assessing the Emergy Yield Ratio (EYR) indices, it is possible to quantify the system's reliance on economic investment. In theory, the minimum value for EYR occurs when the quantity of emergy delivered by the system is equal to the emergy within the economic investment; in this case, EYR would be 1. For such a system, EYR=1 would indicate zero ability of capturing free local resources in the environment and also extreme dependence on economic investment to deliver energy. As table 3 shows, the highest EYR values are observed for fossil fuel production systems, indicating higher economic competitiveness compared with biofuel production systems. Such a difference is explained again by the timescale necessary for fossil fuel formation and accumulation. For fossil fuels, previous emergy "investment" has been made by natural processes during millions of years; in the case of biofuel, more economic investment would be required. It would occur because biomass has a short production timescale (usually one year) and also has low "previous inputs" made by the surrounding environment. As a consequence, biofuel production demands more economic investment and can be less competitive than recent fossil fuel production.

Energy Source	EYR	Reference
Coal	10.5	Odum (1996)
Natual gas	10.3	Odum (1996)
Diesel and gasoline	8.4	Odum (1996)
Sugarcane ethanol, Brazil	1.57	Pereira (2008)
Sugarcane ethanol, U.S.	1.17	Bastianoni & Marchetini (1996)
Corn ethanol, Europe average	1.08	Ulgiati (2001)

Table 3.
EYR indices among various energy sources.

Another fundamental index to assess sustainability is Renewability (%R). Emergy analysis shows that certain energy production systems considered as "renewable" don't have a complete renewable character and rely upon some non-renewable inputs. As table 4 shows, fossil fuels such as coal, diesel, gasoline and natural gas are completely non-renewable, which means 0% renewability since their rates of extraction are thousands or millions of times superior to their rate of production by natural processes. However, less obvious results are shown with Brazilian sugarcane ethanol, U.S. sugarcane ethanol and European corn ethanol where values correspond to 35%, 14.2% and 5.4%, respectively. European Corn ethanol's performance of 5.4% Renewability indicates that 94.6% of all inputs used up in corn ethanol production came from non-renewable inputs. Such performance is mainly affected by the degree of soil erosion, fertilizer application, mechanization, diesel consumption, and other factors.

Energy Source	Renewability	Reference
Coal	0%	Odum (1996)
Natual gas	0%	Odum (1996)
Diesel and gasoline	0%	Odum (1996)
Sugarcane ethanol, Brazil	35%	Pereira (2008)
Corn ethanol, Europe	5.4%	Ulgiati (2001)
Sugarcane ethanol, U.S.	14.2%	Bastianoni & Marchetini (1996)

Table 4.
Renewability indices among various energy sources.

Finally, the Environmental Loading Ratio (ELR) is important to measure environmental stress caused

by energy production systems and it would be mainly applied to agro-ecosystems. The best value would be zero, meaning zero ecosystem disturbances. According to Brown & Ulgiati (2004), values ranging from zero to 2 would indicate a moderate level of environmental impact, but values superior to 10 would indicate high environmental stress. As presented in table 5, soybean biodiesel and sugarcane ethanol production in Brazil have better performance than ethanol produced in other systems presented in this paper. As table 5 shows, Brazilian agro-ecosystems and mills cause moderate stress on the environment, three times inferior to those systems studied in other parts of the world. However, such results don't include the land-use-change negative impacts when cropland systems eliminate ecosystems. ELR only measures the pressure on the environment derived from the temporary pattern of agricultural management. Moreover, Pereira (2008) and Cavalett (2008) affirmed that the agricultural stage causes more impact on the environment than the processing and transportation stages. Because of that, they recommend that such energy production systems should focus on land practices in order to improve their performances.

Energy Source	ELR	Reference
Sugarcane ethanol, Brazil	2.34	Pereira (2008)
Sugarcane ethanol, U.S.	6.04	Bastianoni & Marchetini (1996)
Corn ethanol, Europe	7.42	Ulgiati (2001)
Soybean biodiesel Brazil	2.26	Cavalett (2008)

Table 5.
Comparison of ELR indices among various energy sources.

