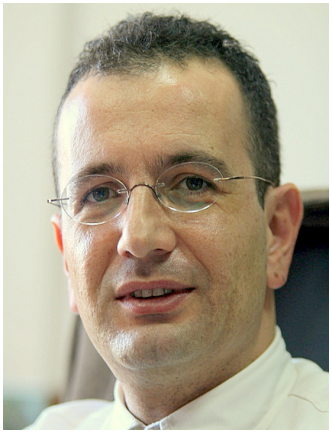
IAEE Energy Forum

Third Quarter 2016

International Association for Energy Economics

President's Message



It is time for our 39th International Conference to be held on June 19-22 at the Norwegian School of Economics in Bergen; such a great pleasure to be back in Norway after 22 years. A pre-conference summer school, three pre-conference workshops, seventy-one concurrent sessions, nine plenary sessions, two post-conference technical tours and rich social events guarantee that there will be a flavor for every taste at this conference entitled Energy: Expectations and Uncertainty.

Our next conference after Bergen will take place on August 28-31 at the Hilton hotel in Baku under the subject Energy Economics Emerging from the Caspian Region: Challenges and Opportunities. It is an exciting venture for us as we're starting a new regional conference series in Azerbaijan. With sixteen concurrent sessions, four plenary sessions, a post-conference workshop, technical tour and rich social events the 1st IAEE Eurasian Conference promises to be a success. It is planned as a typical regional conference, smaller boutique scale at very high quality with a speaker composition including top notch names from the Middle East to which the IAEE family has not been introduced before. Some examples are Dr. Mohammad Hossein Adeli, the Secretary General of the Gas Exporting Countries Forum based in Qatar; Dr. Davood Manzoor, the Secretary General of the World Energy Council Iran National Committee; Minister Dr. Nurkhanbek Momunaliev, the Head of the Government Administration of the Kyrgyz Republic. Of course, there are top speakers from Azerbaijan as well to whom the IAEE family has not been introduced, e.g., the VP of the State Oil Company of Azerbaijan, SOCAR, the Vice Chairman of the State Agency for Alternative and Renewable Energy and many others. As such this new regional conference provides a unique networking opportunity, adding to our stable of well-established conferences, and providing an outreach into an energy-rich region where IAEE is under-represented. It is our hope that this conference will trigger a new regional Affiliate in Central Asia.

Implications of North American Energy Self-Sufficiency is the subject to our 34th North American Conference to be held in Tulsa, OK on October 23-26. The shale revolution in the United States with its implied production turnaround has indeed shaken world energy markets. I would like to share my thoughts on this topic:

The first international shipment of LNG from the Lower 48 states, liquefied natural gas extracted from shale formations, left the export terminal in Louisiana on February 24 destined for Brazil. The first American shale gas shipment to Europe arrived in Portugal recently. In fact, Portugal and Iberia account for nearly half of all LNG imports to Europe and, in my opinion, emerge as an ideal location to become a gas hub in the southwest corner of Europe. However, pipeline links to the rest of Europe are underdeveloped and infrastructure investments are needed to supply the rest of Europe with American gas via Portugal and Iberia. These investments to establish

(continued on page 2)

IAEE
WWW.IAEE.ORG
International Association for Energy Economics

CONTENTS

Editor: David L. Williams

President's Message (continued from page 1)

missing cross-border links between the Iberian Peninsula and the rest of **the EU energy market** will contribute to building a single internal market where energy flows freely without any fragmentation. We will see American LNG exports grow rapidly with terminal capacities increasing over the next years. American shale gas presents a new source featuring diversification of supply for buyers and contributing to competition in the gas markets. As such, consumers benefit from cheaper gas prices while countries benefit from enhanced supply security.

Similar to the case of gas, the decline in oil prices has been a result of global oversupply resulting primarily from unconventional oil production in the U.S. coupled with weak global demand. Low prices have reduced profitability and investment in the sector, which has led to a decline in the number of rigs drilling for oil in the U.S. The drop-off in drilling has had little effect on U.S. crude production so far and U.S. stockpiles of crude oil still stand near the highest level in more than 80 years, but it is expected that the decline in production will continue. This may lead to a temporary increase in prices. Temporary because, as prices go up, investment in oil rig drilling and hence production will increase again leading to a downward pressure on prices. Also, there are good prospects for increased supply outside the U.S. Canadian oil sands production will return. After the lifting of sanctions, if the agreement terms are not violated, Iranian oil production shall return to world markets as well. Moreover, there are significant shale reserves worldwide, e.g., China and Argentina possessing reserves comparable to the U.S. All these facts keep expectations of an oil price rise limited, and major oil producing countries like Saudi Arabia feel the need to adapt to an era of lower oil prices.

Gurkan Kumbaroglu

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

LNG is a popular subject. Member response to our call for articles has been very gratifying...enough so that we're making two issues on the subject. So if you have submitted an article, it's been accepted and you don't see it here, look for it in the fourth quarter issue. Though there is some duplication among these LNG articles, we present them all as each has a unique thought within it. Interspersed among the LNG articles in this issue are a number of other articles which we're sure will be of interest.

Steven Nadel notes that in the past year, a number of papers from economists have questioned the effectiveness of energy efficiency programs and policies. Too often they miss the mark because they miss some key issues in the programs they are evaluating or they seek to overgeneralize their findings. He suggests how economists and energy efficiency practitioners can better avoid these past problems, better understand each other, and better work together.

Mark Finley and Arminé Thompson provide an overview of the 2016 BP EconomicEnergy Outlook. The Outlook considers what current conditions may tell us about the future of global energy markets over the next 20 years. The Outlook includes a clear base case, a review of past revisions to the Outlook and a series of alternative cases exploring key uncertainties.

Yukari Niwa Yamashita reviews Japan's Institute of Energy Economics 2015 Outlook, noting that there are three important messages contained therein. The most significant one is probably that related to the magnitude of the energy situation in Asia. The second interesting observation relates to the possibility of long-lasting low energy prices. Finally, is a discussion of the issues related to climate change and the proposal of a pragmatic approach on ths.

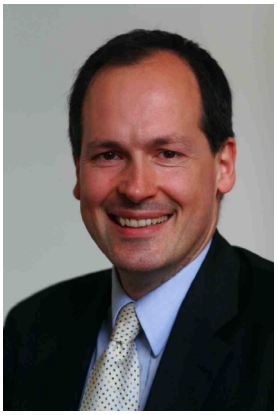
Ronald Ripple notes that the United States has the capacity to meet domestic natural gas demand and sufficient additional volumes to support a significant export industry. However, the opportunities also come with significant market-based challenges that may well constrain the rate of export expansion and the ultimate size of the export industry.

Michelle Foss and Gürcan Gülen suggest that North American natural gas prices will likely increase while global LNG prices will be under strong downward pressure until the early 2020s even if oil prices recovers sooner. The U.S. could well find itself serving as host for surplus LNG.

Fabian Stähr and Reinhard Madlener use the Global Gas Model (GMM) and various scenarios, to investigate the gas supply situation in Eastern Europe (Poland, Baltic States, Ukraine) and in particular the impacts of a geopolitically motivated subsidizing of U.S. LNG exports to that region on trade patterns and gas supply diversification.

DLW

EEEP's New Editor-in-Chief Speaks to the IAEE Membership



I thank the Nominating Committee for the nomination, and Council for its unanimous endorsement, in offering me the opportunity to assume the editorial leadership of our journal, *Economics of Energy and Environmental Policy*, effective in September 2016. I will benefit from the ground-breaking work of the superb initial team led by Jean-Michel Glachant, Paul Joskow and Michael Pollitt. I will also have the opportunity to nominate some new editors and members of the Editorial Board, and I count on receiving recommendations from the membership that will maintain a highly-qualified, diverse, and responsive group of professionals we can all count on to ensure that each issue of EEEP is first-rate.

Once back at full strength, we must of course maintain the quality of the contributions, while also reaching out to all potential authors in industry, government, and academia alike. With the SSCI-rating coming up, EEEP enters into a next phase, so this is a good time to strengthen its position in the segment of energy and environmental policy journals.

EEEP has established a solid balance, at the nexus between "energy" and "environmental" policy, but I see the possibility to enhance the environmental coverage of the journal, i.e. to strengthen the third "E." Environmental policy issues are evolving rapidly, both at the global scale (climate, water, etc.) but also at the regional and local scale, with issues such as NOx, dust, health issues, and local environmental pollutants.

I would also like to extend the outreach of the journal to emerging markets in Asia, Latin America, and Africa, as these regions feature significant growth rates, not only of GDP and energy consumption, but also with regard to the precursors of environmental issues. Experts from these regions should become more involved not only in the authorship of papers, but also in the editorial board.

In the meantime, I encourage all researchers on energy and environmental policy, and in particular IAEE Members, to consider "EEEP" for the submission of their papers!

Prof. Christian von Hirschhausen, TU Berlin, and DIW Berlin
March 2016

Why Economists and Energy Efficiency Practitioners Need to Work Together to Iimprove Energy Efficiency Programs

By Steven Nadel

INTRODUCTION

In the past year, a number of papers from economists have questioned the effectiveness of energy efficiency programs and policies. We have reviewed many of these studies and in general find that some of these studies have useful lessons, but too often they miss the mark because they miss some key issues in the programs they are evaluating, or they seek to overgeneralize their findings to programs very different from the ones they evaluated. These issues are discussed extensively in another paper.[1] But rather than a tit-for-tat debate, it is important to go past some of these details and look more broadly at how economists and energy efficiency practitioners can better avoid these past problems, better understand each other, and better work together.

Steven Nadel is Executive Director of the American Council for an Energy-Efficient Economy (ACEEE), a non-profit research group specializing in programs and policies to reduce energy waste and improve energy efficiency. He may be reached at snadel@aceee.org .

See footnotes at end of text.

THERE IS MUCH TO LEARN

First, we admit that not all energy efficiency programs are stellar. It's critical to have good evaluation to help tell what is working well and what needs improving. For example, one of the useful findings from the recent but controversial Fowlie et al. evaluation of the low-income weatherization program in several Michigan communities is that the energy audits in this program were overestimating the energy savings that can be achieved.[2] Fortunately, as Amann recently wrote, other research has found that calibrating audits to actual energy bills can do much to address this problem.[3] This is an example of how identifying a problem can help lead to solutions.

Similarly, Houde and Aldy find that net energy savings are very small when a program promotes efficient products that already have high market share. They found that incentives for ENERGY STAR® refrigerators, clothes washers, and dishwashers did not have much impact, estimating that, depending on the product, free riders were 73–92% of program participants (free riders are customers who take the rebate but would have made the same purchase decision without the rebate). Free riders were high because, as Houde and Aldy note, ENERGY STAR market share was 46–75% of product sales prior to the program.[4] I have noted this issue previously and suggested that qualifying efficiency levels for rebates and other incentives be set at levels with only a modest market share.[5],[6] However this advice was not followed when DOE and states developed their appliance rebate program. When so many products qualify without incentives, the majority of participants will be free riders that contribute to program costs but not energy savings. Houde and Aldy find that the program did not save much energy, so hopefully this lesson will be better recognized in the future.

GETTING BEYOND PARADIGMS TO DISCOVER THE TRUTH

There is a tendency, in both the economics and energy efficiency communities, to work from established paradigms and work with colleagues who share similar views. When the two communities meet they often talk past each other. There is a need for both sides to better understand where the other side is coming from, and to explore opportunities to find a middle ground.

For example, many economists look for rigorous evaluation, preferring what they call the "gold standard": randomized control trials in which a large group of potential participants is randomly assigned to either a study or control group. But randomized control trials can be very difficult to implement, as Angus Deaton, the most recent recipient of the Nobel Prize in Economics has discussed.[7] This is particularly a problem for full-scale programs in which everyone is eligible and random assignment to a control is not possible.

The Fowlie et al. study illustrates this issue. In their various materials they discuss how they "administered a randomized controlled trial (RCT)—considered the gold standard in evidence—on a sample of more than 30,000 WAP-eligible households in the state of Michigan".[8] However a review of the details of their study shows that many of these (more than 20,000) were a control group, 7,549 were encouraged to get weatherization, and 2074 homes were weatherized. Ultimately they were able to obtain data on 436 of their experimental homes, which was too small a sample to get useful statistics from their RCT experiment. To improve the statistics they included an additional 1,473 weatherized homes that were

not part of their RCT sample.[9] Ultimately, their energy savings results come not from an RCT, but from the quasi-experimental approach that is extensively used in energy efficiency evaluation.

On the other hand, the energy efficiency community in recent years has increased use of "deemed savings estimates," since these are easier to use and provide certainty for program implementers. Deemed savings estimates are supposed to be based on prior evaluations, but these evaluations are not always as rigorous or frequent as would be ideal. Perhaps the two sides could agree on more frequent "quasi-experimental" studies that carefully select a control group that is not randomized. And when pilot studies are conducted, randomized control trials should be considered.

Likewise, economists generally believe in the power of markets and have a tendency to believe consumers make rational decisions and to minimize the presence of market barriers that can cause markets to perform sub-optimally. Such beliefs can effect results. For example, Krupnick et al. find that building, lighting, and appliance standards have a cost of $60 per ton of carbon reduced when calculated using a 20% discount rate, a rate determined from studies of consumer decisions assuming there are no market barriers. But this cost declines to $7 per ton with a 5% discount rate (roughly the consumer cost of capital).[10]

On this issue it is also important to point out that the choice of discount rate should not be based on purchaser decision making alone. For example, many utilities operate energy efficiency programs because energy efficiency is less expensive than building a power plant. In this case the appropriate discount rate is probably the cost of capital for building a power plant (currently about 5% real). Use of a 20% discount rate would severely distort the analysis, resulting in very little efficiency investment and hence the need to build more power plants, raising electric rates for all customers.

THE NEED TO BE OBJECTIVE

Both communities need to be fair and objective when they conduct studies, and not seek to bias the results or report valid results in a biased manner. Examples of tilting the field include studies that look at only costs but not benefits (e.g., Batkins[11]), include extra costs unrelated to energy efficiency (e.g., home repair costs, as included by Fowlie et al.[12]), leave out important costs such as changes in the value of products to consumers (a problem with some energy efficiency evaluations, as discussed by Gayer and Viscusci[13]), or are based on a simple cost–benefit framework without considering other goals that the programs might have beyond energy savings, such as in the case of the Weatherization Assistance Program, improving the health and safety of families[14] and in the case of the American Recovery and Reinvestment Act (the 2009 economic stimulus act), "job preservation and creation."[15]

Likewise, each program is different, and one problematic program should not call into question all the others, particularly dissimilar programs. A notable example of this problem is in the policy brief accompanying the Fowlie et al. study which overstates the findings, saying that "residential energy efficiency appears to be a poor investment on average."[16] This statement attempts to apply the results of a study on low-income weatherization in a few communities to all weatherization, regardless of location and home type, as well as to other residential programs such as those intended to reduce energy use of lighting or appliances, despite the fact that these other programs were not studied. Conclusions can only be generalized to similar programs.

GOING BEYOND SURPERFICIAL RESULTS

To be most useful, a study should not only look at what is happening, but also seek to understand why, and then make recommendations on ways the problems identified can be addressed.

