IAEE
WWW.IAEE.ORG
INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS

IAEE Energy Forum

Fourth Quarter 2014 International Association for Energy Economics

President's Message

I am honored to have chaired the IAEE Council in 2014. Serving as IAEE President in 2014 has been a rewarding experience. I sincerely appreciate the hospitality of members to me in Abuja at the 7th NAEE meeting. The graciousness of members when I visited Medellin, Columbia for the Latin America IAEE mini Energy Conference in April is also appreciated. My experience as IAEE President in New York at the 37th International conference was gratifying with thanks to USAEE members. The prominence of IAEE as an international organization is inestimable. We currently have over 4,300 members spread across more than 90 countries. Relative to 2005, we have almost quadrupled our membership tally. The growth in student membership over the last decade makes IAEE's future tremendously promising.

Thus far in 2014, we have had three successful IAEE sponsored or endorsed conferences. The 7th NAEE/IAEE Annual Conference in Abuja, Nigeria on February 17 – 18, 2014, which coincidentally was my first assignment as IAEE president, availed several influential energy professionals the opportunity to join IAEE for the first time. The 37th IAEE International Conference in New York, USA on June 16 – 18, 2014 was historic in many ways including an amazing entrance of new members and I want to again thank Michael Canes and his team for an excellent job, well done. The 4th IAEE Asia Regional conference in Beijing, China is on record to have also attracted over 300 delegates from nearly 30 countries. I sincerely appreciate Dr. Ying Fan and her team of volunteers for their efforts and hospitality. Having these many international attendees at an IAEE regional conference is commendable. Interestingly, nearly two-thirds of attendees are attending IAEE conferences for the first time and joining IAEE as new members, meaning IAEE is growing by leaps and bounds, worldwide.

I recall that in my second and third quarters' messages I talked about global energy and energy resources and the emerging global energy supply and consumption reconfiguration. It is a pleasure to say that research to analyze the micro/macroeconomic implications of the anticipated new energy supply mix -- as a result of the potential of the U.S. becoming an exporter of oil and gas on resource based economies in Africa and Middle East is ongoing. With advanced extraction technologies towards exploitation of unconventional resources like huge shale deposition in the Americas, the speculation for the world running out of oil seems not to be true at least in the nearest future. Let me reiterate that IAEE's core responsibility is to continue to facilitate information flow and the exchange of ideas among energy professionals, in government, industry, and academia, on all aspects of energy policy issues and problems. This is crucial for the mustering of political will and resources in order to promote energy access for all.

The quest for global access to affordable, clean and available energy must not be taken too lightly as access to energy is vital for human survival and economic development of the human race. Energy access is essential for the provision of basic services such as transportation, lighting, heating, cooking, mechanical power and much more. It is well known that over a billion people around the globe, especially in developing Asia and/or sub-Saharan Africa, and in rural areas are without access to basic energy services. We cannot afford to relent in our efforts because we do not want to surrender over 2.6 billion people to absolute clean energy poverty neither do we want about 1.3 billion people to not have access to electricity (www.worldenergyoutlook.com). Fortunately, empirical evidence suggests that there are enough energy resources (renewable

(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)

and non-renewable) to be exploited and converted to useful energy. Hence, with the requisite political will, technological innovation, and collaborative efforts, IAEE must continue to educate, equip and engage energy industry investors to translate these resources to energy supply in a reliable, cost effective and environmentally friendly manner.

Thus, I look forward to seeing you all at the 14th European IAEE Regional Conference to be held in Rome, Italy on October 28 – 31, 2014 with the theme Sustainable Energy Strategies for Europe. The 8th NAEE/IAEE International Conference in Ibadan, Nigeria comes up February 23 – 24, 2015. Its theme is Future Energy Policy Options: Formulation and Implementation. The 5th Latin America Energy Economics Meeting in Medellin, Columbia on March 16 – 18, 2015 with the theme Energy Outlook in Latin America and Caribbean: Challenges, Constraints and Opportunities. Also in 2015, the 38th IAEE International Conference is in Antalya, Turkey on May 25 – 27, 2015. The theme of the conference is Economic, Environment, Technological and Security Challenges for Energy. I am confident that these IAEE meetings will foster harmonious cooperation among members to find solutions to global energy challenges through engagement and dialogue amongst business/industry, academia, and government officials in ensuring global energy access in the more chronic energy poverty stricken nations. It is also my hope that we will use these conferences to attempt to close the gap between professionals endowed with knowledge and tools and decision makers who are the users of the knowledge and tools endowed in IAEE.

Finally as I leave the stage as the 2014 IAEE president, I want to express my profound gratitude to AMS Staff and IAEE Executive Director, Dave Williams, for guiding and supporting me in my duties as he has done, so very well, for all the past IAEE presidents before me. I also want to thank the IAEE Executive Committee members, the outgoing IAEE Council members, IAEE legal adviser John Jimison, and all IAEE conference organizing committees. It has really been a wonderful experience, filled with many memories despite many travel challenges and tight schedules. I trust that the same support will be accorded to the incoming 2015 president, Professor Peter Hartley, and I wish him and his team great success.

Gracia!!!

Wumi Iledare

With your smart device, visit IAEE at:

International Association for Energy Economics

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 Notes

This issue of the *Energy Forum* covers a wide range of topics. There should be something of interest for virtually everyone.

James Hamilton reviews the history of the oil industry's ups and downs and notes there have been some dramatic changes over the last decade that could mark a major turning point in the world's use of oil. He reviews five of the ways in which the world of energy may have changed forever.

Douglas Reynolds looks at the concept of the energy return on (energy) investment (EROI). Many physicists, scientists and geologists find the EROI concept useful, but many economists do not. His article looks at a compromise concept called the marginal EROI that might help both sides better understand each other.

Once again we're favored with a summary of the *BP Statistical Review*. Christof Rühl and Alexander Naumov discuss how the physical energy imbalances of the world's top three energy producers and consumers have shifted over the past decade and the macro economic implications of this.

Shahriyar Nasirov and Carlos Silva discuss the history and current energy situation in Chile, noting that the country has struggled to obtain a reliable energy mix for decades. They then discuss the alternatives under current consideration including the places played by various clean energy sources.

Tade Oyewunmi notes that an efficient regulatory framework for the downstream gas sector is crucial in the overall build up towards a privatised and liberalized Nigerian electricity industry. He briefly examine the implications of the protracted reforms in the Nigerian petroleum industry (especially the downstream gas sector) to the projected improvements in overall energy access and supply in Nigeria.

Yuliya Pidlisna overviews the subject of commercial interconnection investments in Europe. Further, she includes analysis of a 350 MW Estlink HVDC submarine interconnection line between Estonia and Finland.

DLW

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

Broaden Your Professional Horizons

Join the

International Association for Energy Economics

In today's economy you need to keep up-to-date on energy policy and developments. To be ahead of the others, you need timely, relevant material on current energy thought and comment, on data, trends and key policy issues. You need a network of professional individuals that specialize in the field of energy economics so that you may have access to their valuable ideas, opinions and services. Membership in the IAEE does just this, keeps you abreast of current energy related issues and broadens your professional outlook.

The IAEE currently meets the professional needs of over 3400 energy economists in many areas: private industry, non-profit and trade organizations, consulting, government and academe. Below is a listing of the publications and services the Association offers its membership.

• **Professional Journals:** *The Energy Journal* is the Association's distinguished quarterly publication published by the Energy Economics Education Foundation, the IAEE's educational affiliate. *Economics of Energy & Environmental Policy* is a new journal published twice a year. Both journals contains articles on a wide range of energy economic and environmental issues, as well as book reviews, notes and special notices to members. Topics addressed include the following:

Alternative Transportation Fuels	Energy Management	Natural Gas Topics
Conservation of Energy	Energy Policy Issues	Natural Resource Issues
Electricity and Coal	Energy Security	Nuclear Power Issues
Emission Trading	Environmental Issues & Concerns	Renewable Energy Issues
Energy & Economic Development	Hydrocarbons Issues	Sustainability of Energy Systems
Energy & Environmental Development	Markets for Crude Oil	Taxation & Fiscal Policy

• **Newsletter:** The IAEE *Energy Forum*, published four times a year, contains articles dealing with applied energy economics throughout the world. The Newsletter also contains announcements of coming events, such as conferences and workshops; gives detail of IAEE international affiliate activities; and provides special reports and information of international interest.

• **Directory:** The Online Membership Directory lists members around the world, their affiliation, areas of specialization, address and telephone/fax numbers. A most valuable networking resource.

• **Conferences:** IAEE Conferences attract delegates who represent some of the most influential government, corporate and academic energy decision-making institutions. Conference programs address critical issues of vital concern and importance to governments and industry and provide a forum where policy issues can be presented, considered and discussed at both formal sessions and informal social functions. Major conferences held each year include the North American, European and Asian Conferences and the International Conference. IAEE members attend a reduced rates.

• **Proceedings**: IAEE Conferences generate valuable proceedings which are available to members at reduced rates.

To join the IAEE and avail yourself of our outstanding publications and services please clip and complete the application below and send it with your check, payable to the IAEE, in U.S. dollars, drawn on a U.S. bank to: International Association for Energy Economics, 28790 Chagrin Blvd., Suite 350, Cleveland, OH 44122. Phone: 216-464-5365.

- -

_____**Yes**, I wish to become a member of the International Association for Energy Economics. My check for $100.00 (U.S. members $120 - includes USAEE membership) is enclosed to cover regular individual membership for twelve months from the end of the month in which my payment is received. I understand that I will receive all of the above publications and announcements to all IAEE sponsored meetings.

PLEASE TYPE or PRINT

Name: ________________________________

Position: ________________________________

Organization: ________________________________

Address: ________________________________

Address: ________________________________

City/State/Zip/Country: ________________________________

Email: ________________________________

Mail to: IAEE, 28790 Chagrin Blvd., Ste. 350, Cleveland, OH 44122 USA or
Join online at http://www.iaee.org/en/membership/

4/14Forum

CONFERENCE OVERVIEW

It is my great pleasure to announce the 38th IAEE International Conference and invite you to a beautiful resort in Belek, Antalya.

Turkey's unique location straddling the continents of Europe and Asia at the ultimate crossroads of the world's largest oil & gas deposits in the Middle East and consumption centers in Europe, offers an exclusive hub for the exchange of research, policy, practice and ideas to overcome global energy challenges.

The conference program is being prepared by an International Program Committee (IPC) with outstanding prominent members so as to ensure that critical issues of vital concern and importance to governments and industries are presented, considered and discussed from all perspectives. In this context, many exiting plenary and dual plenary sessions on key current energy issues, featuring internationally established speakers and lively discussions, will be organized.

With its informal social functions, the conference will provide a unique opportunity for networking and enhancing communication amongst energy concerned professionals from business, government, academia and other circles worldwide. The rich social program will include unique arrangements like pre-conference tournaments and a beach party on the Mediterranean shore.

I and my colleagues, an experienced and enthusiastic team of outstanding prominent energy professionals in Turkey, are determined to make this conference a professionally most enriching and socially most memorable event – as we did in Istanbul in 2008. Please visit our website for all details and latest updates about the conference.

On behalf of the organizing committee I wish you all a very warm welcome to Antalya and an exciting conference at a time when spring leads into summer.

Gürkan Kumbaroğlu
General Conference Chair

Topics to be Addressed in Concurrent Sessions

- Carbon trading and taxation
- Climate change and energy industry
- Coal in CO_2-constrained world
- Consumer and self-generation
- Design of energy markets
- Distributed generation issues
- Electricity prices and uncertainties
- Energy access and poverty
- Energy consumer behavior
- Energy efficiency challenges
- Energy policy under 2030 emissions target
- Energy finance
- Energy markets and regulation
- Geopolitics of oil and natural gas
- Green energy and economic growth
- Hydropower issues
- Integration of intermittent power sources
- Economics and prospects of clean energy technologies
- Intelligent grids and demand response
- Investment issues in liberalized markets
- Low carbon energy economics
- Market power issues
- Oil and gas transportation and pipelines
- Oil and gas reserves and production
- Promotion of renewable energy
- Prospects of CCS and CCU technologies
- Prospects for nuclear power
- Alternative transportation fuels and vehicles
- Power and gas trade under volatile prices
- Regulation and regulation uncertainties
- Renewable energy technologies and markets
- Resilience of complex energy systems
- Role of new energy services
- Security of supply issues
- Unconventional oil and gas
- Risk and quality management issues in the energy sector

Zero Emission Conference

HOSTED BY

EED
ENERJİ EKONOMİSİ DERNEĞİ
TURKISH ASSOCIATION for ENERGY ECONOMICS

38TH IAEE INTERNATIONAL CONFERENCE CALL FOR PAPERS

It is our pleasure to announce the Call for Papers for the 38th IAEE International Conference, *Economic, Environmental, Technological and Security Challenges for Energy*, to be held May 25 through 27, 2015, at Gloria Golf Resort, Antalya, TURKEY.



Concurrent Sessions

The concurrent sessions will be organized as Regular, Invited, Discussant or Collaborative Conversation sessions. The Regular sessions will be composed of contributed papers, whose submitted abstracts will be refereed and the accepted ones carefully allocated into coherent groups by the IPC. The topics and functioning of the other types of concurrent sessions will be proposed by their organizing chairs, to be approved by the IPC. Speakers invited to participate in such concurrent sessions (by the organizing chairs) will still be required to submit abstracts to be considered by the IPC. Each concurrent session may accommodate 3-5 speakers, while lasting 80-100 minutes.

Poster Session

A poster session, featuring around 25 poster presentations, all relevant to the Conference theme, and which will run throughout the Conference, is to be held in the main lounge of the conference facility. Poster authors are to be collected into a concurrent session, where each author will have an opportunity to explain/describe his/her poster within a matter of 15-20 minutes.

Concurrent and Poster Sessions Abstract Format and Submission

Authors wishing to make concurrent session presentations must submit an abstract that briefly describes the material to be presented by the abstract submission deadline, December 19, 2014. The abstract must be no more than two pages in length and must include the following sections: i) Overview of the topic including its background and potential significance; ii) Methodology: how the matter was addressed, what techniques were used; iii) Results: key and ancillary findings; iv) Conclusions: lessons learned, implications, next steps; v) References (if any).

Abstracts for the poster session must be submitted by the regular abstract deadline. The abstract format for the Poster Session is identical to that for the Concurrent Sessions. Additionally, such an abstract should clearly indicate that it is intended for the Poster Session.

Please visit the conference website (http://www.iaee2015.org) to download an abstract template. All abstracts must conform to the format structure outlined in the template. Abstracts must be submitted online through the conference website. Abstracts submitted by e-mail or in hard copy will not be processed.

Posters for actual presentation at the conference must be brought directly to the conference venue on the day of presentation and must be in either ANSI E size (34in. x 44in.) or ISO A0 size (841mm x 1189mm) in portrait or landscape format.

Presenter Attendance to the Conference

At least one author of an accepted paper or poster must pay the registration fees and attend the conference to present the paper or poster. 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 author may present only one paper or one poster in the conference. No author should submit more than one abstract as its single author. If multiple submissions are accepted, then a different author will be required to pay the registration fee and present each paper or poster.

Optionally, authors whose abstracts are accepted may submit their final papers or posters for publication in the online conference proceedings. Please visit the conference website (http://www.iaee2015.org) to download a paper template. All such submitted papers must conform to the format structure outlined in the template. Regarding posters to be published in the online conference proceedings, poster presenters should submit a final version of the poster electronically (in pdf format).

Registration Fees	Received on or before March 20, 2015	Received on or before April 17, 2015	Received after April 17, 2015
Speakers/Chairmen (Members)	750 USD	850 USD	950 USD
Speakers/Chairmen (Nonmembers)	900 USD	1,000 USD	1,100 USD
Members	950 USD	1,000 USD	1,050 USD
Nonmembers (including membership)	1,100 USD	1,150 USD	1,200 USD
Full-time Students (Members)	400 USD	450 USD	500 USD
Full-time Students (Nonmembers, including membership)	450 USD	500 USD	550 USD
Spouse/Accompanying Persons	200 USD	250 USD	300 USD

Key Dates and Deadlines

- Receipt of abstracts: *December 19, 2014*
- Notification of acceptance: *February 4, 2015*
- Full paper submission: *March 20, 2015*

Pre-Conference Workshop

A pre-conference workshop entitled "Shale Gas in North America: Resources, Deliverability, Demand and Global Implications" will be held on May 24th 2015. The workshop will be given by Gürcan Gülen and Svetlana Ikonnikova from the Bureau of Economic Geology, The University of Texas at Austin. Registration fee is 100 USD.

Pre-conference Golf Tournament

Gloria Golf Resort is known for its excellent golf courses, attracting golfers from all over the world. In order to offer IAEE golfers an opportunity to meet and enjoy the Gloria golf courses, a pre-conference golf tournament will be organized on Sunday, May 24. The maximum number of participants is 24 (first come first serve) and the fee is 120 USD. Information about the golf tournament will be posted on the conference website. Players are welcome to contact Lars Bergman (lars.bergman@hhs.se) for more detail.

Awards

- Best Student Paper Award
- Best Poster Award
- Energy Development, Growth and Sustainability Award

Contact Information

Host Organization:
Turkish Association for Energy Economics (EED)
Address: Boğaziçi University, 34342, Bebek, İstanbul, Turkey
Tel: +90-212-3597544

For the latest updates about the conference;
Official website: http://www.iaee2015.org
Official Twitter account: @IAEE15
Official Facebook Page: IAEE15
e-mail: info@iaee2015.org

IAEE INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
WWW.IAEE.ORG

EED ENERJİ EKONOMİSİ DERNEĞİ
TURKISH ASSOCIATION for ENERGY ECONOMICS

The Changing Face of World Oil Markets

By James D. Hamilton*

This year the oil industry celebrated its 155th birthday, continuing a rich history of booms, busts and dramatic technological changes. Many old hands in the oil patch may view recent developments as a continuation of the same old story, wondering if the high prices of the last decade will prove to be another transient cycle with which technological advances will again eventually catch up. But there have been some dramatic changes over the last decade that could mark a major turning point in the history of the world's use of this key energy source. In this article I review five of the ways in which the world of energy may have changed forever.

1. World oil demand is now driven by the emerging economies

For most of the twentieth century, the major developed economies were the primary consumers of oil, and their annual consumption grew at a very predictable rate. Figure 1 plots the combined oil consumption of the U.S., Canada, Europe and Japan since 1984. The annual growth in these countries' consumption over 1984-2005 can barely be distinguished from a deterministic linear trend, increasing each year by about 440,000 barrels a day. But the last decade brought a rather astonishing reversal in that trend. Oil consumption in the developed countries has fallen an average of 700,000 b/d every year since 2005, reaching a level as of the end of 2012 that is 8 mb/d lower than one would have predicted in 2005 on the basis of a simple extrapolation of the historical trend.

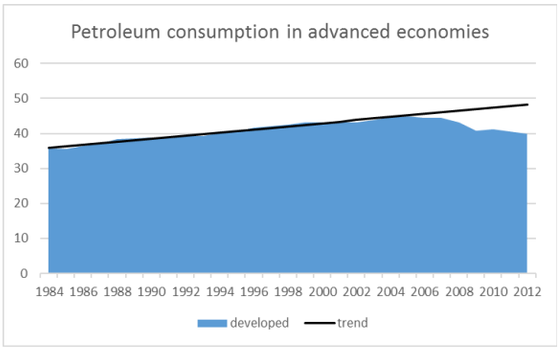


Figure 1. Petroleum consumption in the U.S., Canada, Europe and Japan, 1984-2012, in millions of barrels per day. Black: linear trend estimated 1984-2005. Data source: EIA (http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=5&pid=5&aid=2).

One factor slowing growth in oil demand from the developed countries was the significant loss in income associated with the Great Recession. Figure 2 shows that U.S. real GDP fell significantly in 2008-2009, and has yet to return to its historical trend. However, since 2009 U.S. GDP has been growing at its historical rate even as U.S. oil consumption continued to decline. The primary factor in the latter was the doubling in the price of oil since 2005. It was higher oil prices, not slower income growth, that was most important in forcing reductions in fuel use in North America, Europe, and Japan.

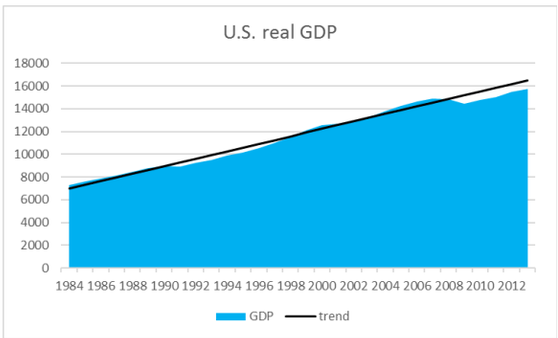


Figure 2. U.S. real GDP, 1984-2013, in billions of chained 2009 dollars per year. Black: linear trend estimated 1984-2005. Data source: FRED (http://research.stlouisfed.org/fred2/series/GDPCA).

The story for the world's emerging economies has been quite different, as seen in Figure 3. Although these countries accounted for only 40% of the world total in 1984, their trend line grew at 650,000 b/d annually over 1984-2005. And whereas consumption in the developed economies fell significantly since 2005, that in the emerging economies grew even faster than it had over the period from 1984-2005. China alone accounted for 57% of the global increase in consumption since 2005. The last decade has brought an astonishing improvement in income to people in China and a number of other countries, one side effect of which was a big increase in these countries' consumption of petroleum. In 1980, the emerging economies accounted for about a third of global oil consumption. Today the figure is 55%.

These breaks in consumption trends also call for a break in thinking from the framework that many analysts traditionally used to make long-run energy forecasts. The dominant approach used by most analysts in 2005 was to project forward the historically stable trends seen in plots like Figure 1 and assume that somehow the world would find a way to continue to increase production to fulfill the projected growth in demand. For example, Figure 4 (reproduced from Benes, et. al., 2012) shows in different colors the projections for world oil consumption through 2020 made each year over 2001-2010 by the U.S. Energy Information Administration (EIA). The actual path (in black) fell far short of those projections, because supply did not increase at the historically predicted pace. I next discuss some of the reasons why that was the case.

2. Growth in production since 2005 has come from lower-quality hydrocarbons

Before going further it is worth focusing on exactly what we are referring to by the total quantity of oil produced or consumed. The figures produced above

* James Hamilton is Professor of Economics at the University of California, San Diego. He received the IAEE's *Outstanding Contribution to the Profession Award* at the International Meeting in New York City this June. He may be reached at jhamilton@ucsd.edu
See footnotes at end of text.

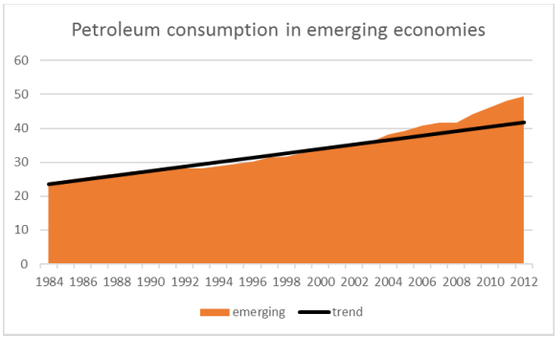


Figure 3. World petroleum consumption outside of the U.S., Canada, Europe and Japan, 1984-2012, in millions of barrels per day. Black: linear trend estimated 1984-2005. Data source: EIA (http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=5&pid=5&aid=2).

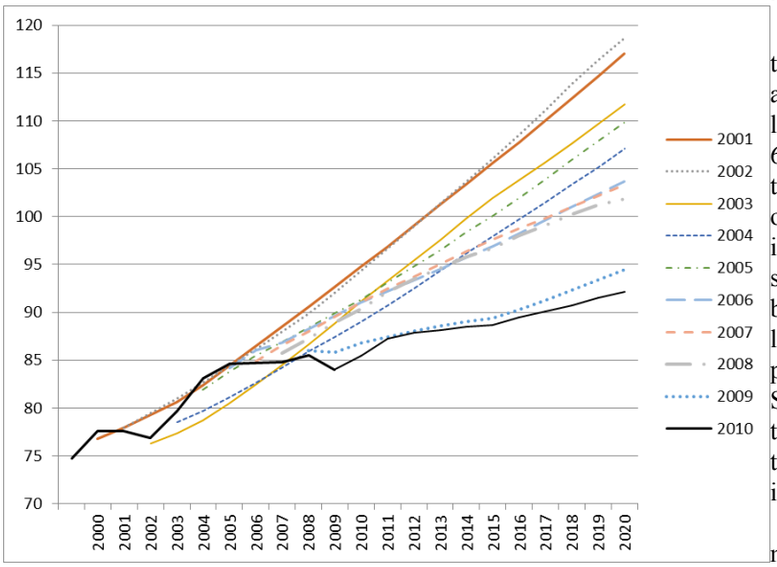


Figure 4. Projections of world oil consumption (total liquids in mb/d) made by EIA in each year 2001-2010, along with actual historical path. Source: Benes, et. al. (2012)

all used the concept of "total oil supply" employed by the EIA. Figure 5 summarizes how the 84.6 mb/d in total liquids produced globally in 2005 broke down in terms of its various components. Eighty-seven percent of this total came from field production of crude oil and lease condensate, which are essentially liquids taken directly out of the ground. A minor contribution came from natural gas liquids (NGL). These are hydrocarbons that are in gaseous form at ambient temperature and pressure, but require less cooling and pressure to liquefy than single-carbon methane, the component of pure natural gas. Because these are more valuable products than methane, if present in sufficient quantities (so-called "wet gas"), it pays natural gas producers to separate these products out and their liquid volume is counted as part of the measure of total liquids production used above. Other even less-important factors historically in "total liquids production" were refinery process gain (a consequence of the fact that the volume of refined products exceeds the volume of the starting crude oil) and "other liquids", which chiefly refers to biofuels.

Although these other components made a relatively minor contribution to the total in 2005, they account for more than half of the increase in total liquids production since 2005, as seen in Figure 6. Does it make sense to add natural gas liquids to barrels of crude oil in arriving at a total measure of total oil production? Of the NGL currently being produced in the United States, about 70% represents two-carbon ethane or three-carbon propane.[1] A barrel of crude oil typically contains about 5.8 million British Thermal Units (BTU), while a barrel of propane has 3.836 mBTU and ethane only 3.082.[2] Sometimes private oil companies even add production of methane (on an equivalent BTU basis) to their liquid oil production to report their production in units of "barrel of oil equivalents."

For some purposes, these various hydrocarbons might indeed be viewed as equivalent or close substitutes. For example, natural gas can replace fuel oil for heating, ethane provides a useful petrochemical feedstock, and propane is even used in some specialized transportation settings. But if the objective is to produce a liquid fuel for cars or planes, natural gas or natural gas liquids are a poor substitute. From an economic point of view, summarizing the substitutability between different energy sources has a very clear answer—we only have to look at the price to see how close substitutes different fuels really are.

The black line in Figure 7 plots the dollar price of a barrel of West Texas Intermediate crude oil. The red line shows the price of natural gas on an equivalent BTU basis (that is, the dollar price of a million BTU of natural gas multiplied by 5.8). These two tracked each other reasonably closely up until 2005, after which oil began to pull away. Today you'd pay four times as much to buy a BTU in the form of oil compared to natural gas. This reflects the fact that U.S. production of gas and wet gas increased much faster relative to their respective demands than has crude oil. An energy-producing company that reports its natural gas production on a "barrel of oil equivalent" basis is clearly doing a disservice to shareholders who care about how profitable the company actually is.

The blue and green lines in Figure 7 plot the price of propane and ethane, respectively, again on a relative BTU basis compared to crude oil. These stayed fairly close to crude oil during the big price run-up in 2008, but ethane has since pulled away, and now sells for about the same price as natural gas. After a brief spike from heating use during the unusually cold North American winter in 2013-2014, propane is now back to selling at a 40% discount to crude. Clearly in an economic sense, a barrel of natural gas liquids is not nearly as valuable today as a barrel of crude oil.

Adding biofuels as equivalent to field production of crude oil is even more problematic. About 40%

of U.S. corn production is currently devoted to producing ethanol (Wisener, 2014), purely as a result of extensive mandates and subsidies. While some have argued that more energy is used in the process of growing the crops and producing the product than is actually contained in the ethanol, there does appear to be some modest net energy gain (Hill, 2006). But adding biofuels to a measure of total liquids production seems to be motivated more by political considerations than by economics or science.