Conclusions

Among biofuel alternatives in this paper, Brazilian ethanol had a very satisfactory performance. Of course, results can vary depending on the region of production and, consequently, more local research using emergy methodology would be necessary to enhance the quality of the discussion. Although fossil fuel production systems require less economic investment to deliver one unit of emergy (high EYR), biofuel systems have higher sustainability performances (higher %R) and could contribute to sustainable development depending on the model of production and land practices. Nevertheless, eventual benefits generated to the economy and environment from biofuel production may be drastically reduced when cropland area expansion leads to ecosystem elimination. Analogously to the carbon balance assessment made by Searchinger et al. (2008), the destruction of such natural systems (rainforests, for example) could result in a long pay-back time to mitigate the negative externalities related to the loss of a variety of goods and services provided by natural systems.

References

BNDES. Banco Nacional de Desenvolvimento Econômico e Social (2008): Sugarcane-based bioethanol: energy for sustainable development / coordination BNDES and CGEE – Rio de Janeiro : BNDES. 304 p.

Bastianoni, S., Campbell, Ridolfi, R., Pulselli, F.M. (2009): The solar transformity of petroleum fuels. Ecological Modelling v.220 p.40-50.

Bastianoni, S., Marchetinni, N. (1996): Ethanol production from biomass: Analysis of process efficiency and sustainability. Biomass and Bioenergy, v. 11, 5 p. 411-418.

Cavalett, O. (2008): Análise de ciclo de vida da soja (title in English: Soybean life cycle assessment). State University of Campinas, Brazil. Data available in: <www.unicamp.br/fea/ortega/extensao/extensao.htm>

Macedo, I.C., Seabra, J.E.A., Silva, J.E.A.R (2008): Greenhouse gases emissions in the produciton and use of ethanol from sugarcane: the 2005/2006 averages and prediciton for 2020. Biomass and Bioenergy, doi:10.1016/j.biombioe.2007.12.006.

Odum, H.T. (1996): Environmental Accounting. Emergy and Environmental Decision Making. J.Wiley & Sons. NY.

Pereira, C.F. (2008): Avaliação de sustentabilidade ampliada de produtos agroindustriais. Estudo de caso: laranja e etanol. (title in English: Sustainability evaluation of agro industrial products. Case studies: orange juice and ethanol). State University of Campinas, Brazil. Data available in: <www.unicamp.br/fea/ortega/extensao/extensao.htm>

Pretty, J.N. et al. (2000): An assessment of the total external costs of UK agriculture. Agricultural Systems 65, 113-136.

Searchinger et al. (2008): Use of U.S. Croplands for biofuel increases greenhouse gases through emissions from land-use change. Science 29, v.319., no.5867, pp. 1238-1240.

Ulgiati, S.(2001): A comprehensive energy and economic assessment of biofuels: when "green" is not enough. Critical Reviews in Plant Sciences, v. 20, p. 71-106.

UNICA. Sugarcane Industry Association (2007, 2008). Data available in <www.english.unica.com.br>

LETTER FROM VIENNA: SEPTEMBER 2009

Bankers save planet

Two energy events of note took place in Vienna in September: the International Association for Energy Economics' European conference and the 154th OPEC meeting. The latter was the more colorful of the two. As the OPEC circus rolled into town, packs of energy journalists staked out Vienna's five star hotel lobbies in the hope of comment from the visiting oil luminaries as they were ushered from car to hotel lift and back again.

Some killjoys get to their rooms via the privacy of the hotel basement, but such is life. They can't be blamed for wanting to avoid an OPEC information arms race that has led to even the most banal comment warranting a news flash from media teams keen to justify their own hotel bills and score points off the opposition.

However, this time round, it was theatre with a well-worn script. Prices around $70/barrel in the midst of recession provided little reason to rock the boat. Increasing signs that the OECD economies have seen the worst meant OPEC could ignore voluminous stock levels and roll over its output targets unchanged.

In the official communiqué, read out to weary journalists at 2 a.m. in the morning – Ramadan necessitated a 9.30 p.m. start to the deliberations – there was not even a reference to greater compliance with current output targets. Indeed, Saudi Oil Minister Ali Naimi said ahead of the meeting, ""We don't have to [enforce stricter compliance]. People are complying anyway. 70% is great." "The price is perfect," he added.

Meanwhile, on the other side of town, in the grand surroundings of the Imperial Hofburg Palace, more significant developments were afoot. But first a footnote: modern economists are obsessed with creating models and subjecting them to, among other things, Monte Carlo analysis, a means of solving problems by running millions of simulations and then analyzing the distribution of outcomes. Or more simply, applying the 'science' of casinos to economic problems. Monte Carlo is one approach to stochastics, which involves mind numbing attempts to make sense of seemingly random price movements.