A good example of looking beyond the superficial findings is a paper by Withers and Vieira. They compared the energy use of a sample of homes built to the 2009 Florida code with the energy use of a sample of homes built to the code in effect during 1984–1985. Previous building energy simulations by their colleagues had compared the 1984 and 2009 energy codes and predicted energy savings of about 50% for combined heating, hot water, and cooling energy use. But when Withers and Vieira compared actual energy consumption of 1984 and 2009 homes for these end uses, they found only a 7–13% difference (varying depending on what specific data they used).[17] Given such data, less rigorous researchers might have concluded that the Florida building code was not working well. Fortunately, Withers and Vieira were very scrupulous and realized that to fully evaluate this code, they had to look at more than energy consumption data. They decided to dig deeper, collecting and comparing detailed data on the homes. They found a number of factors that helped explain the lower-than-expected energy savings:

- In the old homes, much of the equipment (furnaces, air conditioners, water heaters, and appli-

ances) had been replaced, and the new equipment was much more efficient than the requirements in the 1984 code. The authors attribute the changes to appliance efficiency standards, energy efficiency programs, education efforts, and higher energy prices.
- The older homes had more attic insulation on average than was required by the 1984 code.
- Temperatures in the older homes averaged about 1°F higher during the summer and about 0.6°F colder during the winter. In other words, some of the new code's benefits were being taken in the form of slightly increased comfort.
- A somewhat warmer-than-normal winter affected the data on actual energy use.
- The newer homes had more miscellaneous energy loads (gadgets).

Interestingly, code compliance was not a significant factor. The authors found a 90% compliance rate and estimated that the out-of-compliance items resulted in an annual impact on energy use of 1% or less.

Withers and Vieira then ran the energy use simulations again to compare the homes adjusting for these factors. The first factor (subsequent upgrades to appliances and equipment) was the most important, but, accounting for all the factors, the revised simulated energy use of the new homes was 9% lower than the older homes, near the midpoint of the 7–13% difference they found in actual energy consumption data.

The authors conclude that "[the code] has made a significant difference, but measured savings compared to older homes 25 years after construction are decreased by years of home improvement efforts."

COMBINING SKILLS TO CREATE THE BEST RESEARCH POSSIBLE

So how can we better work together? First, rather than each community conducting separate studies, perhaps economists and energy efficiency practitioners can jointly work together on some studies, as each profession brings useful skills, perspectives and information.

Economists tend to be good at research methods and statistics but they don't always understand the markets they are evaluating. A good example of this problem is a study by Levinson on the California residential building code. Levinson (2014) sought to examine energy savings from California building codes. To do this he examined electricity consumption data. However, building energy codes in the United Sates primarily address energy used for space heating and air conditioning, with some impact on water heating energy use. In California this mostly means that codes would affect natural gas and not electricity use; a study prepared for the California Energy Commission[18] found that 93% of California homes are heated with gas and only 5% are heated with electricity. Likewise it found that 87% of homes have gas water heating and only 7% use electricity for water heating. Thus, Levinson's analysis of electricity use missed most of the energy use that the California code is designed to save. And while codes affect air conditioning energy use, in California, with its mild climate, air conditioning energy use is modest. Nadel estimated that even if the California code worked as well as expected, home electricity use would be reduced by only about 1%, a very small change to find in a statistical analysis.[19] By coupling economists with knowledgeable practitioners, problems such as these can be avoided.

Energy efficiency practitioners generally have a deep understanding of the programs being evaluated but sometimes are not as good at research methods. Also, at times energy efficiency professionals can be too close to the programs they evaluate and seek to minimize problems. For example, as discussed earlier, it took independent researchers to point out problems with audit accuracy in the Michigan Weatherization Assistance Program. Having an objective co-researcher can avoid these problems and make results more credible.

More generally, both groups have their biases (in favor of markets and programs respectively) but by working together they can act as a check on each other's biases.

Likewise, it would be useful to have the other community review studies before they are published, thereby allowing problems to be identified and corrected before publication. Such reviews are particularly important before seeking press coverage. Several recent studies sought press coverage before they were vetted with efficiency experts,[20] giving black eyes to both energy efficiency and the researchers.

Also, generally, good practice in evaluation research is to reference other studies that look at similar programs and to discuss how the findings in a study compare to findings in these other studies. Some of the recent studies that critique energy efficiency programs fail to even note other reputable studies that contradict their findings (e.g., Levinson[21] is particularly notable in this regard as discussed by Nadel[22]).

POTENTIAL RESEARCH AREAS TO EXPLORE TOGETHER

If the economics and energy efficiency communities want to work together, what would be worth studying? Many of the recent critical studies have been of programs that energy efficiency experts have

found to be relatively expensive, such as residential weatherization (particularly low-income weatherization) and residential new construction (see Table 1). It would be useful to have joint studies on some of the less-expensive program types.

Sector and program type	Average cost (cents per kWh saved)
Low-income	14.2
Other residential	3.3
New construction	11.1
Whole-home retrofit	9.4
Multifamily	7.1
Behavior/normative feedback	5.7
Prescriptive	5.4
Consumer product rebates	2.1
Commercial and industrial	5.5
MUSH* and government	8.5
Small commercial	6.3
Custom	5.2
Prescriptive	4.5
New construction	4.2
All sectors	4.6

This table summarizes the results of hundreds of programs; an array of approaches was used to evaluate these different programs.

* MUSH is municipalities, universities, schools, and hospitals.
Source: Hoffman et al.[23]

Table 1. Total Cost of Saved Energy by Sector and Program Type

Another area worth exploring together might be the benefits of programs beyond energy savings. For example, a recent nationwide evaluation of the DOE Weatherization Assistance Program found large benefits beyond energy savings.[24],[25] Greenstone and Wolfram take issue with some of their estimates,[26] indicating an area where further work is needed.

CONCLUSION

Energy efficiency programs can have important benefits, but like any type of program and policy, should be regularly evaluated. Both economists and energy efficiency practitioners have complementary expertise that can contribute to good evaluation – the two groups should work together more. Such studies should look at what is happening and what works and to make recommendations on how programs can be improved to work even better in the future.

Footnotes

1 Nadel, S. 2016. Critiques of Energy Efficiency Policies and Programs: Some Trust But Also Substantial Mistakes and Bias. Washington, DC: ACEEE. aceee.org/critiques-energy-efficiency-policies-and-programs.

2 Fowlie, M., M. Greenstone, and C. Wolfram. 2015a. "Do Energy Efficiency Investments Deliver? Evidence from the Weatherization Assistance Program." econresearch.uchicago.edu/sites/econresearch.uchicago.edu/files/paper_draft_06_15_clean.pdf.

3 Amann, J. 2015. "Lower Savings than Predicted? Try Calibration." ACEEE blog, October 30. aceee.org/blog/2015/10/lower-savings-predicted-try.

4 Houde, S., and J. Aldy. 2014. Belt and Suspenders and More: The Incremental Impact of Energy Efficiency Subsidies in the Presence of Existing Policy Instruments. Washington, DC: Resources for the Future. www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-14-34.pdf.

5 Nadel, S. 1991. "Electric Utility Conservation Programs: A Review of the Lessons Taught by a Decade of Program Experience." In E. Vine and D. Crawley, eds., State of the Art of Energy Efficiency: Future Directions (Washington, DC: ACEEE).

6 Nadel, S. 2009. "Matching Grants to States for Appliance Rebates." Policy brief. Washington, DC: ACEEE.

7 Ogden, T. 2015. "Experimental Conversations: Angus Deaton." October 13. medium.com/@timothyogden/experimental-conversations-angus-deaton-b2f768dffd57 - .ypk5gthyd.

8 See epic.uchicago.edu/news-events/news/do-residential-energy-efficiency-investments-deliver.

9 Fowlie et al. See note 2.

10 Krupnick, A., I. Parry, M. Wells, T. Knowles, and K. Hayes. 2010. Toward a New National Energy Policy: Assessing the Options. Washington, DC: Resources for the Future. www.rff.org/files/sharepoint/Documents/RFF-Rpt-NEPI Tech Manual_Final.pdf.

11 Batkins, S. 2015. "The Department of Energy: Under-the-Radar, Overly Burdensome." American Action Forum, October 9. americanactionforum.org/research/the-department-of-energy-under-the-radar-overly-burdensome

12 See note 2.

13 Gayer, T., and W. Viscusi. 2012. Overriding Consumer Preferences with Energy Regulations. Fairfax, VA: Mercatus Center, George Mason University. www.ourenergypolicy.org/wp-content/uploads/2012/07/Energy_regulations_GayerViscusi_WP1221_1.pdf.

14 Caperton, R., A. James, and M. Kasper. 2012. "Federal Weatherization Program: A Winner on All Counts." Center for American Progress, September 28. www.americanprogress.org/issues/green/news/2012/09/28/39115/federal-weatherization-program-a-winner-on-all-counts/.

15 The beginning of the long title of this bill. See en.wikipedia.org/wiki/American_Recovery_and_Reinvestment_Act_of_2009.

16 Fowlie, M., M. Greenstone, and C. Wolfram. 2015b. Costs of Residential Energy Efficiency

Investments Are Twice Their Benefits: Implications for Policy. Chicago: Energy Policy Institute, University of Chicago. e2e.haas.berkeley.edu/pdf/briefs/weatherization_assistance_policy_summary.pdf. (Fowlie, Greestone, and Wolfram 2015b)

17 Withers, C., and R. Vieira. 2015. "Why Doesn't 25 Years of an Evolving Energy Code Make More of a Difference?" In Proceedings of the 2015 Behavior, Energy and Climate Change Conference. escholarship.org/uc/item/1128g46s.

18 Palmgren, C., N. Stevens, M. Goldberg, R. Barnes, and K. Rothkin. 2010. 2009 California Residential Appliance Saturation Study. Sacramento: California Energy Commission. www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-ES.PDF.

19 Nadel, S. 2015. "California Building Codes: To Analyze the Forest You Need to Understand the Trees." ACEEE blog, February 25. aceee.org/blog/2015/02/california-building-codes-analyze.

20 See e2e.haas.berkeley.edu/featured-eeinvestments.html and freakonomics.com/2015/02/05/how-efficient-is-energy-efficiency-a-new-freakonomics-radio-podcast.

21 Levinson, A. 2014. How Much Energy Do Building Energy Codes Really Save? Evidence from California. Cambridge, MA: National Bureau of Economic Research. www.nber.org/papers/w20797.

22 See note 1.

23 Hoffman, I., G. Rybka, G. Leventis, C. Goldman, L. Schwartz, M. Billingsley, and S. Schiller. 2015. The Total Cost of Saving Electricity through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector and Program Level. Berkeley: Lawrence Berkeley National Laboratory. emp.lbl.gov/sites/all/files/total-cost-of-saved-energy.pdf.

24 Tonn, B., D. Carroll, S. Pigg, M. Blasnik, G. Dalhoff, J. Berger, E. Rose, B. Hawkins, J. Eisenberg, F. Ucar, I. Bensch, and C. Cowan. 2014. Weatherization Works—Summary of Findings from the Retrospective Evaluation of the U.S. Department of Energy's Weatherization Assistance Program. Oak Ridge, TN: Oak Ridge National Laboratory. weatherization.ornl.gov/Retrospectivepdfs/ORNL_TM-2014_338.pdf.

25 Tonn, B., D. Carroll, E. Rose, B. Hawkins, S. Pigg, D. Bausch, G. Dalhoff, M. Blasnik, J. Eisenberg, C. Cowan, and B. Conlon. 2015. Weatherization Works II—Summary of Findings from the ARRA Period Evaluation of the U.S. Department of Energy's Weatherization Assistance Program. Oak Ridge, TN: Oak Ridge National Laboratory. weatherization.ornl.gov/RecoveryActpdfs/ORNL_TM-2015_139.pdf.

26 Greenstone, M., and C. Wolfram. 2015. "Are the Benefits of the Weatherization Assistance Program's Energy Efficiency Investments Four Times the Costs?" Energy Institute at Haas blog, October 6. Berkeley: Hass School of Business, University of California. energyathaas.wordpress.com/2015/10/06/weatherization-assistance-program/.

MEMBER GET A MEMBER CAMPAIGN A SUCCESS

Andrew Slaughter Wins Complimentary Registration to attend the

Bergen IAEE International Conference

IAEE's *Member Get a Member* campaign was a smashing success with 20 new members added in the January 1 to April 30 period.

Members had their membership expiration date advanced three months for each new member referred.

Amdrew Slaughter, Executive Director of Deloitte Services LP, referred the most new members. He won complimentary registration to the Bergen IAEE International Conference.

We encourage members to recommend their friends and colleagues to join IAEE.

"Energy Economics Emerging from the Caspian Region:

Challenges and Opportunities"

1st IAEE Eurasian Conference

28-31 August 2016, Baku, Azerbaijan

1st IAEE EURASIAN CONFERENCE
Energy Economics Emerging from the Caspian Region: *Challenges and Opportunities*
28-31 August,2016
Baku - Azerbaijan

The 1st IAEE Eurasian Conference will take place in Baku, Azerbaijan between 28 and 31 August 2016, and will focus on energy economic issues of the Caspian region.

Conference Program

Sunday, August 28

Registration

IAEE Council Lunch (by invitation)

IAEE Council Meeting (by invitation)

Student Happy Hour

Opening Reception

Monday, August 29

Welcome Speech

Opening Plenary Session: Global Energy Market Trends: Challenges & Opportunities

Concurrent Sessions 1-4 *(Energy Policy, Energy Demand, Oil & Gas Modelling-1, Electricity Market)*

Concurrent Session 5-8 (*Electricity Modelling, Oil& Gas Modelling-2, Energy Governance, Energy Security and Geopolitics-1)*

Gala Dinner

Tuesday, August 30

Plenary Session 1:Oil& Gas Price Dynamics and Expectations

Concurrent Sessions 9-12 *(Renewable Integration, Energy Security and Geopolitics-2, Renewable Energy Policy, Technical Scientific Considerations)*

Plenary Session 2: Regional Energy Security

Concurrent Sessions 13-15 (*Energy Efficiency, Oil Price Impact, Energy Regulation)*

Wednesday, August 31

Plenary Session 3:Regional Strategies to Alternative and Renewable Energy

Workshop: Developing a Competent Workforce for Today and the Future

Plenary Session 4:Unlocking Caspian Energy Potential

Tour to Sangachal Terminal of BP (optional)

Plenary Speakers:

Dr. Mohammad Hossein Adeli (GECF)

Natig Aliyev (Minister of Energy, Republic of Azerbaijan)

Prof. Kostas Andriosopoulos (ESCP Europe Business School &Greek Public Gas Corporation DEPA)

Bakhtiyar Aslanbayli (BP)

Prof. Georg Erdmann (Berlin University of Technology)

Prof. Ying Fan (Beihang University)

Ayşe Filiz Kolat (Statkraft Energy)

Prof. Gürkan Kumbaroglu (IAEE)

Dr. Erol Metin (SEM)

Dr. Tatiana Mitrova (ERI RAS)

Nurkhanbek Momunaliev (Minister of the Kyrgyz Republic)

Prof. Chijioke Nwaozuzu (University of Port Harcourt)

Azamat Oynarov (Public-Private Partnership Center of Kazakhstan)

John Roberts (Atlantic Council Dinu Patriciu Eurasia Center& Methinks Ltd)

Prof. James Smith (Southern Methodist University)

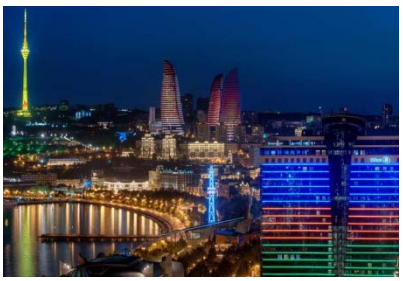
Dr. Vilayat Valiyev (Ministry of Economy and Industry Azerbaijan)

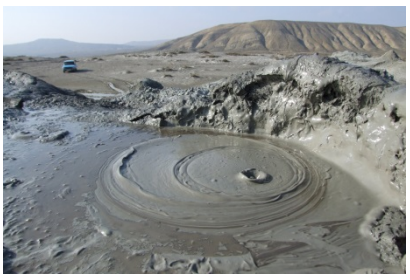
Prof. Nurali Yusufbeyli (State Agency for Alternative and Renewable Energy Azerbaijan

You can find all the information regarding the conference organisation (programme, registration fees, student scholarship funds, registration and accommodation forms and the social events) on the conference website http://www.iaeebaku16.org

Venue: Hilton,Baku

Accommodation: Enjoy European sophistication at Hilton Baku hotel that is situated 30 minutes from Heydar Aliyev International Airport, a short walk along the Caspian Sea Boulevard to the famous 12th-century city walls of Icheri Sheher. Make your reservation online by visiting: http://www.hilton.com (Enter our access/promotion code: GIAEE)





Greek Affiliate holds First Conference

"Vote of confidence" comes for Greece from institutions and key players in the energy market at the first energy market international conference organized by the Hellenic Association for Energy Economics (HAEE) the newly established Greek affiliate of International Association for Energy Economics.