3. Stagnating world production of crude oil meant significantly higher prices

If one looks only at field production of crude oil, the picture becomes quite stark. Field production increased worldwide by only 2.3 mb/d between 2005 and 2013. That compares with a predicted increase of 8.7 mb/d from extrapolating the pre-2005 trends in consumption growth for developed and emerging economies, and that's without even taking account of the dramatic acceleration in demand from the emerging economies. It's also instructive to relate these numbers to global growth of real GDP. According to the 2014 IMF World Economic Outlook database,[3] world real income increased by 27.7% between 2005 and 2013. If we assume an income elasticity of 0.7, for which Cseresklyei, Rubio, and Stern (2014) provide abundant empirical support, we would have expected that in the face of a stable price of oil, production should have increased by 19.4%. The actual increase in field production of crude oil was only 3.1%, consistent with a shortfall of 12 mb/d.

The story behind the doubling of real oil prices since 2005 is thus quite simple—if prices had not risen, growth in demand, particularly that coming from the emerging economies, would have outstripped production. A big price increase was necessary to reverse the trend of growing consumption in the developed economies. In the following sections I explore some of the reasons why world oil production stagnated during this period of strong demand.

4. Geopolitical disturbances held back growth in oil production

One factor holding back production in a number of locations today is geopolitical unrest. The biggest single contributor over the last three years has been Libya. A civil war in 2011 led to the overthrow of Qadhafi and near cessation of exports. The subsequent peace proved to be temporary, and production has recently again been sharply curtailed as a result of labor disputes and conflicts between warring militias. Sanctions continue to reduce Iran's production, and attacks on oil infrastructure keep Nigeria's production below its potential. About 400,000 b/d is currently lost as a result of open conflict in Sudan and Syria. All told, the EIA estimates that these and other unplanned disruptions reduced world oil production by 3.3 mb/d in June 2014 (see Figure 8).

If all of this production were to return next year, it would eliminate a third to a half of the shortfall calculated above. In this sense one could argue that geopolitical disruptions are a major part of the story. However, it is misleading to view geopolitical events such as those tabulated in Figure 8 as temporary aberrations. An examination of the history of some of the key oil-producing regions should remind us that much bigger disruptions than these are fairly common and usually have quite long-lasting effects. For example, the top panel of Figure 9 plots crude oil production from Iraq since 1973. Iraq's war with Iran, which began in September of 1980, was associated with an immediate drop in Iraq's oil production of 3 mb/d. But the war went on (and continued to exert a negative effect on production) until 1988. It was only two years later that Iraq

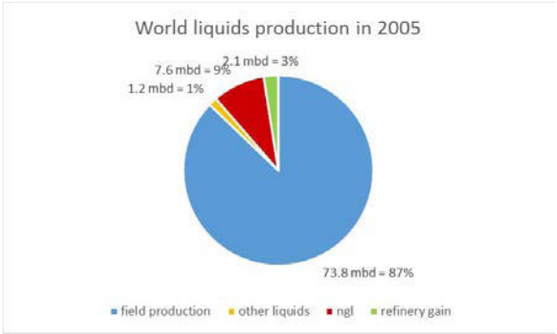


Figure 5. Total liquids production in 2005. Data source: EIA (http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm).

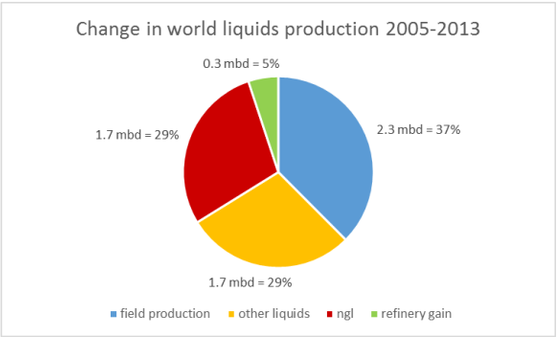


Figure 6. Amount of increase total liquids production between 2005 and 2013 that is accounted for by various components. Data source: EIA (http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm).

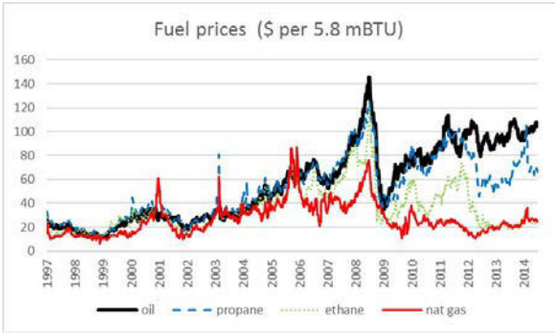


Figure 7. Prices of different fuels on a barrel-of-oil-BTU equivalent basis (end of week values, Jan 10, 1997 to Jul 3, 2014). Oil: dollars per barrel of West Texas Intermediate, from EIA (http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RWTC&f=D). Propane: FOB spot price in Mont Belvieu, TX [(dollars per gallon) x (1 gallon/42 barrels) x (1 barrel/3.836 mBTU) x 5.8], from EIA (http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EER_EPLLPA_PF4_Y44MB_DPG&f=D). Ethane: FOB spot price in Mont Belvieu, TX [(dollars per gallon) x (1 gallon/42 barrels) x (1 barrel/3.082 mBTU) x 5.8], from DataStream. Natural gas: Henry Hub spot price [(dollars per mBTU) x 5.8], from EIA (http://tonto.eia.gov/dnav/ng/hist/rngwhhdd.htm)

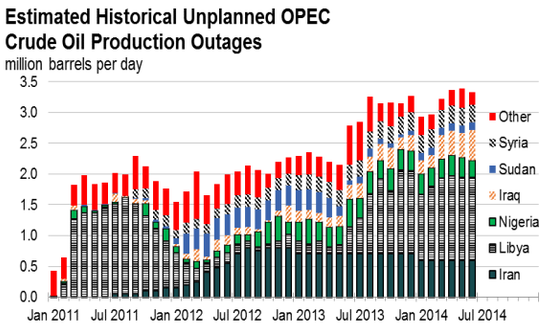


Figure 8. Global oil supply disruptions, Jan 2011 to June 2014. Source: constructed by the author from data provided in EIA, Short-Term Energy Outlook (http://www.eia.gov/forecasts/steo/report/global_oil.cfm).

invaded Kuwait. Again the loss in production was dramatic, and although this war was resolved relatively quickly, sanctions continued until the Gulf War of 2003, which brought its own set of new disruptions. Iraq's geological potential led Maugeri (2012) to expect it to make a major contribution to world oil production over the next five years. But recent geopolitical events in that country make it clear that's not going to happen.

The history of Iran (second panel in Figure 9) relates a similar lesson. Although the revolution of 1978 resulted in an immediate loss of over 5 mb/d, the country also lost many of its engineers and organizational infrastructure. Iranian production has never returned to levels of the early 1970s, and we will see when (if ever) production returns to its levels from before the recent sanctions. And in the case of Libya (bottom panel of Figure 9), the overthrow of Qadhafi occurred in 2011, but we are still discussing its "temporary" consequences three years later. One has only to read the most recent news from Iraq and Israel to conclude that perhaps we should consider ourselves fortunate that production from the Middle East is as high as it is presently. A big new drop in oil production rather than a sudden increase seems a more likely next outcome of the current political turmoil.

Moreover, the initial big run-up in oil prices came in 2008, well before the latest events in Libya, Iran, or Syria. Global field production of crude was flat between 2005 and 2008, despite the absence of a major identifiable geopolitical disruption, and despite the strong growth in demand from emerging countries. Furthermore, blaming the ongoing production shortfall on geopolitical events invites the more fundamental question of why the only sources of supply are in such unstable parts of the world. Why weren't supplies found elsewhere to make up the difference? I turn to this question in the next section.

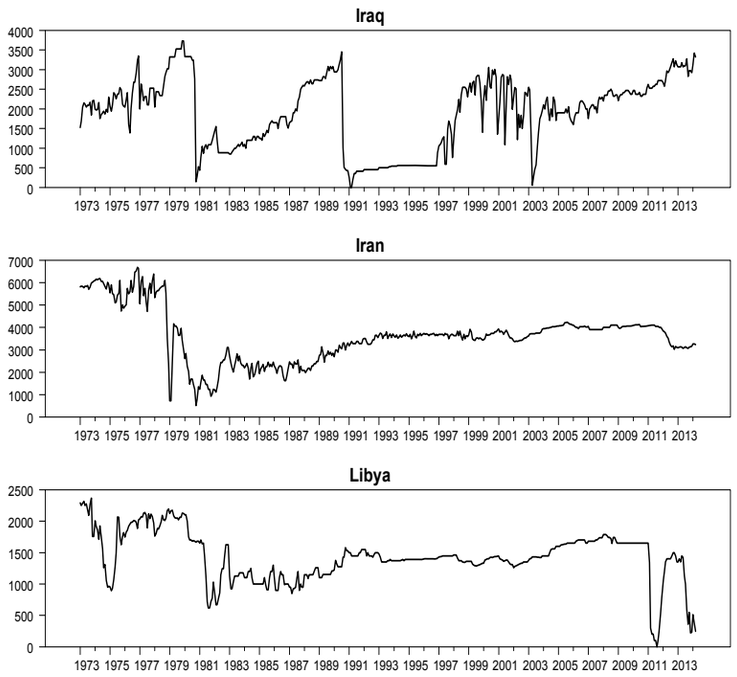


Figure 9. Field production of crude oil from Iraq, Iran, and Libya, Jan 1973 to Mar 2014, in thousands of barrels per day. Data source: EIA, Monthly Energy Review, Table 11.1a (http://www.eia.gov/totalenergy/data/monthly/#international).

5. Geological limitations are another reason that world oil production stagnated

The top panel of Figure 10 plots monthly oil production for all of OPEC, of which Saudi Arabia (bottom panel) accounts for about a third all by itself. Whereas the dramatic changes in production in the countries in Figure 9 often resulted from geopolitical events, most of the swings in Saudi production were the result of deliberate calculations, with the kingdom decreasing production when the market was weak and increasing production when the market was strong. Historically Saudi Arabia acted as the world's primary swing producer and maintained excess production capacity in order to be able to play that role. Projections such as those in Figure 4 assumed that the kingdom would continue to do so, with an assumption of ever-increasing Saudi and OPEC production filling the gaps between projected demand and supply.

But the bottom panel of Figure 10 shows that this isn't what happened. Saudi Arabia has continued to some extent to make modest changes in production in response to demand, decreasing production for example in the recessions of 2001 and 2007-2009. But apart from these minor adjustments, Saudi production has been remarkably flat for over a decade.

Some analysts maintain that this again represents a deliberate market decision, and that most OPEC members could achieve big increases in production any time they wanted. This view is hard to reconcile with evidence such as that in Figure 11, which shows that stagnant production from the Middle East has coincided with a dramatic increase in drilling effort in the region. There is a temporary drop

in the reported number of drilling rigs in January 2006 because Baker Hughes decided to no longer include Iran in their count after that date. There was also a modest decline during the Great Recession, consistent with the observation noted above that the decline in OPEC production in 2008-2009 was very much a deliberate response to market conditions. But the overall picture is that the Middle East countries have been devoting ever increasing resources to upstream development and yet have very little additional oil production to show for it.

In the case of oil produced by the major international companies that conclusion is even more compelling. Figure 12 shows that combined production from the 11 largest publicly-traded oil companies has fallen by 2.5 mb/d since 2005, despite a tripling of their capital expenditures.

Depletion of older reservoirs and the high cost of developing new resources are unquestionably part of the explanation. For example, production in the North Sea has moved increasingly north since the 1960s in search of more oil, but total production from the area has nevertheless been declining for the last 13 years, as seen in the top panel of Figure 13. Production from Mexico's Cantarell, once the world's second-largest producing oil field, has also been declining significantly since 2004. The earlier growth in Mexican and North Sea production had made a significant contribution globally, accounting for 12% of the world total in 2003 (see the bottom panel of Figure 13). But between 2005 and 2013, the combined production from Norway, U.K., and Mexico fell by 2.9 mb/d. The contribution from these three countries alone is at least as important as the geopolitical considerations noted in the preceding section.

It is also interesting to take a look at the history of production in individual U.S. states, which is summarized in Figures 14-15 and Table 1. Production from Pennsylvania, where the oil industry began in 1859, peaked in 1891, and in 2013 was at a level only 1/6 of that achieved in 1891. But despite falling production from Pennsylvania after 1891, U.S. production continued to increase, because of the added boost from Ohio (which peaked in 1896) and West Virginia (which peaked in 1900). And so the story continued, with increases in overall U.S. production despite declines from the areas first exploited, for nearly a century. Looking at the United States as a whole, production continued to climb every year through 1970, although production from many individual states was well into decline before that date.

Alternatively, one can summarize U.S. production in terms of broader categories. Field production from the lower 48 states (not counting production obtained from tight geologic formations using the now-popular horizontal fracturing drilling methods) was 5.5 mb/d lower in 2013 than it had been in 1970 (see Figure 16). The decline in production was only partially offset by development of Alaska's supergiant Prudhoe Bay field and other resources (which peaked in 1988) and offshore production (which peaked in 2003).

More recently, the decline in U.S. production has turned around dramatically with the exploitation of tight oil formations, whose 2.9 mb/d increase since 2005 more than offset the combined 0.6 mb/d drop in conventional lower 48, Alaska, and offshore production. Indeed, the net gain in U.S. production of 2.3 mb/d since 2005 by itself accounts for all of the increase in field production worldwide discussed in Section 3 above. Tight oil plays in the Bakken in North Da-

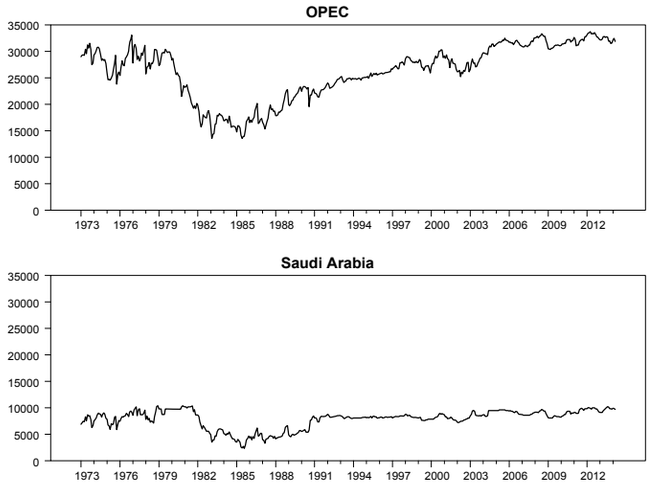


Figure 10. Field production of crude oil from OPEC and Saudi Arabia, Jan 1973 to Mar 2014, in thousands of barrels per day. Data source: EIA, Monthly Energy Review, Table 11.1a (http://www.eia.gov/totalenergy/data/monthly/#international)

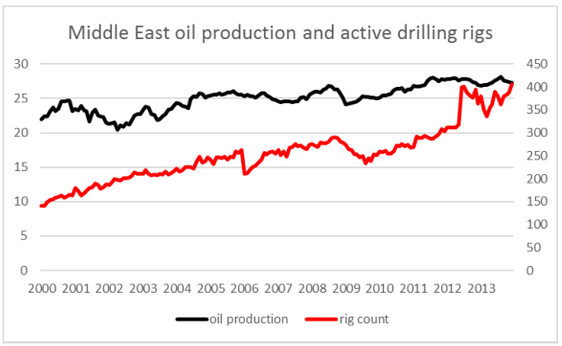


Figure 11. Middle East oil production and active drilling rigs, Jan 2001 to Dec 2013. Black line: total liquids production from the Middle East, in millions of barrels per day, from EIA (http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm). Red line: number of drilling rigs active in the Middle East (right scale), from Baker Hughes (http://phx.corporate-ir.net/phoenix.zhtml?c=79687&p=irol-rigcountsintl).

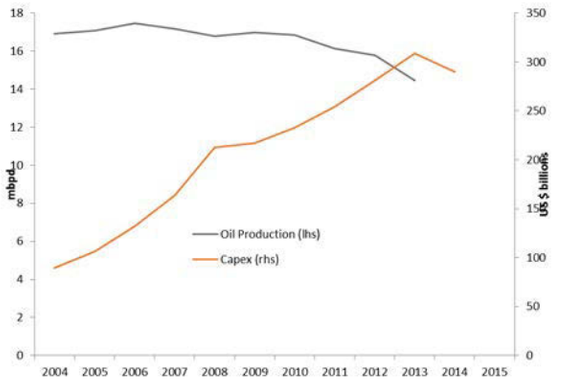


Figure 12. Total oil production and capital expenditures for the major international oil companies, 2004-2013. Includes XOM, RDS, BP, CVX, STO, TOT, PBR, PTR, ENI, REP, and BG. Source: updated from Kopits (2014)

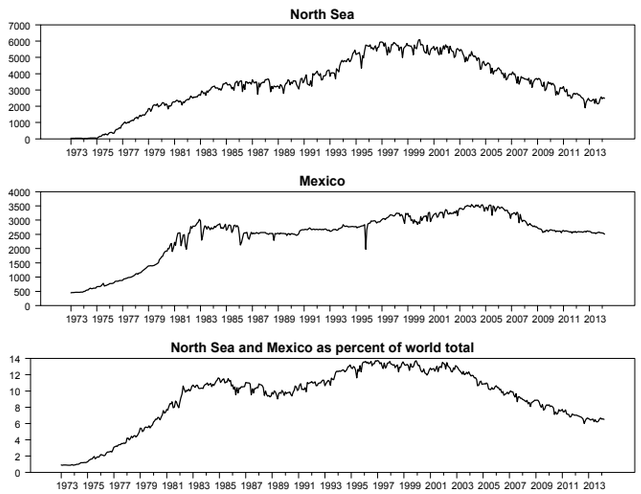


Figure 13. Oil production from the North Sea and Mexico, Jan 1973 to March 2014. Top panel: combined field production of Norway and the United Kingdom in thousands of barrels per day, from EIA, Monthly Energy Review, Table 11.1b. Bottom panel: sum of Norway, U.K., and Mexico production as a percent of world total

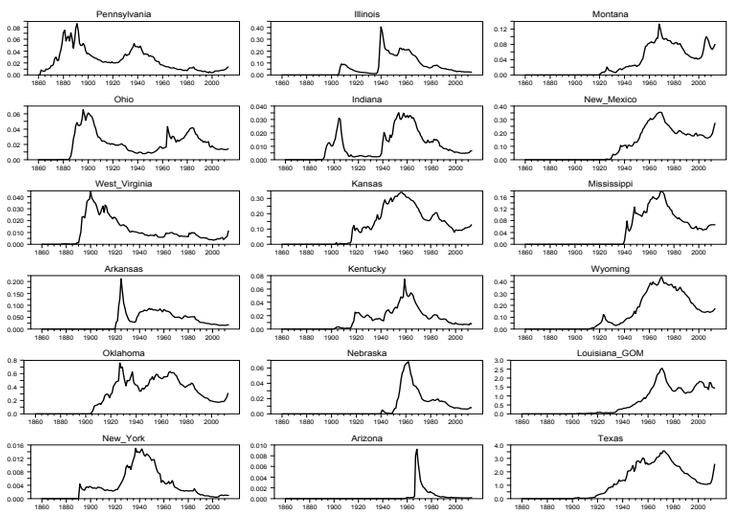


Figure 14. Annual production (in mb/d) from 18 U.S. states that peaked earliest, 1860-2013. Updated from data sources detailed in Hamilton (2013)

kota and the Niobrara in Colorado have brought production in those states to all-time highs (Table 1). Many analysts are optimistic that the trend of growing production from this resource will continue for the next several years, with the EIA's Annual Energy Outlook 2014 predicting that tight oil could bring total U.S. oil production back near or above the 1970 peak before resuming its long-term decline.

But even if this forecast proves accurate, it is abundantly clear that it would not return real oil prices to their values of a decade ago. One reason is that it is much more costly to produce oil with these methods. Although estimates of the break-even cost vary, we do know that the most of the companies producing from the tight oil formations have a negative cash flow (Sandrea, 2014)—they are spending more than they are bringing in at current prices. Although companies are presumably doing so in order to acquire an asset that will be productive in the future, it's also well documented that production from typical tight-oil wells falls to 20% of peak production within two years.[4]

So far development of oil from tight formations has occurred almost exclusively in the United States, though other countries including Russia, China, Argentina, and Libya also have promising geological potential.[5] But separate logistical obstacles may make it difficult to replicate the U.S. success elsewhere on a near-term basis. U.S. advantages include exploration and drilling assets that can be quickly moved, infrastructure to transport the product, mineral rights, ability to raise capital quickly, and political stability. That other countries can replicate the U.S. success at lower cost seems doubtful. Rather than a force pushing oil prices back to historical lows, it seems more accurate to view the emerging tight-oil plays as a factor that can mitigate for a while what would otherwise be a tendency for prices to continue to rise in the face of growing demand from emerging economies and stagnant supplies from conventional sources.

6. Conclusions

Although the oil industry has a long history of temporary booms followed by busts, I do not expect the current episode to end as one more chapter in that familiar story. The run-up of oil prices over the last decade resulted from strong growth of demand from emerging economies confronting limited physical potential to increase production from conventional sources. Certainly a change in those fundamentals could shift the equation dramatically. If China were to face a financial crisis, or if peace and stability were suddenly to break out in the Middle East and North Africa, a sharp drop in oil prices would be expected. But even if such events were to occur, the emerging economies would surely subsequently resume their growth, in which case any gains in production from Libya or Iraq would only buy a few more years. If the oil industry does experience another price cycle arising from such developments, any collapse in oil prices would be short-lived.

My conclusion is that hundred-dollar oil is here to stay.

Footnotes

[1] Data source: EIA (http://www.eia.gov/dnav/pet/pet_pnp_gp_dc_nus_mbblpd_m.htm).

[2] Source: EIA (http://www.eia.gov/totalenergy/data/monthly/pdf/sec13.pdf).

[3] http://www.imf.org/external/pubs/ft/weo/2014/01/weodata/index.aspx.

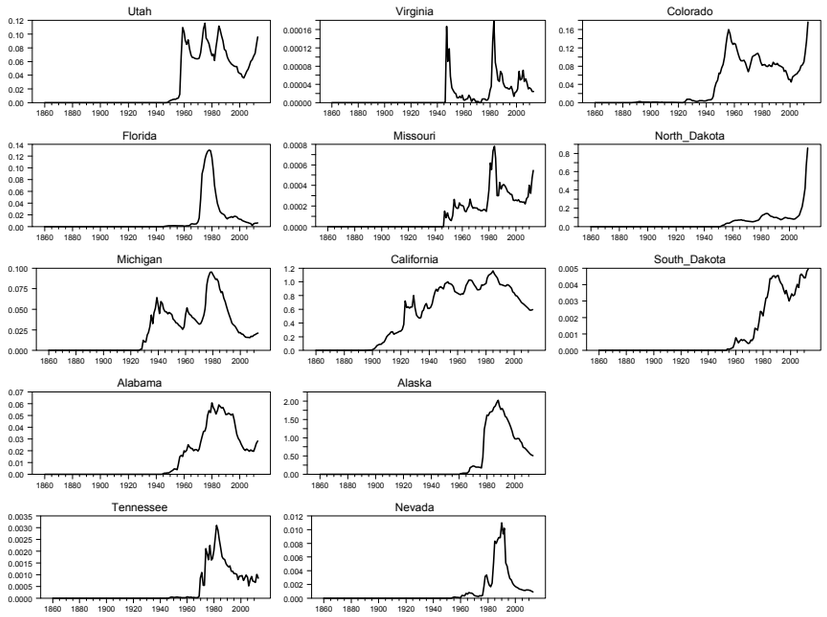


Figure 15. Annual oil production (in mb/d) from the 13 U.S. states with later peak dates. Updated from data sources detailed in Hamilton (2013)

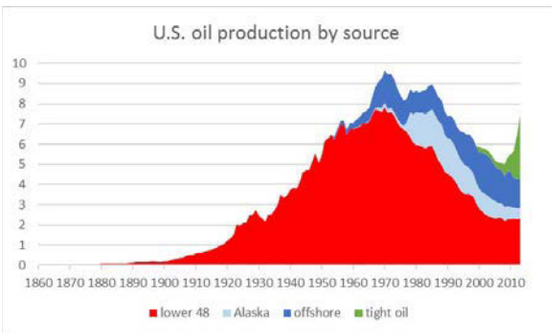


Figure 16. U.S. field production of crude oil, by source, 1860-2013, in millions of barrels per day. Data sources: Hamilton (2013) and EIA: Annual Energy Review Table 5.2; Crude Oil Production (http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm); Annual Energy Outlook 2014.

State	Date of peak
Pennsylvania	1891
Ohio	1896
West Virginia	1900
Arkansas	1925
Oklahoma	1927
New York	1937
Illinois	1940
Indiana	1953
Kansas	1956
Washington	1957
Kentucky	1959
Nebraska	1962
Arizona	1968
Montana	1968
New Mexico	1969
Mississippi	1970
Wyoming	1970
Louisiana and Gulf of Mexico	1971
Texas	1972
Utah	1975
Florida	1978
Michigan	1979
Alabama	1980
Tennessee	1982
Virginia	1983
Missouri	1984
California	1985
Alaska	1988
Nevada	1990
Colorado	2013
North Dakota	2013
South Dakota	2013
U.S. total	1970

Table 1. Year of peak crude oil field production for U.S. oil-producing states. Federal offshore production included in California and Louisiana totals. Calculated from an updated version of the database developed in Hamilton (2013).

[4] "Development of the Bakken Resource," North Dakota Department of Mineral Resources, 2014 (https://www.dmr.nd.gov/oilgas/presentations/ActivityUpdate2014-03-06ND-911MeetingBismarck.pdf).

[5] EIA, "Today in Energy," Jan 2, 2014 (http://www.eia.gov/todayinenergy/detail.cfm?id=14431).

References

Benes, Jaromir Benes, Marcelle Chauvet, Ondra Kamenik, Michael Kumhof, Douglas Laxton, Susanna Mursula, and Jack Selody (2012). "The Future of Oil: Geology versus Technology," working paper, International Monetary Fund.

Hamilton, James D. (2013). "Oil Prices, Exhaustible Resources, and Economic Growth," in Handbook of Energy and Climate Change, pp. 29-57, edited by Roger Fouquet. Cheltenham, United Kingdom: Edward Elgar Publishing.

Hill, Jason, Erik Nelson, David Tilman, Stephen Polasky, and Douglas Tiffany (2006), "Environmental, Economic, and Energetic Costs and Benefits of Biodiesel and Ethanol Biofuels," Proceedings of the National Academy of Sciences, 103 (30) 11206-11210.

Kopits, Steven (2014). "Oil Demand and Growth: A Supply-Constrained View," presentation at Columbia University (http://energypolicy.columbia.edu/sites/default/files/energy/Kopits%20-%20Oil%20and%20Economic%20Growth%20%28SIPA%2C%202014%29%20-%20Presentation%20Version%5B1%5D.pdf).

Maugeri, Leonardo (2012). "Oil: The Next Revolution," working paper, Harvard University.

Sandrea, Ivan (2014). "U.S. Shale Gas and Tight Oil Industry Performance," working paper, Oxford Institute for Energy Studies.

Wisener, Robert (2014). "Ethanol Usage Projections & Corn Balance Sheet," Agricultural Marketing Resource Center, (https://www.extension.iastate.edu/agdm/crops/outlook/cornbalancesheet.pdf).

2016 International Conference to be in Bergen, Norway

The 2016 International Conference of IAEE will be in Bergen, at Norwegian School of Economics, NHH. IAEE representatives David Williams and Gurkan Kumbaroglu visited NHH early April to take part in preparations. "Refreshing and comforting to know we will be on campus and have seen the facilities," says Dave" and we met with rector, hotels and the conference team, headed by former IAEE president Einar Hope. The overall theme of the conferece is *Energy: Expectations and Uncertainty, Challenges for Analysis, Decisions and Policy.*

"Bergen being wedged between a century old hydroelectric energy journey, a half-century old petroleum adventure, and a future fueled by a pretty impressive oil fund, we are pretty excited", says Gurkan.