These might or might not be worthy pursuits, but at the Vienna conference they had clearly not yet learnt Monte Carlo's one golden rule; the numbers might appear random but the house – or perhaps the incumbent – always wins. Moreover, as economists appear wholly incapable of explaining the relevance and limitations of their models to even an informed audience, one has to wonder whether this is a failure of communication, an over indulgence in 'black box' economics, or academic misdirection on a grand scale.

But back to the topic in hand. Some of the more mature economists did feel that a look at the real world might not go amiss. One such came in the amiable figure of Fatih Birol, the International Energy Agency's chief economist. He gave a tantalizing foretaste of the IEA's World Energy Outlook 2009, which is due to be published in November, although a section on climate change will appear earlier for the benefit of those preparing for the Climate Change conference in December in Copenhagen. He noted that in the long term decisions at Copenhagen were likely to have far more impact than those of OPEC in Vienna.

Birol revealed, first, that the answer to the question of whether Paris or Vienna is the most beautiful city in the world was Istanbul, and, second, that the recession has a silver lining. Current climate change targets are "no longer a fantasy", he said. This is a major shift as both Birol and IEA Executive Director Nobuo Tanaka have regularly in the past given the impression that anyone who thinks climate change can be limited to a 2 degree Celsius change in temperature should be locked away somewhere safe.

And with good reason; last year's IEA World Energy Outlook made the point that coal use in the global energy mix was still increasing. According to the IEA, the targets being agreed by politicians were somewhat divorced from reality as the world had yet to set itself on the right trajectory let alone start to make serious progress.

However, the WEO 2009 promises to be radically different. Not only has the IEA long since made the slow journey from climate change skeptic to believer, it will this year formally take a step further to argue that there is now a window of opportunity to achieve the climate change goals that politicians have set. In addition, the "silent revolution" in unconventional gas, which somewhat understates awareness of the industry in the United States, was a real "game changer," Birol said. The IEA has never been a supporter of peak oil theory, and it is clear now that the idea has even less relevance when it comes to natural gas.

So who, apart from the many roughnecks working on US gas rigs, has turned fantasy into achievable reality, one that might literally save the earth? Step forward the banking community, currently being vilified for their attachment to large bonuses, despite already being in receipt of vast amounts of public funds.

Underlying the IEA's new stance is an inadvertant basis for the defense of such bonuses. By making a concerted effort to destroy the world economy in pursuit of personal profit, the financial community has in fact made the achievement of climate change goals feasible. This is a great service to humanity. Such has been the contraction in economic activity, and overall energy demand, that emissions in 2009 are likely to look decidedly healthy, particularly in contrast to those expected in the pre-recession strong-growth scenarios of former WEOs. They are, it has to be said, unlikely saviors, but perhaps the bankers deserve those bonuses after all.

Ross McCracken

This article first appeared in *Platts Energy Economist*, Issue 336, October 2009 and is reprinted with the permission of Platts.

Scenes from the 10th IAEE European Conference

Vienna, Austria | September 7–10, 2009

Calendar

16-20 November 2009, Underground Gas Storage Course at Hampshire Hotel Plaza Groningen, the Netherlands. Contact: Andrea Poelstra, Study Advisor/Account Manager, Energy Delta Institute, Groningen, Netherlands. Phone: +31 50 524 8319 Email: poelstra@energydelta.nl URL: http://www.energydelta.org/nl/mainmenu/edi-programmes/specific-programmes/underground-gas-storage-course

8-19 November 2009, Nano Petroleum, Gas and Petro-Chemical Industries Conference: "Providing Nano-Powered Solutions" at Cairo, Egypt. Contact: Neveen Samy, Assistant, Sabry-Corp Ltd. for Science and Development, 4 Al-Sabbagh Str., El Korba, Cairo, Egypt. Phone: +20 2 2414 6493. Fax: +20 2 2415 0992 Email: neveen.samy@sabrycorp.com URL: www.npg.sabrycorp.com