The conference titled: "Energy Market: Unlocking Greece's Economic Potential" was held on Tuesday, March 22nd 2016 at the Intercontinental hotel in Athens. More than two hundred participants attended among which Presidents, CEOs and other executives from major companies of the international and local energy market. Representatives of international and European organizations were also there to give the institutions' perspective on current developments around the energy market.

During the conference, important perspectives were highlighted for the economic growth and the upgrade of Greece's geostrategic role in the EU and especially in southeastern Europe, both through the energy market. Despite the financing, legal and bureaucracy difficulties that occur in the country, key players in the energy market expressed their optimism for Greece's potential in the industry.

According to the President of the Technical Chamber of Greece, Mr. George Stasinos, in the next few years the energy market is estimated to produce around 40 thousand direct and indirect jobs in the country. Professor Dr. Kostas Andriosopoulos, president of HAEE, stated at his opening speech the key role that the energy field can play in the development and the growth of the Greek economy. Professor Dr. Gurkan Kumbaroglu, president of IAEE, highlighted the importance of the Southern Gas Corridor and said that the Greek/Turkish border emerges as a natural hub location where diversification, supply security and competitive pricing would be attained. The director of the office of the US Government for Europe, the western hemisphere and Africa , Mr. William Silkworth, stated that the US aren't turning against Russia but aim at ensuring a healthy competition and the market transparency so that there can be a decrease in prices that will benefit the consumers. The CEO of DESFA (Hellenic Gas Transmission System Operator), Mr. Konstantinos Xifaras said that this is a golden opportunity to make good infrastructure through the continued investments from the Independent Power Transmission Operator and DESFA, that will attract investment capitals either Greek or foreign for a balanced growth. The CEO of Attica Bank, Mr. Alexandros Antonopoulos mentioned immediate financing of mature projects in the field of Renewable Energy Sources and waste management, in the second half of this year. Finally, Mr. Anar Mammadov, CEO of Socar Energy Greece after mentioning important benefits of the TAP, he also said that he is looking forward to the completion of the takeover of the majority of DESFA, that is delaying due to objections on behalf of the EU.

The conference was followed by a dinner at the same venue, where attendants where given the opportunity to exchange opinions in private and – why not- lay the ground for future partnerships and deals. A special ceremony was held during the dinner, and IAEE president Prof. Dr. Gurkan Kumbaroglou awarded an honorary plaquette to HAEE's president, Prof. Dr. Kostas Andriosopoulos.

Spiros Papaeffthimiou

The 2016 Edition of the BP Energy Outlook

By Mark Finley and Arminé Thompson

EXECUTIVE SUMMARY

The *BP Energy Outlook* attempts to look beyond the here and now and consider what current conditions may tell us about the future of global energy markets over the next 20 years. While the long term outlook presents many uncertainties, three main themes are highlighted in this year's edition of the *BP Energy Outlook.*

First, global demand for energy is likely to continue to grow over the next 20 years. As the global economy expands, more energy will be needed to drive the higher levels of activity and living standards. The growth in energy will be reduced by faster gains in energy efficiency. While there is significant uncertainty as to how quickly global GDP will grow over the Outlook, and how rapidly energy intensity will decline, it seems clear that more energy will be required over the next 20 years to enable the world to grow and prosper.

Second, the fuel mix is likely to change significantly over the next 20 years, given a boost by the commitments made during the COP21 in Paris. Renewable energy is expected to grow strongly over the forecast period because of favorable environmental policies, improving technology and falling costs. Those same forces will support growth in natural gas, while the prospects for oil are likely to be less robust. Coal becomes the main loser as China rebalances towards a more sustainable economic growth path and a less carbon-fuelled economy.

Third, we expect a considerable slowing in the global growth of carbon emissions relative to the past 20 years. The rate of growth of carbon emissions is projected to more than halve over the Outlook period compared to the past 20 years. The slowing growth in carbon emissions reflects faster increases in energy efficiency and a shift towards lower-carbon fuels, both aided by the pledges made in Paris.

The value of the Energy Outlook is that it provides a consistent framework which can be used to explore and analyse the forces shaping energy markets over the next 20 years. This year's Energy Outlook also looks backwards and asks what events over the past few years turned out differently than what we expected. We also ask what are the key uncertainties over the Outlook and how might they turn out differently than expected. The Outlook includes a clear base case, a review of past revisions to the Outlook and a series of alternative cases exploring key uncertainties. More detail is available at www.bp.com/energyoutlook.

Mark Finley is General Manager of Global Energy Markets & US Economics at BP America; Arminé Thompson is an Oil Supply Economist with the firm. The BP Energy Outlook and a more detailed analysis including alternative cases can be found at www.bp.com/energyoutlook.

GLOBAL ECONOMIC GROWTH DRIVES ENERGY DEMAND OVER THE NEXT 20 YEARS

Over the Outlook, global economic growth is expected to increase by 3.5% per annum (p.a.), just slightly slower than growth over the past 20 year period. This equates to GDP roughly doubling over the Outlook. The increase in GDP is partially driven by population growth, however the vast majority, four-fifths, is driven by increases in productivity, especially in emerging Asian economies. China and India account for almost half of the projected increase in global GDP.

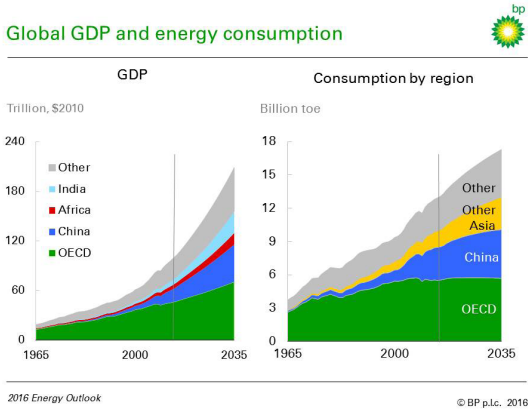


Chart 1

The growing global economy means that more energy is required. We expect energy consumption to grow by 34% between 2014 and 2035, or 1.4% p.a. for the next 20 years. Virtually all the growth in energy consumption is consumed in fast-growing emerging economies, while energy demand in the OECD barely grows. Global energy demand growth over the Outlook is slower than the recent past, reflecting both a sharp deceleration in China's energy demand as the country rebalances to a more sustainable pace and the plateauing in energy demand within the advanced economies. The sharp slowing in China's energy demand growth is partially offset by a pickup in other developing countries.

In an alternative case we explore what happens if Chinese GDP grows slower than expected (3.5% p.a. vs 5% p.a. in the base case). In this alternative case global GDP grows by a little less than 3% p.a. and global energy demand grows by just 1% p.a., slower than any 20-year period in history. Even in this case, however, energy demand still grows by almost 25% by 2035.

SIGNIFICANT SHIFTS IN THE GLOBAL FUEL MIX EXPECTED

The fuel mix is projected to evolve over the Outlook. Fossil fuels remain the dominant source of energy powering the global economy, providing 60% of energy growth over the Outlook. However, the share of fossil fuels in the global fuel mix declines from 86% in 2014 to 80% by 2035. Gas is the fastest growing fossil fuel, increasing by 1.8% p.a., and its share in primary energy gradually increases. Gas overtakes from coal as the second-largest fuel by the end of the Outlook. Coal suffers a sharp reversal of fortunes, with its growth slowing to just 0.5% p.a., such that by 2035 the share of coal in primary energy is at an all-time low. Oil grows steadily over the Outlook; however its share in primary energy declines slowly. Renewables are the fastest growing group of fuels, increasing by 6.6% p.a., over the Outlook, with their volume almost quadrupling. Their share in the fuel mix increases from 3% today to 9% by 2035.

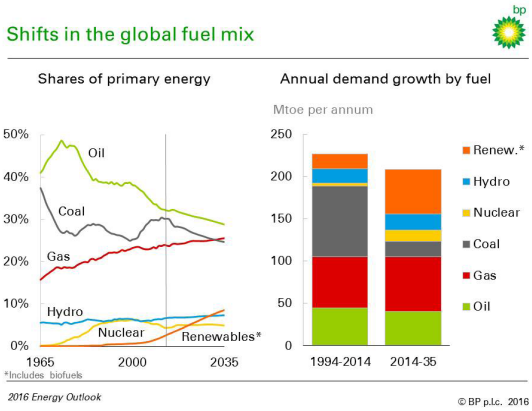


Chart 2

GROWTH IN EMERGING ECONOMIES DRIVE OIL CONSUMPTION

The judgment underlying the Energy Outlook is that the oil market gradually rebalances, with the current level of low prices boosting demand and dampening supply. Over the longer term, global oil demand increases by around 20 Mb/d to reach 112 Mb/d by 2035. Demand growth is concentrated in the emerging economies, with China and India accounting for over half the increase. Oil consumption in the OECD continues its secular decline, dropping by 5 Mb/d by 2035. Around two-thirds of the increase in oil demand reflects higher transport demand, as the number of vehicles outside of the OECD is expected to triple over the next 20 years to around 1.5 billion vehicles. The impact of this increase on fuel demand is partly offset by gains in vehicle efficiency, which is assumed to improve even more rapidly than in the past.

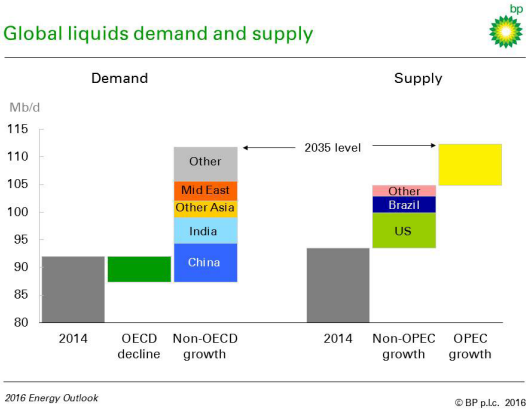


Chart 3

The increased demand for oil is met by increases in both non-OPEC and OPEC supply. Non-OPEC supply is projected to grow by 11 Mb/d and all the net increase comes from the Americas: U.S. shale, Brazilian deepwater and Canadian oil sands. In terms of OPEC, we assume the group acts to maintain its market share of around 40%, increasing production by 7 Mb/d by 2035.

As the market gradually rebalances, U.S. tight oil production returns to growth, rising by almost 4 Mb/d to reach just under 8 Mb/d by 2035 and account for around 40% of total U.S. production. North America is expected to continue to dominate global tight oil production, however during the last ten years of the Outlook, growth from the rest of the world accounts for half of the global increase. Global tight oil output reaches 10 Mb/d by 2035, but still accounts for less than 10% of all liquids production in 2035, compared to 5% today.

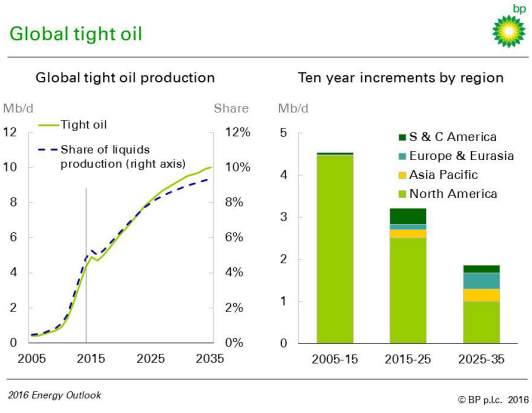


Chart 4

The strength of the U.S. shale revolution has continued to surprise and over the past three Outlooks we have revised up our forecast for U.S. tight oil and shale gas production. In an alternative case we consider a world where the resource base for both tight oil and shale gas are much larger than assumed in our base case and productivity is significantly higher. As a result, global tight oil production is 10 Mb/d higher than in our base case by 2035 and shale gas production is 75 Bcf/d higher. The implications of this supply shock for conventional supply and demand for oil, gas and other fuels are explored in the Outlook.

NATURAL GAS SUPPLIES GROW ROBUSTLY

Natural gas is the fastest growing fossil fuel over the Outlook.

Growth is driven by gas gaining market share relative to coal in the power sector and by its increased use in industry as emerging economies industrialize. The majority of natural gas consumption growth is from emerging economies, with China and India together accounting for around 30% of the increase and the Middle East over 20%. Demand growth in emerging markets is fairly evenly split between use in the industrial sector, as these economies continue to industrialize, and use for power generation. In contrast, growth in the OECD is more concentrated in the power sector.

Natural gas supply growth is roughly evenly split between increases in conventional production and shale gas. Much of the increase in conventional production is from the Middle East, China and Russia. Shale gas production grows by 5.6% p.a. throughout the Outlook, with the share of shale gas in total production increasing from just over 10% in 2014 to nearly a quarter in 2035. The growth in shale gas supply is dominated by North American production, which accounts for around two-thirds of the increase in global shale gas supplies. Over the Outlook, growth outside of North America expands, most notably in Asia Pacific and in particularly in China, where shale gas production reaches 13 Bcf/d by 2035.

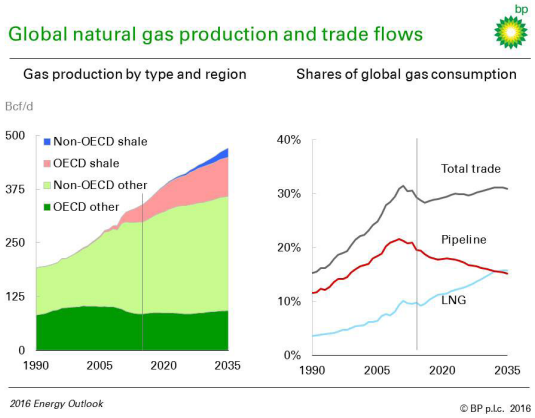


Chart 5

A key feature of the gas Outlook is the sharp increase in global supplies of Liquefied Natural Gas (LNG), which is expected to more than double over the Outlook. Over 40% of the increase in global LNG supplies is expected to occur over the next five years as a series of in-flight projects come online. This equates to a new LNG train coming on stream every eight weeks for the next five years. By 2035, LNG surpasses pipeline imports as the dominant form of traded gas.

COAL DEMAND GROWTH SLOWS SHARPLY

Coal suffers a sharp reversal of fortune over the Outlook, with demand growing by just 0.5% p.a. compared with almost 3% p.a. growth over the past 20 years. The slowdown can largely be attributed to the deceleration in China's coal consumption as its economy rebalances away from heavy industrial growth towards more consumer-led growth. China's demand for coal grows by just 0.2% p.a. over the Outlook; compared to growth of over 8% p.a. from 2000-14, and by 2030 coal consumption is in decline. Despite the slowdown, China remains the world's largest coal market, consuming half of global coal supplies in 2035. India shows the largest growth in coal consumption, overtaking the U.S. to become the world's second largest consumer of coal. Coal consumption is projected to fall sharply in the OECD countries due to a combination of cheaper natural gas and renewable energy, as well as stronger environmental regulation.