The Grieg Hall – Bergen is also culturally and touristically ambitious – will be the venue for the Gala Dinner, and the city is welcoming the conference delegates to a reception at the Haakon's Hall, where King Haakon Haakonsen dined and threw parties three quarters of a millennium ago.

Energy economists will be excited to hear that themes of policy analysis, expectations and risk will be highlighted at the conference, in addition to themes such as resources, environment, technology and climate change.

Corporate sponsors from electricity sectors as well as petroleum – Statkraft, Statoil and others - are helping make the conference possible, and will also ensure interesting content and technical tours.

So mark your calendars now with the dates of June 19-22, 2016.

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

CONFERENCE OVERVIEW

Massive transformations in how and where energy is produced and consumed are drastically changing our energy economy. This dynamic energy landscape is challenging government and industry decision makers to formulate a clear path forward. Policy and investment decisions need to balance the use of natural resources with impacts on the environment and local economies. One answer is to stimulate innovative technologies to enable access to increasing supplies of energy as well as more efficient consumption. But doing this requires appropriate policies, incentives and mandates, something that challenges even the most well informed policy makers.

The conference will bring together business, government, academic and other professionals to explore these themes through a series of plenary, concurrent, and poster sessions. Speakers will address current issues and offer ideas for improved technical, commercial, and policies covering all facets of energy development and use. The conference also will provide networking opportunities for participants through informal receptions, breaks between sessions, public outreach, and student recruitment. There also will be offsite tours to provide a direct and close-up perspective on the region's dynamic energy landscape.

The 2015 conference will be held in Pittsburgh, Pennsylvania, one of the main centers of American energy. The region around Pittsburgh contains a rich history of energy, with the discovery of the Coal Hill seam in 1762, the commercialization of the Drake Oil Well in 1859, and the formation of Westinghouse Electric Company in 1886. Today, the Pittsburgh area is a U.S. leader in energy development. The region is ranked 25th for the number of employees in energy-related industries. Among other things, it is the center of one of the most active natural gas plays in North America, the Marcellus Shale, and is the locus of the first U.S. nuclear power plants being built in over 30 years. Over the past three decades, Pittsburgh has had a remarkable environmental evolution and has been repeatedly named one of America's most livable cities. The Pittsburgh region is fortunate to support a diverse mix of energy activities including nuclear, coal, natural gas, and renewables. The region is home to a host of energy businesses, research facilities, industry groups, and world-class colleges and universities, many of which have active energy centered policy and academic programs. Finally, more than $1 billion per year in government-funded research flows through the region's academic, corporate and government energy research centers, assuring that new ideas and new technologies constantly emerge.

TOPICS TO BE ADDRESSED INCLUDE:

The general topics below are indicative of the types of subject matter to be considered at the conference. A more detailed listing of topics and subtopics can be found at: www.usaee.org/usaee2015/topics.html

- Energy Demand and Economic Growth
- Energy Supply and Economic Growth
- Financial and Energy Markets
- Energy and the Environment
- Non-fossil Fuel Energy: Renewables & Nuclear
- International Energy Markets
- Energy Efficiency and Storage
- Energy Research and Development
- Political Economy
- Public Understanding of and Attitudes towards Energy
- Other topics of interest include new oil and gas projects, transportation fuels and vehicles, generation, transmission and distribution issues in electricity markets, etc.

HOSTED BY

THREE RIVERS CHAPTER, USAEE

33RD USAEE/IAEE NORTH AMERICAN CONFERENCE CALL FOR ABSTRACTS

We are pleased to announce the Call for Abstracts for the 33rd USAEE/IAEE North American Conference, *The Dynamic Energy Landscape*, to be held October 25-28, 2015, at the Wyndham Grand Hotel, Pittsburgh, PA, USA.

The deadline for receipt of abstracts for both the Concurrent Sessions and the Student Poster Session is Thursday, **May 21, 2015**.

CONCURRENT SESSIONS

There are two categories of concurrent sessions: 1) Academic research on energy economics, and 2) practical case studies involving applied energy economics or commentary on current energy-related issues. This latter category aims to encourage participation not only from industry but also from the financial, analyst and media/commentator communities. In either instance, papers should be based on completed or near-completed work that has not been previously presented at or published by USAEE/IAEE or elsewhere. Presentations are intended to facilitate the sharing of both academic and professional experiences and lessons learned. It is unacceptable for a presentation to overtly advertise or promote proprietary products and/or services. Those who wish to distribute promotional literature and/or have exhibit space at the Conference are cordially invited to take advantage of sponsorship opportunities www.usaee.org/usaee2015/sponsors.html.

Concurrent Session Abstract Format

Authors wishing to make concurrent session presentations must submit an abstract that briefly describes the research or case study to be presented.

The abstract must be no more than two pages in length and must include the following sections:

a. Overview of the topic including its background and potential significance

b. Methodology: how the matter was addressed, what techniques were used

c. Results: Key and ancillary findings

d. Conclusions: Lessons learned, implications, next steps

e. References (if any)

Please visit www.usaee.org/USAEE2015/PaperAbstractTemplate.doc to download an abstract template. All abstracts must conform to the format structure outlined in the template. Abstracts must be submitted online by visiting www.usaee.org/USAEE2015/submissions.aspx. Abstracts submitted by e-mail or in hard copy will not be processed.

Student Poster Session

The Student Poster Session is designed to enable students to present their current research or case studies directly to interested conference delegates in a specially designed open networking environment. Abstracts for the poster session must be submitted by the regular abstract deadline and must be relevant to the conference theme. The abstract format for the Poster Session is identical to that for papers; please visit www.usaee.org/USAEE2015/PaperAbstractTemplate.doc to download an abstract template. Such an abstract should clearly indicate that it is intended for the Student Poster Session – alternatively that the author has no preference between a poster or regular concurrent session presentation. Abstracts must be submitted online by visiting www.usaee.org/USAEE2015/submissions.aspx. Abstracts submitted by e-mail or in hard copy will not be processed. Poster presenters whose abstracts are accepted should submit a final version of the poster electronically (in pdf format) by August 21, 2015, for publication in the online conference proceedings. Posters for actual presentation at the conference must be brought directly to the conference venue on the day of presentation and must be in either ANSI E size (34in. x 44in.) or ISO A0 size (841mm x 1189mm) in portrait or landscape format.

Presenter Attendance at the Conference

At least one author of an accepted paper or poster must pay the registration fees and attend the conference to present the paper or poster. The corresponding author submitting the abstract must provide complete contact details—mailing address, phone, fax, e-mail, etc. Authors will be notified by July 7, 2015, of the status of their presentation or poster. Authors whose abstracts are accepted will have until August 21, 2015, to submit their final papers or posters for publication in the online 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 author may present only one paper or one poster in the conference. No author should submit more than one abstract as its single author. If multiple submissions are accepted, then a different author will be required to pay the registration fee and present each paper or poster. Otherwise, authors will be contacted and asked to drop one or more paper(s) or poster(s) for presentation.

STUDENTS

In addition to the above opportunities, students may submit a paper for consideration in the Dennis J. O'Brien USAEE/IAEE Best 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 June 23, 2015. Visit www.usaee.org/usaee2015/bestpapers.html for full details.

Students are especially encouraged to participate in the Student Poster Session. Posters and their presentations will be judged by an academic panel and a single cash prize of $1,000 will be awarded to the student with the best poster and presentation. For more details including the judging criteria visit www.usaee.org/usaee2015/postersession.html

Students may also inquire about scholarships covering conference registration fees. Please visit www.usaee.org/usaee2015/scholarships.html for full details.

HOSTED BY

THREE RIVERS CHAPTER, USAEE

WITH SUPPORT FROM:

USAEE United States Association for Energy Economics

IAEE International Association for Energy Economics
WWW.IAEE.ORG

CAEE

AMEE

The Marginal Energy Return On (Energy) Investment (MEROI)

By Douglas B. Reynolds*

Many physicists look at the specific concept of the energy return on (energy) investment (EROI), or more generally energy return ratios (ERR), as a way to help explain a relationship between economic growth and energy in the tradition of Meadows et. al (1972, 2004) or Forrester (1958, 1961). See Cleveland et. al (1984), Hall et. al (1986), Hall (2008), and Bardi (2011). Although as Brandt et. al (2013) say:

> Energy return ratios (ERR) are often easy to describe, but generally challenging to operationalize in a rigorous and specific manner. Thus ERRs are often defined loosely.

Of course such problems have not stopped economists before from making assumptions around science or engineering, so why should it stop us now. After all, how many economists reading this have actually gone out to a local factory and measured, not estimated, what the marginal cost is? Nevertheless economists are suspicious of the ERR concepts, just like many physicists are, and suggest that the more appropriate concept for analyzing energy is energy costs, including marginal costs and marginal benefits of energy, and not ERR or EROI. See Gordon (2009) and Adelman (1995). There may be, though, a compromise concept that can help bridge the gap between economists and physicists on the energy/economy relationship similar to Hall and Klitgaard (2012) and Kümmel (2011).

Consider first that one of the most important energy resources in the economy is oil for a number of reasons as Reynolds (1994), and Hamilton (1983) explain. So instead of trying to define energy in general, it may be helpful to simply look at oil in particular as its own energy resource market. Even if the economy can use oil substitutes that use many different energy resources such as electricity, nevertheless, most of the substitutes for oil include a liquid energy resource and not a general energy substitute. Therefore, in this article, as far as the energy product is concerned, we look at oil or a liquid oil substitute specifically, called here "oil" for simplicity, and not at energy supplies in general.

The Supply of Oil

When it comes to finding, extracting and transforming oil, or liquid oil alternatives, then the more oil that the market is able to supply, the higher is the pecuniary cost per barrel of oil for each additional barrel, i.e., the marginal cost rises, as conventional microeconomic supply theory suggests. The costs would include the capital and labor costs used in more elaborate replacements for oil, such as producing corn ethanol. However, in an alternative but parallel manner, we can think about all the energy that goes into finding and extracting conventional and unconventional oil when looking at the EROI concept: the more oil that the market is able to supply, the higher is the energy cost per barrel of oil for each additional barrel.

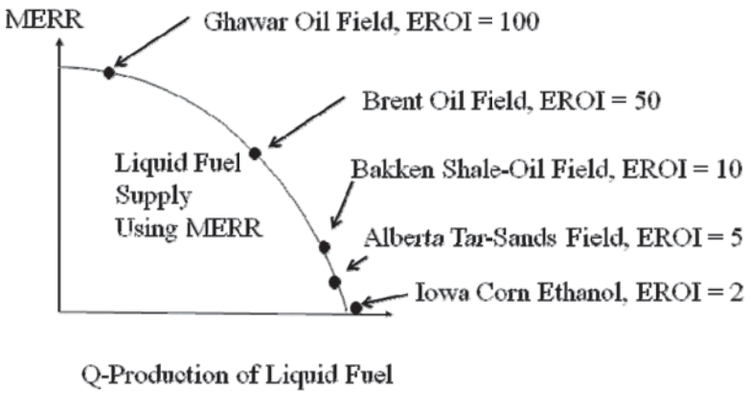


Figure 1. The aggregated MERR of supplying oil or liquid oil substitutes.
As more oil is supplied, the market provides increasingly lower EROI oil or oil alternatives.

Consider, not all energy costs of producing oil are the same for various oil fields and oil resources, and, therefore, not all oil and oil substitute EROI's are the same. Clearly, Saudi Arabian light crude-oil takes less energy to extract, refine and get to market than does Alberta's tar-sand bitumen (oil). Therefore, there are many different EROI's for different oils. Indeed, we can create a sort of hierarchy of EROIs for each oil resource starting with high EROI oils and gradually going to low EROI oil substitutes. This hierarchy is a sort of supply curve, in the traditional economic sense, only instead of a cost-oriented supply curve, it is an EROI-oriented supply curve as shown in Figure 1. Furthermore, each specific oil resource has its own marginal EROI (MEROI) energy cost for that particular oil, called here the marginal energy return ratio (MERR). In general the market supplies high MERR oil first and low MERR oil later creating a sort of aggregated MERR supply curve. Instead of a supply curve made up of aggregated marginal costs, which increase as more oil is produced, it is a supply curve

* Douglas Reynolds is Professor of Economics at the University of Alaska-Fairbanks. He may be reached at dbreynolds@alaska.edu

made up of aggregated marginal EROIs, which decrease as more oil is produced.

However, we cannot only look at extraction alone, as there is also the cost and MERR of exploration too. It takes energy to look for new oil fields, and if the probability of finding a new field is say 10%, than on average you need to drill ten exploration wells, or conduct ten seismic surveys, to find that one field. All that exploration takes energy and the more energy it takes to find the marginal field, the lower the MERR is.

Going back to the original quote on ERR, which says that ERRs and EROIs are loosely defined, it is clear that there is not a one-to-one relationship between economic marginal costs and MERRs. That means that Figure 1 cannot be mapped into a true economic supply curve, nor can Figure 1 accurately map out what the true cost of supplying oil is. Some high energy-intensive, oil-producing processes actually produce cheap oil, while some low energy-intensive, oil-producing processes produce expensive oil. Nevertheless, Figure 1 does explain to the average physicist looking at ERRs how markets tend to operate. Figure 1 is a proximate supply curve.

The Demand for Oil

On the demand side, the economy prefers to buy low cost oil over high cost oil, and in general will buy more oil the lower is the price. Therefore, the demand for oil is not tied to an average price of oil, rather the demand for oil explains how the economy prefers different quantities of oil at different prices. If we aggregate the marginal benefits of each additional barrel of oil used, we create a demand curve for oil, which is a hierarchy of economic values of (needs for) oil. In a similar manner, we can create a hierarchy of the marginal beneficial uses of low or high EROI oil. Since the EROI implies a certain value, then we can conclude that high value oil uses can occur even if only low MERR oil is available, but low value oil uses can only occur if high MERR oil is available. Therefore, we can likewise create a hierarchy of the demand for oil based on the MERR. The lower the MERR, the less the economy will demand oil or oil substitutes. The higher the MERR, the more the economy will demand oil or oil substitutes. The MERR demand curve for consumers looks like a normal demand curve except that the MERR demand curves starts at a low MEORI and gradually increases. This is shown in Figure 2.

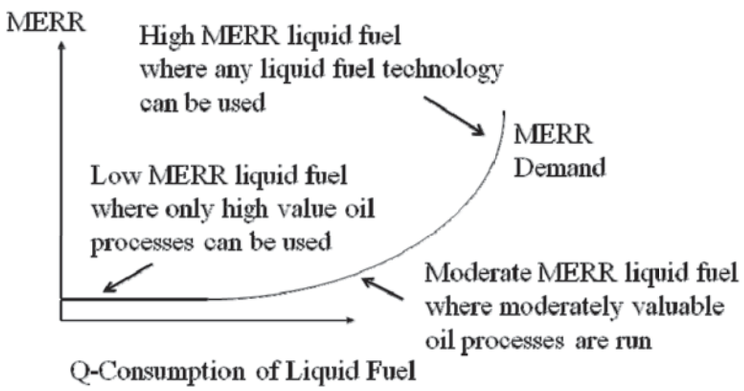


Figure 2. The MERR of oil that the economy demands. The higher the MERR available, the more oil that an economy will want to use, all other factors staying the same.

Once again, Figure 2 is only a proximate demand curve as there is not a one-to-one correspondence between the aggregated MERR curve and the marginal benefit curve (pecuniary demand). It is possible to have situations where certain high MERR oil gives a high marginal benefit, or vise-versa. Nevertheless, Figure 2 does show how the economy might roughly organize its demand for various oil resources along the lines of MERR.

The Market Clearing MERR for Oil

If we put supply and demand together, we get a kind of MERR market. The MERR cost of oil will just meet the MERR benefit of oil at the market clearing MERR. See Figure 3. However, the market clearing MERR is only proximate as both the MERR demand and MERR supply are only proximate values in comparison to actual marginal costs and marginal values. Nevertheless, Figure 3 gives a good picture of how the physical economy works.

When we look at the MERR market, most high, pecuniary, marginal-value consumers will be able to consume low MERR oil, but most low, pecuniary, marginal-value consumers will not be able to consumer low MERR oil. Alternatively, high MERR oil producers will be able to sell their oil for a low MERR price on the market and keep the rent. Low MERR producers may not be able to sell their oil at a low MERR price. This creates a MERR oil-producer energy-surplus, and a MERR oil-consumer energy-surplus.

For example, if I own the East Texas oil field, and it can still produce oil at an average EROI of 20, (20 Btus produced for every 1 Btu used in production, refining and distribution) but the economy is buying and selling oil at the marginal tar-sands MEORI of say 5, then I get all the energy rent from the East Texas oil field. I will use that energy rent to build a big house, go on vacations and drive a big car

all of which I receive from simply owning the field and without having to do any additional work. These splurges will in turn require energy use. The economy then, when they buy my East Texas oil, is forced to pay me for all that extra energy I use up on these luxury endeavors. The net effect is that society still pays a high energy price for low EROI liquid fuel based on the equilibrium MERR. It is as if the high MERR fuel were a low MERR fuel. The rent receiving energy producer, with high MERR fuel, spends much of his revenue on luxuries while non-rent receiving energy producers with low EROI tar-sands spend their revenue on necessary labor, capital and energy input costs. The net cost effect of obtaining energy is the same to the economy whether the cost of energy is to build luxury swimming pools for the rent receiving oil producers or build mining machinery for the non-rent receiving oil-alternative producers. Either way, there is less general goods and services for energy consumers.

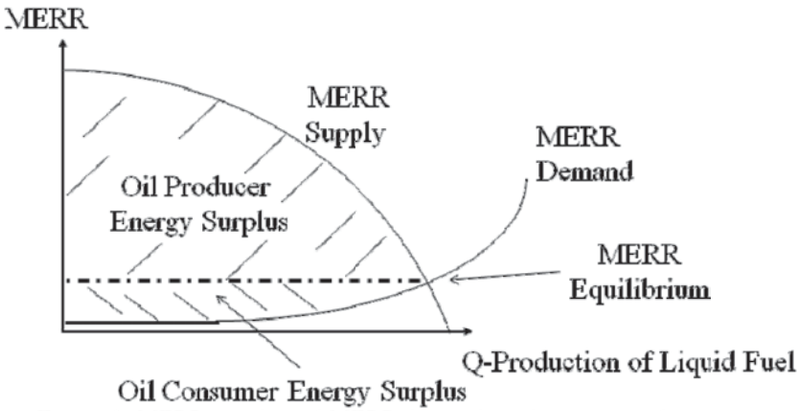


Figure 3. MERR supply and MERR demand on the same market.

It will be the case that because the energy owner spends his rent by splurging on all these goods and services from the general economy that that producer rent adds value to the economy. Nevertheless, the rent is unearned from any extra work or capital inputs or risk taking, and so society has to provide much goods and services to the producer for no additional productivity to the economy. For those who believe that allowing all that rent to the producer is fair or unfair, read Friedman and Friedman (1980) or Mander (2012). Nevertheless, no matter who gets the rent, the economy will then reduce its demand and production for normal goods and services as the equilibrium MERR goes down. Granted, having more EROI rent is better than having less EROI rent, all other factors the same, however, the market clearing MERR still represents a constraint on economic performance. Also over time, the MERR of the high EROI energy producer tends to decline due to exhaustion of any given field, and the MERR and the quantity of liquid fuels produced in the entire economy can decline due to scarcity of high MEROI oil sources.

Note, that the oil-producer and oil-consumer energy-surpluses on the MERR market do not correspond exactly to social/economic pecuniary value. That is, the energy-surpluses do not have a one-to-one correspondence between the area represented by the surpluses and the pecuniary value of energy. In general, the marginal value of each incremental increase in MERR is increasingly smaller. For example, the difference in value to society, or alternatively the difference in costs of production, of an energy source with a MERR of 50 as compared to an energy source with a MERR of 100 is small. However, the cost change and value change of going from a MERR of 5 to a MERR of 10 is large. Therefore, the area of oil producer and consumer energy-surplus as shown in Figure 3 is only a representation of a cardinal value not an ordinal value, i.e., greater area only infers a greater rank in value not an exact value increase.

The bottom line is the average MERR for oil production is not important. What is important is that the market clearing MERR, or a close approximation, is the MERR that determines the general market value and cost of oil. Therefore, anyone who wants to look at oil alternatives has to look at the MERR of that alternative in comparison to the market clearing MERR, such as for example in Pimentel and Patzek (2005). If an alternative has a MERR of less than three (3), then, as Hall, et. al (2009) suggest, it is not a viable alternative.

References

Adelman, Morris A. (1995). The Genie Out of the Bottle: World Oil since 1970, Cambridge, Mass, MIT Press.

Bardi, Ugo (2011), The limits to growth revisited, Energy series: springerbriefs in energy analysis. Springer.

Brandt, Adam R., Michael Dale, and Charles J. Barnhart, (2013). "Calculating systems-scale energy efficiency and net energy returns: A bottom-up matrix-based approach," Energy, number 62, pp. 235-247.

Cleveland, Cutler J., Robert Costanza, Charles AS Hall, Robert Kaufmann (1984). "Energy and the US economy: a biophysical perspective," Science, New Series, Vol. 225, No. 4665 (Aug. 31, 1984), pp. 890-897.

Forrester, Jay W. (1958). "Industrial dynamics: A major breakthrough for decision makers," Harvard Business Review. 36 (4), July/August, 37-66.

_____. (1961). Industrial Dynamics. Pagusus Commiunications, Waltham MA, 258 pp.

Friedman, Milton and Rose Friedman, (1980) Free to Choose: a personal statement, Harcourt.

Gordon, Richard (2009). "Hicks, Hayek, Hotelling, Hubbert, and Hysteria or Energy, Exhaustion, Environmentalism, and Etatism in the 21st Century," The Energy Journal, Volume 30, number 2, pp. 1 – 16.

Hall, Charles A.S., (2008). EROI on the Web, Part 1–6, The oil Drum.com, 1) Why EROI matters, http://www.theoildrum.com/node/3786, 2) Natural gas and imported oil, http://www.theoildrum.com/node/3810 3) Tar sands and oil sands, http:// www.theoildrum.com/node/3839 4) Nuclear power, http://www.theoildrum.com/ node/3877 5) Passive solar, photovoltaic, wind and hydroelectricity, http:// www.theoildrum.com/node/3910 6) Wind, geothermal, http://www.theoildrum. com/node/3949.

Hall, Charles A. S., Klitgaard, Kent A. (2012). Energy and the Wealth of Nations: Understanding the Biophysical Economy, 1st Edition., 2012, XIV, 407 p. Springer Energy Series.

Hall, Charles A. S., Stephen Balogh and David J. R. Murphy, (2009). "What is the Minimum EROI that a Sustainable Society Must Have?," Energies, volume 2, pp. 25-47;

Hall, Charles A.S., Cleveland, Cutler J., Kaufmann, Robert, (1986). Energy and Resource Quality: The Ecology of the Economic Process, Reprint edition. University Press of Colorado. (February 1992).

Hamilton, James D. (1983). "Oil and the Macroeconomy since World War II., The Journal of Political Economy, Vol. 91, No. 2 (Apr), pp. 228-248.

Kümmel, Reiner, (2011). The Second Law of Economics: Energy, Entropy, and the Origins of Wealth, Series: The Frontiers Collection. Springer Press.

Mander, Jerry (2012). The Capitalism Papers: Fatal Flaws of an Obsolete System, Counterpoint.

Meadows, Donella H., Dennis L. Meadows, Jorgan Randers, W.W. Behrens (1972). The Limits to Growth, Universe Books, New York.

Meadows Donella, Randers J, Dennis L. Meadows (2004). Limits to Growth: The 30-Year Update, Chelsea Green; 3rd edition, New York.

Pimentel, D. & T.W. Patzek. (2005). "Ethanol production using corn, switchgrass, and wood; biodiesel production using soybean and sunflower." Natural Resource Research, Volume 14 pp. 65–76.

Reynolds, Douglas B. (1994) "Energy Grades and Economic Growth," Journal of Energy and Development, Volume 19, Number 2, Spring 1994, pp. 245 – 264.

IAEE Welcomes New Institutional Member: The Inter-American Development Bank

The Inter-American Development Bank (IDB) initiative, The Energy Visualization Database, provides an entirely new way of understanding energy. Created by IDB's Energy Innovation Center, it shines a new light on the energy sector in the Americas. By conveying complex information in visually compelling ways, it helps scholars as well as policy-makers, and citizens develop a better understanding of the most important energy issues facing the region today.

This goes to the heart of open government and transparency—a core commitment of the IDB. The IDB's Energy Innovation Center created the Energy Visualization Database as a tool that is practical, flexible, and easy to use. Built on Linked Open Data, it allows search engines to connect information in new and useful ways.

The database contains energy information, by fuel source and sector, on the IDB's 26 borrowing countries plus Cuba. For comparison purposes, it also includes other major producing or consuming countries and regions. It identifies the leading industry players and institutions in each country and puts energy sector legal framework documents at your fingertips.

The Energy Visualization Database consolidates information sourced from the International Energy Agency and other institutions, as well as data gathered by IDB staff. It presents the information in accessible ways that make it possible to view the energy sector from different perspectives and quickly zero in on key challenges, pitfalls, and opportunities.

Energy in 2013 – Taking Stock: Highlights from the 2014 BP Statistical Review of World Energy

By Christof Rühl and Alexander Naumov*

Introduction

Today, the energy world looks rather different than it did ten years ago; much of what we took for granted has changed. The dominant role of the developing world in energy growth, oil prices above $100 and a wide gap between regional gas prices, the emergence at scale of renewables and uncoverntional oil and gas – many would have found all of this hard to believe ten years ago.

Yet, nowdays we think of these trends as normal. If we loosely group together fuels that classify as "new", simply by virtue of having not been of any materiality a decade ago, including renewables, then these accounted for 81% of global primary energy production growth last year.

The global energy system is huge and moves only slowly, but it does move. It is the purpose of this paper to review the latest global energy developments and to document changes in global energy markets based on the 2014 edition of BP Statistical Review of World Energy. The best place to start is by investigating the relationship between energy and the economy.

Energy and the economy

Global economic growth has been softening since 2010, the year of big economic stimuli. Last year it was 3%, a little weaker than 2012, and considerably below its ten year average (3.7% p.a.), which now includes the years of boom and bust before and after the economic crisis. Economic performance softened in the OECD and non-OECD alike, but the economic "growth gap" between them has narrowed since the crisis.

The relationship between economic and energy growth was quite similar in the OECD and non-OECD the ten years before the crisis. After the crisis, and presumably related to large, energy intensive fiscal stimuli in the developing world, energy intensity improved faster in the OECD.

2013 broke this pattern. Global primary energy consumption accelerated from 1.8% to 2.3%, just a tick below the ten year average (2.5% p.a.) and despite slackening economic growth. For the two subgroups, however, fortunes diverged.

OECD energy demand rose by 1.2%, offsetting an equal decline the previous year, despite slowing and lacklustre economic performance – almost on a par with GDP growth (1.3%) and well above the 10-year average. Non-OECD energy consumption, in contrast, grew by only 3.1%, the slowest rate for 13 years, except for the crisis year 2009 – and substantially below GDP growth (4.8%).

The contrasting experiences of the OECD and non-OECD reflect the differing fortunes of the world's largest energy consumers, China and the U.S. Together, they accounted for more than 70% of world energy consumption growth.

In 2013 Chinese energy growth slipped from 7.0% to 4.7%, and thus well below its ten year trend (8.6% p.a.) – although China reported unchanged economic growth of 7.7%. The slowdown in Chinese growth was concentrated in coal but is visible in oil as well. Meanwhile, U.S. primary energy consumption grew by 2.9%, rebounding from a 2.8% decline in 2012. Much of this is due to weather effects; but beyond the weather, there are signs of underlying strength in U.S. industrial sector energy use, in particular of oil products.

The diverging performance of China and the U.S. caused the "gap" between non-OECD and OECD energy consumption growth to narrow sharply. It became the smallest since 2000.

We tend to think of energy demand as the consequence of economic growth. In reality, where data measurement is less than perfect, energy data often allows for conclusions about real economic activity. In the present context, it is easy to see how abundant domestic resources in the U.S. would eventually give a boost to the economy, not just to energy demand. It is much harder to see how the fundamental restructuring underway in China could leave an imprint only on energy demand without, eventually, affecting economic performance as well.