22-22 November 2009, Energy Economics: Making Energy Transition Feasible at Expo -and congrescentre Erasmus University Rotterdam. Contact: rhuisman@ese.eur.nl, Rotterdam, Zuid-Holland, 3000 DR, Netherlands Email: rhuisman@ese.eur.nl, vishwanathan@ese.eur.nl URL: http://www.eur.nl/ese/english/expertise/ese_conferences/energy_economics/

November 30, 2009 - December 2, 2009, Canadian Renewable Fuels Summit at Vancouver, British Columbia, Canada. Contact: Deborah Elson, Director Member Relations and Industry Promotions, Canadian Renewable Fuels Association, Suite 1005, 350 Sparks Street, Ottawa, ON, K1R 7S8. Phone: 613-594-5528. Fax: 613-594-3076 Email: d.elson@greenfuels.org URL: www.greenfuels.org

5-6 December 2009, Nanotech Business Summit at Cairo, Egypt. Contact: Neveen Samy, Admin Assistant, SabryCorp Ltd. for Science and Development., 4 Al-Sabbagh St., 11757, El Korba, Cairo, Egypt, Cairo, Egypt. Phone: +20 2 2414 6493. Fax: +20 2 2415 0992 Email: neveen.samy@sabrycorp.com URL: http://www.nanobus.sabrycorp.com

January 11, 2010 - December 10, 2010, Executive Master of Petroleum Business Engineering at Groningen / Delft / Paris. Contact: Andrea Poelstra, Study Advisor/Account manager, Energy Delta Institute, Netherlands. Phone: +31 50 524 8319 Email: poelstra@energydelta.nl URL: http://www.energydelta.org/nl/mainmenu/edi-programmes/executive-master-programmes/executive-master-of-petroleum-business-enginee

20-22 January 2010, The New Green Economy at Ronald Reagan Building and International Trade Center -- Washington, DC. Contact: Lyle Birkey, Conference Organizer, National Council for Science and the Environment, 1101 17th Street NW, Suite 250, Washington, District of Columbia, 20036, USA. Phone: 202 530 5810 Ext. 234. Fax: 202 628 4311 Email: lbirkey@ncseonline.org URL: http://ncseonline.org/conference/greeneconomy/

February 15, 2010 - September 30, 2011, Executive Master of Finance & Control for the Energy Industry at Houston / Damman / Groningen. Contact: Andrea Poelstra, Study Advisor / Account Manager, Energy Delta Institute, Netherlands. Phone: +31 50 524 8319 Email: poelstra@energydelta.nl URL: http://www.energydelta.org/nl/mainmenu/edi-programmes/executive-master-programmes/executive-master-of-finance-control-for-the-en

23-25 February 2010, 11th Mediteranean Petroleum Conference and Exhibition at Tripoli, Libya. Contact: Dr. M.A.Muntasser, President, International Energy Foundation, P.O.Box 83617, Tripoli, Libyan Arab Jamahiriya. Phone: 218 21 3331832/3/4. Fax: 218 21 3331831 Email: training@ief.ly URL: www.ief.ly

29-30 March 2010, Water Resources and Renewable Energy Development in Asia at Sarawak, Malaysia. Contact: Mrs. Margaret Bourke, Conference Project Manager, Aqua-Media International Ltd., PO Box 285, Wallington, Surrey, SM6 6AN, United Kingdom. Phone: 44-20-8773-7244. Fax: 44-20-8773-7255 Email: mb@hydropower-dams.com URL: www.hydropower-dams.com

19-23 April 2010, Hydrogen + Fuel Cells at HANNOVER MESSE at Hannover fairgrounds, Hannover, Germany. Contact: Ms. Megan McCool, Project Manager, Tobias Renz FAIR, Thalkirchnerstr. 81, KH2, 330, Munich, 81371, Germany. Phone: +498972013840 Email: megan@h2fc-fair.com URL: www.h2fc-fair.com

6-9 June 2010, 33rd IAEE International Conference: The Future of Energy: Global Challenges, Diverse Solutions at Rio de Janeiro, Brazil. Contact: IAEE Conference Secretariat, IAEE, 28790 Chagrin Blvd Ste 350, Cleveland, OH, 44122, USA. Phone: 216-464-5365. Fax: 216-464-2737 Email: iaee@iaee.org URL: www.iaee.org