NON-FOSSIL FUELS GROW OVER THE OUTLOOK, LED BY RENEWABLES

Hydroelectric and nuclear energy are both projected to increase steadily, growing at 1.8% p.a. and 1.9% p.a. respectively. The period of unprecedented growth of hydro in China is coming to an end and China hydro is expected to grow at 1.7% p.a. over the Outlook, compared with almost 10% p.a. over the previous two decades. Brazil supplies the second largest increase in hydro power (after China), overtaking Canada to be the world's second largest hydro producer. China's nuclear output increases rapidly (11.2% p.a.) over the Outlook, more than doubling by 2020 and increasing nine-fold by 2035. Nuclear output declines in the EU (-29%) and North America (-13%), as ageing plants are gradually decommissioned and the economic and political challenges of nuclear energy stunt new investments. Japanese reactors are expected to restart over the next five years to reach 60% of their 2010 levels by 2020.

Renewables are projected to be the fastest growing group of fuels (6.6% p.a.), almost quadrupling over the Outlook. Renewables account for over a third of the growth in power generation, causing their share of global power to increase to 16% by 2035, from 6% today. The EU continues to lead the way in the use of renewable power. By 2035, the penetration of renewables in some OECD markets is expected to reach levels where the challenge of integrating intermittent sources into the power grid becomes an increasing constraint: for example, renewables are expected to account for more than a third of EU power generation by 2035. The rapid growth in renewables is supported by both government policy as well as expected cost reductions: the costs of onshore wind and utility-scale solar PV are likely to fall by around 25% and 40%, respectively, over the next 20 years.

THE CHANGING OUTLOOK FOR CARBON EMISSIONS

The growth of carbon emissions from energy use should slow significantly relative to the past, growing by 0.9% p.a. versus 2.1% p.a. over the past 20 years. Given that GDP is projected to grow just slightly slower than the historical trend, this represents a significant degree of 'decoupling' of carbon emissions from GDP. This decoupling reflects significant increases in the expected pace of decline of both energy intensity (energy used per unit of GDP) and carbon intensity (carbon emissions per unit of energy consumption).

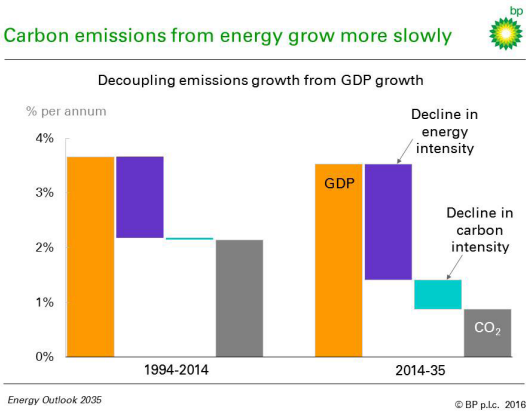


Chart 6

Energy intensity over the Outlook is expected to fall more quickly than in the past, declining by 2.1% p.a. from 2014 to 2035, compared to a decline of 1.5% p.a. over the past 20 years (which is already the fastest 20-year improvement in our data set). The shift in the fuel mix means that carbon intensity also falls far more quickly than in the past. Carbon intensity is projected to decline by 0.5% p.a. over the Outlook, compared to a decline of just 0.04% p.a. from 1994 to 2014. The world is embarking on a transition to a lower-carbon energy system. The agreements and pledges made during the COP21 meeting in Paris have increased our confidence that the world will achieve this break from past trends. Despite the slowdown in growth, emissions are projected to continue to grow by around 20% by 2035. A meaningful global price for carbon is likely to be the most efficient mechanism for responding to this challenge, since it provides incentives for greater improvements on both sides of the market: on the demand side, reducing energy intensity and on the supply side, reducing the carbon intensity of the fuel mix.

A major uncertainty to the Outlook is the speed of transition to a lower carbon world. This uncertainty is explored in an alternative case, where a carbon price reaches $100 per tonne in the OECD and other leading economies. Other policy and technology assumptions include tougher fuel efficiency standards in transport, and additional measures to drive significant gains in energy efficiency in industry and buildings. As a result, both energy intensity and carbon intensity are projected to decline at historically unprecedented rates in this alternative case. Emissions peak in 2020 and by 2035 are around 8% lower than their 2014 level. Energy demand still grows, but at around two-thirds of the pace in the base case; non-fossil fuels account for all of the net growth in global energy demand.

CONCLUSION

The demand for energy is likely to increase greatly over the next 20 years as the world economy expands and more energy is required to power higher levels of activity and rising living standards. Increased energy enables that growth. The rate of GDP growth and the pace of improved energy intensity are key uncertainties. The global fuel mix is likely to change significantly with coal losing ground, renewables gaining, and oil and gas combined broadly holding their own. And finally, the Outlook for carbon emissions is changing significantly; with emissions likely to grow far less quickly than in the past, but it is not changing quickly enough, suggesting the need for further policy action.

IEEJ's Asia/World Energy Outlook 2015

By Yukari Niwa Yamashita

ENERGY SITUATION IN ASIA

To better understand the conclusions reached in IEEJ's *Outlook*, it is important to understand that the *Outlook* is comprised of a few different scenarios, each providing a different point of view on future energy and environment policies. The *Reference Scenario*, for example, represents the core scenario for the *Outlook* and serves as the basis for comparison with the other scenarios. In the *Reference Scenario*, the future is developed according to past policies currently in place. The scenario incorporates traditional and conventional policies and rejects any assumptions for aggressive energy conservation or low-carbon policies.

In terms of economic expansion, all scenarios assume that Asia and Africa are projected to grow at 4.3% per year, while the Middle-East and Latin America are expected to grow at 2.7% per year, slightly less than the world average assumed at 2.9%. Accordingly, IEEJ's *Reference Scenario* suggests that world energy demand will increase from about 13,600 Mtoe in 2013 to 19,000 Mtoe in 2040, an increase close to 40% in 27 years. Projections for Europe, North America and Oceania show energy demand in those regions to remain relatively unchanged during the period. On the other hand, annual demand increases at slightly more than1.8% in Asia, Africa, the Middle-East and Latin America. Given that Asia's demand in 2013 was about 6,000 Mtoe (almost one third of world demand), 1.8% per year means that 60% of the global increase (5,500 Mtoe) will be accounted for in Asia and the rest of the increase will occur in the other 3 non-OECD regions.

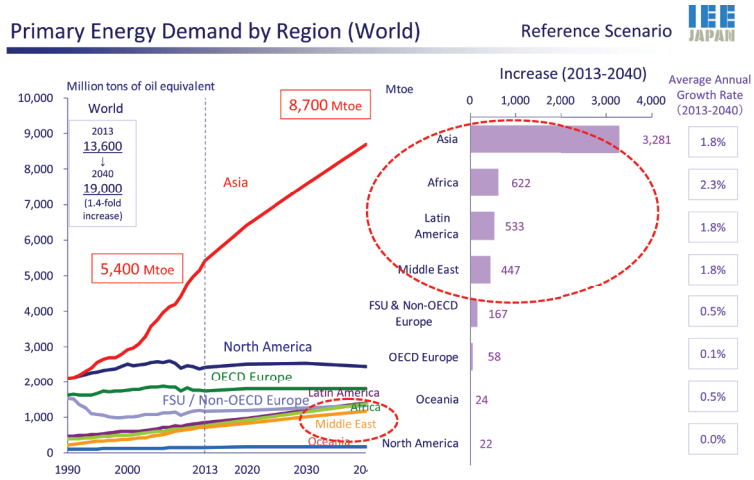
Using the same economic growths, an *Advanced Technologies Scenario* is developed where the world strongly implements energy and environment policies, contributing to a secure and stable energy supply and enhancing climate change measures. The projection is based on the assumption that the best technologies for both the supply and demand sides will be introduced where possible. The policies' effects are, therefore, maximised.

In such scenario, the transportation sector lowers its oil requirements by more than 10% relative to the *Reference Scenario* with more stringent regulations or switching to clean energy vehicles. With regard to electricity, demand is substantially reduced with the adoption of policies and measures on energy efficiency while, from a supply perspective, the introduction and support for more renewables and nuclear energies lowers the need for fossil fuels (mainly coal) generation. Although coal use would remain the number 'one' fuel in Asia, its consumption could be reduced by about 30% under this scenario, either due to more efficient generating technologies or the fuel switch to less or non- emitting fuels such as natural gas or renewables.

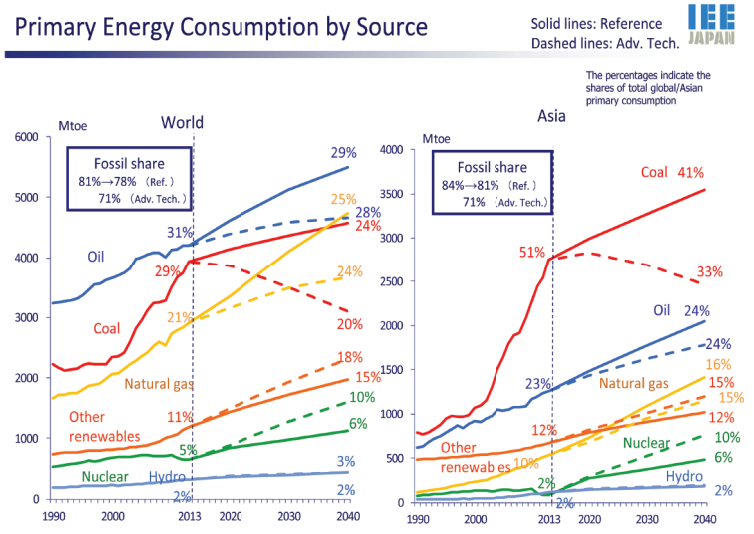
The fuel choice is often related to domestic availability and a price advantage. For Asia, coal

Yukari Niwa Yamashita is Director of Japan's Institute of Energy Economics. This article is adapted from her presentation at the 5th IAEE Asia Conference in Perth, Australia, in February of this year.

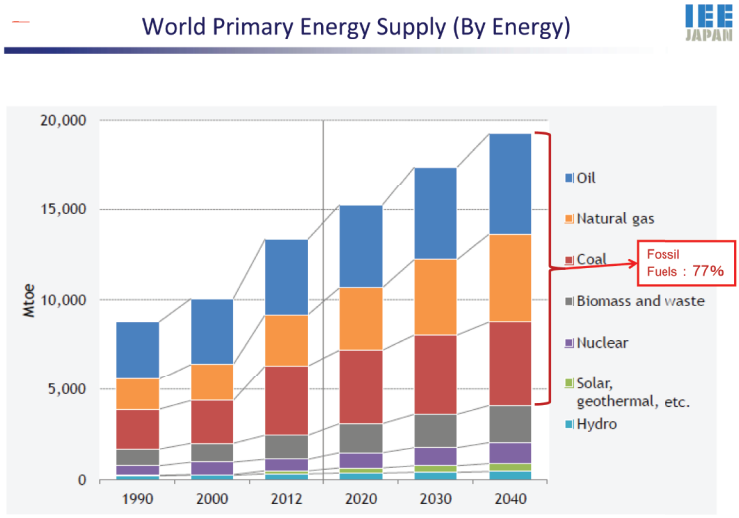
See footnote at end of text.



Source: IEEJ, Asia/ World Energy Outlook 2015



Source: IEEJ, Asia/ World Energy Outlook 2015



Source: Institute of Energy Economics, Japan, Asia/World Energy Outlook 2015

is chosen because of its availability within the region; with a self-sufficiency rate of about 90%. The self-sufficiency rate for natural gas is 60% and for oil around 18%. Both China and India follow the same pattern.

In the *Reference Scenario*, with the absence of stringent energy and environmental policies, fossil fuels are expected to fulfill slightly below 80% of the world energy mix by 2040. Despite all the talk on the benefits of renewables and push for carbon-free societies, which were incorporated into the *Advanced Technologies Scenario*, the need for fossil fuels by 2040 drops only slightly to reach 71% in the world as well as in Asia.

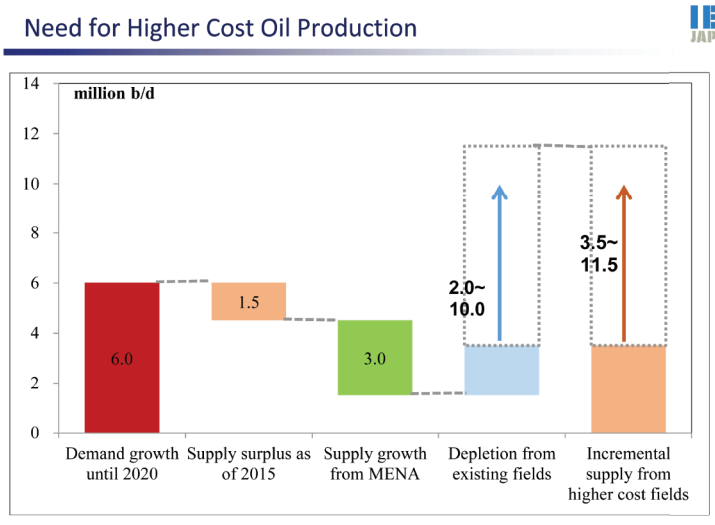
The reality is that the world will depend on fossil fuels for many years to come with strong implications regarding greenhouse gas emissions.

LOWER PRICES FOR ENERGY

In any market (including futures market), prices are based on expectations among market participants in regard to four factors – demand, supply, risks, and finance. This means that in the oil market, factors other than pure supply and demand can play important roles in forming oil prices.

For example, geopolitical related risks generally influence upward swings in oil prices. Some of the current risks include militants operating in Iraq and Syria, the Ukraine-Russia conflict, or even the return of Iran to the international oil market scene. In addition there are financial and speculative factors that have been growing more important over recent years with open interest for crude futures. Such an increase indicates that crude oil futures are viewed as an investment "commodities" in the world's financial markets. Unlike geopolitical risks, the financial and speculative factors effects on prices are difficult to predict.

Our estimation indicates that the spiking in oil prices in 2011 responded more to geopolitical or speculative factors rather than those related to supply and demand fundamentals. Of course, those risk factors continue to exert upward pressures on current prices but to a much lower extent; the abundant supply relative to demand is more than counter-balancing. In a way, the current reading of the market is back to basics with supply by far exceeding demand. It is believed that the shale revolution has brought more supplies than required to the international oil market where demand was weakened by slower economic growth in China and a stagnant EU economy creating a supply surplus position of more than 1 Mb/d.



Source: Prepared by IEEJ based on IEA data and others

Lower prices have been observed in the past. During the 80s, prices dropped in response to an overall demand decrease while supplies from non-OPEC sources were on the rise (the result of a prior period of high prices). The price plunge was not induced by demand but by supply as traditional oil suppliers, especially OPEC countries, competed for market shares and over supply continued. The other two cases of 'supply exceeded demand' were induced by lower demand caused by economic shocks, namely, the Asian financial crisis and the Lehman Brothers shock.