To trace these developments in more detail it is best to look at them fuel by fuel.

Fuel by fuel

Oil

Oil prices over the last three years have been high but remarkably stable. In 2013, they dipped slightly, with Dated Brent averaging almost $109 ($108.66),

* Christof Rühl is Chief Economist and Vice President at BP plc.; Alexander Naumov is a Macro Economist with the firm. The Statistical Review data and a more detailed analysis can be found at www.bp.com/statisticalreview

See footnote at end of text.

$3 below the average of 2011 and 2012. This has been the third consecutive year of prices above $100, a first in both real and nominal terms; and it has been the three year period with the lowest price volatility since 1970[1].

The stability in oil prices betrays significant changes in the underlying balance between consumption and production and yet another year of record supply disruptions. To understand why prices remained so stable one needs to delve into the detail.

Global oil consumption last year rose by 1.4 Mb/d, or 1.4%, higher than both 2012 and the ten year average. As has become the norm, growth was driven by the emerging economies of the non-OECD, which for the first time accounted for the majority of global consumption.

OECD demand remained stagnant. The U.S. stood out as its consumption grew by 400 Kb/d, against an average annual decline of 110 Kb/d over the last ten years. This was the fastest growth of any country last year – and (in volume terms) outpacing China for the first time since 1999. The rise was focused in the industrial sector, including refining and petrochemicals, which contributed almost 80% of net growth. In contrast, consumption in the rest of the OECD fell by a larger than average 380 Kb/d, led by a 160 Kb/d decline in Japan, where oil was backed out of power generation by renewables, coal and improved efficiency.

Non-OECD consumption rose by 1.4 Mb/d or 3.1%, well below the ten year average (3.9% p.a.). This weakness was especially pronounced in China, where demand grew by only 390 Kb/d – the lowest since the recession in 2009 and in India, where growth fell to its lowest level since 2001 (40 Kb/d) as subsidies were reduced.

Turning to production, global output rose slightly in 2013 (560 Kb/d), due to the largest increase in non-OPEC countries (1.2 Mb/d) since 2002. The main contributor to this growth was the US, but supplies also grew in Canada and Russia – together more than offsetting continued declines in mature areas such as Mexico and the North Sea.

U.S. oil production exceeded 10 Mb/d in 2013, reaching the highest level since 1986. Driven by tight oil plays, U.S. production rose by over 1.1 Mb/d in 2013 – the second consecutive year of above 1 Mb/d of supply growth, and the second consecutive "biggest increase in U.S. history". Indeed, only Saudi Arabia has ever had a bigger increase than the U.S. in 2013 – nine times in total, to be precise; but in six of those nine times the increment resulted from the ability to tap existing spare production capacity. In terms of "organic" growth, based on capacity expansion, last year's U.S. increase, therefore, was the fourth biggest in history.

Meanwhile, OPEC production contracted by 600 Kb/d. In addition to unplanned disruptions (which we discuss below), Saudi Arabia cut output by 110 Kb/d after producing at record levels in 2012. The declines were only partly offset by an increase in the UAE (250 Kb/d), which set a new record for itself.

As in recent years, supply disruptions were large and concentrated in North Africa and the Middle East. Cumulative disruptions since the advent of the "Arab Spring" in Libya, Iran, Syria, Yemen and the two Sudans have reached an extraordinary 3 Mb/d.

We are now in a better position to return to the question of why oil prices were so stable the last three years, despite the violent shifts we observed in production.

For the biggest part the answer has to be that the supply disruptions in Africa and the Middle East were matched almost exactly by the shale-based production increases in the U,S. It is a fair conclusion that oil markets would look very different today, had we only witnessed supply disruptions on the scale that actually happened. And vice versa, oil markets would look very different today had we only witnessed the shale "revolution" in the U,S. Importantly, the match is sheer coincidence. Higher prices may induce more shale production eventually. But virtually nothing else of logic or substance connects the two developments. And so markets remain on edge – or eerily calm – until one side will gain the upper hand.

This current stand-off was also reflected in the relationship between prices and the level of OECD commercial inventories. Since the advent of significant supply disruptions in early 2011, the shape of the forward curve indicates that market participants are willing to pay a risk premium relative to future prices for holding physical inventories – a clear indication of an increased desire for precautionary inventory holdings.

Refining

Global refining has been struggling for years, squeezed between excess capacity and slower throughput growth. Regional disparities are adding to the woes of the sector, with more capacity being added East of Suez and U,S, throughputs rising as a result of rising tight oil production: since crude exports

from the US are legally constrained, U.S. refineries are processing the discounted domestic crude at home and exporting products instead.

Global refining capacity grew by 1.4 million b/d last year, the highest net capacity addition since 2009. Capacity growth was led by China (660 Kb/d) with the Middle East not far behind. Global crude runs, in contrast, grew by only 0.4 million b/d and as a result, global spare capacity is now almost 7 Mb/d more than it was in 2005, the low point in our data series. Despite this dismal background, global refining margins were strong during the first half of 2013 due to a combination of cold northern hemisphere weather and refinery outages.

The U.S. added new crude pipeline capacity, which has made it possible to move more crude to the Gulf Coast, but export constraints mean that the price discounts have spread to a wider range of crudes. As a consequence, U.S. refiners exported record volumes of distillate last year (1.1 Mb/d) rather than replenish domestic stocks. Its reduced dependence on long-haul crude imports may well have facilitated a longer term drop in working product inventory. Conversely, European crude runs in 2013 fell (-550 Kb/d), to their lowest annual level since 1985. European demand is contracting and – different from Asia – today's problems can only be fixed by reducing capacity.

Natural Gas

Natural gas markets are slowly transforming themselves, on the back of two developments: the shale gas "revolution" in the U.S. and the increasing integration of hitherto segmented regional markets, brought about by the rapid expansion of liquefied natural gas (LNG). In 2013, these forces took a breather - U.S. shale gas production growth slowed, and LNG expansion remained very modest.

Globally, growth of consumption (1.4%), production (1.1%) and trade (1.8%) all slowed. Regional price differentials narrowed. As in all other fossil fuels, the slowdown in demand growth was more pronounced in the developing world: natural gas was the only fuel where OECD consumption growth outpaced non-OECD growth. Like oil, tracing OECD growth leads to the U.S.; but unlike oil, China was not the reason for weak growth in the non-OECD.

To disentangle what happened, we start with the latest chapter of the evolving U.S. shale story. U.S. gas prices hit a 13 year low in 2012, and started rebounding in the wake of a cold winter early in 2013. For the year Henry Hub prices were up 34.5% on average, almost offsetting the 2012 decline. However, because of the persistently high oil-gas price differential, this was not enough to accelerate production growth (1.3% in 2013). It remained more attractive to "chase liquids", i.e., to continue to divert drilling rigs from shale gas to tight oil production. Almost all the growth in gas production last year came from associated and wet shale gas; dry shale gas was down.

U.S. total natural gas consumption grew by 2.4% driven by residential heating demand. However, higher prices meant that for the first time since 2008, gas lost market share in U.S. power generation to coal, falling back almost 3 percentage points (30.3% to 27.4%) – the biggest such loss since 1973.

Turning to LNG, currently global supply growth is in the middle of a multi-year lull, with very limited capacity expansion. LNG projects are large and investments can be lumpy. In 2013, supplies expanded by merely 0.6%. This is keeping markets tight, allocating flexible cargoes to those willing and able to pay high prices. Asia, where 81% of all natural gas imports are met by LNG, remained the prime destination, with almost 75% of all cargoes headed that way.

Japan remained the world's largest LNG importer, with post-Fukushima demand for LNG persisting at record levels – but its gas fired power plants are now operating at full capacity, and so Japanese imports have stopped growing. Instead, South Korea assumed the mantle of recording the world's largest import growth, and again triggered by nuclear outages.

Meanwhile in China, big strides were made toward the stated political goal of increasing the share of natural gas in the energy mix (currently 5.1%). At 10.8%, China logged the biggest increase in gas consumption in the world last year (15.3 Bcm). And although domestic production listed the second largest global increment (9.5%, 9.9 Bcm), this still left a large gap for import growth.

The flip-side of higher demand growth and limited LNG availability is that it puts the spot-light on problems with domestic production. India is the prime example: caps on producer prices have stalled investment and last year led to the world's largest decline in gas production (-6.7 Bcm or -16.3%). Lack of cheaper priced domestic gas and the huge price advantage of coal over LNG imports has caused large scale substitution of gas with coal, assigning to India also the world's largest decline in gas consumption (-7.3 Bcm or -12.2%). Ironically, almost a third of the coal was imported.

Europe took a rain check on the competition for LNG, helped out by Russia. EU production appears in terminal decline and consumption reached the lowest level since 1999. In 2013 consumption fell by

1.1% and production by 0.5%; imports declined slightly as well.

As was the case for global oil markets, EU imports were affected by the social unrest plaguing Africa. Falling exports from North Africa (-18.7%), Nigeria (-43.9%), and also Norway (-5.2%) meant a need for alternative deliveries. In the event, Russia stepped into the void, eliminating the need to compete for expensive LNG. The net result was a big shift in the composition of imports, with imports from Russia rising by 19.5% – a marked reversal of 2012, when Russia had lost 12% of the EU gas market to Norway after Norway had adjusted its prices close to spot price levels while Gazprom maintained oil price indexation. In 2013 the rapid increase of European spot prices eroded much of the previous differential, but Gazprom, by its own accounts, also offered discounts and rebates to sell gas on more competitive terms.

How do these differing regional stories affect the evolution of global gas trade? Trade has grown at more than twice the rate of global consumption for at least two decades, with LNG expanding even faster. Since 2011, this relationship has started to de-couple, with trade growing slower than consumption and LNG losing market share. In 2013, gas trade expanded by only 1.8%, slightly above consumption growth but considerably below the long term average of 5.2% p.a., with pipeline trade again expanding faster (2.3%) than LNG (0.6%). However, the temporary lull in LNG supply growth can not obscure the long term direction of travel – towards a more inter-connected gas world.

Coal

Coal rounds out the fossil fuel picture. In developing economies, this fuel of industrialization often is a reasonable indicator of economic health; in the OECD, coal markets are characterized more by competition with other fuels in power generation, driven by politics as much as by prices. 2013 was no exception.

Overall, coal markets slowed. Consumption growth of 3.0% remained below its long term average; production growth (0.8%) was the weakest since 2002; prices fell in all regions on de-stocking and low demand while regional price differentials narrowed with intensifying competition between suppliers.

The big story in coal markets is China, where coal accounts for 67% of the national energy mix. Coal consumption rose by 4% in 2013, less than half the ten year average (8.3% p.a.). New policies to conquer local pollution by shutting down coal-intensive production and encouraging coal substitution may have played a part, but they started only late in the year and their scale is limited by the restricted availability of natural gas. In China, the share of the service sector in GDP exceeded that of the industrial sector for the first time last year and so moderating industrial production growth was one contributing factor. Still, it remains hard to reconcile the coal slowdown with the official, steady, GDP growth.

Elsewhere we find the data corresponding to the fuel switching described in the gas section. In India, rapidly declining domestic gas production and the price advantage of coal over LNG imports caused coal consumption to rise by 7.6%, the second largest volumetric increase on record. In the OECD, U.S. consumption rebounded (4.6%) on higher natural gas prices whereas in the EU's shrinking energy market, coal contracted (-2.5%) faster than gas, losing market share also to renewables.

Non fossil fuels

2013 was a big year for non-fossil fuels: growth was above average and they increased their share of global power generation to almost one third (32.5%), crowding out fossil generation in the EU and the U.S. along the way. Many will not be aware that the share of non-fossil fuels in total power generation was on a declining trend through the 1990s and the early 2000s, as renewables were too small to make a difference and the growth of hydro and nuclear failed to keep up with total power generation. Only over the past decade have faster hydro growth and the scaling up of renewables halted the decline.

Nuclear made the smallest contribution (0.9%, 15 TWh), simply by ending two years of decline. Post-Fukushima safety reviews were scaled down and fewer reactors were out of operation. Global hydro growth slipped to 2.9%, down from 4.5% in 2012, largely because of slowing capacity additions in China and – how could it be otherwise – global precipitation patterns: Brazil experienced severe drought conditions for the second consecutive year (-7.0%) while Europe and Eurasia saw a second year of generation increase (5.5%).

Renewable power was the largest contributor to non-fossil growth in 2013 and made a larger contribution to primary energy growth than natural gas. However, at 16.3% this was the slowest growth rate since 2009 while growth in volume terms (170 TWh) recorded an all-time high.

Renewables grew in all regions, and in almost all countries. The EU as a bloc is still ahead of the U.S. and China, in annual increment and in the share of renewables in power generation. The EU now receives 15.0% of its power from renewable sources. At the same time, however, the growth rate in the EU

has slowed more than in other regions, from 20.6% in 2011, to 18.0% in 2012 and 13.5% last year, leaving even the 2013 volume increment smaller than the 2011 and 2012 increments. It is no accident that this slowdown affects most the very region where penetration rates, and, therefore, subsidies, are highest.

The coincidence of slower growth rates with high volumetric contribution points at the underlying dilemma. Renewables are still subsidized. Sizeable annual increments reflect the scale renewables have already reached, while the slowdown of their growth indicates the weakening of financial support as they scale up and the burden of rising subsidies on society increases.

The fuel mix and carbon emissions

An easy way of weaving the annual fuel by fuel changes into a coherent pattern is to look at how they affect the global fuel mix. With the exception of gas, which saw its market share dip to 23.7%, the shares of each fuel pushed into unfamiliar territory in 2013. Oil's share declined to 32.9%, a new low in our data set and extending a 40 year declining trend that goes back to the first oil price shock in 1973. Coal's share took another step on the steady upward march that had started in 2002, when non-OECD industrialisation started in earnest; its share increased to 30.1%, the highest since 1970.

Carbon emissions per energy unit vary widely among fuels, and so the evolution of the fuel mix has implications for carbon emissions. In 2013, because of the rising share of coal, global carbon emissions grew almost as rapidly as total primary energy (2.1% versus 2.3%). This has been a very important trend over the years – carbon emissions have grown less rapidly than GDP courtesy of improved energy efficiency, but they did keep pace with energy consumption. In other words, there has been no change in the carbon intensity of the global fuel mix over the last decade. The net result is that carbon emissions continue to rise too fast for comfort – restrained by improving energy efficiency, but not affected by changes in the global fuel mix.

Concluding remarks

In conclusion we return to the linkages between energy and the economy; and to an example of how the remarkable shift in physical energy balances which has occurred over the last decade will affect the global economy.

China, the U.S. and Russia are the world's top three consumers and producers of energy today – in this order, and for both consumption and production. Russia is the world's largest exporter of fossil fuels, while the U.S. and China are the second and third biggest importers (after Japan).

Over the last ten years, physical energy imbalances for these countries – simply the difference between domestic production and consumption – have shifted. Globally, the U.S. had the biggest increase in oil and gas production – and the largest decline in oil and coal consumption. China had the biggest increase in coal production and in the consumption of every single fossil fuel. Russia had the second biggest increment in oil production.

Working out the net results of changes in physical production and consumption shows China's deficit for oil and gas worsening by almost exactly the same magnitude by which the U.S. deficit improved. As a result, the Chinese primary energy deficit overtook that of the U.S. for the first time last year. Russia's surplus improved for every fossil fuel over this period, so far allowing it to maintain its position as the world's largest holder of an energy surplus.

These shifts in physical energy balances do have macroeconomic implications. One of them is a global balance of payment effect. Global energy trade amounts to roughly 15% of the global trade in goods and services and changes in national energy balances typically have a sizeable effect on any countries balance of payments. In the U.S., energy imports still make up about half of the trade deficit. However, on the back of diminishing oil and gas imports, this deficit is shrinking fast. China, on the other hand, sees increasing import dependence eating into its trade surplus; despite rapid economic growth. Meanwhile, in Russia the non-energy deficit is rising fast, reducing its overall trade surplus as it is not being compensated for by rising energy export revenues.

Where does this all leave us? Energy goes directly or indirectly into any type of economic activity and the link between the economy and energy is not a one-way street. Every year, when preparing the Statistical Review, we encounter strange twists and turns in the data and every year, it is rigorous interrogation of the data which delivers answers to the question of what happened and why.

Footnote

[1] Volatility is defined as three year standard deviation.

SPECIAL OFID/IAEE SUPPORT FUND FOR STUDENTS FROM DEVELOPING COUNTRIES

IAEE is pleased to announce the continuation of a special program offering conference support to IAEE student members from developing countries (for a list of qualifying countries please visit http://www.iaee.org/documents/LIC.pdf). Your country of origin must be on this list for support to be considered. The program covers eight of the Association's conferences in 2014 & 2015. This program is generously underwritten by the OPEC Fund for International Development (OFID) and the International Association for Energy Economics. The program covers transportation and lodging reimbursement up to $1750.00 plus waiver of conference registration fees for a limited number of qualifying students. Note: you must be (1) from a qualifying country, (2) a current IAEE member, (3) registered as a full-time student in a program of study and (4) be enrolled in full-time PhD academic coursework during the application stage as well as during the conference to be attended. It is further strongly suggested that you submit a paper for presentation at the conference you wish to attend and receive this support and be in the process of obtaining your PhD. The conferences included in the program are the 7th NAEE/IAEE International Conference in Abuja, Nigeria, February 17-18, 2014, the 37th IAEE International Conference in New York City, USA, June 15-18, 2014, the 4th IAEE Asian Conference in Beijing, China, September 19-21, 2014, the 14th IAEE European Conference in Rome, Italy, October 28-31, 2014, the 8th NAEE/IAEE International Conference in Ibadan, Nigeria, February 23-24, 2015, the 5th ELAEE Conference in Medellin, Colombia, March 15-18, 2015, the 38th IAEE International Conference in Antalya, Turkey, May 24-27, 2015, and the 34th USAEE/IAEE North American Conference in Pittsburgh, PA, October 25-28, 2015.

Application deadlines for the remaining conferences are as follows: Ibadan Conference – application cut-off date, November 24, 2014; Medellin Conference – application cut-off date, December 31, 2014; Antalya Conference – application cut-off date, February 18, 2015; Pittsburgh Conference – application cut-off date, July 20, 2015.

Please submit the following information in one succinct email (e.g., all below materials sent in the same email – including your professor's letter of recommendation) electronically to iaee@iaee.org to have your request for support considered. Make the subject line of your email read "Application to OFID/IAEE Support Fund (mention the conference you wish to attend)."

- Full name, mailing address, phone/fax/email, country of origin and educational degree pursuing.
- A letter stating you are a full-time graduate/college student during the application stage as well as during the time of the conference you wish to attend, a brief description of your course work and energy interests, and the professional benefit you anticipate from attending the conference. The letter should also provide the name and contact information of your main faculty supervisor or your department chair, and should include a copy of your student identification card.
- Indication of whether or not you have submitted an abstract to the conference you wish to receive OFID/IAEE Support to attend.
- A letter from your academic faculty, preferably your faculty supervisor, recommending you for this support and highlighting some of your academic research and achievements, and your academic progress.
- A cost estimate of your travel/lodging expenses to participate in your conference of choice.

Please note that students may apply for this support at only one of the above conferences. Multiple requests will not be considered. If you are awarded support and are unable to attend the conference this support is not transferrable to another conference. Further note that you must be a student member of IAEE to be considered for this support. Membership information can be found by visiting https://www.iaee.org/en/membership/application.aspx

Applicants will be notified whether their application has been approved approximately 21 days after the applicable application cut-off date, above. After the applicant has received IAEE approval, it will be his/her responsibility to make their own travel (air/ground, etc.) and hotel accommodations to participate in the conference. Reimbursement up to $1750.00 will be made upon receipt of itemized expenses and after the conference is held. The reimbursement will only cover transportation and lodging expenses. No other expenses will be covered (e.g., paying for Visa's/Passports, meals outside the conference provided meal functions); no more than three nights lodging will be covered.

For further information regarding the IAEE support fund for students from developing countries to participate in our conferences in 2014 & 2015, please do not hesitate to contact David Williams at 216-464-5365 or via e-mail at: iaee@iaee.org

For a list of qualifying countries please visit http://www.iaee.org/documents/LIC.pdf If your country of origin is not on this list your application for support will not be considered.

Diversification of Chilean Energy Matrix: Recent Developments and Challenges

By Shahriyar Nasirov and Carlos Silva*

As a result of market-driven policies and integration into the global economy, Chile has become one of the fastest-growing economies in Latin America over the past decade. The Chilean economy grew at an average rate of 5.0% between 2003 and 2013 (World Bank, 2013). However, the Chilean government has failed to spur adequate development of the power sector to keep pace with economic growth. As a consequence, the country is facing high energy prices from a critical lack of investment in the sector. This is a principal concern for coming years. This is an especially concerning situation in a fast developing economy with increasing energy consumption, and almost no fossil fuels.

Chile's power sector had 17,600 MW of installed capacity and 65,913 GWh of energy generation in 2012 (CNE, 2013). The sector is divided into two main interconnections, SING and SIC. The SIC system has hydro-thermal generation and covers the central and southern regions of the country, including the main consumption centres around the capital, Santiago. The SING has thermal-based generation and provides primary electricity demands for mining and mineral industries in the north of the country. As Chile's economy continues to grow, it is expected that energy demand will increase from under 65 TWh in 2012 to over 100 TWh by 2020 (IEA, 2012). Therefore, the country will have to add over 8 GW of new generation capacity by 2020 in order to meet the expected expansion in demand.

Chile has struggled to obtain a reliable energy matrix for decades. In the 1980s, Chile relied heavily on power from hydro resources. However, in the mid-1990s, a combination of continued rapid growth in energy demand, increasing environmental concerns regarding large hydro, and the unreliability of hydropower due to droughts, prompted the Chilean government to diversify energy sources by encouraging use of natural gas from Argentina. The low cost of imported natural gas made combined-cycle plants attractive compared to large hydro plants and coal. As a consequence, the sector invested heavily, including building four pipelines from Argentina, new gas distribution networks and a half a dozen new combined-cycle gas fired power plants, costing around of US$4 billion, and forming Chile's gas infrastructure (Speiser, 2008). In 2004, natural gas accounted for 26% of Chile´s total energy consumption of which 80-90% came from Argentinean gas suppliers. However, that year the Argentinean government started restricting gas exports to Chile in order to ease its own domestic gas shortages. Shortly after, the gas supply was restricted between 30% and 50% (CNE, 2008). In the following years, Argentina became a non-reliable partner to a point where gas supplies practically halted. This brought about another energy crisis where generators were forced to replace gas-fired electricity with expensive diesel operation.

Recurring droughts, unreliable gas imports and rising demand have troubled the Chilean power sector and forced the Chilean government to search for additional sources of energy to foster more reliable supplies. This article studies strategically important energy alternatives currently under consideration in Chile, including development of clean energy sources (Renewable Energy Technologies, Energy Efficiency (EE) programs), traditional energy sources (large hydro, large coal fired plants and LNG), and the nuclear energy option. We mainly focus on recent developments and remaining challenges.

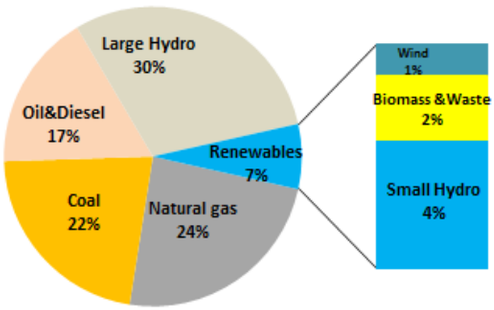
Clean Energy Sources

Entrance of Renewable Energy Sources (RES)

Chile is considered to be one of the most attractive countries for the development of RES thanks to strong power demand growth, one of the highest electricity prices in the region and rich, local renewable sources. With the purpose of attracting renewable energy investment, several new regulatory incentives have been introduced. In 2008, the Chilean government took an important step forward by approving the Law 20,257 that introduced the obligation of companies to include at least 5% of their electricity from non-conventional renewable energy sources by 2010 in a Renewable Portfolio Standard (RPS) scheme. Since Chile does have a significant number of large hydro plants, the RPS only applied to Non-Conventional Renewable Energy, and excluded hydro plants over 20 MW. This quota of renewable energy covered 2010 to 2014 with 5% as the transition period, and was then set to increase 0.5% each year from 2015 through to 2024, by which time generators should be producing 10% of their power from renewable sources. In case companies do not comply with the quota, they would be subject to a fine of approximately US$28 for every MWh incompliant. If the incompliance is repeated, the fine rises to a total of 42 US$/MWh.

So far, energy generation from RES has met or even surpassed the defined

* Shahriyar Nasirov and Carlos Silva are both with the Universidad Adolfo Ibañez, Santiago, Chile. Shahriyar Nasirov may be reached at shahriyar.nasirov@uai.cl The authors acknowledge that the work reported in this article was part of the project CONICYT/ FONDAP/ 15110019 (SERC–CHILE) and supported by the Center for the Innovation in Energy (UAI, Chile).



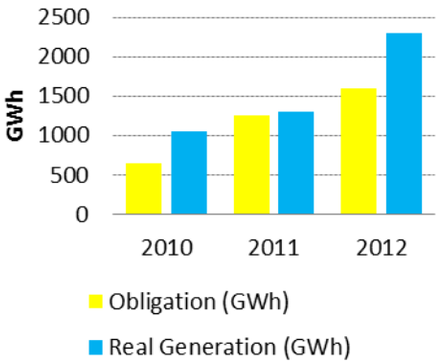
Sources: BNEF, CNE and own elaboration

Figure 1: Electricity Generation by Source, 2012

quota of 5% during the 2010 to 2012 period (See Figure 2). Renewable energy generation reached 7% of the country´s total energy generation in 2012. Until early 2012, small hydro and biomass were leading renewable technologies, accounting for almost 90% of total renewable generation (See Figure 1). However, recently other renewable technologies, including solar and wind, have started to play a more significant role. Moreover, in 2012, Chile´s renewable energy sector received $2bn investment of which 67% has been invested in new wind projects and 15% in solar projects (BNEF, 2013).

In 2013 the Chilean government introduced new incentives by doubling the renewable-energy target from the previous goal of 10% by 2024 to 20% by 2025. This modification was included in the recently approved Law 20,698. This new target provides an even more attractive incentive for the development of the renewable energy industry. However to reach to the 20/25 target, a total of around 6,000 MW of new renewable capacity must be added to the current energy matrix in the next 10 years, which means around 600 MW every year. That is 400-500 MW more than the average annual renewable capacity that entered the matrix during the last five years.

Although the Chilean government has shown significant interest in prioritizing local energy production from RES, a number of obstacles remain for the implementation of renewable projects. In 2012, around 9,000 MW in projects were side-lined, despite having their environmental approval from Chile's Environmental Impact Assessment System. Only a few projects have materialized because of barriers. Most of these projects are wind and solar technologies (See Figure 3). The most common barriers are the high cost of initial investment, the limited access for financing, opposition from local communities; difficulties in connecting to the grid and lack of interest from large consumers in signing long-term contracts (PPAs) with intermittent sources. Removing these barriers and creating further incentives remains a key challenge for the development of Chilean renewable energy sector.

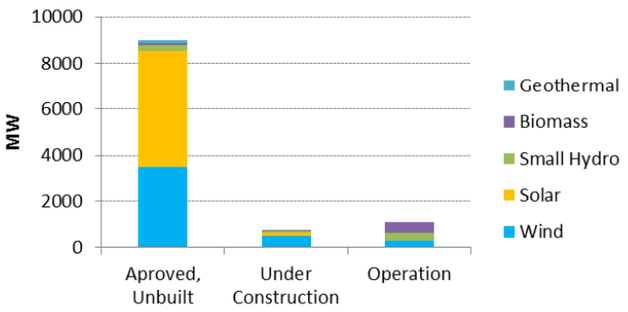


Sources: CDEC and own elaboration

Figure 2: Compliance Evaluation of generation obligation from RES

Energy Efficiency (EE) Programs

Growing concerns regarding energy prices from a fast increase in energy consumption and barriers facing energy projects, have led to a rising awareness of the need to develop energy efficiency (EE) programs in Chile. Energy efficiency is considered to be one of the most cost-effective alternatives for reducing costs and increasing energy security of the country. The savings from EE programs in Chile have been estimated between 1,700 MW and 4,100 MW by 2025 (OECD, 2010), showing that the country has a tremendous potential in this area. Traditionally, EE has not been a priority of the Chilean government without a permanent state policy. Although there have been several unrelated attempts to promote EE (including the Energy Conservation and Rational Use programme), these have had a minor effect. However, the situation improved with the formation of the Energy Efficiency Country Program (PPEE) (2005-2010) in 2005. The PPEE initially started under the Ministry of Economy in 2005 and in 2010 it was transferred to the National Energy Commission (CNE). After the reforming of the institutional framework of the energy agencies, the PPEE was transferred to the Chilean Energy Efficiency Agency (CEEA) in 2012, and made responsible for implementation of energy efficiency studies and initiatives. During this short time, energy efficiency programs drew significant attention, especially from 2006 to 2009, when the annual budget of the energy efficiency programs increased from USD 1 million to more than USD 34 million (CCAP, 2012). However, this budget has decreased in the last few years to around USD 6 million in 2012 due to the shifting of priorities within the government (LYD, 2011 reference).