26-27 August 2010, 11th IAEE European Conference: Energy Economy, Policies and Supply Security: Surviving the Global Economic Crisis at Vilnius, Lithuania. Contact: David Williams, Executive Director, IAEE, 28790 Chagrin Blvd., Ste. 350, Cleveland, OH, 44122, USA. Phone: 216-464-5365. Fax: 216-464-2737 Email: iaee@iaee.org URL: www.iaee.org

22-23 September 2010, BIEE 8th Academic Conference at St Johns College, Oxford, UK. Contact: BIEE Admin Office, British Institute of Energy Economics, United Kingdom. Phone: + 44 01296 747916 Email: admin@biee.org URL: www.biee.org

14-16 October 2010, 29th USAEE/IAEE North American Conference: Energy and the Environment: Conventional and Unconventional Solutions at Calgary, AB, Canada. Contact: USAEE, 28790 Chagrin Blvd Ste 350, Cleveland, OH, 44122, USA. Phone: 216-464-2785. Fax: 216-464-2768 Email: usaee@usaee.org URL: www.usaee.org

Publications

The Oxford Handbook of Economic Inequality. Wiemer Salverda, Brian Nolan and Timothy M. Smeeding, Eds. (2009). 848 pages. Price: US$120.00. Contact: Order Dept., Oxford University Press, 2001 Evans Road, Cary, NC 27513, USA. Phone: 800-451-7556. Fax: 919-677-1303. URL: www.oup.com/us

The Great Warming: Climate Change and the Rise and Fall of Civilizations. Dr. Brian Fagan (2009). Contact: Julie Mancini, Lyceum Agency, 433 NW Fourth Avenue, Portland, OR 97209, USA. Phone: 503-313-2862. Email: Julie@lyceumagency.com URL: www.lyceumagency.com

Peak Everything. Richard Heinberg (2009). Contact: Julie Mancini, Lyceum Agency, 433 NW Fourth Avenue, Portland, OR 97209, USA. Phone: 503-313-2862. Email: Julie@lyceumagency.com URL: www.lyceumagency.com

Big Coal: The Dirty Secret Behind America's Energy Future. Jeff Goodell (2009). Contact: Julie Mancini, Lyceum Agency, 433 NW Fourth Avenue, Portland, OR 97209, USA. Phone: 503-313-2862. Email: Julie@lyceumagency.com URL: www.lyceumagency.com

International Review of Applied Economics. Malcolm Sawyer, Managing Editor (2009). Price: US$406.00. Contact: Routledge Customer Services, Taylor & Francis Inc., 325 Chestnut Street, 8th Floor, Philadelphia, PA 19106, USA. Phone: 1-800-354-1420. Fax: 1-215-625-2940. Email: customerservice@taylorandfrancis.com URL: www.tandf.co.uk/journals

Annual Review of Economics, Volume 1. Kenneth J. Arrow and Timothy F. Bresnahan, Editors (2009). Price: US$54.60. Contact: Annual Reviews, 4139 El Camino Way, PO Box 10139, Palo Alto, CA 94303-0139, USA. Phone: 800-523-8635. Email: service@annualreviews.org URL: www.annualreviews.org

The Environmental Resource Handbook. (2009). 1200 pages. Price: $155.00. Contact: Jessica Moody, Vice President, Marketing, Grey House Publishing, 4919 Route 22, PO Box 56, Amenia, NY 12501-0056, USA. Phone: 1-800-562-2139 x101. Email: jmoody@greyhouse.com URL: www.greyhouse.com

IAEE INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
WWW.IAEE.ORG

IAEE ENERGY FORUM

Volume 18, Fourth Quarter, 2009

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

Advertisements: The IAEE *Energy Forum*, which is received quarterly by over 3400 energy practitioners, accepts advertisements. For information regarding rates, design and deadlines, contact the IAEE Headquarters at the address below.

Membership and Subscription Matters: Contact the International Association for Energy Economics, 28790 Chagrin Boulevard, Suite 350, Cleveland, OH 44122, USA. Telephone: 216-464-5365; Fax: 216-464-2737; e-mail: IAEE@IAEE.org; Homepage: http://www.iaee@iaee.org

IAEE *Energy Forum*
Energy Economics Education Foundation, Inc.
28790 Chagrin Boulevard, Suite 350
Cleveland, OH 44122 USA

PRSRT STD
U.S. POSTAGE
PAID
Richfield, OH
Permit No. 82