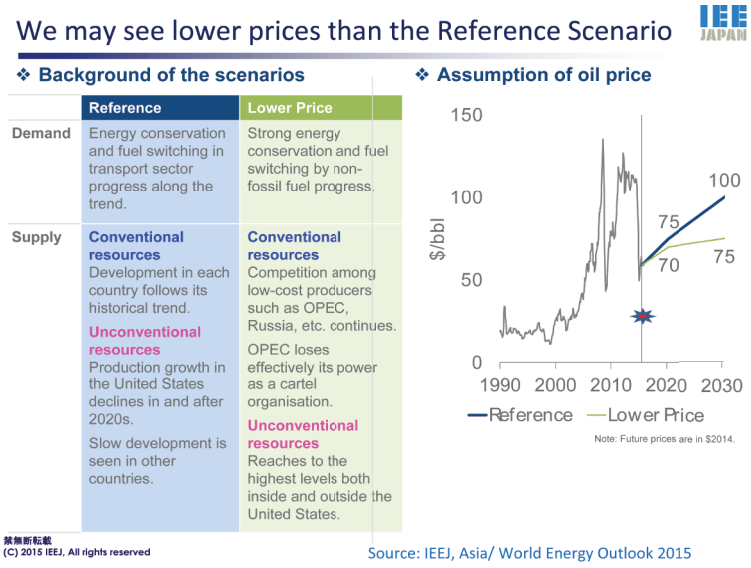
In previous *Outlooks*, the projection of future oil prices was done under the assumption that oil prices will follow an upward trend over a medium to long term because global oil demand is generally expected to continue growing in the future. Higher-cost oilfield development will, therefore, have to be implemented to make up for a decline in production from currently operating oilfields and secure

new oil supply sources to satisfy the increasing demand.

If global oil demand increases at an annual average pace of 1.2 million barrels per day (Mb/d), the cumulative demand expansion through 2020 will be 6 Mb/d. At present, the international oil market's surplus is estimated as exceeding 1.0 Mb/d. Consequently, even with expected additional production from MENA, some higher-cost oil production will soon be required to fulfil the emerging gap. It is IEEJ's estimate that oil prices should be expected to rise to $75/bbl in 2020. In and after 2020, a continued expansion in demand and relevant investment (including investment in higher-cost oil production) could continue to exert upward pressure on oil prices, leading oil prices to exceed $100/bbl in 2030.

In the *Lower Price Scenario* where the current situation is reflected, the oil price will reach $75 only by 2030.

On the demand side for the *Lower Price Scenario*, efficiency and productivity will continue to improve while U.S. shale oil output will reach 5.5 Mb/d in 2020 despite lower prices. In the meantime, with technology advancement, shale oil development will spread widely in other countries, leading global shale oil output to rise to 8.9 Mb/d in 2030. Due to a possible escalation of rivalry among OPEC members, the cartel may no longer work effectively and OPEC's influence on the crude oil market will remain very limited. Later, upstream oil development investment will expand in African oil producing countries, further increasing global supply.



Source: IEEJ, Asia/ World Energy Outlook 2015

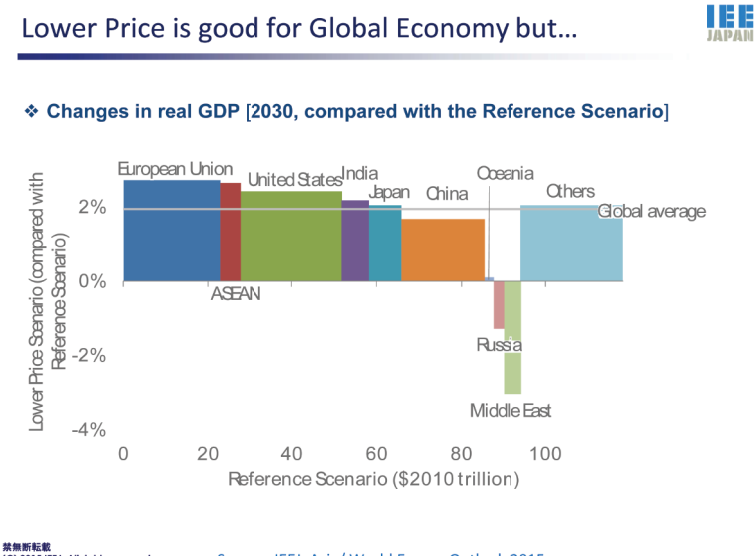
Based on the above, the supply-demand balance will stay structurally loose and risk factors will exert less influence in the crude oil market. The background to this scenario is slack demand combined with a substantial expansion in crude oil production; progress in the shale revolution as well as growth in production from Iraq, Iran and other members of OPEC. Consequently, in the *Lower Price Scenario*, prices will be limited to $75/bbl in 2030 with the next question related to prices for the medium and long term.

As oil demand is restricted and as real crude oil prices are set at 25% lower than in the *Reference Scenario*, the net value of crude oil imports and exports in the *Lower Price Scenario* will be far less than in the *Reference Scenario*. An oil price fall will directly invigorate net oil-importing economies by reducing their income outflow and raising their real purchasing power. On the other hand, such an oil price drop will work to shrink net oil-exporting economies.

China will benefit the most from a decline in crude oil import costs. The drop in import costs from the *Reference Scenario* in 2030 will be $217 billion. Lower energy prices, fuel switching to natural gas and lower domestic demand are contributing to the decline in the cost of China's crude oil imports. The United States is the second largest beneficiary from a drop in the value of crude oil imports. For most of the other crude oil importers, the lower levels of prices capture the greatest share of the drop in the cost of crude oil imports.

Meanwhile, by 2030, Middle Eastern oil producing countries' net exports are valued at $457 billion less than in the *Reference Scenario*. The decline will become a major economic downside factor for oil producing countries. The net value of crude oil exports will be $148 billion less for Russia and $115 billion less for Africa.

Nevertheless, the oil price fall will serve to expand the world economy. In the *Lower Price Scenario*, the world's real GDP for 2030 will increase



Source: IEEJ, Asia/ World Energy Outlook 2015

by 1.9% from the *Reference Scenario*.

Asia, heavily dependent on energy imports, for example, will greatly benefit from lower energy prices. The ASEAN economy will expand by 2.6% from the *Reference Scenario* in 2030. Real GDP will increase by 2.2% for India and by 1.7% for China. The EU and the U.S. economy will benefit as well.

Meanwhile, the Middle East's real GDP in 2030 will decline by 3.1% from the R*eference Scenario*. The global growth in unconventional resources development will further weaken the Middle East's presence as producers. Russia will also suffer from contraction of its real GDP by 1.3% from the *Reference Scenario.*

From IPCC 5th Assessment Report (AR5)

Scenarios in IPCC AR5 WG3

	Concentration of CO_2-eq in 2100, ppm CO_2-eq	Sub-category	Change in GHG emissions from 2010 to 2050, %	2100 temperature change relative to 1850-1900 (°C)*	
RCP2.6	450 (430-480)	Overshoot (vast majority)	-72 to -41	1.5 - 1.7	
	500 (480-530)	No overshoot	-57 to -42	1.7 - 1.9	2 °C
		Overshoot	-55 to -25	1.8 - 2.0	
	550 (530-580)	No overshoot	-49 to -19	2.0 - 2.2	
		Overshoot	-16 to +7	2.1 - 2.3	
RCP4.5	(580-650)		-38 to +24	2.3 - 2.6	
	(650-720)		-11 to +17	2.6 - 2.9	
RCP6.0	(720-1000)		+18 to +54	3.1 - 3.7	BAU

Temperatures in parentheses include carbon cycle and climate system uncertainties.

CLIMATE CHANGE

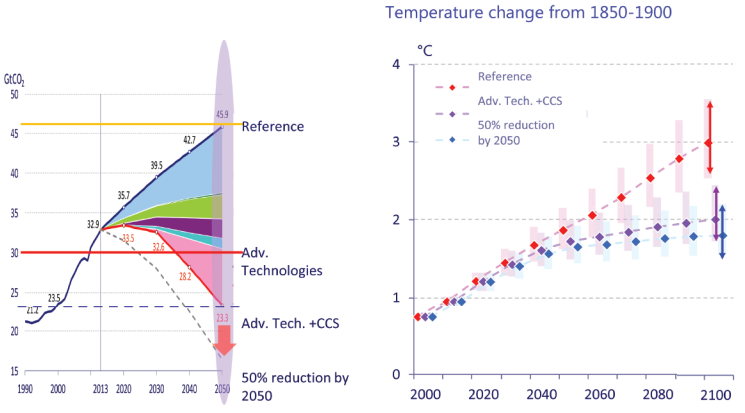
Although the issue of climate change and global warming are more and more present in the public mind, it is not becoming any easier to understand the mixed messages on how to combat climate change. The IPCC 5th Assessment Report (AR5) compiled a table that clearly showed that a concentration equivalent to 450 ppm CO_2-equivalent would be the ideal scenario for keeping the temperature rise below 2 degrees Celsius by 2100. Both the 500 and 550 ppm scenarios are included as possibly achieving a similar objective until the end of this century.

For the Representative Concentration Pathway (RCP 2.6), which is the typical scenario for the "450 ppm" category, the CO_2-eq concentration is expected to temporarily overshoot 450 ppm before declining to the objective level by the end of the century. This scenario assumes reductions of emissions by two-thirds from 2010 levels by 2050, and the need for negative emissions after 2070. At the G7 in 2015, a reduction of GHG emissions in the range of 41% to 72% were announced as agreed targets which make such a scenario more ambitious than the "50% reduction by 2050" target.

IEEJ's *Reference Scenario* discussed earlier corresponds very well with the worst of the scenarios presented in the table above (RCP 6.0). Another way to present the same information would be to graphically plot the related energy-related CO_2 emissions that correspond to selected scenarios from IPCC. The 450 ppm scenario would be the lowest curve with the need for negative emission beyond 2070.

The emissions results from IEEJ's Energy Outlook 2015 *Reference* and *Advanced Technologies Scenarios* are plotted against those of IPCC. As shown by the red arrow, the use of advanced technologies combined with CCS would not even be enough to reach the so-called "50% reduction by 2050" target which is indicated by dotted line.

How Much is Temperature Change ?



The results of the *Reference Scenario* correspond to a level of concentration in the atmosphere in 2100 in the range of 760-860 ppm[1] (CO_2-eq.), with an average temperature rise of about 3.0°C the same year. On the other hand, the *Advanced Technologies Scenario* is comparable to concentrations in 2100 of 540-600 ppm (CO_2-eq.), with the average rise in temperature between 1.7 and 2.4°C. This is lower than 2.5°C and possibly lower than 2°C by 2100.

Prior to the United Nations Climate Change Conference (COP21) in Nov. 2015, many participating countries submitted their Intended Nationally Determined Contributions (INDCs) presenting their respective post-2020 climate actions. By October 1st, 117 countries and regions (totaling 144 countries) had submitted their INDCs.

IEEJ analyzed the pledges of the top 8 major countries that cover 65% of global GHG emissions

in 2010, (49.8 Gt). At first sight, the reduction targets of those countries are quite impressive, ranging between 25 to 65%. But as one looks closer, the base years and the target years on which the targets apply are different for each participant. Of more interest is the fact that the EU, USA, Russia, Japan and Brazil are setting their targets in absolute value of GHG emissions while China and India are setting their target in terms of GDP intensity. Indonesia sets its target of 29% as a reduction from its BAU case.

From the information provided above, it is possible to construct a comparison of the emissions before and after the application of the target using IEEJ's model results for each country under the *Reference* and the *Advanced Technologies Scenarios*. It is more difficult to assess properly the impact of a GDP intensity target as it is highly dependent on prospects for economic growth.

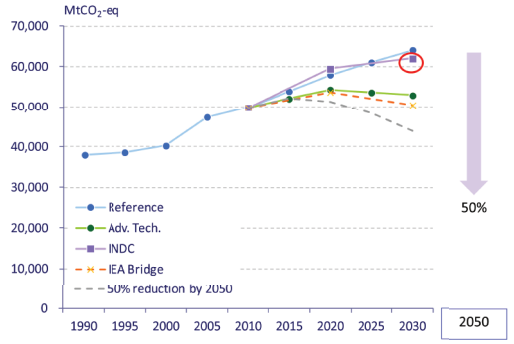
Intended Nationally Determined Contributions (INDCs)
Major Countries

Party	Date of submission	Target type	Reduction target	Base year	Target year	Coverage
EU	Mar 6	Absolute emissions	40%	1990	2030	GHG
United States	Mar 31	Absolute emissions	26～28%	2005	2025	GHG including LULUCF
Russia	Apr 1	Absolute emissions	25～30%	1990	2030	GHG
China	Jun 30	GDP intensity	60～65%	2005	2030	CO_2
Japan	Jul 17	Absolute emissions	26%	2013	2030	GHG
Indonesia	Sep 24	Reduction from BAU	29%	BAU	2030	GHG
Brazil	Sep 30	Absolute emissions	37% (43% for 2030)	2005	2025	GHG
India	Oct 1	GDP intensity	33～35%	2005	2030	GHG

The targets of the United States and Japan are as ambitious as the *Advanced Technologies Scenario* while the target for the EU is positioned close to that scenario. The targets of China and India are interesting as they exceed IEEJ's CO_2/GHG emissions expectations under the *Reference Scenario*.

When combined the evolution of the emissions suggested by the INDCs of the 8 parties follows a similar path to that of IEEJ's *Reference Scenario* for those parties. The climate actions based on the current INDCs are far from reaching the *Advanced Technologies Scenario*, which in turn is far behind the target of "50% reduction by 2050", and not even close to the 450 ppm scenario

Comparison of INDCs with the Reference/Adv. Tech. Scenarios

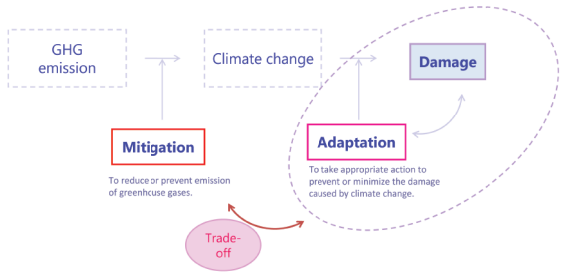


While it clearly appears that the INDCs are far from enough, should we keep on aiming at reaching the 50% target or even further down to the reduction level which 450ppm scenario suggests?

The 450ppm target (2.0°C) is clearly the minimum any planet doctors could ask for. The planet would be better at half that temperature rise and yet it is not what the planet used to look like a century ago. The 450ppm target is only the best next ideal as we cannot yet turn the clock back. Unfortunately the 450 ppm is out of reach for the moment. It may be better to temporarily lower expectations and be pragmatic.

There exists trade-offs between mitigation, adaptation and it would seem appropriate to aim at balancing the costs of adaptation with mitigation. Minimizing the overall costs of mitigation and adaptation would be an optimal way to tackle the climate change challenge in a more pragmatic manner.

Mitigation and Adaptation Costs



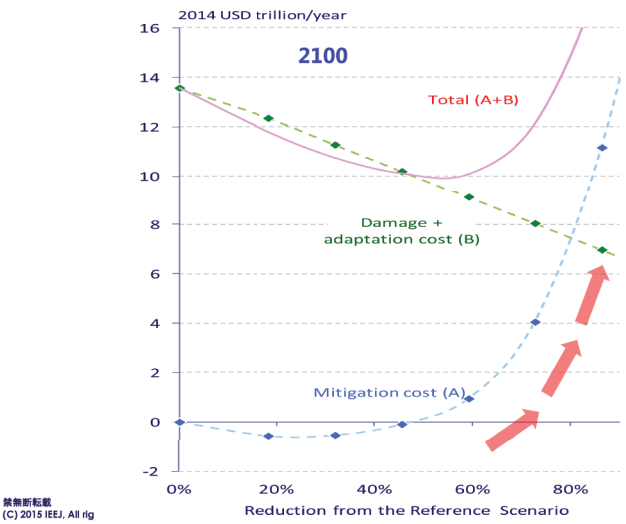
There is a trade-off relationship among the mitigation, adaptation and damage costs. it is impossible to reduce all three costs at the same time.

It would be realistic to expect a balance among the three, while minimizing the total cost.

Based on the limited number of models that have been published to project climate change damage and adaptation costs, IEEJ constructed the Mitigation-Adaptation Costs chart. It is a simple representation that trade-offs exist between actions directed at lowering emissions and actions aimed at lowering the impact of climate change. The more spent on mitigation, the less will be required for adaptation.