Source: CER, 2013 and own elaboration

Figure 3: Status of Renewable Energy Projects in Chile, 2012

In contrast to the growth trend in gross domestic production (GDP) between 2005 and 2011, Chile was able to

reduce its energy intensity over 10 % during these years (See Figures 4 & 5). However, achievements on energy intensity reductions were primarily the result of development of the clean gas infrastructure rather than EE programs.

One of the few promising EE initiatives was the National Efficient Lighting Strategy (NELS) in 2013. In this effort the Ministry of Energy of Chile, along with Foundation Chile, have successfully introduced a framework on transition to NELS. The NELS would help to save annually US $486.4 million in energy costs. This represents a total of 2.8 terawatt hours of electricity or the equivalent of almost 5% of total yearly energy consumption.

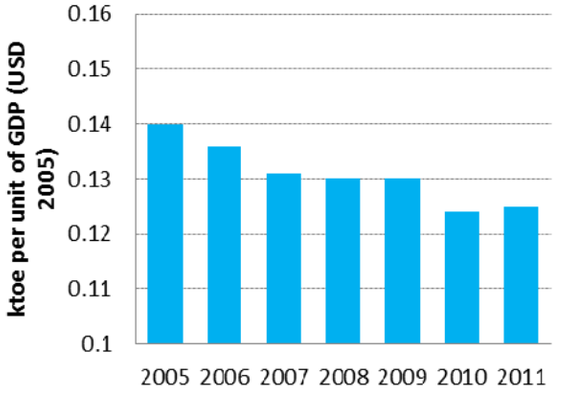
However, to be able to achieve higher targets and get closer to the EE savings potential, the government needs to take a more consistent approach towards it. At this point, if the budget for EE continuous the decreasing trend of the last few years it looks almost impossible to advance in this area. Future plans and strategies must be translated into concrete actions and energy efficiency must become a country wide practice for all public and private investors.

Development of Traditional Energy Sources

Chile is also trying to diversify its sources of traditional energy supply. These include liquefied natural gas (LNG), large hydro plants, and further development of cleaner coal-fired plants as an alternative source of energy in the mid-term, until technologies such as renewable energies can provide a greater portion of the energy matrix.

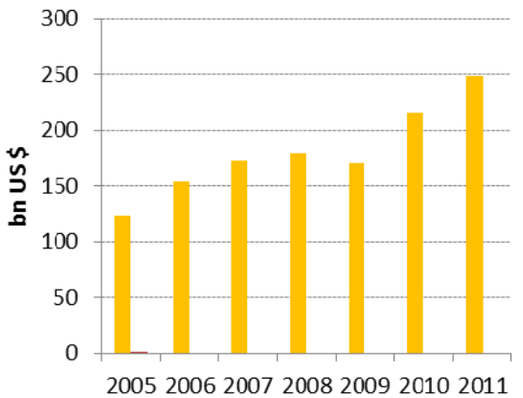
Large Hydro Option

Chile is also considering developing unexploited large hydroelectric resources as a more conventional alternative source. Hydroelectricity is known as a mature technology in Chile since it has been in the region a long time. Ten years ago hydroelectricity represented 78% of total electricity production in Chile, nowadays it only contributes 30%. However, there are still large amounts of unexploited resources that would add significant energy to the matrix; unexploited capacity of large hydro resources in Chile was estimated about total of 21,279 MW (Rudnick et al, 2008). In 2008 the Chilean government approved HidroAysén, the largest energy project in the country´s history. The HidroAysen project requires a $3.2 billion investment and consists of a total of five hydroelectric dams in the Aysen region of Chilean Patagonia (Barrionuevo, 2011). It is expected to generate 18,430 GWh of electricity annually which would account for 28% Chile´s 2012 annual consumption. Despite the potential benefits, the financing of the project and particularly possible environmental impact of the plants and of the transmission line remain a major challenge. Most of the opposition to the project comes from Chileans and foreigners who consider Patagonia a ¨treasure of nature¨ that should remain untouched.



Sources: World Bank Indicators, 2005-2011 and own elaboration

Figure 4: Energy Intensity Indicators in Chile, 2005-2011



Sources: World Bank Indicators, 2005-2011 and own elaboration

Figure 5: Growth Trend of GDP in Chile, 2005-2011

Liquid Natural Gas (LNG)

Another alternative for Chile to replace its natural gas imports from Argentina is to increase LNG import capabilities. LNG is considered one of the more reasonable options since LNG can use the existing natural gas infrastructure that was constructed in the late 1990s to transport and generate electricity from the no longer availble Argentinean natural gas. Chile expedited construction of two regasification terminals: Mejillones, in the north, and Quintero, close to Santiago. Most of Chile's LNG imports come in tank ships from Equatorial Guinea, Trinidad and Tobago, Qatar, and Yemen (EAI, 2013). Additionally, some mining companies have shown an interest in expanding port capacity to increase LNG imports in the SING. Currently, LNG provides 23% of the demand in the SIC, the central main grid, and 10% in the SING, the northern grid (CNE, 2012). But, given the declining trends natural gas prices are showing, due to shale gas development, all energy intensive sectors are ready to switch their suppliers as soon as

cheaper gas is made available. Further, building terminals for LNG imports could play a major role in meeting rising energy demand generally and especially in easing mounting power demands in the crucial mining industry. Considering Chile already has strong economic ties with the Asian continent, it is likely the country would participate in the global LNG trade with rich Asian countries, primarily Indonesia, Malaysia, and Brunei.

Coal Plants

Coal has been, and still is, considered to be one of the key elements of Chile's energy security strategy. During the mid-1990s, Chile replaced its major coal plants with combined cycle plants to use the Argentinean natural gas for electricity generation. However, as a result of the collapse of Argentinean gas exports to Chile, coal consumption received renewed attention as a reasonable alternative. Although Chile possesses more reserves of bituminous coal than larger countries in South America such as Venezuela and Argentina, this coal has high exploitation costs, which eventually forced the government to close the mines and shift from local production to a dependency on imports. In 2011, coal accounted for 22% of total electricity production in Chile with 95% imported largely from Colombia (40%), Indonesia (30%) and Australia (15%) (See Figure 1). At present, SING and SIC combined have 2,050 MW of coal-fired electricity capacity, and some additional capacity is currently under construction and in the pipeline. In 2011 the Chilean government gave final approval for the operation of the controversial Isla Riesco, which is a sub-bituminous coal-mining project in Patagonia, in the extreme south of Chile. It is estimated that the project could meet 30% of the country's coal needs but it is facing considerable opposition from environmentalists (EIA, 2013).

Although coal provides both technical and economic stability to the Chilean electricity system and its significant role in the technology mix is growing, investments in coal generation brings new challenges. CNE projections indicate that installed coal capacity will increase from 16% in 2007 to 26% in 2020 and, as a result, Chile's GHG emissions are expected to double between these years (CNE, 2012). Parallel to coal investments, it is important to replace older plants with more efficient, environmentally friendly technologies with less local pollutants, such as NOx and SOx as well as particulate matter. One alternative that looks promising is coal gasification technologies that could make the use of coal in Chile's electricity matrix more efficient and sustainable in the future.

Nuclear Energy Option

Among the alternatives, the future use of nuclear power in Chile has been proposed as way of handling both the country´s energy and global warming dilemmas. As nuclear power is still considered to be one of the cheapest sources of electricity generation, nuclear power could be an important part of energy diversification.

Chile does not possess any nuclear power plants besides two research reactors. However in 2006, the government committed to an open debate on the prospects of utilizing nuclear energy in the near future. In general, nuclear energy in Latin America is not new. Countries such as Argentina, Brazil, and Mexico produce nuclear power. The nuclear plants in Argentina provide 8% of the country's electricity generation; Brazil's plants account for 3% of the power supply, and Mexico's plants supply over 5% of the country's electricity generation. In 2007, the Chilean Commission on Nuclear Energy (CCHEN) received US$12.3 million (approximately 23% of the total budget for the Ministry of Mines and Energy) to conduct preliminary studies into the development of nuclear power (Speiser, 2009). Since that time government officials and experts have visited several countries to learn about their experiences with the nuclear power industry, seeking training opportunities for local experts and nuclear cooperation agreements. A primary program for possible Chilean nuclear power was presented in 2009, aimed at introducing the first nuclear power plant in Chile around the 2020s.

After the terrible 8.8 earthquake and tsunami in Chile on February 27, 2010 and the Fukushima Daiichi nuclear incident in Japan in 2011, things have turned dramatically. Many countries implemented regulatory changes that lead to a slowing or even cessation of plans for expansion and investments in nuclear power. Likewise, ongoing fears regarding nuclear technologies in seismic countries had a profound impact on Chilean policy makers, resulting in a complete halt to the process. Still the Chilean government is keeping the nuclear option open and it can be brought into debate anytime. However, more than ever, the government is aware than in highly seismic country, lacking necessary infrastructure, institutions and experience in nuclear civil protection, introducing a new complex nuclear power infrastructure from scratch will be a challenge for the country.

References

Barrionuevo,A., 2011, ¨ Plan for Hydroelectric Dam in Patagonia Outrages Chileans¨, N.Y. Times.

Bloomberg New Energy Finance, 2013, ¨New Frontiers for Low Carbon Energy Investment in Latin America and Caribbean¨.

Center for Clean Air Policy (CCAP) (2012), ¨Taking Initiative on Energy Efficiency, Chile¨.

Chilean Energy Efficiency Agency, http://www.acee.cl/

Chilean Commission of Nuclear Energy (CCHEN), http://www.cchen.cl/

Energy National Commission (CNE), Chilean Government, http://www.cne.cl/

Energy National Commission (CNE), 2009, ¨ Non-Conventional Renewable Energy in the Chilean Electricity Market¨.

Energy Ministry of Chile, 2012, ¨National Energy Strategy 2012 -2020¨ .

International Energy Agency. 2012. "Chile".

Load Economic Dispatch Center (CDEC): CDEC-SING http://www.cdec-sic.cl/ and CDEC –SIC http://www.cdec-sing.cl/

Renewable Energy Center (CER, Chile), 2012, ¨Annual Report¨.

Speiser,R. , 2008, ¨Energy Security and Chile: Policy Options for Sustainable Growth¨.

U.S. Energy Information Administration (EIA), 2013, "Chile".

World Bank, 2013 ¨World Development Indicators, ¨Chile¨.

IAEE/Affiliate Master Calendar of Events

(Note: All conferences are presented in English unless otherwise noted)

Date	Event, Event Title and Language	Location	Supporting Organization(s)	Contact
2015				
February 23-24	8th NAEE/IAEE International Conference *Future Energy Options: Assessment, Formulation and Implementation*	Ibadan, Nigeria	NAEE/IAEE	Adeola Adenikinju *adeolaadenikinju@yahoo.com*
March 15-18	5th ELAEE Conference *Energy Outlook in Latin America and Caribbean: Challenges, Constraints and Opportunities*	Medellin, Colombia	ALADEE/IAEE	Isaac Dyner *idyner@yahoo.com*
May 24-27	38th IAEE International Conference *Energy Security, Technology and Sustainability Challenges Across the Globe*	Antalya, Turkey	TRAEE/IAEE	Gurkan Kumbaroglu *gurkank@boun.edu.tr*
October 25-28	33rd USAEE/IAEE North American Conference *The Dynamic Energy Landscape*	Pittsburgh, PA, USA	3RAEE/USAEE	David Williams *usaee@usaee.org*
2016				
February 14-17	5th IAEE Asian Conference *Meeting Asia's Energy Challenges*	Perth, Australia	OAEE/IAEE	Peter Hartley *hartley@rice.edu*
February 18-19	9th NAEE/IAEE International Conference *Theme to be Announced*	Abuja, Nigeria	NAEE NAEE/IAEE	Adeola Adenikinju *adeolaadenikinju@yahoo.com*
June 19-22	39th IAEE International Conference *Energy: Expectations and Uncertainty Challenges for Analysis, Decisions and Policy*	Bergen, Norway	NAEE	Olvar Bergland *olvar.bergland@umb.no*
September 21-22	11th BIEE Academic Conference *Theme to be Announced*	Oxford, UK	BIEE	BIEE Administration *conference @biee.org*
October 23-26	34th USAEE/IAEE North American Conference *Implications of North American Energy Self-Sufficiency:*	Tulsa, OK, USA	USAEE	David Williams *usaee@usaee.org*
2017				
June 18-21	40th IAEE International Conference *Meeting the Energy Demands of Emerging Economic Powers: Implications for Energy And Environmental Markets*	Singapore	OAEE/IAEE	Tony Owen *esiado@nus.edu.sg*

World Natural Gas Markets and Trade: A Multi-Modeling Perspective

Edited by Hillard G. Huntington and Eric Smith

This special issue is an important outgrowth of the Stanford University Energy Modeling Forum (EMF) 23 working group. The volume explores nascent modeling efforts to represent international natural gas markets and trade for improving the understanding of key policy and investment decisions. Although formal modeling is not required to describe the growth of liquefied natural gas or the role of spot markets, decision makers can gain powerful insights from these frameworks.

Following the editor's introductory and overview chapter, the volume includes 12 technical papers by participants in the EMF study. Seven chapters provide unique perspectives on the regional price, volumes and trade estimates from individual modeling frameworks. These systems include competitive models of world natural gas markets as well as strategic models of European markets with market power. The remaining five chapters cover important topics discussed by the working group during the study.

The range of issues is comprehensive and intriguing: trans-Atlantic price convergence, the linking of oil and gas prices through future gas-to-liquid (GTL) capacity additions, the critical role of Middle Eastern natural gas supplies, the extraordinary potential for Russia supplies if key constraints can be overcome, potential collusive behavior by Russian and Middle East exporters, the dynamics of transportation and storage capacity adjustments in response to market power opportunities, European markets reliance upon Russian natural gas exports, the interrelationship between resource constraints and market power, reserve appreciation in known North American fields, and improving insights and decisions through use of quantitative models.

Order online at: http://www.iaee.org/en/publications/specialorder.aspx
ISSN Number 0195-6574

ORDER FORM • Special Issue from the IAEE

World Natural Gas Markets and Trade: A Multi-Modeling Perspective

☐ Domestic Shipment $135.00 each (includes postage and handling)
☐ International Shipment $150.00 (includes postage and handling)

Total enclosed_____

Make check payable to IAEE in U.S. dollars with checks drawn on a U.S. bank

Credit Card ☐ Visa or ☐ Mastercard

Card No _____ Exp. Date _____ CVC2 _____

Signature_____not valid without signature

NAME: _____

TITLE: _____

COMPANY: _____

ADDRESS: _____

CITY,STATE,MAIL CODE: _____

COUNTRY: _____

Send order form along with payment to: International Association for Energy Economics, 28790 Chagrin Blvd., Suite 350, Cleveland, OH 44122 USA
Phone: 216-464-5365 - Fax: 216-464-2737 - E-mail: iaee@iaee.org • Website: www.iaee.org

CONTENTS

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

Regulatory Issues in the Downstream Gas Sector and Emerging Electricity Supply Industry in Nigeria

By Tade Oyewunmi*

Introduction

Securing a reliable, affordable and sustainable energy access and supply in resource-rich countries like Nigeria is essential to economic growth. Generally, such energy access and supply, especially with regards to natural gas or gas utilisation in electricity markets, requires substantial ex ante investments that also requires definite levels of regulatory certainty and efficiency.[1] Furthermore, sound economic wisdom suggests that when government run vertically-integrated utility industries are being transformed into privatised and liberalised sectors (as the Nigerian petroleum and electricity industries has been witnessing over the last 13 years) there are certain variables required for ensuring short, medium and long-term efficiency. These variables include regulatory responsiveness and certainty, an apolitical and independent regulator, a cost-reflective pricing framework, competition and consumer protection.[2]

While the progress made thus far in the privatisation and liberalisation of the Nigerian electricity supply industry (the "NESI") as conceived under the National Electric Power Policy (NEPP), 2001 and the Electric Power Sector Reform Act (EPSRA), 2005 is commendable,[3] there remains a number of lingering questions bordering on the implications of delays in consolidating the needed reforms in the downstream gas market and overall domestic energy production and supply in the NESI. This paper seeks to briefly examine the implications of the protracted reforms of the Nigerian petroleum industry (especially the domestic or downstream gas sector) to the expected improvements in overall energy access and supply in Nigeria.

Reforming the NESI and Downstream Gas Sector

As of 2012, Nigeria is reported to have the largest proven gas reserves in Africa and the 9th largest in the world, with over 182 trillion cubic feet (Tcf) of proven gas reserves.[4] However, Nigeria's gas production and consumption rates fall far short of its potential (even in comparison with other African countries like Algeria and Egypt).[5] Although gas utilization is said to be the backbone of expected increases in electricity generation and supply, there remains a lingering disequilibrium between the NESI and the petroleum or downstream gas market.[6] The following has been identified as the main factors to be considered in addressing the challenges of the downstream gas sector and the shortfalls in access and supply:

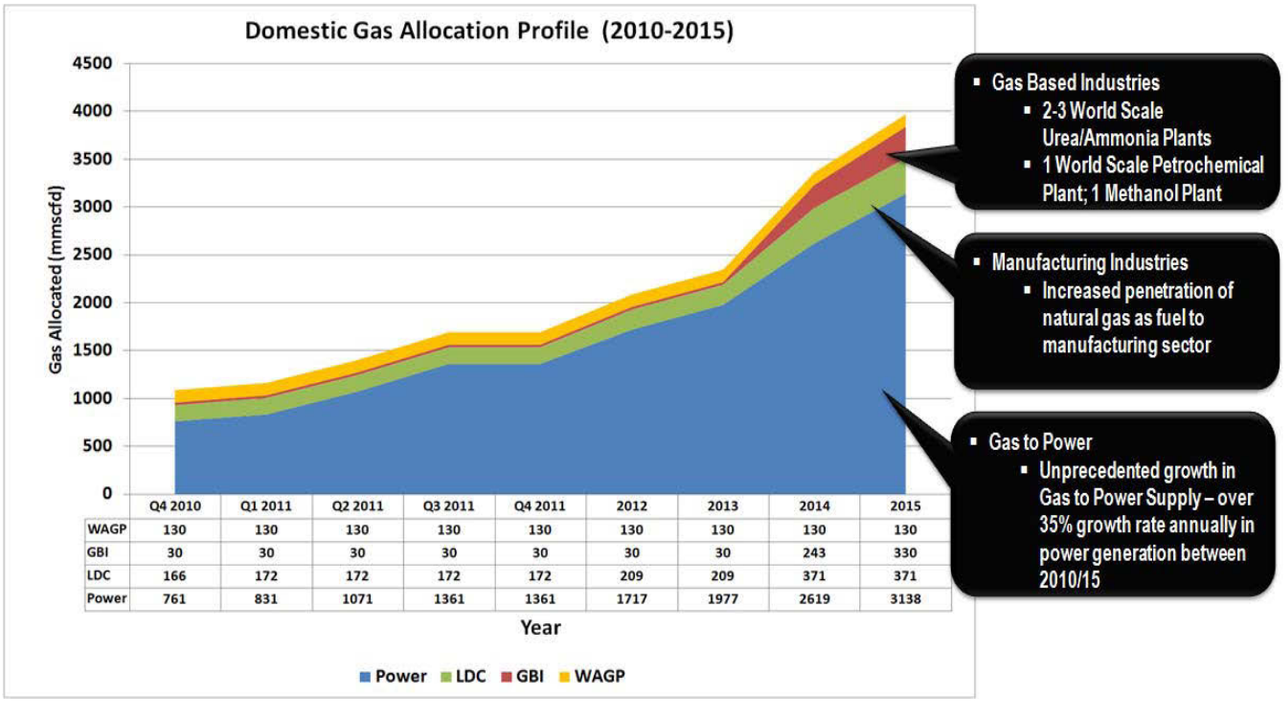
- Gas availability – balancing accessible resources in the light of growing and fluctuating demand in the domestic, regional and international markets;
- . Gas affordability – international and domestic gas pricing and the varying capacity of domestic gas buyers to pay;
- Gas deliverability – Inadequate gas transportation and processing infrastructure;
- Establishing an efficient legal and regulatory framework for domestic gas supply as envisaged under the National Oil and Gas Policy (NOGP), 2004 and the Nigerian Gas Master Plan (NGMP), 2008; and
- Commerciality of supply – establishing the right commercial (legal and contractual) framework and environment to guide and secure ex ante and ex post investments in downstream gas.[7]

The Federal Government of Nigeria (FGN) recently handed over the privatised successor companies of the Power Holding Company of Nigerian (PHCN) to their respective investors. Six power-generation successor companies were established around PHCN's erstwhile power generation assets, four of which are gas-fired thermal power producers. Furthermore, the National Integrated Power Project (NIPP)[8] plants which are also an integral part of the projected developments in the NESI are essentially gas based generators. Power generation fuelled by gas is anticipated to grow to over 20,000 megawatts (MW) by 2020 and contribute over 75% of grid capacity.[9]

This projection, however, seems unrealistic, unless the challenges to domestic gas access and supply are effectively resolved. The multiplicity of economic and non-economic objectives without proper identification and implementation of necessary trade-offs between divergent or counter-intuitive objectives in the reform of the downstream gas industry (within the larger petroleum industry reforms) remain a major challenge. Furthermore, the institutional and regulatory failures which induced gross distortions and inefficiency in production, supply

* Tade Oyewunmi is an energy law (doctoral) researcher at the University of Eastern Finland (Joensuu, Finland) and a Senior Counsel at the law firm of Adepetun Caxton-Martins Agbor & Segun, Lagos, Nigeria. He can be reached at oyetade.oyewunmi@uef.fi or toyewunmi@acas-law.com

See footnotes at end of text.



	Q4 2010	Q1 2011	Q2 2011	Q3 2011	Q4 2011	2012	2013	2014	2015
WAGP	130	130	130	130	130	130	130	130	130
GBI	30	30	30	30	30	30	30	243	330
LDC	166	172	172	172	172	209	209	371	371
Power	761	831	1071	1361	1361	1717	1977	2619	3138

Figure 1: 2010 - 2015 Domestic Gas Utilisation Forecast [10]

and investment choices, high costs of operation, low return on investment and expensive delays and cost overruns in the state energy enterprises are also a major challenge.[11]

The FGN/PTFP recently published a revised Roadmap for Power Sector Reform (Revision 1) (the "Roadmap").[12] The reform objectives identified in the Roadmap rightly identified the gas sector reform (through the Petroleum Industry Bill (PIB)) as an outstanding issue. It also identifies the reported challenges of: (a) insufficient fuel/gas supply or gas pipeline infrastructure to power plants; (b) increasing debts to upstream and downstream operatives in the gas-to-power chain; and (c) the unresolved inadequacies in the commerciality of gas-to-power business.[13] The Roadmap, however, did not provide a clear signal on the consolidation of the outstanding issue of the legal and regulatory framework for the reformed and liberalised domestic gas supply sector. It should be noted that 'plans' or 'roadmaps' cannot replace or make irrelevant the prerequisite of clearly defined laws and regulations or efficient regulatory institutions created based on well-considered laws and regulations.

Regulating Downstream Gas Access and Supply

The principal legislation for oil and gas activities in Nigeria is the Petroleum Act 1969 (the "Act"). The Act was enacted primarily for crude oil operations and provides very little on gas development and utilisation. The Petroleum (Drilling and Production) Regulations 1969 made pursuant to the Act only requires an oil prospecting licensee to submit a feasibility study programme or proposal for the utilisation of associated or non-associated gas within five years of commencement of crude oil production. A need for reforms was recognized over 10 years ago and some of the initiatives taken in this regard include:

- *The National Oil and Gas Policy (NOGP) 2004.* The objectives of the NOGP includes the establishment of a comprehensive National Gas Master Plan (the "NGMP"), downstream gas sector liberalization and 3rd party access, creating appropriate gas pricing to facilitate efficiency in gas to power, maintaining a balance between domestic growth and gas export revenue earnings. The objectives included enacting a law to consolidate the plans.
- *The Downstream Gas Bill (DGB) 2005 (incorporated into the PIB 2008/2009 and now partly in PIB 2012).* The DGB was aimed at the efficient regulation of a liberalized downstream gas sector. It was never enacted, but its key provisions can be traced to sections 230 to 256 of the PIB 2012, which was submitted to the National Assembly in July, 2012.
- *The NGMP, 2008.* The NGMP comprises: (i) the gas pricing policy, which provides a framework for establishing the minimum domestic gas price in the strategic demand sectors;[14] (ii) the domestic gas supply obligation (DGSO), which obligates upstream gas producers to supply gas to

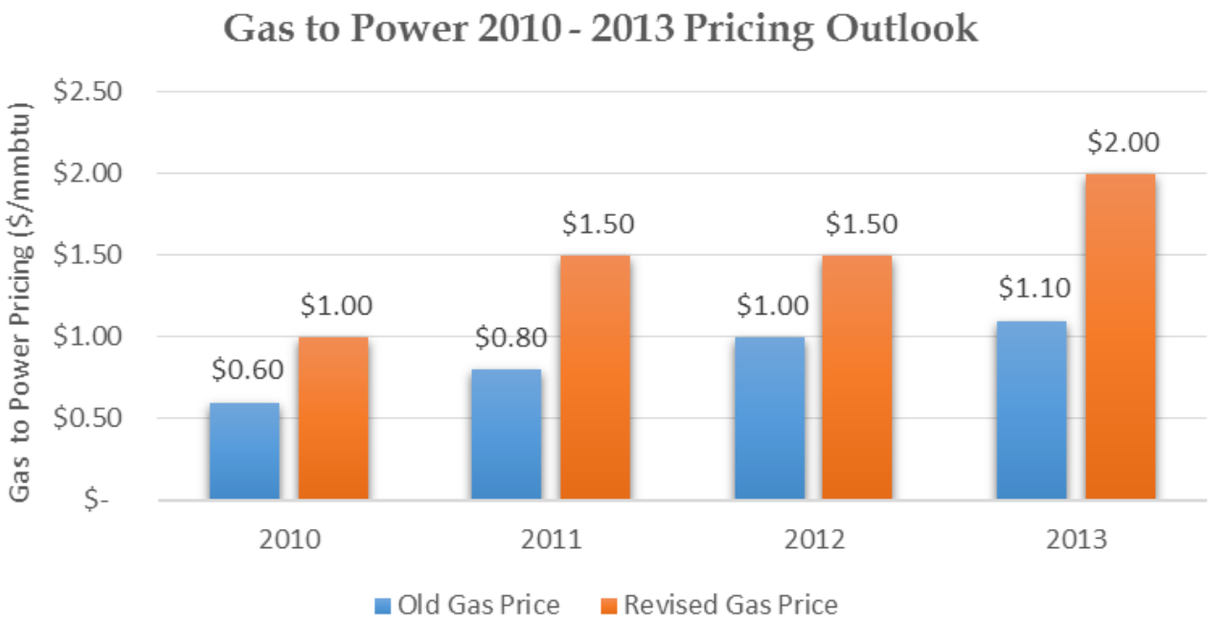


Figure 2: 2010 - 2013 Transitional Pricing Outlook for Gas to Power

the domestic gas market; and (iii) the gas supply infrastructure blueprint.

- *The National Domestic Gas Supply and Pricing Policy 2008 (the "Policy") and the National Domestic Gas Supply and Pricing Regulations 2008 (the "Regulations").*[15] To some extent, the Policy and Regulations have provided a regulatory basis for recent developments in the implementation of the NGMP. The Policy focuses on the three strategic sectors of the economy as identified under the NGMP. Each demand sector has a dedicated pricing regime and current revised transitional pricing structure for gas supplied for electricity as depicted in Figure 2.[16]

  The Regulation establishes a Department of Gas (DoG) within a "Ministry of Energy" to regulate the gas sector as provided under the NGMP and relevant policies.[17] The DoG should among other things regulate and monitor gas pricing and the DGSO, and establish guidelines/code of conduct for domestic gas operators. However, the current and future legal status of the DoG is quite unclear, to the extent that there is no ministry currently called "Ministry of Energy" among other issues. The Regulations were made pursuant to the Act and the Act only recognizes a Minister of Petroleum Resources (MPR).[18] Furthermore, the DoG is currently located within the Department of Petroleum Resources (DPR), which is a department under the Ministry of Petroleum Resources headed by the MPR. In addition, the DPR is famous for its own inefficiencies, legal and operational handicaps as the regulator of the Nigerian petroleum industry.

  The Regulations also entrust the DoG with the responsibility of ensuring equitable and transparent access to the downstream gas transportation network.[19] It, however, fails to specify any other relevant conditions or guidelines in this regard such as competition and grounds for denying new entrants access to the existing network. It is also doubtful whether a DoG working under the MPR (a political institution) can efficiently regulate a competitive and liberalized downstream gas sector, which is supposed to run primarily by commercial and contracting principles. One needs to ask if these institutional and regulatory provisions are more or less of the pre-reform framework that was deemed inefficient.

  Clause 3 of the Regulations provides for the establishment of a domestic gas aggregator. This has been effected by the incorporation of the Gas Aggregation Company of Nigeria (GACN) Limited in 2010. The GACN among other things is responsible for processing requests from domestic gas buyers, managing the allocation of gas to domestic buyers, facilitating negotiations of Gas Supply and Aggregation Agreements (GSAA), and managing an escrow account on behalf of domestic gas sellers, etc.[20]

- *The PIB 2012.* The PIB 2012 proposes the creation of the Downstream Petroleum Regulatory Agency (DPRA) and the Upstream Petroleum Inspectorate (UPI) as semi-autonomous regulators. The DPRA and UPI should, among other things, take over the functions, assets and liabilities of the DPR and the DoG relat-

ing to downstream gas. The DPRA will also assume the role of the current Petroleum Products Pricing and Regulatory Agency. Furthermore, the PIB 2012 also recognizes the role of the domestic gas aggregator and reflects the key provisions of the DGB, NOGP and NGMP with regards to downstream gas pricing and supply, third party access, consumer protection and competition, etc.

Current, Medium and Long Term Issues

In resolving some of the challenges of downstream gas supply to the NESI, the Roadmap recounts that an Inter-Ministerial Domestic Gas Committee (with membership from the Ministry of Power, the MPR, upstream gas companies and the GACN) was recently formed to provide necessary regulatory and supervisory oversight.[21] While this move shows commitment at the highest level of government, it begs the question as to the inefficiencies of the current legal and regulatory framework. One solution maybe to: (i) enable the DoG to function effectively and semi-autonomously by enacting or amending existing law or regulations; or (ii) empowering the Nigerian Electricity Regulatory Commission (NERC)[22] to regulate downstream gas and electricity supply by amending existing law or regulations; or (iii) enacting a well-considered PIB and implementing its proposals for the downstream gas sector.

Currently, the downstream gas supply market in Nigeria comprises mainly (i) the Nigerian Gas Company ("NGC") Limited,[23] and (ii) upstream oil and gas producers currently in Joint Venture/Joint Operating Agreements (JV/JOA) with the Nigerian National Petroleum Corporation (NNPC). The PIB proposes the re-registration of the NGC as a public limited liability company and its becoming independent from NNPC while inheriting some of NNPC's assets and liabilities. It also proposes the transfer of NNPC's interests in JV/JOAs to a newly incorporated Nigerian Assets Management Company (NAMC). These proposals, among others, raises certain concerns about probable future transaction costs and commercial implications for the supply of gas to the NESI. It is noted that the NGC and GACN participated in the execution of Gas Supply and Aggregation Agreements (GSAAs) and Gas Transportation Agreements (GTAs) as part of the NESI's reform process. Also, upstream oil and gas producers and independents continue to negotiate and execute Gas Supply and Purchase Agreements with investors in the NESI. The imminent and probable risks of whether or not the PIB will be passed as it is or a radically different set of law(s) will be passed seems to have been contained by the considerable provisions in some of these agreements with regards legal and political risk mitigation. Also, there are arrangements for the provision of World Bank Partial Risk Guarantees (PRGs) through: (i) the International Bank for Reconstruction and Development (IBRD); and (ii) the Nigeria Electricity and Gas Improvement Project (NEGIP) financed by the International Development Association (IDA). There is also the Political Risk Insurance (PRI) package offered through the Multilateral Investment Guarantee Agency (MIGA).

In April, 2013, the World Bank provided its first PRG for the sum of US$145 million in support of a GSAA involving the PHCN, Egbin Power Plc., Chevron Nigeria Ltd, and Deutsche Bank.[24] The PRGs generally cover risks associated with changes in law and regulatory/tariff framework, failure to meet contractual payment obligations by the government owned entity, while the PRI covers risks such as transfer and convertibility, expropriation, war and civil disturbance, and breach of contract.

Conclusion

From all indications, the establishment of a commercially viable NESI in which access and supply of energy is reliable, affordable and sustainable in the short, medium and long term is largely dependent on the successful and effective reform and liberalization of the downstream gas sector of the Nigerian Petroleum industry. The role of a responsive and efficient regulator and an established framework based on laws and regulations (as opposed to plans and roadmaps) in this regard cannot be over-emphasized. As the scenarios unfold and stakeholders are dealing with the knotty issues and challenges, it is important to see the reforms which started about 13 years ago as a means to an end and not an end in itself. The end is the actual successful implementation of clear policy objectives and the guaranty of reliable and affordable energy access and supply to Nigerians.

Footnotes

[1] Prasad V.S.N. Tallapragada, 'Nigeria's Electricity Sector- Electricity and Gas Pricing Barriers' (First Quarter 2009), International Association for Energy Economics Journal, pg. 29 – 34; The Organisation for Economic Co-operation and Development/International Energy Agency (OECD/IEA, Energy Policies of IEA Countries: the United Kingdom 2012 Review, (IEA Publications, Paris, 2012), pg. 1 – 182 at 132 – 133.

[2] OECD/IEA, Lessons from Liberalised Electricity Markets, (IEA Publications, Paris, 2005), p. 1 - 124; Ashley C. Brown, Jon Stern, Bernard Tenenbaum and Defne Gencer, Handbook for Evaluating Infrastructure

Regulatory Systems (The International Bank for Reconstruction and Development/The World Bank, 2006), p. 1 – 418 at pp.60–61.

[3] The power sector reform process is currently in the late pre-transitional phase, following the payment by investors for respective equity and concession interests in the power generation and distribution assets erstwhile held by the Power Holding Company of Nigeria (PHCN). See the Presidential Task Force on Power (PTFP), The Roadmap for Power Sector Reform – Revision 1, August 2013, pg. 1 – 66 at 6 available at <www.nigeriapowerreform.org/content/Roadmap%20for%20Power%20Sector%20Reform%20-%20Revision%201.pdf>; see also <www.nigeriaelectricityprivatisation.com/?page_id=2>; <www.nigeriaelectricityprivatisation.com/?m=201302>

[4] BP Statistical Review of World Energy June, 2013 at pg. 22, available at <www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf>

[5] Ibid at pg. 23.

[6] Akin Iwayemi, 'Nigeria's Dual Energy Problems: Policy Issues and Challenges' IAEE Energy Forum (4th Quarter, 2008), 17-21. See also the Generation Report of the Presidential Task Force on Power (PTFP) available at http://nigeriapowerreform.org; Premium Times, 'Nigeria's power generation declines to 10-month low, says presidential task force' Published: October 21,2013.

[7] Engr. Abubakar L. Yar'adua (Former GMD, NNPC), 'The Nigerian Gas Master-Plan' a paper delivered at the Nigeria Gas Stakeholders Forum, Abuja, Nigeria, November, 26, 2007, p. 1 – 51 at 24, available at <www.pppra-nigeria.org/presentation_2.pdf> ; Engr. F.M Kupolokun (Former GMD, NNPC), 'Nigeria and the future gas market' a paper delivered at the Baker Institute Energy Forum, Rice University, Houston, USA on May 2, 2006, available at www.nnpcgroup.com/PublicRelations/NNPCinthenews/tabid/92/articleType/ArticleView/articleId/211/Nigeria-and-the-future-gas-market.aspx;

[8] The NIPP was conceived in 2004 as a government funded initiative to support the NESI while the reforms took effect. It was originally designed around 7 (seven) gas-fired power stations (now 10 (ten) power stations) in the Niger Delta, it includes the transmission infrastructure needed to evacuate the added power into the national grid and the distribution infrastructure to electrify communities in which the power stations and major substations are located. The Federal Government of Nigeria incorporated the Niger Delta Power Holding Company Limited (NDPHC) as the corporate vehicle to hold the NIPP assets. The privatization of the NIPP Plants has now been slated for mid-2014.

[9] The PTFP (n4) at p. 24.

[10] Dr. David Ige, 'Gas to Power – Status and Outlook' paper presented at the 2011 Electric Power Investor Forum: Lagos, Dubai, London, New York, Johannesburg, p. 1 – 16, available at <http://gacn-nigeria.com/images/stories/download/PresentationGACN_gastopower.pdf>

[11] See Iwayemi (n7) at p. 18.

[12] Published in August, 2013.

[13] PTFP (n4) at p. 8 and 9.

[14] Adepetun Caxton-Martins Agbor & Segun (ACAS), 'A review of the Nigerian Gas Pricing and Supply Framework', (Oil & Gas Update, January 2009) p. 1 – 4 at 2, available at <www.acas-law.com/cipxprobe/publications/OIL%20UPDATE.pdf>

[15] The Regulations were made pursuant to the Petroleum Act 1969.

[16] Dr. David Ige, 'the Gas Aggregation Company Nigeria Limited (GACN) "Strategic Aggregator" Roles and Functions In the Nigerian Domestic Gas Market, published by GACN, pg. 1 – 24 at 11, available at <http://gacn-nigeria.com/images/stories/download/PresentationRoleofAggregatorinDomgasMarket.pdf>

[17] Clause 1, Regulations 2008.

[18] The EPSRA also only talks about a Minister of Power & Steel with regards to the NESI.

[19] Clause 2(g), the Regulations, 2008.

[20] See <http://gacn-nigeria.com/index.php/aboutus/faqs/36-what-are-the-functions-of-the-aggregator>

[21] PTFP (n4) at pg. 19.

[22] The NERC is the semi-autonomous entity created under the EPSRA 2005 as the regulator of the NESI.

[23] A subsidiary of the Nigerian National Petroleum Corporation (NNPC) responsible for downstream gas transmission and supply network.

[24] The World Bank, 'World Bank to Help Nigeria Improve Gas Supply and Reliability, and Bring More Electricity to Nigerian Consumers' April, 2013, available at <www.worldbank.org/en/news/press-release/2013/04/22/world-bank-to-help-nigeria-improve-gas-supply-and-reliability-and-bring-more-electricity-to-nigerian-consumers

IAEE/USAEE CONFERENCE PROCEEDINGS - ORDER FORM

Energy & The Economy

Proceedings of the 37th IAEE International Conference, New York City, NY, USA, June 15 – 18, 2014

Single Volume $130 – members; $180 – non-members.

This CD-ROM includes articles on the following topics:

- Transportation Developments
- International Shale Development: Prospects and Challenges
- Oil & Gas Reserve Valuation & Financing
- International Implications of U.S. Energy Renaissance
- Climate Change and Carbon Policies – International Lessons and Perspectives
- Renewable, Power Prices, and Grid Integration
- Energy Financing
- Utility Business Model
- Global Energy Demand Growth
- Demand for Liquid Fuels
- Investment in Electricity Markets
- GHG Emissions Reduction
- OPEC and Geopolitical Issues
- Cap-and-Trade
- Biofuels
- Electricity Modeling
- Oligopolistic Behavior in Energy Markets
- Climate Issues
- Intermittent Energy Integration
- Auctions and Bid Analysis

Industry Meets Government: Impact on Energy Use & Development

Proceedings of the 32nd USAEE/IAEE North American Conference, Anchorage, AK, July 28 to 31, 2013

Single Volume $130 - members; $180 - non-members.

This CD-ROM includes articles on the following topics:

- Energy Development in the Arctic
- Natural Gas Markets
- Isolated / Dedicated Power Grids: Making them Work
- Unconventional Oil and Gas Development
- Managing Resource Wealth
- Petroleum Fiscal Regimes
- Industrial Energy Use and Efficiency
- Developments in Electricity Generation and Distribution
- Arctic Transport: Technology and Opportunities
- The Interconnection Between Industry and Government
- Methane Hydrates
- Shale Gas
- Renewables - Wind Energy
- Transportation
- Evolution of Global Gas Markets
- Oil and Refined Products Markets
- Carbon Capture and Storage
- Effects of Energy Taxes

Energy Economics of Phasing out Carbon and Uranium

Proceedings of the 13th European IAEE Conference, Düsseldorf, Germany, August 18 – 21, 2013

Single Volume $130 – members; $180 – non-members.

This CD-ROM includes articles on the following topics:

- Electricity Market Design
- European Gas Markets
- Support Mechanisms for Low Carbon Technologies
- German Energy Transformation
- Long Term Planning of Infrastructures
- Energy Efficiency and Consumer Behavior
- CO2 Issues and Markets
- Energy Demand
- Energy & Economic Growth
- Renewable Markets & Policies
- Fossil Fuels & Biofuels
- Electric Grid Issues & Nuclear
- Wind Power & Energy Transformation
- Energy Market Modeling
- Renewable Costs & Investments
- Carbon Modelling
- Grid Regulation & Governance
- Renewables: Balancing & Load
- Vehicles

****

To order, please send check (payable to IAEE in U.S. dollars, drawn on a U.S. bank) or credit card order to:
Proceedings Order Department, IAEE, 28790 Chagrin Blvd., Ste. 350, Cleveland, OH 44122 USA
Phone: 216-464-5365 Fax: 216-464-2737 E-mail: iaee@iaee.org

Method of payment: Check_____ Credit Card _____ Name on Card (print) _____

Visa_____ MasterCard _____ Number _____Expiration Date _____

_____ "Industry Meets Government: Impact on Energy Use & Development" - $130.00 members - $180.00 non-member
_____ "Energy Economics of Phasing out Carbon and Uranium" - $130.00 members - $180.00 non-members
_____ "Energy & The Economy" - $130.00 members - $180.00 non-members

Please send publication(s) to:

Name: _____

Company: _____

Mailing Address: _____

Mailing Address: _____

Country: _____

Phone: _____ Fax: _____ E-mail: _____

Other Proceedings are available. Contact IAEE at address above for details or visit www.iaee.org/en/publications/proceedings.aspx

Opportunities and Challenges for Interconnection Investment in Europe: Case Example of Estlink HVDC Power Cable Between Estonia and Finland

By Yuliya Pidlisna*

Introduction

According to Jong & Hakvoort (2006), lagging commercial investment in interconnections is slowing the unification process of the European electricity market. Electricity market integration and liberalization is not possible without new cross-border transmission lines for the exchange of power between neighboring countries. Additionally, the appearance of new merchant interconnection lines increases the need for cross-border market pricing agreements. Price agreements between countries create a single price zone where there are no cross-border power exchange limitations. For example, the North-Western Europe (NWE) price agreement is awaited in November 2013. It is one of the stages of the pan-European market integration. According to the NWE, this agreement will combine into one large system countries in Central Western Europe, Nordic countries, Great Britain, Baltic countries, and the SwePol link between Sweden and Poland. Following this combination, every consumer in Europe will be able to purchase power contracts from any supplier in Europe and suppliers will get access to all European customers.

Cross-Border Power Transmission in Europe

According to the recent report by IEA, "Redrawing the energy-climate map," requires improving power transmission lines and providing additional transmission capacity. Additionally, in order to decrease the level of the power sector carbon-dioxide emissions, it is necessary to boost investment in new transmission and distribution lines. Interconnection links also lead to a increased supply security, stronger competition among suppliers, higher price transparency, as well as creating the possibility of an advanced cross-border integration to exchange energy. A well-functioning network of transmission power lines across countries' borders is also a source of national energy efficiency improvement.

Other sources emphasize the importance of market driven incentives to invest in electricity transmission networks. Considering energy transmission power regions, the European Commission highlights the importance of investments in interconnections between the UK and mainland Europe, as well as between the Iberian Peninsula and mainland Europe. European electricity grid optimization, to be achieved by increasing interconnection capacity between member states is part of ENTSO-E's Ten-Year Network Development Plan, (TYNDP). Additionally, another study named "Vision for European Electricity Markets in 2030," undertaken by Lappeenranta University of Technology and the Finnish Energy Industry in 2010, underlines the importance of incentives for TSOs to reduce the number of bottlenecks. It calls for more investment in new intra- and interregional transmission lines and for the simplification of permitting procedures for new transmission investments. The EU study, Connecting Europe Facility (CEF), addresses the question of mitigating the risks involved in the public funding of construction of new transmission lines as put forth in TYNDP. The CEF also stresses the strengthening of interconnection links between Finland, Sweden and Poland as part of the Baltic Energy Market Interconnection Plan (BEMIP). BEMIP implementation is one of the top priorities for the EU. It is an action plan aimed to integrate the Baltic Sea Region to EU's internal energy market, both for electricity and gas. Introducing more interconnections in the region will eliminate market isolation, enhance supply security, and fuel internal market liquidity. Sufficient investments are best ensured when the power price is market driven, not artificially regulated.

European electricity market liberalization is regulated by European parliament directive. According to an EU press release, EU 2020 energy and climate objectives will require EUR 9.1 billion investment in trans-European energy infrastructure. BEMIP requires a total investment of EUR 5 billion in the electricity sector with an estimated investment gap of EUR 3 billion. Estonia and Finland investment requirements are estimated at EUR 0.3 and 0.8 billion, respectively.

In this paper, an analysis of the Estlink-1 HVDC submarine power cable is used as one example of improving power system security and enabling power market integration in the Baltic region. A brief description of the Finnish and Estonian power sector is included. It is supplemented with data analysis based on data points from Nord-PoolSpot on Elspot hourly prices (EUR/MWh) and interchange data (MW) dur-

* Yulia Pidlisna is with Markedsdata in Oslo, Norway. She may be reached at ypidlisna@gmail.com

ing the first 28 weeks of 2013.

Description of the Market Setup for the Estlink Transmission Line

Finnish Power Market

In Finland, power is generated mainly from nuclear plants, hydropower plants, and thermal plants fueled by natural gas and coal. The share of renewables in this generation mix is quite small and depends on the amount of hydropower available on the Nordic market, in particular from Norway and Sweden. Starting in 2007, electricity network operations were unbundled and the Finnish power network was integrated into the Nordic power system. There are 120 companies producing electricity and approximately 400 power plants operating in Finland. Since July 2007, the Finish electricity market has been open for international companies. Therefore, such companies as Vattenfall and E.ON have joined Finish energy production, sales, and distribution. The major Finnish companies such as Fortum operate in the Nordic and Baltic markets as well as in Russia, providing energy-related services. Finland has the ability to transmit electricity to Sweden, Norway and Russia. Fingrid Oyi is a national electricity transmission grid operator with the Finland owning 53.1% and other institutional investors owning 46.9%.

According to Fingrid, in 2009 15% of the total power consumed by Finland was imported from Russia, Norway, and Sweden. Finland is connected to the Nordic system with several transmission connections:

two 400kV and one 220kV AC connection to Sweden
HVDC link Fenno-Skan to Sweden (second submarine HVDC link is under construction)
one 220kV AC connection to Norway
one 350kv HVDC cable to Estonia
three 400kV and one 110kV DC link to Russian Federation

Estonian Power Market

Eesti Energia is a state owned company in Estonia with 97% of the production capacity and an 88% share of the retail market. Eesti Energia controls the Estonian transmission system. The Estonian market consists of 4 balance operators, 50 independent generators, and 40 independent DSOs that account for 15% of the market. Estonia accounts for 8 existing interconnectors:

two 330kV and two 110kV to Latvia
three 330kV to Russian Federation
one 350kV HVDC cable to Finland

According to EU Directive, the Estonian electricity power market is expected to be open by the end of 2013. This compares to Lithuania and Latvia with fully liberalized electricity markets,. However, Latvia and Lithuania intend to open the Elbas intraday market only at the end of 2013. In Estonia, Elspot and Elbas markets have been available as parts of the Nordic day-ahead market since 2010. According to the NordPoolSpot annual report, Estonian bidding turnover in 2011 was 4.6 TWh, up from 1.8TWh in 2010.

Baltic Market Price

According to a study done by "T E N – Energy – Invest," in which particular attention was paid to the future development of the energy market in the Baltic region, a Baltic power exchange must be first created with day-ahead market coverage, and later expanded to include intraday market and financial market coverage.

As part of the market integration, Estonian, Latvian and Lithuanian TSOs have purchased shares of the NordPoolSpot, Europe's largest power exchange. This will enable Baltic TSOs to participate in the power market decision-making process. Moreover, reinforcing transmission links between the Baltic and Nordic countries is an important step toward a common power market. Therefore, additional interconnection cables such as Estlink-2 and NordBalt are planned to be completed by 2014. Estlink-2 will increase transmission capacity between Finland and Estonia to 1,000 MW (additional 650 MW) and NordBalt will create a total transmission capacity of 700MW between Lithuania and Southern Sweden.

Consideration of Governance Structure

Merchant interconnections are financially and legally independent of the government. However, these transmission lines require approvals from national authorities and TSOs. Therefore, agreeing on a long-term perspective and including contract provisions for all mechanisms needed for efficient and fair decision making is vital. Additionally, it is important to include all payout schemes in the contract, especially for periods of highly fluctuating electricity flow. The main governance structures usually are full ownership by one TSOs, joint ventures between TSOs, or joint ventures with third parties.

Estlink-1 HVDC is a submarine transmission link of 350 MW from Estonia (Harku) to Finland (Espoo) and is owned by the Nordic Energy Link AS. It started commercial operations in November 2006 with full cable capacity coming on line the 20th of September 2010. Nordic Energy Link AS is a direct subsidiary of Eesti Energia AS. Partners of the Estlink project are Eesti Energia (39.9%), Latvenergo (25%), Lietuvos Energija (25%), and a 10.1% share divided between Pohjolan Voima and Helsingin Energia of Finland. Therefore, the cable governance structure today is that of a joint venture with third parties. However, according to the Estlink investment agreement, the cable will be transferred into full ownership of Elering and Fingrid (TSO in Estonia and Finland) in 2013. According to Elering corporate web page, the total cost of Estlink-1 was EUR 40 million. Estlink-2 HVDC submarine interconnection cable of 650 MW from Estonia (Püssi) to Finland (Anttila SS) is planed to be built by 2014. Estlink-2 is also owned by Fingrid and Elering. According to the Fingrid web page the total budget for Estlink-2 is approximately EUR 320 million with a EUR 100 million subsidy from the EU. Construction is underway and progressing according to schedule.

Data Analysis

The power balance in the Nordic and Baltic countries determines the current flow on the Estlink-1 connection. On average, the flow is more often in the direction of Estonia as prices are higher there. However, another characteristic has been noticed. During night hours (11.00 p.m. to 05.00 a.m.) the flow is towards Finland. At 06.00 a.m., it switches back towards Estonia.

In order to evaluate the cable's profitability, calculations were made based on hourly Elspot prices from NordPoolSpot from 1 January 2013 until 19 July 2013. Hourly EUR/MWh prices in Finland and Estonia were recorded. The difference in these prices multiplied by the amount of capacity transmitted corresponds to the hourly profit. By summing up, the daily and weekly profit of the cable is obtained. This is shown in Table 1. (Note, however, there are a number of factors, such as planned maintenance and unplanned errors, which affect directly the profitability rate of the cable and these factors are not included in the analysis). The mean weekly prices shown in Figures 1 and 2 show a rather flat pattern, on average, with a higher level in Estonia than in Finland.

Date	Power flow from Estonia to Finland (EUR)	Power Flow from Finland to Estonia (EUR)
Week 1, 2013	360.4	198,061.79
Week 2, 2013	21,731.50	9,936.23
Week 3, 2013	79,788.74	12,519.39
Week 4, 2013	36,918.99	5,220.99
Week 5, 2013	20,586.41	19,561.63
Week 6, 2013	29,985.07	58.56
Week 7, 2013	12,782.13	67,589.42
Week 8, 2013	3,131.81	54,747.04
Week 9, 2013	94,799.52	10,877.81
Week 10, 2013	120,403.19	541.68
Week 11, 2013	17,578.39	120,596.34
Week 12, 2013	8,494.31	105,943.52
Week 13, 2013	22,477.39	139,880.14
Week 14, 2013	26,934.06	86,156.30
Week 15, 2013	2,329.93	96,725.63
Week 16, 2013	97,312.52	3,393.09
Week 17, 2013	155,167.59	0
Week 18, 2013	142,344.64	0
Week 19, 2013	62,603.512	0
Week 20, 2013	0	23,787.662
Week 21, 2013	665.42	83,583.69
Week 22, 2013	0	26,070.39
Week 23, 2013	524.06	46,027.59
Week 24, 2013	0	0
Week 25, 2013	0	1,264,200.12
Week 26, 2013	0	1,507,996.67
Week 27, 2013	0	218,284.84
Week 28, 2013	0	467,740.50
	956,919.58	4,569,501.02

Table 1. Weekly Profit of the Cable Based on Price Difference Model

Conclusion

There are many companies that have an interest in constructing interconnections in highly competitive electricity markets. The governance structure of these interconnection lines is an important question to answer. A joint venture contract between TSOs in many cases results in more efficient cable functionality. An Estlink example shows how the investment project carried out by third party members turns into the full ownership by national TSOs.

Estlink is an important connection link between Finland and Estonia that significantly increases the liquidity of electricity markets and broadens the opportunities for inter-regional power trade. The future of a pan-European

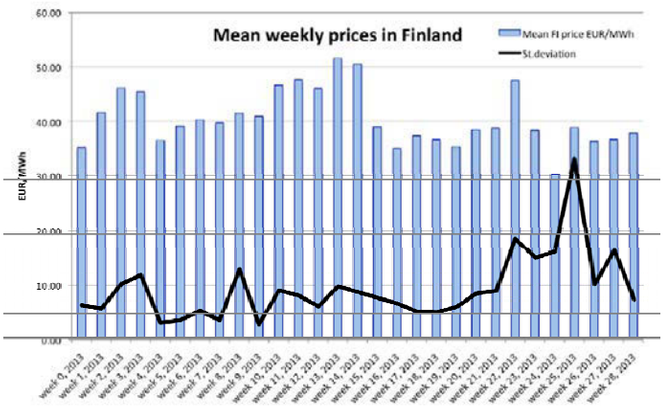


Figure 1. Mean Weekly Prices in Finland (EUR/MWh)

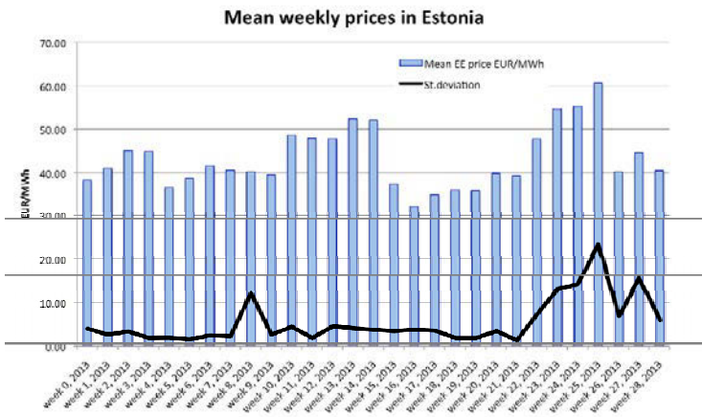


Figure 2. Mean Weekly Prices in Estonia (EUR/MWh)

integrated market depends on the development of such merchant interconnection links.