As the reduction ratio exceeds that of the *Advanced Technologies Scenario* (40%), the mitigation cost increases enormously. Consequently, based on the information available, it may be advantageous to concentrate on adaptation and damage costs in order to minimize overall costs. It is also important to speed up the reduction of the mitigation costs with innovative technologies and flatten the mitigation cost curve. A long-term perspective is indispensable to address the problem of climate change. And it

Mitigation vs. Adaptation Costs in 2100



may still be possible to optimize.

Of course, the optimum emission path differs widely depending on assumptions. Even if mitigation costs and damage were determined accurately, the path cannot be determined uniquely. At least, however, estimates indicate that the case in which the world would fail to halve emissions by 2050 and pursue greater emission cuts later would still be more economically rational and most probably closer to the optimal path.

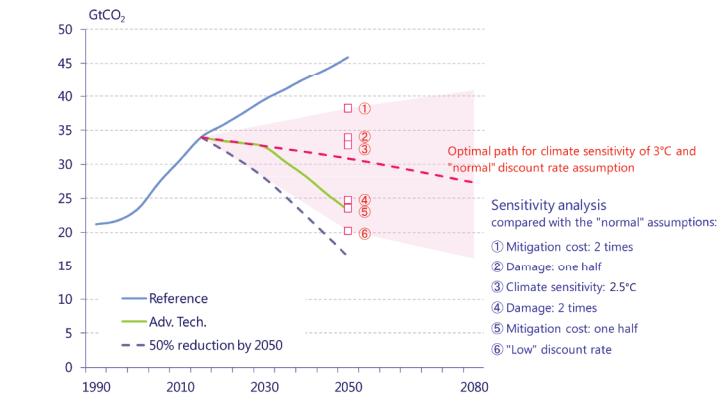
Should we keep aiming at meeting a "mitigation" target only?

Should we consider minimizing costs of "mitigation" and "adaptation"?

Before considering answering those questions, it is important to note that there remain many uncertainties regarding the climate change issues. There are huge variations with regard to future costs of mitigation, adaptation and damages. Part of that big uncertainty (and subject to huge debates) induces the discussions on an appropriate discount rate to use for cost estimations.

The most complicated uncertainty is related to the 'obvious' link between atmospheric concentration and temperature rise. The "Equilibrium Climate Sensitivity" seems not to stand the scientific tests for accuracy for commitments. IPCC recently reported that some (new) studies suggest that the "sensitivity" may be lower than previous reported. If it were to be the case, a lower climate sensitivity means that damage costs become smaller and that the future mitigation path can be less ambitious and yet optimal.

Example of the calculation of the long-term optimal path



CONCLUSION

The current lower energy prices may look good for energy consuming Asia but the world will remain dependent on fossil fuels until 2040 and more costly energy may be required beyond 2020. For growing Asia, it will continue to be essential to pursue improvement of energy efficiency and productivity. Moreover, lower prices with less export volume will cause a reduction in income and lower economic growth for traditional energy producers. This can be considered as an encouragement to diversify their economies from being heavily dependent on resource exports. Thus both consumers and producers need to avoid microscopic actions and are required to adopt strategies with longer-term perspectives. Climate change also requires long-term strategies, especially in development of innovative technologies. Rather than aiming only at meeting 450 ppm target, speeding up the technology development while optimizing the total costs of mitigation and adaptation need to be considered.

Footnote

[1]The "CO_2-equivalent concentration" includes the forcing of all GHGs, as well as aerosols and albedo change.

U.S. Natural Gas (LNG) Exports: Opportunities and Challenges

By Ronald D. Ripple

INTRODUCTION

The rapid expansion of natural gas production in the United States in the latter half of the first decade of the 21st Century created an environment where production was expanding much faster than consumption, which laid the foundation to pursue opportunities to export natural gas particularly to the Asia Pacific region where gas prices have been traditionally significantly higher than elsewhere in the world. However, opportunities arise and fade in the energy world, and this truism hold for exports in the form of LNG, too.

Ronald Ripple is the Mervin Bovaird Professor of Energy Business and Finance at the University of Tulsa. He is also a Vice President of IAEE. He may be reached at ron-ripple@utulsa.edu

SOME CLARIFICATIONS

Let's begin with some clarification and correction of media discussions. First, what is LNG? LNG is not a separate and distinct commodity with a market of its own. LNG is simply the transportation phase of natural gas that is going to be moved from point A to point B where no pipeline connection exists. More recently it is also used as a storage medium for natural gas to be used for various transportation options. However, in actual use the fuel is always in its gaseous form. So, natural gas (mostly methane) is transformed into its liquid phase by dropping its temperature to -161 C (-260 F), which reduces the physical space required to hold the gas by a factor of 600. It is loaded into a storage mechanism, including LNG tankers for overseas shipping, and it is then re-gasified for use as a fuel or input to petrochemical processes. LNG competes directly against natural gas and is priced just like natural gas, i.e., according to heat content, for example $ per million Btu (MMBtu) or gigajoule (GJ) or therm, etc. The natural gas that has been shipped in the LNG form also competes against other alternative fuels on exactly the same basis as natural gas that is brought to market via pipelines.

For U.S. exports of natural gas in the form of LNG, we frequently see statements that we are exporting shale gas. We are exporting natural gas sourced from the national (indeed, international grid that interconnects with Canada and Mexico) natural gas pipeline grid, which is a mixture of natural gas from all production sources in the U.S. Indeed, one can imagine that the primary source of natural gas that is the input to Cheniere's operations at Sabine Pass is most likely from offshore Gulf of Mexico. It is true that the technological developments of combining hydraulic fracturing with horizontal drilling led to a production surplus of a magnitude that can support both domestic and export demands. But we are still at a stage where so-called conventional natural gas production exceeds that of the unconventional. Moreover, even the unconventional is comprised of more than just shale sourced gas; it also includes coal seam gas.

THE OPPORTUNITIES AND CHALLENGES

So now onto the opportunities and challenges faced by current and prospective U.S. exporters of natural gas. One additional clarification is necessary. The March 2016 shipment of natural gas from the Cheniere Energy Sabine Pass facilities to Brazil was not the first export of natural gas from the U.S. in the form of LNG. The first occurred in 1959 carried in the Methane Pioneer from the U.S. to Great Britain. Moreover, commercial export of natural gas via LNG tankers commenced in 1969 from Nikiski, Alaska to originate the LNG trade in Asia with shipments still flowing to Japan.[1]

The expansion of U.S. natural gas production that began with force around 2005 suggested to many that there was significant commercial opportunity available for exports. The growth in production drove prices below $2.00 per MMBtu at a time when natural gas delivered into Asia was going for $15.00 per MMBtu or more. That potential margin appeared to provide a window of opportunity so large that one could expect to easily drive an LNG tanker through and come away with wads of cash.[2] Eventually, the delivered prices in Asia pushed up to around $19.00 per MMBtu while the U.S. prices remained in the $2.00 - $5.00 range.

The export potential brought a rush of applications to export natural gas, which would also require constructing natural gas liquefaction facilities where none previously existed. However, one characteristic of the U.S. market structure that facilitated this move was the existence of several LNG regasifica-

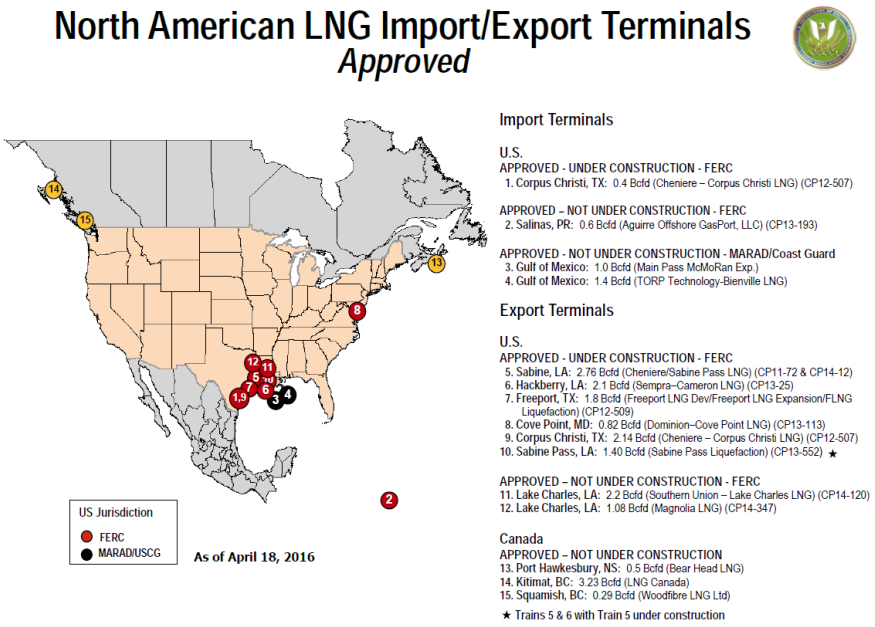
tion terminals along the U.S. Gulf and East Coasts. Some of these facilities date back to the 1970s, but they contained a significant share of the capital requirements for an LNG export operation. They were already connected to the pipeline grid, they had dock facilities built to handle LNG tankers, and they had LNG storage facilities. While not insignificant, this meant that to enter the natural gas export trade these facilities needed to only construct liquefaction trains. This meant that relative to other proposed, or even under construction, projects around the world, the U.S. projects (at least the earliest ones proposed) had a significant capital expenditure advantage over virtually all greenfield projects and even some brownfield projects.

LNG Export Projects
DOE application as of March 18, 2016
59 line items, occasionally with numerous line items for a single company
59 applications for FTA approvals; of which 3 are vacated or withdrawn
49 applications for Non-FTA approvals
48 FTA approvals
18 Non-FTA approvals
48.053 Bcf/d approved
Subset with FERC approval
11.02 Bcf/d approved and under construction
3.28 Bcf/d approved but not under construction

Table 1 – LNG Project Application Summary

In rapid succession, LNG export projects were proposed and began the export license application process, which requires approvals from both the DOE and FERC. Table 1 provides a summary of proposed projects, the DOE approved export capacities, and the subset of FERC approved projects. A detailed list of the DOE applications may be found at http://energy.gov/fe/downloads/summary-lng-export-applications-lower-48-states. Figure 1 shows locations of both FERC-approved LNG export and regasification projects.

Under current market conditions, and even under earlier more favorable conditions, many of the proposed projects are quite unlikely to be developed. One way to think about the reasoning behind these applications is to see them as representing options on future development should market conditions warrant. Effectively, it comes down to not being able to enter the game without a ticket, and the required ticket for entry to this game is an approved project.



Source: http://www.ferc.gov/industries/gas/indus-act/lng.asp.
Figure 1

The opportunity window began to close with the decline in crude oil prices in 2014, initiated by the growth in production in the U.S. from shales and exacerbated by the OPEC decision in December of that year to not reduce production. The price of natural gas in Asia has been closely linked to the price of crude oil since the inception of the trade in 1969 with the natural gas flowing via LNG tankers from Nikiski to Japan. Nearly all long-term contracts for natural gas transported as LNG in Asia have price contractually tied to crude oil. The most common benchmark is the Japanese Customs Cleared average price, referred to as JCC and colloquially as Japanese Crude Cocktail. So, as crude oil prices declined so did the prices for natural gas delivered into Asia. As of March 2016, the average spot delivered price into Japan was below $7.00 per MMBtu.[3] For Europe, natural gas prices have also fallen substantially, as they too have been closely related to oil prices. The current futures price for June 2016 for the UK's National Balancing Point is equivalent to $4.12 per MMBtu, and the Continental price is very similar. Now with shipping costs included the margins that a U.S. exporter can realize may still be double digit, but unfortunately these digits may have a decimal point in front of them rather than behind.

Table 2 provides a view of estimated costs of delivering natural gas from the U.S. Gulf Coast to Asia and Europe, and a comparison with those from Australia to Asia. It shows that for Asia the route of commercial viability is via the Panama Canal, and that route is not open until the canal expansion project

is completed; this has been stated recently to be June, 2016, but there have been several delays previously. The table is comprised of three panels, with the differences based on a range of LNG tanker day rates.

The LNG tanker day rates are currently relatively low, being in the low $30,000 range. Within the past five or so years the rate has exceeded $130,000 per day, and these rates vary according to their own market dynamics. The shipping cost estimates are based on an LNG tanker with 160,000 cubic meters of capacity, which translates to approximately 3,000,000 MMBtu of deliverable natural gas. Tankers have to be paid for in both directions, and the calculations account for a day for loading and a day for unloading. If these operations take longer or harbors are congested and additional demurrage time occurs, these costs will increase. The costs also account for fuel at $35 per nautical mile. Included in these calculations for shipments transiting the Panama Canal are the proposed tolls that will add approximately $0.20 per MMBtu.[4]

A – Low day rate

LNG Carrier shipping cost comparison between XXX and YYY

160,000 m^3 tanker => ~ 3,000,000 MMBtu

Accounts for round trip, includes 2 additional days for loading and unloading, $35/nm fuel cost, and $0.20/MMBtu for Panama

						Day rate	
		Appr. Distance	Fuel	18 knots		$ 33,000	
Port-to-Port		nautical miles		Days	Hours	18 knots	Cost/MMBtu
Sabine	Zeebrugge	4861	$ 340,248	13	6	$ 874,500	$ 0.40
	Tokyo (S.Afr.)	15825	$ 1,107,755	36	12	$ 2,409,000	$ 1.17
	Tokyo (Panama)	9149	$ 640,440	21	8	$ 1,408,000	$ 0.88
Dampier	Tokyo	3762	$ 263,319	8	12	$ 561,000	$ 0.27

B – Medium day rate

LNG Carrier shipping cost comparison between XXX and YYY

160,000 m^3 tanker => ~ 3,000,000 MMBtu

Accounts for round trip, includes 2 additional days for loading and unloading, $35/nm fuel cost, and $0.20/MMBtu for Panama

						Day rate	
		Appr. Distance	Fuel	18 knots		$ 70,000	
Port-to-Port		nautical miles		Days	Hours	18 knots	Cost/MMBtu
Sabine	Zeebrugge	4861	$ 340,248	13	6	$ 1,855,000	$ 0.73
	Tokyo (S.Afr.)	15825	$ 1,107,755	36	12	$ 5,110,000	$ 2.06
	Tokyo (Panama)	9149	$ 640,440	21	8	$ 2,986,667	$ 1.40
Dampier	Tokyo	3762	$ 263,319	8	12	$ 1,190,000	$ 0.48

C – High day rate

LNG Carrier shipping cost comparison between XXX and YYY

160,000 m^3 tanker => ~ 3,000,000 MMBtu

Accounts for round trip, includes 2 additional days for loading and unloading, $35/nm fuel cost, and $0.20/MMBtu for Panama

						Day rate	
		Appr. Distance	Fuel	18 knots		$ 130,000	
Port-to-Port		nautical miles		Days	Hours	18 knots	Cost/MMBtu
Sabine	Zeebrugge	4861	$ 340,248	13	6	$ 3,445,000	$ 1.26
	Tokyo (S.Afr.)	15825	$ 1,107,755	36	12	$ 9,490,000	$ 3.52
	Tokyo (Panama)	9149	$ 640,440	21	8	$ 5,546,667	$ 2.25
Dampier	Tokyo	3762	$ 263,319	8	12	$ 2,210,000	$ 0.82

Author calculations; distance and travel time taken from www.sea-distances.org

Table 2 – LNG Shipping Cost Estimates (A, B, and C)

In panel A, the low day-rate environment ($33,000 per day), shipping from Sabine Pass to Tokyo via the Panama Canal (which as noted above is not yet open for LNG tanker traffic) will cost $0.88 per MMBtu. If instead the route around South Africa were taken the shipping cost will be $1.17 per MMBtu. For prospective exports to Europe, the shipping cost to Zeebrugge, Belgium is $0.40. In panel C, we see that the shipping costs rise significantly to $2.25, $3.52, and $1.26 per MMBtu for Panama, South Africa, and Zeebrugge, respectively. So even if we focus on just the Panama Canal route for exports to Asia, we see that shipping costs can range from $0.88 to $2.25 per MMBtu, based on the range of LNG tanker day rates that have been experienced in the relatively recent past.