References

1. BEMIP Electricity in Regulation of the European Parliament and of the Council establishing the Connecting Europe Facility SEC (2011) 1262 and SEC (2011) 1263 from 19/10/2011. Retrieved from http://ec.europa.eu/energy/infrastructure/doc/20120726_3rd_bemip_progress_report_final.pdf on August 8, 2013.

2. Estgrid Eesti Energia corporate web page https://www.energia.ee/

3. Fingrid corporate web page http://www.fingrid.fi/en/company/Pages/default.aspx

4. Estlink 1-2 project description. Retrieved from http://elering.ee/estlink-1-2/ on August 14, 2013.

5. Fortum press release on the new Vision for European Electricity Markets in 2030. Retrieved from http://www.fortum.com/en/mediaroom/in-focus/commentaries/position-papers/fortumwelcomesthenewvisonforeuropeanelectricitymarketsin2030/pages/default.aspx on August 12, 2013.

6. Hanneke de Jong and Rudi Hakvoort. 2006. Interconnection investment in Europe. Optimizing capacity from a private or a public perspective? E-Bridge Consulting. Retrieved from http://e-bridge.at/fileadmin/templates/downloads/DE/interconnector-investment-in-europe--final.pdf on August 3, 2013.

7. IEA Publication. World Energy Outlook Special Report 2013: Redrawing the Energy Climate Map. 2013. Retrieved from http://www.iea.org/publications/freepublications/publication/name,38764,en.html on August 16, 2013.

8. EU directive (EU) No 347/2013 of the European parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure. Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:115:0039:0075:EN:PDF on August 12, 2013.

9. EU Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009. Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0001:0014:EN:PDF on August 8, 2013

10. EU report ”Updating TEN – Energy – Invest study with a particular attention paid to the future development of the Energy Market in the Baltic region – Methodology to prioritize infrastructure project. Retrieved from http://ec.europa.eu/energy/infrastructure/doc/2009_bemip_a9012549-market-design-final_-_8_may_2009.pdf on August 8, 2013.

11. EU study ”T E N – Energy - Invest”. Retrieved from http://ec.europa.eu/energy/infrastructure/studies/doc/2005_10_ten_e_invest_summary.pdf on August 16, 2013.

12. EU study Connecting Europe Facility: Commission adopts plan for EUR 50 billion boost to European networks. Press release IP/11/1200 from 19/10/2011. Retrieved from http://europa.eu/rapid/press-release_IP-11-1200_en.htm?locale=en on August 8, 2013.

13. The market setup in the Baltics – the explantion with examples. Retrieved from http://www.nordpoolspot.com/Global/Download%20Center/Elspot/Baltics-market-setup_05%2006%202013.pdf on August 4, 2013

14. EU study on Connecting Europe Facility Investing in Europe’s growth 2014-2020. Retrieved from http://ec.europa.eu/bepa/pdf/cef_brochure.pdf on August 1, 2013.

15. EU study on Connecting Europe. The energy infrastructure tomorrow. Retrieved from http://ec.europa.eu/energy/mff/facility/doc/2012/connecting-europe.pdf on August 4, 2013.

16. NordPoolSpot Annual Report 2011. Retrieved from http://www.nordpoolspot.com/Global/Download%20Center/Annual-report/annual-report_Nord-Pool-Spot_2011.pdf on August 3, 2013.

17. NWE Price Coupling Joint implementation. Retrieved from http://www.amprion.net/sites/default/files/pdf/20130218_NWE_JOINT%20DECLARATION_FINAL.PDF on August 13, 2013.

18. Press release by Fingrid on Estlink operations. Retrieved from http://www.fingrid.fi/en/news/announcements/Pages/From-Nordic-to-Baltic-markets.aspx on August 6, 2013.

19. Report by Finnish Energy Industries implementation of TYNDP for European transmission networks development. Retrieved from http://energia.fi/en/energy-and-environment/electricity-generation on August 14, 2013.

20. UK Parliament Publications ”No Country is an Energy Island: Securing Investment for the EU’s Future – European Union Committee”. Chapter 6. Interconnection and energy security. Retrieved from http://www.publications.parliament.uk/pa/ld201213/ldselect/ldeucom/161/161/16109.htm on August 15, 2013.

21. Vision for European Electricity Markets in 2030 prepared by Finish Energy Industries and University of Technology. Retrieved from http://energia.fi/en/julkaisut/sahkomarkkinavisio-2030-vision-european-electricity-markets-2030-0 on August 11, 2013.

Summary of the 4th IAEE Asian Conference in Beijing

The 4th IAEE Asian Conference, themed "Energy Economics: New Challenges and Solutions," was held in Beijing, China, from September 19 to 21, 2014. "It is the first time for the IAEE to hold an event in mainland China," said Professor Ying Fan, the conference chair, who is the director of the Center for Energy and Environmental Policy Research (CEEP) at the Chinese Academy of Sciences (CAS). The opening ceremony was held at the new auditorium of CAS. The conference was a big success, with nearly 400 delegates from 28 countries (regions) sharing their state-of-the-art research findings in the field of energy economics and beyond.

We are experiencing changes in world energy supply and demand structures, including the modernization of the emerging economies and the accompanying transfer of the center of energy demand, the threat of global climate change, uncertainty over nuclear safety, the upsurge of unconventional energy supplies, and the adjustment of geopolitical relationships. These changes constitute new challenges and provide new opportunities for the global community. Faced with these new challenges and opportunities, studies in energy economics may contribute enlightening ideas and possible solutions. These perspectives were given by CAS vice president, ***Jinghai Li***, and the vice president of the National Natural Science Foundation of China (NSFC), ***Minghong He*** in their gracious welcome addresses.

Four plenary sessions were held and 14 well-known experts made keynote speeches. Some of the highlights are summarized below.

During the opening ceremony, ***Guobao Zhang***, the former Minister of National Energy Administration, pointed out that world, and particularly Asian, energy development is facing multiple challenges, including a resource shortage, climate change, environmental pollution, and geopolitical changes, and that no single energy resource or single policy instrument can address these challenges. As a result, it is necessary to innovate the energy economics and energy policy mix to stimulate the development of conventional energy sources, unconventional energy sources, and new energy sources and to promote the transition process in the energy system. ***Hans-Joachim Ziesing***, a member of the German expert commission for the "Energy of the Future" monitoring process, shared the experience of German energy policy and concluded that a well-designed, effective, coherent, robust, and adaptive policy framework is necessary for the energy transition and climate change mitigation.

Wumi Iledare, the IAEE president, spoke about the successful development of unconventional hydrocarbon resources in the United States and its global implications. He pointed out that the world is endowed with as many unconventional resources as conventional ones and that the key challenge is how the oil and gas industry can safely extract these resources with minimal damage to the environment. The question arises as to whether this success could be replicated in other countries and regions. In addition, a glut in the gas market has led to low natural gas prices and has made natural gas competitive with other fuels, which may have a significant impact on the development of alternative energy sources, especially renewable energy. In addition, the United States may become a less attractive destination than countries of the Asia-Pacific region, such as China, Japan, India, and South Korea, for oil and gas exporters, and this may have significant implications for the international energy market structure.

If unconventional oil and gas are seen as new, visible energy sources, improvements in energy efficiency can be seen as new invisible energy resources. These improvements have significant advantages in terms of cost effectiveness, environmental sustainability, and energy security. In practice, the accurate measurement of energy efficiency is the basis of quantifying its benefits, tracking its performance, raising public awareness about it, and making appropriate public policies. However, although energy efficiency has contributed to energy savings, according to many empirical studies, how energy efficiency is measured and further improved remain great challenges, as ***B. W. Ang*** from the National University of Singapore pointed out. To make this energy resource visible, he argued that a transparent, credible, robust, and practical economy-wide energy efficiency accounting system is needed for quantifying improvements and tracking progress. Index decomposition is an effective approach to analyzing energy efficiency.

Faced with the challenge of global climate change, the development of low-carbon energies has become a global trend. According to Professor ***Jiankun He*** from Tsinghua University, who is the deputy director of the National Expert Committee on Climate Change, to realize the economic growth transition, an energy system revolution is necessary. This will require the substitution of a low-carbon energy system for a fossil fuel-supported, high-carbon energy system. In addition, he pointed out that the new energy revolution would promote the transformation of human civilization from an industrial civilization to an "ecological civilization," in which increasing "carbon productivity" is a fundamental goal of the

global society.

China is the world's largest annual greenhouse gas emitter, and its future CO_2 emissions trend and when the peak occurs have significant implications for the world. ***Yi Wang***, the director-general of the Institute of Policy and Management, Chinese Academy of Sciences, summarized the existing studies on CO_2 emission in China and pointed out that China's CO_2 emissions would probably reach their peak between 2030 and 2040, depending on economy development, population growth, energy consumption, domestic environmental and climate policy, and international negotiations. Because coal consumption is the biggest source of CO_2 emissions and coal plays a dominant role in China's primary energy consumption, future coal consumption will have a significant impact on when CO_2 emissions peak. As ***Dadi Zhou*** from the Energy Research Institute of China National Development and Reform Commission noted, the substitution of fossil energy to renewable, and widely using clean coal technology is necessary for China's CO_2 emissions to peak.

The cost of greenhouse gas mitigation is critical when making decisions on how much effort to put in to this. However, there is a huge variation in predicted mitigation costs across different models and countries. ***David I. Stern***, a professor from the Crawford School of Public Policy at the Australian National University, analyzed how the substitution elasticities in production and consumption affect the marginal and total costs of mitigation and concluded that although lower substitutability increases the average abatement cost, total costs are reduced with lower substitutability, due to lower GDP and emissions growth.

During the energy system transition, the role that the market should play in energy supply and demand is a contentious topic. Professor ***Adonis Yatchew*** from the University of Toronto analyzed the power and failures of markets, based on the history of the development of the world economy. He argued that markets have provided a remarkably responsive and adaptive mechanism and brought about the accumulation of financial and physical capital, which was required for ever greater productivity. However the market also has limitations, he said, providing the examples of the success of the industrial revolution, the Great Depression in the 1930s, the Great Stagflation in the 1970s, and global warming in the twenty-first century. Although, in the twentieth century, there was an adversarial relationship between market-based and centrally planned economies, centrally planned economies are now incorporating market ideas and market-based economies are using many policies and programs that are intended to correct for market limitations. He concluded that energy policies should be made in broader political contexts and that political, economic, and historical narratives are useful, and even essential, for understanding energy.

Against the background of globalization, energy and environmental issues are becoming common global issues, and more regional and global collaboration is needed to cope with the common challenges. Asia is a center of economic growth—which means a center of energy consumption— resulting in a rapid increase in import dependence and CO_2 emissions. In addition, drastic changes in the global energy landscape are taking place. ***Masakazu Toyoda***, CEO and chairman of the Institute of Energy Economics, Japan (IEEJ), stated that Asian countries needed to work together to surmount their common challenges and that possible areas for energy cooperation included more greater energy conservation, the cleaner use of fossil fuels, lower-cost renewable energy, and safer nuclear energy. ***Philip Andrews-Speed***, principal fellow at the National University of Singapore, summarized the key supporting factors for energy cooperation in Asia under changing market conditions as being desire, trust, commitment, need, and timing. Bringing a perspective from China, ***Zhong Xiang Zhang***, a distinguished professor at Fudan University, said that China's global quest for oil and natural gas has received unprecedented worldwide attention and scrutiny because of China's high-profile energy diplomacy and a number of debatable issues, including the management and operation of Chinese national oil companies (NOCs) and misconceptions and misunderstandings about China's quest for energy security, both inside and outside China. He concluded that both China and the West need to de-politicize China's global quest for energy security.

More than 230 papers around the manifold facets of the conference theme were presented in 48 concurrent sessions. The topics included energy and economic growth, energy and the environment, energy and climate change, energy security, energy efficiency, energy markets, energy investment and finance, energy technology innovation, energy demand management, fossil power and its clean utilization, unconventional energy development, renewable energy development, the potential and cost of emissions reduction for energy-intensive sectors, carbon emissions trading, and energy planning.

In addition, a special workshop titled "Petroleum Futures Market: International Experience and Implications to China" was held to mark the establishment of the Shanghai International Energy Exchange and to prepare for the launch of Chinese crude oil futures contracts. More than 40 experts participated in the workshop and the key message was that China's oil demand will continue increasing and that China

would play a dominant role in the future world energy market; therefore, it is necessary for China to build an oil futures market to reflect the supply and demand conditions of Asia and to provide a hedge instrument against market risks. The critical issue is that the related institutional improvement and capacity building are the prerequisites for a well-functioning market. As ***John Jimison***, the managing director of the Energy Future Coalition, pointed out, market transparency is very important and rules and regulations are necessary to limit excessive speculation and excessive price fluctuations.

During the conference, the Best Student Paper Competition was held, with ***Peter Hartley***, the president-elect of IAEE, hosting the session. Four PhD students—***Jose Fernandez*** from the University of Bath (UK), ***Livingstone Senyonga*** from the Norwegian University of Life Sciences (Norway), ***Wang Dong*** from the University of Western Australia (Australia), and ***Xu Wang*** from Tianjin University (China)—entered the competition. ***Livingstone Senyonga*** received the highest score. "This event provides a good platform and opportunity for me to show my latest research achievement and communicate with students from other countries, and it is really an exciting and unforgettable experience." Said ***Xu Wang***.

Two technical tours were held. Nearly 100 participants visited the Solar Thermal Power Generating Project in Yanqing, Beijing, and the Clean Energy Projects in ENN Group. The Solar Thermal Power Generating Project in Yanqing is the first solar thermal power tower plant with capacity above 1 MW in China as well as in Asia. The ENN Group is a private Chinese company that has been actively promoting innovations in clean energy for over 20 years. ENN is committed to continuously developing proprietary technologies, improving efficiency in energy production and utilization, constructing a modern energy system, and promoting the harmonious development of energy, the economy, and the environment. All participants praised the achievements in low carbon technologies in China.

The 4th IAEE Asian Conference offered not only stimulating presentations and discussions but also social and culture programs, which the delegates enjoyed and appreciated. They included a welcome dinner, a Chinese traditional culture show, a farewell dinner, and technical tours. On the whole, the conference was a great success, and all the participants had a good time and left with unforgettable memories.

For more information, please visit our colorful gallery at: http://iaeeasia.csp.escience.cn/dct/page/70063 .

Jian-Lei Mo
Center for Energy and Environmental Policy Research,
Chinese Academy of Sciences

IAEE INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
WWW.IAEE.ORG

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.

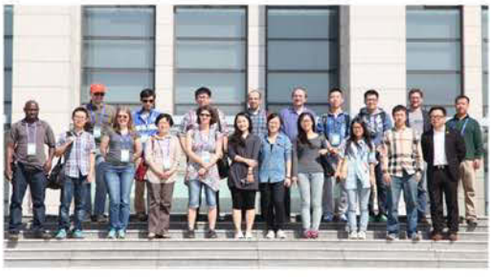
Employers are invited to use this database, at no cost, to advertise their graduate, senior graduate or seasoned professional positions to the IAEE membership and visitors to the IAEE website seeking employment assistance.

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.

SCENES FROM THE 4TH IAEE ASIAN CONFERENCE SEPTEMBER 19-21, 2014





CHAIR






The 4th

IAEE THE 4th IAEE ASIAN CONFERENCE 第四届国际能源经济学会

IAEE
The 4th IAEE Asian Conference




The 4th IAEE Asian Conference
Beijing, China
Sept.19 - 21, 2014

IAEE
The 4th IAEE Asian Conference


Call for Paper

Conference Overview

Analysts forecast that most energy demand worldwide will take place in developing countries including those in Latin American and the Caribbean (LATAM) region. This will happen with the support of significant technological and regulatory transformations in energy supply systems, under a highly competitive environment and taking into account sustainable development considerations. Thus, the challenge to the LATAM region will be to accelerate and maintain economic and social progress supported by energy policies.

The V ELAEE will take place in Medellin on March 15, 16, 17 and 18, 2015; and will feature first level world-speakers, notable business and political leaders, academics, consultants and analysts that simultaneously will alternate discussions and debates about the aforementioned and related topics. The conference will provide opportunities to delegates that include encounters among energy professionals and specialists during receptions and session breaks.

Topics to be addressed include:

Energy integration in LATAM
Energy policy in Latin America
Energy and Economic Development
Energy Supply and Economic Growth
Financial and Energy Markets
Energy and the Environment
Non-fossil Fuel Energy: Renewables & Nuclear
International Energy Markets
Energy Research and Development
Energy and macroeconomics
Energy Access and wealth distribution
Energy efficiency and electricity consumption
Organization of markets for biofuels
Renewables: Government's Promotional Role
Integration of Solar and Wind Generation In Power Dispatch
Technology and energy supply and demand
Energy and climate changes
Energy and environment
Regulation of the energy industry
Energy modeling
Energy and geopolitics
Institutional aspects of the energy industry
Other topics of interest include new oil and gas projects, transportation fuels and vehicles, generation, transmission and distribution issues in electricity markets, etc.

Invited

epm® CIIEN UNIVERSIDAD NACIONAL DE COLOMBIA SEDE MEDELLÍN UNIVERSIDAD DE BOGOTÁ JORGE TADEO LOZANO ceiBA

IAEE WWW.IAEE.ORG INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS ALADEE ASOCIACION LATINOAMERICANA de ECONOMIA de la ENERGIA

Concurrent Sessions

Concurrent sessions will include presentations of results from energy economics research or practical case studies involving applied energy economics analysis or discussions of current energy-related issues. In either instance, papers should be based on completed or near-completion work that has not been previously published. Presentations are intended to share both academic and professionals and lessons learned experiences. It is unacceptable for a presentation to overtly advertise or promote proprietary products and/or services. Those who wish to distribute promotional literature and/or have exhibit space at the Conference are cordially invited to take advantage of sponsorship opportunities – please write to **info@5elaee.aladee.org.**

Concurrent Session Abstract Format

Authors wishing to make concurrent session presentations must submit online by visiting **http://5elaee.aladee.org** an abstract that briefly describes the research or case study, by the deadline of **November 16, 2014.**

The abstract must be not be exceed two pages in length and must include the following sections:

1. Overview of the topic including its background and potential significance
2. Methodology: how the matter was addressed, what techniques were used
3. Expected results: Key findings
4. Conclusions: Lessons learned and implications
5. References

As soon as abstracts are approved by the Program Committee, authors will be given until **January 30, 2015** to submit their final online proceedings paper to be published on the conference website.

For more information please visit: **http://5elaee.aladee.org** or write to **info@5elaee.aladee.org**

Poster Session

To encourage students work in energy economics, ALADEE will promote a student poster session. Entrants must be full-time students (where a full-time student is defined as being registered full-time according to the definition of their respective academic institution and not employed full-time) at the time of submission. In this unique event, students will be able to present their recent academic work, completed or in progress, to all conference delegates in a specially designed networking session.

Abstracts for the Poster Session must be submitted online by visiting **http://5elaee.aladee.org by the deadline of November 16, 2014**. Students will be notified by **December 16, 2014** of their poster status. Students whose abstracts are accepted will have until **January 30, 2015**, to submit their final poster electronically (pdf) for publication in the conference proceedings.

Posters for actual presentation at the conference must be brought by the student directly to the conference venue and must be in A2 size (420 mm wide x 594 mm high) in portrait format.

Presentations at the conference

At least one author of an accepted paper or poster must pay the registration fees and attend the conference to present the paper or poster. The corresponding author submitting the abstract must provide complete contact details-mailing address, phone, fax, e-mail, etc. Authors will be notified by **December 16, 2014** the status of their presentation or poster. Authors whose abstracts are accepted will have until **January 30, 2015**, to submit their final papers or posters for publication. The abstract selection process will seek to ensure as broad participation as possible: each author may present only one paper or one poster in the conference. No author should submit more than one abstract as its single author. If multiple submissions are accepted, then a different author will be required to pay the registration fee and present each paper or poster. Otherwise, authors will be contacted and asked to drop one or more paper(s) or poster(s) for presentation.