But how will these shipping costs affect the competitiveness of U.S. natural gas aimed to be exported to Asia or Europe? The most widely discussed arrangements for exports of U.S. natural gas are those associated with Cheniere Energy. Cheniere has approved projects at Sabine Pass and Corpus Christi, where they have 4.16 Bcf/d and 2.14 Bcf/d of liquefaction capacity under construction, respectively. And initial commissioning volumes have been produced and shipped from Sabine Pass.

The pricing mechanism that is in place for these projects is represented in Table 3. The system is effectively cost-plus, whereby Cheniere purchases natural gas from the national pipeline grid and charges the Henry Hub price plus 15%. It then transports via pipeline to its facilities and processes it into LNG by lowering the temperature as described above. Cheniere has entered into a number of agreements to cost this step in the process, as can be seen in the table. The lowest cost is $2.25 per MMBtu for 3.5 million tonnes per annum (mtpa) for BG rising to $3.00 per MMBtu for several buyers totaling 12.75 mtpa at the Sabine Pass facility. For Corpus Christi the liquefaction cost is $3.50 per MMBtu for all buyers.[5]

Project	Buyer	Contractual Quantity (mmtpa)	Liquefaction Costs (US$/mmBtu)	HH price	HH + 15%	FOB Price
Sabine Pass	BG	3.50	2.25	2.15	2.4725	4.72
Sabine Pass	GNF	3.50	2.49	2.15	2.4725	4.96
Sabine Pass	BG	2.00	3.00	2.15	2.4725	5.47
Sabine Pass	GAIL	3.50	3.00	2.15	2.4725	5.47
Sabine Pass	KOGAS	3.50	3.00	2.15	2.4725	5.47
Sabine Pass	TOTAL	2.00	3.00	2.15	2.4725	5.47
Sabine Pass	Centrica	1.75	3.00	2.15	2.4725	5.47
Corpus Christi	PERTAMINA	0.76	3.50	2.15	2.4725	5.97
Corpus Christi	Endesa	1.50	3.50	2.15	2.4725	5.97
Corpus Christi	Endesa	0.75	3.50	2.15	2.4725	5.97
Corpus Christi	Enel	1.11	3.50	2.15	2.4725	5.97
Corpus Christi	Enel	1.11	3.50	2.15	2.4725	5.97
Corpus Christi	Iberdrola	0.80	3.50	2.15	2.4725	5.97
Corpus Christi	GNF	1.52	3.50	2.15	2.4725	5.97
Corpus Christi	Woodside	0.85	3.50	2.15	2.4725	5.97
Corpus Christi	EDF	0.77	3.50	2.15	2.4725	5.97
Corpus Christi	PERTAMINA	0.76	3.50	2.15	2.4725	5.97
Corpus Christi	EDP	0.77	3.50	2.15	2.4725	5.97

Contractual quantities and liquefaction costs provided by FGE; calculations by the author.

Table 3 – Cheniere "formula"

Table 3 shows what the price of the gas to Cheniere's buyers, once liquefied, would be given the pricing mechanism and a price of natural gas at Henry Hub of $2.15 per MMBtu. The costs to the buyers range from a low of $4.72 to $5.47 for natural gas processed at Sabine Pass, and $5.97 for gas processed at Corpus Christi.

To examine the economic viability of exports into Asia or Europe the shipping costs must be added. For example, under the terms of the BG contract and the current low day rate environment, exports to Tokyo may be delivered for a cost of $5.60 per MMBtu, if it can be shipped via Panama or $5.89 per MMBtu around South Africa. If we examine the high day rate environment the costs rise to $6.97 via Panama and $8.24 per MMBtu via South Africa. To Europe, for the low day rate the cost would be $5.12 per MMBtu, and for the high day rate is would be $5.98 Per MMBtu.

It was noted above that natural gas prices for LNG-based imports into Asia have fallen below $7.00 MMBtu. Table 4 shows the prices of spot-LNG deliveries into Japan spanning the period from March 2014 to preliminary numbers for March 2016. On an arrival basis, they have fallen from $18.30 per MMBtu in April 2014 to $6.80 per MMBtu for March 2016; quite a narrowing of the window of profitable opportunity.[6]

Japan - Spot-LNG prices (USD/MMBtu)				
Year	Month		Contract-based	Arrival-based
2014	3	Detailed	18.3	-
	4	Detailed	16.0	18.3
	5	Detailed	14.8	16.3
	6	Detailed	13.8	15.0
	7	Detailed	11.8	13.8
	8	Detailed	11.4	12.5
	9	Detailed	13.2	11.3
	10	Detailed	15.3	12.4
	11	Detailed	14.4	14.3
	12	Detailed	11.6	15.1
2015	1	Detailed	10.2	13.9
	2	Detailed	7.6	10.7
	3	Detailed	8.0	7.6
	4	Detailed	7.6	7.9
	5	Detailed	×	×
	6	Detailed	7.6	7.6
	7	Detailed	7.9	×
	8	Detailed	8.1	7.7
	9	Detailed	7.4	7.7
	10	Detailed	7.6	7.9
	11	Detailed	7.4	7.5
	12	Detailed	7.4	7.5
2016	1	Detailed	7.1	7.9
	2	Detailed	6.5	6.9
	3	Preliminary	×	6.8
x - indicates that there were not two or more reporters.				
Source: METI				

Table 4 – Japanese LNG Prices

So with current market conditions, both in the U.S. and the two primary export target regions, BG has the potential to realize a margin of $1.20 per MMBtu if it can transit the Panama Canal, and $0.91 per MMBtu via South Africa if the LNG tanker day rates remain as low as $33,000 per day. Indeed, if Panama is viable BG may realize a positive margin up to a day rate of about $118,000; around South Africa the day rate will need to be below $70,000. However, under current conditions exports to Europe are not commercially viable since the cost of the gas as it will be loaded into the LNG tanker is higher than the competing gas available in the region, even before accounting for shipping costs. For those buyers at Sabine Pass who have agreed to pay a price that includes the $3.00 per MMBtu liquefaction cost, even Panama cannot provide them with a positive margin if the day rate exceeds $65,000; Corpus Christi buyers are obviously worse off.

But what does the future hold for U.S. exports of natural gas? Table 5 shows projections of regional imbalances for natural gas according BP's 2016 Outlook to 2035. It is important to note that Russia is included within the Europe & Eurasia region and Australia is included within the Asia Pacific region as defined by BP. This is relevant because that means, for example, that the shortfalls projected for the Asia Pacific region are after accounting for Australia's production. So, while Australia will become the largest exporter of natural gas in the form of LNG by 2018, there will continue to be a need for more natural gas imports into the region. Not all of the shortfall will be supplied from the sea via LNG tankers, but the projections suggest that there will be need in the region to import from other regions, including North America. The key question will be at what price.

North America (United States, Canada, and Mexico) is projected to have significant surplus natural gas production over consumption throughout the period to 2035. Indeed, from 2030 onward the North American surplus is projected to exceed that of even the Middle East

or Africa. So, the physical opportunity appears to be there well into the future, but will the economic opportunity be realized? The projection for North America for 2020 is equivalent to 9.5 Bcf/d. As shown in the FERC map above there are 11.02 Bcf/d of capacity currently approved and under construction. If, as with many large complex capital intensive projects like an LNG facility, these projects are completed and operate near 90% capacity factor, there is a very near match; assuming Canada does not bring on any of its proposed projects.

Regional imbalance (production minus consumption) - mtpa											
	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035
North America	4.06	(18.16)	(21.80)	(23.33)	(20.33)	(0.02)	1.50	72.11	73.76	139.82	138.77
S & C America	0.23	0.39	4.52	12.27	10.77	3.63	1.33	(5.52)	(11.99)	(22.04)	(29.93)
Europe & Eurasia	(9.14)	(27.84)	(37.52)	(51.40)	(73.52)	(5.34)	(22.28)	(18.43)	4.44	(0.07)	(10.91)
Middle East	5.34	5.19	15.27	30.78	68.72	100.26	93.42	91.06	89.52	85.43	88.25
Africa	21.50	27.89	53.01	67.71	78.32	60.91	55.48	53.13	45.52	60.03	92.59
Asia Pacific	(1.43)	(1.72)	(13.92)	(25.65)	(56.69)	(108.79)	(106.85)	(127.34)	(213.33)	(260.66)	(287.49)
Total Natural Gas Imbalance	20.56	(14.25)	(0.43)	10.39	7.27	50.64	22.59	65.01	(12.08)	2.51	(8.73)

Source: BP Outlook 2016; author calculations. To convert to Bcf/d multiply by 48 and divide by 365. For example, the 2020 shortfall for Asia Pacific is equivalent to 16.7 Bcf/d.

Table 5 – Projected Regional Natural Gas Imbalances

CONCLUSION

The opportunity for the United States to become a major player in the international trade of natural gas, shipped in the form of LNG, arose very abruptly as a result of the massive increase in domestic natural gas production due to the technological advances brought on by combining horizontal drilling and hydraulic fracturing. In a rapidly evolving energy world, with prices declining significantly around the world, the economic opportunity afforded by technological advance has nonetheless shrunk to the point that only modest volumes of natural gas can currently be expected to be exported profitably, except perhaps where pre-existing take-or-pay contracts may save the day. And while a significant imbalance in production and consumption in the Asia Pacific suggests export opportunities over the next 20 years, the dynamics of the U.S. domestic natural gas market, the Asia Pacific natural gas market, and LNG tanker market will play significant roles in determining the degree to which U.S. natural gas exports may be able to expand much beyond the current capacity approved.

Footnotes

[1] ConocoPhillips recently received approval to extend its export license through 2018.

[2] This is clearly a mixed and mashed metaphor, but it seems pretty representative of the mood and attitude in the U.S. natural gas industry at the time.

[3] Similarly, an estimate of the JCC-linked price for natural gas, given a JCC price of $37, will also be under $7.00 per MMBtu.

[4] The approved tolls for LNG tankers involve three stages of pricing based on capacity, plus a discount for return transit under ballast if the return is within 60 days. The roundtrip, with discount, for the 160,000 cm tanker is $635,500. By comparison, the round trip tolls through the Suez Canal would be about $324,000, but the extra transit days (one-way 33 days and 15 hours compared to 21 days and 8 hours for Panama) would add $811,250 to the Suez route relative to Panama at the day rate of $33,000. It also turns out that due to the tolls for the Suez that it will tend to be less costly to travel around South Africa than to transit the canal.

[5] Cheniere Energy explicitly eschews the term tolling related to these liquefaction charges, because they will own the gas moving their facilities, and ownership only changes hands at dockside. This differs from some of the other projects whereby the gas to be liquefied is sourced by the customer and the LNG facility operator never takes ownership of the gas and is simply providing a service by transforming someone else's natural gas to the liquid state.

[6] An April 29, 2016 article in Reuters ("GLOBAL LNG-Prices rise on oil, European gas hub levels") notes that LNG prices for June 2016 delivery into Asia are reported at below $5.00 per MMBtu, which will place even more pressure on potential margins even with the completion of the Panama Canal expansion.

CONFERENCE OVERVIEW

North America, if not the United States alone, is expected by many to soon be energy self-sufficient. Horizontal drilling, coupled with hydraulic fracturing, reversed the downward trend in production of both crude oil and natural gas. As a result, the lower-48 US will be exporting natural gas by the time we meet in Tulsa. The debate over crude oil exports from the US will likely still be raging, and is likely to be an element of the 2016 US Presidential election. The production turnaround has shaken world energy markets, and the operation of our energy markets produced substantial reductions in CO_2 emissions through economic substitution from coal to natural gas in power generation. When we add advances in renewables and the promise of industrial-capacity battery systems, the potential for North American energy self-sufficiency appears to be on the near horizon. So, the focus of the 34th USAEE/IAEE Conference will be to provide a constructive and collegial forum for extensive debate and discussion, based on solid research and evidence, to facilitate deeper and broader understanding of the implications of this transformation for North America and the rest of the world.

The Tulsa conference will bring together business, government, academic and other professionals to explore these themes through a series of plenary, concurrent, and poster sessions. Your research will be a significant contribution to this discussion. Speakers will address current issues and offer ideas for improved policies taking full account of the evolution of the North American energy sector and its implications for the rest of the world. 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 Oklahoma's dynamic energy landscape.

Tulsa became known as the Oil Capital of the World at the turn of the twentieth century, and, for a time, Oklahoma was the number one oil producer in the world. The first oil field waterflood was carried out in Oklahoma in May 1931, and the first commercial hydraulic fracturing was performed in Oklahoma in 1949. More recently, Oklahoma companies have led the way with the application of horizontal drilling and hydraulic fracturing techniques to commercialize the vast shale gas and oil resources in Oklahoma and across the country.

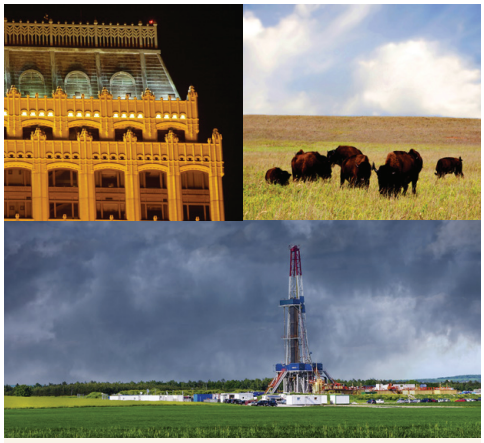
Cushing, Oklahoma is the pricing point for the most active commodity futures contract in the world, home to nearly 80 million barrels of crude oil storage, and is the junction for numerous crude oil pipelines collecting and moving crude oil from around the Mid-Continent and Canada to refining centers. The influence reaches from the wellhead, through the midstream, to the refinery and beyond.

In addition to Oklahoma's long-standing role in oil and gas, it is the fourth largest generator of wind energy in the country. The State has five hydroelectric projects, including a rare pump storage facility.

HOSTED BY

USAEE United States Association for Energy Economics

IAEE International Association for Energy Economics www.iaee.org



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 by clicking here: http://www.usaee.org/usaee2016/topics.html

- US oil and gas exports
- Energy Demand and Economic Growth
- Energy Research and Development
- Non-fossil Fuel Energy: Renewables & Nuclear
- Energy Efficiency and Storage
- Financial Markets and Energy Markets
- Political Economy
- OPEC's role in a changing energy world
- Energy Supply and Economic Growth
- Energy and the Environment
- International Energy Markets
- Energy Research and Development
- 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.