Welcome New Members

The following individuals joined IAEE from 7/1/14 to 9/30/14

Kristin Aadland
BKK
NORWAY

Azlina Abd Aziz
University Malaysia Terengganu
MALAYSIA

Claes Af Buren
Stockholm School of Economics
SWEDEN

Ebenezer Akinola
Obafemi Awolowo Univ Ile Ife
USA

Volkan Alacam
Energy Market Regulatory Authority
TURKEY

Augustus Alakija
NAPIMS-NNPC
NIGERIA

Susan Alamri
Saudi Aramco
SAUDI ARABIA

Isabella Alloisio
Fondazione Eni Enrico Mattei
ITALY

Napoleon Almonte Jiminian
Electrical Industry Dominican
DOMINICAN REPUBLIC

Nadia Ameli
OECD
FRANCE

David Ammons
Winstead PC
USA

Karim Anaya Stucchi
University of Cambridge UNITED KINGDOM

Thomas Anderski
Amprion GmbH
GERMANY

Barbara Annicchiarico
University of Rome Tor Vergata
ITALY

Niklas Anzinger
Hertie School of Governance
GERMANY

Anahita Asadolahniajami
Ryerson University
CANADA

Frank Asche
University of Stavanger
NORWAY

Peter Ashcroft
USA

Edi Assoumou
Mines Paris Tech/Armines - CMA
FRANCE

Tarek Atallah
KAPSARC
SAUDI ARABIA

Ofira Ayalon
Univ of Haifa Samule Neaman Inst
ISRAEL

Ceren Ayas
Univ Autonoma de Barcelona
TURKEY

Rossella Bardazzi
University of Florence
ITALY

Sriparna Basu
CANADA

Joan Batalla
University of Barcelona
SPAIN

James Batty
UNITED KINGDOM

Gino Baudry
University of Nantes
FRANCE

Guillaume Baumgartner
Service Public 2000
FRANCE

Robert Beestermoeller
IER
GERMANY

Julia Bellenbaum
Universitat Duinsburg-Essen
GERMANY

Laila Berge
OED
NORWAY

Marina Bertolini
University of Padova
ITALY

Chrostophe Bertram
PIK
GERMANY

Joachim Bertsch
University of Cologne
GERMANY

Valentin Bertsch
Karlsruhe Institute of Technology
GERMANY

Gregor Beyer
Clausthal Unlversity of Technology
GERMANY

Sankar Bhattacharya
Monash University
AUSTRALIA

Arnaud Blaser
University of Neuchatel
SWITZERLAND

Andreas Bloess
TU Berlin
GERMANY

Richard Boampong
University of Florida
USA

Rodolphe Bocquet
Carbone 4
FRANCE

Paul Boedeker
Fraunhofer ISI
GERMANY

Inga Boie
Fraunhofer ISI
GERMANY

Heloisa Borges Esteves
Agencia Nacional do Petroleo
BRAZIL

Siri Aspevik Bosheim
OED
NORWAY

Yassin Bouyraman
University of Paderborn
GERMANY

Christine Brandstaett
Fraunhofer IFAM
GERMANY

Francois Briens
MINES Paris Tech/CMA
FRANCE

Tom Brijs
KU LEUVEN
BELGIUM

Christoph Brunner
EnBW Energie Baden-Württemberg AG
GERMANY

Soren Buchmann Petersen
Dansk Erhverv
DENMARK

Richard Buechele
Vienna University of Tech
AUSTRIA

Joern Bugge
EC Group
NORWAY

Bettina Burgholzer
Vienna Univ of Tech
AUSTRIA

Liam Byrnes
The University of Queensland
AUSTRALIA

Priyantha Cabral Wijayatunga
Asian Energy Specialist
PHILIPPINES

Hong Cai
NHH
NORWAY

Wenjia Cai
Tsinghua University
CHINA

Natalia Caldes Gomez
CIEMAT
SPAIN

Manuel Cantavella-Jorda
Universitat Jaume I
SPAIN

Antonio Cardoso Marques
University of Beira Interior
PORTUGAL

Samuel Carrara
Fondazione Eni Enrico Mattei
ITALY

Laura Castellucci
University of Rome Tor Vergata
ITALY

Felipe Castro
UC Berkeley
USA

Tine Cato
Copenhagen Business School
DENMARK

S Gokhan Cay
Caspian Strategy Inst
TURKEY

Silvia Centero Rodriguez
ETSIMyE Univ Politecnica de Madrid
SPAIN

Konstantinos Chalvatzis
University of East
UNITED KINGDOM

Vincent Champain
General Electric
FRANCE

Hsiao-fen Chang
Aletheia University
TAIWAN

Xiaomei Cheng
NHH
NORWAY

Alessandro Chiodi
University College Cork (UCC)
IRELAND

Jimmi Christensen
CBS
DENMARK

Michail Chronopoulos
Norwegian School of Economics
NORWAY

Alesandro Clerici
CESI SPA
ITALY

Francois Cohen
Grantham Research Institute
UNITED KINGDOM

John Collins
USA

Emmanuel Combet
CIRED
FRANCE

Meliyara Consuegra Diaz Granados
UNED
SPAIN

Bruno Cova
CESI SPA
ITALY

Cathy Xin Cui
University of Strathclyde
SCOTLAND

Juncal Cunado
Universidad de Navarra
SPAIN

Dominique Daniel
EDF Research Engineer
FRANCE

Cristina De la Rua Lope
CIEMAT
SPAIN

Kristof De Vos
KU LEUVEN
BELGIUM

Roberto Del Ciello
ENEA
ITALY

Erik Delarue
KU Leuven
BELGIUM

Michael Delgado
Purdue University
USA

Nadezeda Dementjeva
AS Eesti Energia
ESTONIA

Olga Demyanova
Heriot-Watt University
UNITED KINGDOM

Barnabas Mate Derekas
Corvinus University of Budapest
HUNGARY

Jacques Despres
CNRS PACTE EDDEN
FRANCE

Corrado Di Maria
Univ of East anglia
UNITED KINGDOM

Marie-Pierre Digard
Nova Green
FRANCE

Gavin Dillingham
HARC
USA

Fabio Disconzi
University of Padua
ITALY

Paul Drummond
UCL Inst for Sustainable Resources
UNITED KINGDOM

Davia Dumciuviene
Kaunas University of Technology
LITHUANIA

Yunus Durgun
Izaydas
TURKEY

Vicki Duscha
Fraunhofer-ISI
GERMANY

Wolfgang Eichhammer
Fraunhofer ISI
GERMANY

Anselm Eicke
TU Berlin
GERMANY

Klaus Eisenack
Carl Von Ossietzky
GERMANY

Mogens Elchendorv
DENMARK

Jihad Elnaboulsi
Universite de Franche Comte
FRANCE

Bede Emuka
Africa Media Grp Inc Oil Bus Daily
USA

Axel Ensslen
KIT
GERMANY

Abdullah Erdem
Socar Gas Trade Inc
TURKEY

Mehmet Ali Ergul
Accenture
TURKEY

Holden Erling
Sogn og Fjordane University College
NORWAY

Ramon Espinasa
Inter American Development Bank
USA

Tara Esterl
AIT Austrian Insitute of Technology
AUSTRIA

Ryan Evans
Woodside Energy
AUSTRALIA

Francesco Fabiano
Universita della Calabria Cosenza
ITALY

Meiting Fan
Shanghai Univ of Finance & Econ
CHINA

Karim Farhat
Stanford University
USA

Latifa Fellah
Clinique Saint-Luc
BELGIUM

Nuno Carvalho Figueiredo
Univ of Coimbra
PORTUGAL

Robert Fischer
freelance
SWEDEN

Marte Fodstad
Thomson Reuters
NORWAY

Silvia Forin
MCC FU Berlin
GERMANY

Matthew Foss
Alberta Government
CANADA

Julia Fourne
GERMANY

Iklaga Fred
University of Surrey
UNITED KINGDOM

Kohei Fujii
Hitotsubashi University
JAPAN

Filippo Gaddo
Arup
UNITED KINGDOM

Nurit Gal
Public Utility Organisation
ISRAEL

Frederick Gallagher
Innovitas Inc
CANADA

Toben Galvin
Navigant Consulting Inc
USA

Christian Gambardella
PIK
GERMANY

Maurizio Gargiulo
E4SMA Srl
ITALY

Ernesto Garnier
RWTH Aachen University
GERMANY

Claire Gavard
Fondazione Eni Enrico Mattei (FEEM)
ITALY

Todd Gerarden
Harvard University
USA

Gabriel Giabicani
AREVA
FRANCE

Romano Gigliolo
University of Pisa-DESTEC
ITALY

Gael Giraud
CNRS
FRANCE

Louis Gaeta Giraudet
CIRED
FRANCE

Nicholas Good
University of Manchester
UNITED KINGDOM

Johan Gottschling
IER University of Stuttgart
GERMANY

Pedro Joao Gouveia
CENSE, FCT-UNL
PORTUGAL

Martin Graf
E Control Austria
AUSTRIA

Kirsten Grebstad
OED
NORWAY

Bethany Green
Samson Resources
USA

Thomas Greve
University of Cambridge UNITED KINGDOM

Tanja Groth
London Economics
UNITED KINGDOM

Seyma Gurkan
Bogazici University
TURKEY

Thomas Haasz
IER University of Stuttgart
GERMANY

Simeon Hagspiel
IEE University of Cologne
GERMANY

Zain Hak
Shell Oil Products US
USA

Sumio Hamagata
Ctrl Rsch Inst of Elec Pwr Ind
JAPAN

Jim Hanly
IRELAND

Xiao Hao
CHINA

Silas Harbo
Danish Energi Association
DENMARK

Michelle Harding
OECD
FRANCE

Rupert Hartel
Karlsruhe Institute of Technology
GERMANY

Nicolas Hary
Microeconomix
FRANCE

Richard Hayat
GMS INC
USA

Marian Hayn
KIT
GERMANY

Tobias Heffels
KIT-IIP
GERMANY

Thorsten Helms
University of St. Gallen
SWITZERLAND

Annette Hester
InterAmerican Development Bank
USA

Richard Hochstetler
Instituto Acende Brasil
BRAZIL

Susanne Hounsell
IHS Energy
FRANCE

Nicholas Howarth
KAPSARC
SAUDI ARABIA

Shupei Huang
China Univ of Geosciences
CHINA

Raphael Hudson
Hart Energy
USA

Olav Peter Hypher
Statkraft Energy Inc
TURKEY

Zimako Ibe
NNPC-NAPIMS
USA

Sunday Idowu
Federal Ministry of Power
NIGERIA

Godknows Boladei Igali
Federal Ministry of Power
NIGERIA

Chinwe Iheme Sanomi
Vitol
NIGERIA

Hakan Irgit
Accenture
TURKEY

Edward James Smith
Energistyrelsen
DENMARK

Jikhan Jeong

Qiang Ji
CEEP, IPM, CAS
CHINA

Alexander Kaller
Hasselt University
BELGIUM

Abhilash Kantamneni
Michigan Tech
USA

Zeynep Kaptan
Caspian Strategy Institute
TURKEY

CharIlkLeia Karakosta
NTUA
GREECE

Kevin Kaushal
NMBU
NORWAY

Dirk Kayser
USA

Sarah Keay-Bright
The Regulatory Assistance Project
BELGIUM

Hamza Nasiru Khalid
NNPC
NIGERIA

Moon Jung Kim
Seoul National University
SOUTH KOREA

Ayse Filiz Kolat
Statkraft Energy Inc
TURKEY

Steven Kopits
Princeton Energy Advisors LLC
USA

Christoph Kost
ISE
GERMANY

Vincent Krakowski
MINES Paris Tech/CMA
FRANCE

Elie Lacroix
University Paris Dauphine
FRANCE

Erik Laes
VITO
BELGIUM

Latika Lagalo
Michigan Technological University
USA

Sidney Lambert-Lalitte
IFP EN
FRANCE

Amadi Law
Ctr for Petroleum Energy Econ Law
NIGERIA

Boris Le Ngoc
Societe Francaise D'Energie Nuclear
FRANCE

Gaelle Le Treut
CIRED
FRANCE

Patrizio Lecca
Univ of Strathclyde
UNITED KINGDOM

Randy Legaspi
Kinder Morgan Inc
USA

Jennifer Lehn
LG&E and KU Energy
USA

Kathryn Leininger
Oxford University
USA

Rong Li
North China Electricity Power
CHINA

Yuanjing Li
University of Paris Dauphine
FRANCE

Mei Liao
Beijing University of Technology
CHINA

Siew Hoon Lim
North Dakota State University
USA

Da Liu
CHINA

Huizheng Liu
CHINA

Stefan Lorenczik
IEE University of Cologne
GERMANY

Casimir Lorenz
TU Berlin
GERMANY

Hari M P Variam
Energy Studies Institute
SINGAPORE

Gail Y Ma
Australian National University
USA

Lin Ma
NNBU
NORWAY

Pandey Mahi Manus
OED
NORWAY

Fuki Makut
Nigerian Petroleum Dev Co
NIGERIA

Enrico Malfa
Centro Sviluppo Materiali
ITALY

Rauf Mammadov
USA

Giacomo Marangoni
FEEM/CMCC/Politecnico di Milano
ITALY

Ralf Michael Marquardt
Westfälische Hochschule
GERMANY

Luis Miguel Marques
University of Beira Interior
PORTUGAL

Paolo Mastropietro
Universidad Pontificia de Comillas
SPAIN

Peter Mc Gregor
University of Strathclyde
UNITED KINGDOM

Florent Mc Isaac
University of Paris1
FRANCE

Russell Mc Kenna
KIT-IIP
GERMANY

Zachary Mcgill
University of Calgary
CANADA

Bastien Mechard
GDF Suez
FRANCE

Helena Meier
IEE University of Cologne
GERMANY

Thomas Meister
Tenne T TSO GmbH
GERMANY

Yetik Kadri Mert
Energy
TURKEY

Laurent Meunier
ADEME
FRANCE

Julia Michalis
Fraunhofer-ISI
GERMANY

Jason Minalga
USA

Irina Mironova
Energy Research Inst of the Russian
RUSSIA

Peggy Mischke
DTU Riso Campus
DENMARK

Barn Misund
University of Stavanger
NORWAY

Daniel Monnerat Gorodicht
Boston Consulting Group
BRAZIL

Julian Moral Carcedo
CEPREDE
SPAIN

Yaqian Mu
CHINA

Surena Neshavd
University of LuxemburgLUX-EMBOURG

Melissa Newman
Jamaica Energy Partners JA-MAICA

Kristina Nienhaus
DLR - German Aerospace Center
GERMANY

Joseph Nyangon
University of Delaware - CEEP
USA

Emmanuel Ofomana
African Univ of Science and Tech
NIGERIA

Oyebisi Oladeji
NIGERIA

Arigbabuwo Taofeeq

Olayemi Mabayoje
IHS Nigeria Plc
NIGERIA

Ayotomide Olugbenga
Olumoyegun
Offc of the Head of Civil Service
NIGERIA

Chinyere Onyeisi
Enugu State College of Education
NIGERIA

Ogbonna Onyeisi
Hotel Presidential
NIGERIA

Sebastian Osorio
Univ of Lausanne - HEC
SWITZERLAND

Takashi Otsuki
Asia Pacific Energy Research Centre
JAPAN

Margaret Ovonlen
Nigeria National Petorleum Corp
NIGERIA

Volkan Ozdemir
Inst for Energy Mrkts and Policies
TURKEY

Yigit Ozkan
Socar Gas Trade Inc
TURKEY

Vamsi Krishna
P V
INDIA

Maria Beatriz Palatinus Milliet
BRAZIL

Yun Peng
CNPC
CHINA

Quentin Perrier
GDF Suez
FRANCE

Philippe Pinchon
IFP
FRANCE

Alcino Pinto Couto
University of Beira Interior
PORTUGAL

Ezio Piperissa
ITALY

Guillaume Piquet
Total MS
FRANCE

Patrick Ploetz
Fraunhofer ISI
GERMANY

Edouard Plus
Riskergy
FRANCE

Sergey Podkovalnikov
Russian Academy of Sciences
RUSSIA

Niklas Poier
Le3 - TU Dortmund University
GERMANY

Kris Poncelet
Energy Ville - KU Leuven
BELGIUM

Ram Poudel
University of Massachusetts Amherst
USA

Fynnwin Prager
University of Southern California
USA

Harald Prodil
Energie Control Austria AUS-TRIA

Sara Proenca
Polytechnic Institute of Coimbra
PORTUGAL

Jessica Raasch
University Duisburg-Essen
GERMANY

Nikoloaus Rab
Vienna University of Technology
AUSTRIA

Viktor József Rácz
University of Southern Denmark
DENMARK

Parminder Raeewal
APERC
CANADA

Margarethe Rammerstorfer
Modul University Vienna
AUSTRIA

Kristin Rasdal
OED
NORWAY

Rachel Ravagnani
State University of Campinas
BRAZIL

Matthias Reeg
GERMANY

Katrin Rehdanz
GERMANY

Lauro Andre Ribeiro
University of Coimbra
PORTUGAL

Martin Roach
FRANCE

Andrzej Robaszewski
European Central Bank
GERMANY

Maria Rodriguez Arteaga
GECF
QATAR

Birgit Rosalowsky
University of Freiburg
GERMANY

Alessandro Rubino
Bari University
ITALY

Katharino Ruikis
TU Dortmund
GERMANY

Pablo Ruiz Castello
Inst for Energy and Transport JRC
NETHERLANDS

Hanee Ryu
Seoul National University
SOUTH KOREA

Perry Sadorsky
York University
CANADA

Mari Sakudo
Development Bank of Japan
JAPAN

Sener Salci
University of Birmingham
UNITED KINGDOM

Sarah Salm
University of St. Gallen
SWITZERLAND

Bakatjan Sandalkhan
Accenture
TURKEY

Muhammet Sarac
Izaydas
TURKEY

Joshua Sarpong-Kumankomah
Geoquaye Company Limited
GHANA

Sabina Scarpellini
Circe University of Zaragoza
SPAIN

Johannes Schaeuble
KIT
GERMANY

Bert Scholtens
University of Groningen NETH-ERLANDS

Anne Schopp
GIER
GERMANY

Lisa Schulten
University of Siegen
GERMANY

Daniel Schwabeneder
Vienna Univ of Technology
AUSTRIA

Manal Shehabi
Univ of Western Australia Business
AUSTRALIA

Tamara Sheldon
University of California, San Diego
USA

Peiyao Shen
University of New South Wales
AUSTRALIA

Leslie Shiell
University of Ottawa
CANADA

Alice Shiu
Hong Kong Polytechnic University
HONG KONG

Bianka Shoai Tehrani
RITE
JAPAN

Mary Ruth Shortall
University of Iceland
ICELAND

Mori Shunsuke
Tokyo University of Science
JAPAN

Robert Siatecki
rensys
GERMANY

Luisa Sievers
Fraunhofer - ISI
GERMANY

Eivind Skjaerven
NMBU
NORWAY

Timothy Smith
University of Minnesota
USA

Petur Solnes
DENMARK

Inge Stenklov
Statnett
NORWAY

Aviv Steren
Ben Gurion University of the Negev
ISRAEL

Mads Stolberg Larsen
KU
DENMARK

Elena Stolyarova
Mines Paristech
FRANCE

Han Pang Su
Taiwan Rsch Inst
TAIWAN

Swantje Sundt
Kiel Inst for the World Economy
GERMANY

Ole Svihus
OED
NORWAY

Yashar Tarverdi Mamaghani
The University of Western Australia
AUSTRALIA

Lars Broemsoe Termansen
Energistyrelsen
DENMARK

Christian Thiel
European Comm JRC
NETHERLANDS

Jesse Thompson
FRB Dallas- Houston Branch
USA

Jessica Thomsen
ISE
GERMANY

Wenhui Tian
Ecole Centrale Paris
FRANCE

Oliver Tietjen
PIK
GERMANY

Atit Tippichai
Asia Pacific Energy Research Centre
JAPAN

Sergio Tirado Herrero
Univ of Manchester
UNITED KINGDOM

Benjamin Tischler
University of Vologne
GERMANY

Tolga Toprak
Socar Gas Trade Inc
TURKEY

Daniel Tormey
ENVIRON International Corporation
USA

Jacopo Torritti
University of Reading
UNITED KINGDOM

Marta Trabucchi
Universita degli Studi di Bergamo
ITALY

Stefan Traub
University of Bremen
GERMANY

Mariya Trifonova
Sofia Univ St Kliment Ohridski
BULGARIA

Erik Tromborg
Norwegian Univ of Life Sciences
NORWAY

Thomas Tunstall
University of Texas at San Antonio
USA

Vladimir Udalov
University of Wuppertal GERMANY

Ismail Uludag
Izaydas
TURKEY

Niyaz Valitov
University of Wuppertal
GERMANY

Arne Van Stiphout
KU LEUVEN
BELGIUM

Jeroen Vandewalle
KU Leuven
BELGIUM

Emmanuel Vaz
Mott Mac Donald
UNITED KINGDOM

Stefano Verde
European University Institute
ITALY

Niels Vestergaard
Syddansk Universitet
DENMARK

Lucio Visconti Parisio
University of Milano - Bicocca
ITALY

Stefan Voegele
Forschungszentrum Julich GmbH
GERMANY

Zhong Wang
Chengdu University of Technology
CHINA

Jaeger Wells
Kiewit Oil Gas & Chemical
USA

Jonathan Wildman
PowerAdvocate Inc
USA

Leonard Williamson
UCL Energy Institute
UNITED KINGDOM

Even JA Winje
OED
NORWAY

Matthew Winning
University College London
UNITED KINGDOM

Oliver Woll
CEER ZEW
GERMANY

James Woods
Portland State University
USA

Bai-Chen Xie
Tianjin University
CHINA

Weiming Xiong
Tsinghua University
CHINA

Tan Xiujie
Wuhan University
CHINA

Yuan Xu
Chinese University of Hong Kong
HONG KONG

Malcolm Yadack
University of Hohenheim
GERMANY

Shiyu Yan
NHH
NORWAY

Muyi Yang
University of Technology, Sydney
AUSTRALIA

Yuying Yang
CHINA

Haldun Yavas
Caspian Strategy Institute
TURKEY

Yuri Yegorov
University of Vienna
AUSTRIA

Ariel Yepez
Inter American Development Bank
USA

Tuba Yilmaz Gozbasi
Ozyegin University
TURKEY

Jin Zhang
Rsch Inst of Econ and Mgmt
CHINA

Ran Zhang
BGE Exelon
USA

Xiaoli Zhao
North China Electric Power Univ
CHINA

Junwei Zheng
Lanzhou Literature and Info Ctr C
CHINA

Hui Zhou
Nanjing Univ of Info Science & Tech
CHINA

Liangxu Zhu
The University of Sydney
AUSTRALIA

Michael Zipf
TU Dresden
GERMANY

Vanesa Zorrilla Muñoz
Universidad Carlos III
SPAIN

Tatsiana Zoryna
State Enterprise IPEAA BELARUS

Roman Zytek
International Monetary Fund
USA

!!! Congratulations to the 2015 IAEE Officers !!!

IAEE nominations chair Lars Bergman and committee members Edmar de Almeida, Georg Erdmann, Tony Owen, Jim Smith and Mine Yucel are pleased to announce the election of the following 2015 IAEE Officers. They will take office on January 1, 2015.

President-Elect
Gurkan Kumbaroglu

Vice President for Finance
Jurgis Vilemas

Vice President for Communications
Lori Smith Schell

Vice President for Academic Affairs
Ricardo Raineri

Vice President for Business & Government Affairs
Christophe Bonnery

Student Representative
Lisa Koch

New Danish Student Chapter Established

A new student organization is born. In collaboration with the Danish Association for Energy Economics (DES) and the International Association for Energy Economics (IAEE) a so-called Student Chapter has been established. The new organization was officially inaugurated on September 4th as students from CBS, CPHU, and DTU were invited to the kick-off meeting.

The organization encourages all students, from undergraduate level to PhD level, with an interest in energy solutions to apply for membership, which offers a variety of benefits.

A DES membership is only DKK 100 per year and it gives you access to a broad variety of interesting conferences, influential people, interesting businesses, and scientific articles and data, says Luis Boscán, initiator of the new organization and PhD student at the Department of Economics at CBS.

- Moreover, DES is a member of the International Association for Energy Economics (IAEE), which you automatically become a member of through your DES membership.

- The IAEE has members in more than 100 countries and therefore offers rich opportunity to meet like-minded people, he adds.

You can sign up for DES and IAEE membership here.

Organizing students of the Danish student chapter. Luis Boscán, the lead organizer is seated.

The Facebook page keeps you posted

As the organization is brand new, updates on activities and events, and news are only available on the Facebook page, which you can find here.

On the page you can make your contributions to the ongoing debate as well as make suggestions to what subjects should be focused on in relation to the next IAEE Student Event.

- At the kick-off meeting we discussed whether to make maritime transportation and shipping the first subject. The idea is to invite professors, students, and representatives from various relevant companies. For instance, we could invite representatives from Maersk to discuss sustainability in shipping.

Discuss the energy challenges of tomorrow

Luis Boscán emphasizes that energy economics embraces a broad variety of subjects, e.g. sustainability, renewable energy, fossil fuels, the Arctic, climate change, political measures etcetera.

All energy-related subjects can be discussed in the new IAEE student organization; and Luis Boscán expects to organize 4-6 events per year.

The aim of the events is to gather students from different universities for debates on energy solutions in collaboration with relevant companies and scientists. Come join us! And bring your friends along.

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

38TH IAEE INTERNATIONAL CONFERENCE

MAY 25-27, 2015 | GLORIA GOLF RESORT | ANTALYA, TURKEY

TURKISH ASSOCIATION for ENERGY ECONOMICS

Energy Development, Growth and Sustainability (EDGS) Award

"Social Responsibility Activities for Improving Access and Use of Clean Energy in Rural Areas"

Overview

In developing countries, especially in rural areas, 2.8 billion people rely on biomass, such as fuel wood, charcoal, agricultural waste and animal dung, to meet their energy needs. Approximately three-fourths of these live in Asia. Nearly 4.3 million people – mostly women and children – die prematurely every year because of exposure to indoor air pollution from biomass. For instance, indoor air pollution associated with biomass is directly responsible for more deaths than malaria, almost as many as tuberculosis, and approximately half as many as HIV/AIDS. In addition, much valuable household time and effort is devoted to fuel collection instead of education or income generation. Significant environmental damage can also result, such as land degradation and regional air pollution. Two complementary approaches can improve this situation: increasing the accessibility of energy and promoting wide access to energy and more efficient and sustainable use of traditional energy forms such as biomass, and providing and encouraging people to switch to clean energy sources and technologies.

Social responsibility activities at national or international scale, which reduce energy poverty and feature a more sustainable use of traditional energy forms or promote the development and diffusion of suitable technologies as well as creating awareness on clean energy, will be evaluated by the EDGS Award Committee. All such activities are eligible for application, whatever the end-use services they meet (cooking, heating, lighting, communication, mechanical power, mobility, etc.).

Application Process

Corporations are encouraged to apply for the EDGS Award until December 19, 2014. In parallel, the EDGS Award Committee will identify potential candidates and encourage them for application. A two-tier evaluation system will be implemented. For the first round, submission of a Summary of maximum 2 pages length will suffice; it shall include the following information:

- Title
- Definition of the work
- Beneficiaries
- Objectives
- Social/economic/environmental impacts

Those applicants who pass the first round will be asked to submit more detailed information including

- Description of the results(realized or expected) – double-spaced; 3 pages maximum;
- Social/economic/environmental impact analyses details including all scenarios and assumptions (both Word and Excel files if applicable)
- Supplementary technical reports (if available)
- Supplementary audiovisual material (if available)

It is important that eligible applicants provide evidence of how the activities were evaluated and what the wider benefits of these have been for the socio-economic development of the specific community/area.

Award

The winner will receive the benefits of

- High level recognition at the Gala Night with the EDGS Award Plaque presented during the Award Ceremony;
- Complimentary TRAEE Corporate Membership with all its benefits for one year;
- Complimentary exhibition table at next year's IAEE International Conference;
- Recognition by 4500+ distinguished IAEE members through the IAAE Newsletter.

Contact Information

Host Organization:
Turkish Association for Energy Economics (EED)
Address: Boğaziçi University, 34342, Bebek, İstanbul, Turkey
Tel: +90-212-3597544
For the latest updates about the conference;
Official website: http://www.iaee2015.org
Official Twitter account: @IAEE15
Official Facebook Page: IAEE15
e-mail: info@iaee2015.org

Application deadline: December 19th, 2014
Please upload to: http://www.iaee2015.org

IAEE INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
WWW.IAEE.ORG

Calendar

27-29 October 2014, Master Class Gas Transport at Vienna, Austria. Contact: Thiska Portena, Senior Course Manager, Energy Delta Institute, Netherlands. Phone: +31 (0) 88 1166827, Fax: +31 (0) 88 1166899, Email:portena@energydelta.nl, URL: http://www.energydelta.org/mainmenu/executive-education/specific-programmes/master-class-gas-transport,

27-28 October 2014, Shale Gas Environmental Summit 2014 at Holiday Inn Regents Park, Carburton Street, London, W1W 5EE, United Kingdom.. Contact: Vinh, Trinh, SMI Group, 47-51 Great Suffolk Street, 2nd Floor South, Harling House, London, SE1 0BS, United Kingdom. Phone: 44 207 827 6078, Email: dlee@smi-online.co.uk, URL: http://atnd.it/12174-0,

28-29 October 2014, Exploration, Mining and Processing Fundamentals at Radisson Blu Gautrain Hotel Sandton, Rivonia Rd, Sandton, 2196, South Africa. Contact: John , Wilson, Informa Australia, 0. Email:info@informa.com.au, URL: http://atnd.it/13762-0,

28-30 October 2014, LNG Fundamentals at Informa Australia, St Georges Terrace, Perth WA, 6000, Australia.. Contact: Informa , Australia, Informa Australia, 120 Sussex Street, Sydney, NSW, 2000, Australia. Phone: 0, Email: Info@informa.com.au , URL: http://atnd.it/6479-0,

28-29 October 2014, Offshore Energy Exhibition and Conference 2014 at Amsterdam RAI, Europaplein 22, Amsterdam, NL-1078 GZ, Netherlands. Contact: Philip, Mulder, Navingo BV, Las Palmas Building, Wilhelminakade 302, Rotterdam, South Holland, 3072 AR, Netherlands. Phone: 31 0 10 2092674, Email:pmu@navingo.com, URL: http://atnd.it/6703-0,

28-31 October 2014, 14th IAEE European Energy Conference: Sustainable Energy Policy Strategies for Europe at Rome, Italy. Contact: Carlo Andrea Bollino, General Conference Chair, Italy. Email: assaiee@aiee.it;, URL: www.iaee2014europe.altervista.org,

28-29 October 2014, 12th Annual FLNG Asia Pacific Summit at Renaissance Seoul Hotel, 237 Teheran-ro, Gangnam-gu, Seoul, 135-979, South Korea. Contact: Suhailah, Ishak, IQPC, 61 Robinson Road #14-01, Robinson Centre, Singapore, Singapore, 068893, Singapore. Phone: 6567229428, Email:seri.suhailah@iqpc.com.sg, URL: http://atnd.it/12980-0,

29-30 October 2014, Gas to Liquids 2014 at Millennium Gloucester Hotel London, 4-18 Harrington Gardens Kensington & Chelsea, London, SW7 4LH, United Kingdom. Contact: Julia Rotar, SMI Group Ltd, 2nd Floor South, Harling House, 47-51 Great Suffolk Street, London, SE1 0BS, United Kingdom. Phone: 0207 827 6088, Email: jrotar@smi-online.co.uk, URL: http://atnd.it/11011-0,

29-30 October 2014, Oil & Gas Exploration & Production Fundamentals: October at Informa Australia, St Georges Terrace, Perth, 6000, Australia. Contact: Informa Australia, Informa, Level 6, 120 Sussex Street, Sydney, 2000, Australia. Phone: 61 2 9080 4050, Email: Info@informa.com.au, URL: http://atnd.it/6476-0,

03-05 November 2014, Operational Excellence in Oil and Gas at Royal Sonesta Houston Galleria, 2222 West Loop South Houston, Houston, Texas, 77027, USA. Contact: Alae Ismail, IQPC UK, United Kingdom. Phone: 0207 368 9804, Email: alae.ismail@iqpc.co.uk, URL: http://atnd.it/15001-0,

03-06 November 2014, Energy Markets Course at Utrecht, The Netherlands. Contact: Janet Smid, Senior Course Manager, Energy Delta Institute, Netherlands. Phone: 31 (0) 88 1166825, Fax: 31 (0) 88 1166899, Email: smid@energydelta.nl, URL: http://www.energydelta.org/mainmenu/executive-education/introduction-programmes/energy-markets,

03-04 November 2014, O&M and Lifecycle Management for CCGT Power Plants Conference at Embassy Suites Houston, USA. Contact: Jessica Southwell, Mr, T.A. Cook Conferences, USA. Phone: 919 510 8142, Email: info-us@tacook.com, URL: http://atnd.it/15381-0,

03-07 November 2014, Africa Oil Week 2014 at Cape Town International Convention Centre, 1 Lower Long St, Cape Town, 8000, South Africa. Contact: Babette van Gessel, Africa Oil Week 2014, Global Pacific and Partners, Cape Town International Convention Centre, 1 Lower Long St, Cape Town, 8000, South Africa. Email:babette@glopac-partners.com, URL: http://atnd.it/12737-0,

03-05 November 2014, 3 Day MBA in EPC Contracts at Terrapinn Holdings, 10-11 Charterhouse Square, London EC1M 6EH, United Kingdom. Contact: Rebecca Sloan, 0. Phone: +442076087072, Email:rebecca.sloan@terrapinn.com, URL: http://atnd.it/14995-0,

04-05 November 2014, O&M and Lifecycle Management Strategies for CCGT Power Plants at Doubletree by Hilton Hotel Kuala Lumpur, Malaysia. Contact: Luba, Jersova, T.A Cook, 0. Email: l.jersova@tacook.com, URL: http://atnd.it/15257-4,

04-07 November 2014, World Shale Oil & Gas Summit at Fairmont Dallas Hotel, 1717 N. Akard Street, Dallas, 75201, USA. Contact: Ania, Szewczyk, CWC Group, 16-18 Lombard Road, London, London, SW11 3RB, United Kingdom. Phone: +44 (0) 207 978 0777, Email: aszewczyk@thecwcgroup.com, URL: http://atnd.it/13199-2,

05-06 November 2014, EMART Energy 2014 at Amsterdam RAI, Europaplein, Amsterdam, 1078 GZ, Netherlands. Contact: Eva van de Pol, Synergy Events, P.O. Box 1021, MAARSSEN, Netherlands. Phone: +31 346 290 803, Email: eva@synergy-events.com, URL: http://atnd.it/11711-0,

05-06 November 2014, WWEM Water, Wastewater and Environmental Monitoring at Telford International Centre, St. Quentins Gate, Telford, TF3 4JH, United Kingdom. Contact: Marcus, Pattison, WWEM, Sandridge Park, Porters Wood, St. Albans, Hertfordshire, AL3 6PH, United Kingdom. Phone: 01727858840, Email:marcus@iet-pub.com, URL: http://atnd.it/6117-0,

05-06 November 2014, Exploration, Mining & Processing Fundamentals: Sydney at Informa Australia, 120 Sussex St, Sydney, 2000, Australia. Contact: Informa Australia, Informa, Level 6, 120 Sussex Street, Sydney, 2000, Australia. Phone: 61 2 9080 4050, Email: Info@informa.com.au, URL: http://atnd.it/6531-0,

08-11 November 2014, International Mini MBA Energy Transition and Innovation at The Netherlands. Contact: Thiska Portena, Energy Delta Institute, Netherlands. Phone: +31 (0) 88 1166827, Fax: +31 (0) 88 1166899, Email: portena@energydelta.nl, URL: http://www.energydelta.org/mainmenu/executive-education/executive-master-programmes/international-mini-mba-energy-transition-and,

10-11 November 2014, Annual Americas Iron Ore Conference at Windsor Atlantica, Brazil. Contact: John Wilson, Annual Americas Iron Ore Conference, Informa Australia, Avenida Atlntica 1020 - Leme, Rio de Janeiro, RJ, 22010-000, Brazil. Email: info@informa.com.au, URL: http://atnd.it/13086-0,

IAEE INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
WWW.IAEE.ORG

IAEE ENERGY FORUM
Volume 23, Fourth Quarter, 2014

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 4100 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
Hanover, PA
Permit No. 4