34TH USAEE/IAEE NORTH AMERICAN CONFERENCE SESSIONS & SPEAKERS

Visit our conference website at: **www.usaee.org/usaee2016/**

PLENARY SESSIONS

The 34th USAEE/IAEE North American Conference will attract noteworthy energy professionals who will address a wide variety of energy topics. Plenary sessions will include the following:

- Energy Policy – Competing Visions from the Two Parties
- Managing in a Low-Price Environment
- Challenges and Opportunities in the Transport Sector
- U.S. Oil and Natural Gas Exports – How have the Economics Changed?
- Challenges and Opportunities for Renewables
- Shale and the Future of World Oil
- Clean Power Plan – Implications and Strategies
- Across the Borders – Updates from Canada and Mexico
- On the Other Side of the Meter – Demand Side Issues
- Outlook and Global Perspectives

SPEAKERS INCLUDE

Angela S Becker-Dippmann (Invited)
Democratic Staff Director, Senate Committee on Energy and Natural Resources

Seth Blumsack
Associate Professor, Penn State University

Jeff Brown
Energy Efficiency & Consumer Programs Manager, Public Service Company of Oklahoma

Sanya Carley
Associate Professor, Indiana University

David E Chenier
GM, Contracts, Sourcing & Supplier Management, ConocoPhillips

Melanie Craxton
PhD Candidate, Stanford University

Jeffrey R Currie
Global Head of Commodities Research, Global Investment Research Division, Goldman Sachs

Kathleen Eisbrenner
Founder, Chairman & CEO, NextDecade

John Felmy
Consultant, Midnight Energy Economics

Fereidun Fesharaki
Chairman, FACTS Gobal Energy

Mark Finley
GM Global Energy Markets, BP America Inc

Randy A Foutch
Chairman and CEO, Laredo Petroleum Holdings Inc

Kenneth Gillingham
Assistant Professor of Economics, Yale University

James M Griffin
Texas A & M University

Miriam Grunstein
Nonresident Scholar at the Baker Institute Mexico Center, Rice University

Peter R Hartley
Professor and Baker Institute Scholar, Rice University

Colin Hayes
Staff Director, Senate Energy and Natural Resources

Eric Hittinger
Assistant Professor, Rochester Institute of Technology

Marianne S Kah
Chief Economist, ConocoPhillips

David H Knapp
Chief Energy Economist, Energy Intelligence Group

Andre Plourde
Dean Faculty of Public Affairs, Carleton University

Juan Rosellon
Professor, CIDE

Charles Rossmann
Forecasting & Model Development Manager, Southern Company

Benjamin Schlesinger
President, Benjamin Schlesinger & Assoc LLC

Adam E Sieminski
Administrator, Energy Information Administration

James L Smith
Professor of Finance, Southern Methodist University

Jameson T (JT) Smith
Director, Policy Studies, MISO

Michael J Teague
Secretary of Energy and Environment, State of Oklahoma

Christine Tezak
Managing Direct, Research, Clearview Energy Partners LLC

Bob Tippee
Editor, Pennwell Corp

Philip K Verleger Jr
Vice President, PK Verleger LLC

WITH SUPPORT FROM:

USAEE United States Association for Energy Economics

IAEE International Association for Energy Economics www.iaee.org

CAEE

AMEE

Highlights of the 9TH NAEE/IAEE Annual International Conference

The 9th NAEE/IAEE Annual International Conference, with the theme was held in the colourful and vibrant Capital City of Nigeria, Abuja, 24-26 April 2016. The Conference, which was declared open by the Vice President, Federal Republic of Nigeria, Professor Yemi Osinbajo, SAN, GCON, through a representative, came on the heels of myriad of upheavals in the energy sector of Nigeria and amid the great plunge in oil prices in the international oil market. It attracted over Three hundred (300) participants from various parts of the globe - United States of America, Chile, United Kingdom, Finland and neighbouring African countries. The participants cut across diverse areas of expertise - policymakers/ regulators, industry players, academics and students.

From the policy angle, presentations were made by the Nigerian National Petroleum Corporation (NNPC), Ministry of Petroleum Resources, Petroleum Technology Development Fund (PTDF), Petroleum Products Pricing Regulatory Agency (PPPRA), and the Central Bank of Nigeria (CBN). There were also presentations by the Multinational and Indigenous Oil Companies, Electricity Distribution Companies, Nigerian Bulk Electricity Trading PLC., and the Nigeria Electricity Regulatory Commission (NERC).

The Conference also featured a special presentation by the IAEE President-Elect, Professor Ricardo Raineri, centered on the theme of the Conference particularly on the Role of Renewable Energy and Climate Policy in energizing emerging economies.

The Conference unfolded in twelve (12) specialised sessions focused on Natural Gas and Renewable Energy Development Patterns; Renewable Electricity Market Development; Geopolitics of Petroleum Resources and Supply; Role of Natural Gas and Renewable Electricity Market Development; Energy Finance and Investment Analysis; Electricity Economics and Policy; Petroleum Economics and Policy Research; Climate Change and Energy Industries; Green Energy and Economic Growth; Hydropower and Market Power Issues; Institutional and Regulatory Frameworks for Natural Gas Developments; and Renewable Energy Project Finance.

A plenary session was also held on Gas and Power Policy Issues: Problems and Prospects. There was also a Roundtable on Petroleum and Power Economics and Policy, which addressed Oil, Gas, and Power Infrastructure: Policy Issues, and Prospects in Nigeria.

In a paper titled 'Dwindling Oil Prices and Unemployment: The Nigeria Experience,' Babalola O. Oladapo examined the nexus between the Oil price variation and unemployment rate in Nigeria. He finds that because of Nigeria's over-dependence on oil revenues, oil price variations have a significant effect on the unemployment rate and urged the government to make other sectors more viable, be financially disciplined and be prudent in the application of resources.

The paper by A. S Sambo, I. H. Zarma and D. O. Otokpa explored the problem of Pipeline Protection in the Oil and Gas Sector in Nigeria. The presenters emphasised the importance of resolution of a multitude of local community issues before the determination of the site for any pipeline. This, according to them is as important as ensuring structural integrity and would minimize the problems of pipeline vandalism, theft, militancy, insurgency, and cabals.

Dimnwobi S. K., Nwokoye E. S., Ekesiobi C. S. and Obegolu C. C. analyzed the challenges and prospects in the power infrastructure and electricity demand in Nigeria. They articulated strategies for bridging the infrastructure gap in the power sector. These include improved investment and expansion of infrastructure; creation of an enabling environment for private investors, free from corruption and undue interference; proper maintenance of the transmission and distribution network; and ensuring security of the grid and its components.

The legality of the use of the Treasury Single Account (TSA) in the management of petroleum revenue was explored by Law Amadi who urged caution in the implementation of the policy in view of the technological feasibility, capability challenges and legal complexities involved. Friday K. Ohuche and Phebian N. Bewaji analyzed the implications for energy regulatory reforms in Nigeria in their paper titled Institutional Frameworks and Regulation of "Energy Mix" Markets: Analysis and Implications for Energy Regulatory Reforms in Nigeria. The authors raised three fundamental questions. Do poorly developed institutional and regulatory frameworks impact development of the "Mix of Energy" markets? Should Nigeria develop a single institutional framework for regulating different types of Energy - Hydro, Gas, Solar, Oil and Coal? Should different institutional frameworks be developed for regulating different sources of the "energy mix" markets? Their findings are **captivating.**

A case was also made for the inclusion of nuclear energy in the energy mix of Nigeria. Chukwunonso Ekesiobi, Bruno Ibekilo, Ifebi Ogonna and Ude Damian while acknowledging that there are concerns regarding nuclear safety and liability, environmental and health risks associated with radioactive material and long-term waste management in the development of nuclear energy, still believe that there is need for the mainstreaming of nuclear energy in the country's energy mix in order to maximize the proven benefits of the technology.

The climax of the Conference was an Award Night, at which the immediate past President of NAEE, Professor Adeola Adenikinju was inducted as a Fellow of the NAEE.

Dr Balkisu Saidu, Editor, NAEE Newsletter
Usmanu Danfodiyo University, Sokoto, Nigeria

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/

3/16Forum

Is U.S. LNG Competitive?

By Michelle Michot Foss and Gürcan Gülen

FROM "NEED TO IMPORT" TO "MUST EXPORT"

As late as 2007, many believed that the U.S. would need to import LNG to compensate for declining conventional natural gas production in the country (e.g., 2007 Hard Truths report by the NPC). Four new regasification (import) terminals were built and the capacity of existing facilities was increased in the 2000s. However, the expectation of increasing prices for natural gas also lured new investment to domestic geologic plays, including emerging shale gas locations. With the turnaround in domestic supply, imports were no longer needed, and U.S. natural gas prices collapsed by mid-2009. Despite occasional spikes, the Henry Hub spot price averaged $3.64 per MMBtu since that time through the end of 2015 with extended periods below $3 (Figure 1).

By contrast, global conditions appeared to be moving in a different direction. Outside of the U.S., LNG importing countries typically purchase natural gas via contract pricing indexed to crude oil. Oil prices had recovered fairly quickly to $90 per barrel by the end of 2010, at which time the Brent price started to diverge from the WTI benchmark in the U.S. for a variety of reasons. Until late 2014, oil prices remained generally between $90 (WTI) to $110 (Brent) per barrel. Perhaps, more importantly, throughout this period, forward curves were indicating the persistent expectation of high oil prices. The gap between Henry Hub and global natural gas prices (delivered via pipelines or as LNG) encouraged the idea of exporting excess natural gas production from the U.S. The increase in LNG prices in the Asia-Pacific market following the Fukushima accident in Japan was also an important driver for LNG exports from the U.S. as well as other global developments including Australia and Papua New Guinea. Owners of new LNG import, regasification, and storage capacity built in the U.S. in the 2000s had incentive to enhance the value of their now mostly idle facilities.

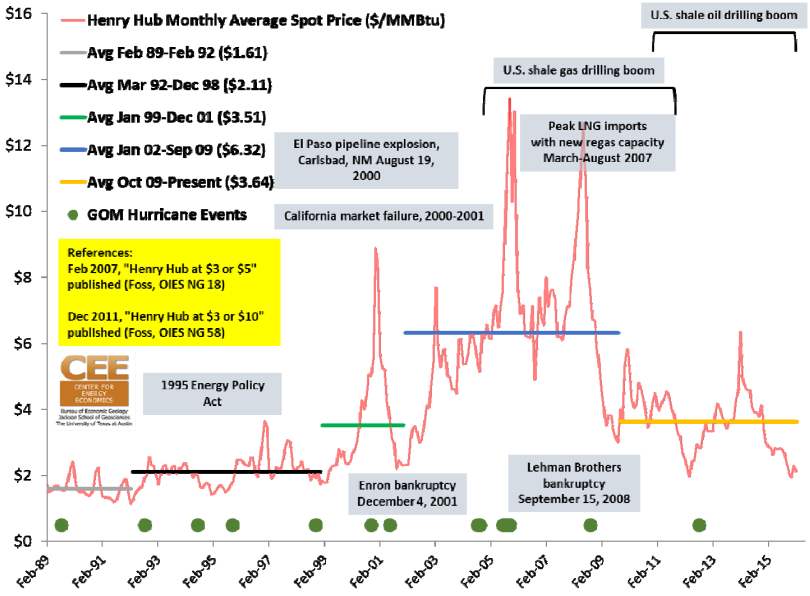


Figure 1. History of Henry Hub Spot Price

For a while, public discussion and media coverage focused on the Department of Energy (DOE) permits to export. This focus was somewhat misplaced. DOE permits for exporting to countries, with which the U.S. had a free trade agreement (FTA), were routinely granted to project developers. More than 30 applicants received these permits. The permitting of exports to non-FTA countries was crucial as most of the likely buyers in Europe and Asia were in this category. Nonetheless, the DOE permit is only one of many permits in a long process. The environmental impact assessment and other studies necessary for the Federal Energy Regulatory Commission (FERC) review, and any other permits that might be required by local authorities were more expensive and time-consuming. Pursuing a DOE permit before at least some of these more demanding requirements were met was probably necessary for developers and customers to feel confident that natural gas from the U.S. could legally be exported to those countries. But, this process became unacceptable to the DOE. Since August 2014, the DOE requires the FERC environmental impact assessment to be completed before considering non-FTA export permits.

At the time of writing (late April), seven terminals received eight permits to export LNG to non-FTA countries. All have FERC approval. Construction to expand the Sabine Pass terminal, originally built in the 2000s to import LNG, to include liquefaction and export facilities was initiated in August 2012. The first train was completed and the first cargo was shipped in late February 2016. At the time of writing, seven cargoes were shipped. Although significant symbolically and in terms of providing **some price**

Michelle Foss and **Gürcan Gülen** are with the Bureau of Economic Geology's Center for Energy Economics, Jackson School of Geosciences, The University of Texas at Austin. Gurcan Gülen may be reached at gurcan.gulen@beg.utexas.edu

See footnotes at end of text.

relief at Henry Hub (5-10 cents per MMBtu according to some market analysts), these cargoes represent a fraction of the first train's send-out capacity. Two more trains are expected. Construction in four other terminals started in late 2014 or early 2015. These facilities are expected to start producing LNG at various times from late 2017 through 2019.

NORTH AMERICAN DEMAND AND SUPPLY CONSIDERATIONS

It is important to underline that DOE permits do not imply any guarantee by the U.S. government that supplies will be available to buyers, who should be fully aware that they are exposing themselves to the volatility of the gas-on-gas competition in North America. The share of natural gas in power generation has been expanding significantly, driven, to a large extent, by cheap natural gas and the retirement of large capacities of coal and nuclear plants across the country. Environmental regulations and market conditions are expected to force more base-load capacity and older cycling units to retire. Our electricity dispatch modeling suggests that gas burn in power generation can increase by 5 BCFD (about 25%) by 2020 relative to 2013-14. Industrial use of natural gas in the petrochemicals sector and other facilities has been increasing as well. Our petrochemicals projects database, which covers primarily Texas and Louisiana, indicates the potential for several BCFD of new demand in the next couple of years. Finally, pipeline exports to Mexico have been increasing significantly, averaging 2.9 BCFD in 2015 and surpassing 3.2 BCFD in early 2016. With new pipelines under construction, and gas and power sector reforms in Mexico, pipeline exports may double by 2020. Although there are uncertainties associated with these expectations (especially in the power sector), these volumes add meaningfully to a U.S. natural gas market of roughly 73 BCFD (annual average).

On the supply side, all of the added capacity to monetize U.S. domestic gas production must be viewed through the lens of reductions in supply as the upstream cycle follows an inevitable path of adjustment. Low oil and gas prices finally seem to have led to natural gas production plateauing in early 2016; oil production started to decline in early 2015. A great deal of pressure exists on upstream operators to rationalize their businesses and reach solid footing on a financially sustainable basis.[1] About 100 companies declared bankruptcy and more bankruptcies are expected; capital budgets have been cut 50% or more. The decline in oil prices forced the operators as well as oilfield service companies to become more efficient and reduce costs, often pushing beyond maintainable efficiency gains. Including the support services, the oil and gas industry laid off close to 400,000 employees globally, a large portion of which occurred in the U.S. unconventional industry. It is safe to assume that all of the cost decline is not permanent. Given the historical relationship between the oil price and upstream capital and operating expenses, we expect a noticeable and rapid increase in costs as the oil price recovers (e.g., 30-35% of the increase in the price of oil from current levels). Accordingly, the future pace of drilling is highly uncertain even when the natural gas price recovers to $3 or more.

Since the collapse of the natural gas price, operators increased efficiencies and high-graded acreage to best locations, nearly always targeting locations with liquids that could improve realized values. They drilled in-fill wells and reduced levels of water and proppant to manage costs of completing wells with hydraulic fracturing. They followed similar completion techniques in cluster drilling of new acreage.[2] These short-term responses might have helped to sustain drilling but potentially at the risk of exhausting good acreage that could have been developed with higher recovery factors in the future. The remaining acreage is not likely to be fully drilled. Financial rationalization in the industry will ultimately lead to consolidation. Companies emerging from this phase will hold on to the best acreage and discard the lowest productivity areas. Without robust liquids price signals and suitable margins, drilling investment that has yielded the cheapest incremental source of gas supply – associated gas or non-associated gas that includes sufficient ethane for value added – will not continue or return at the pace we have seen in recent years. This implies that a gas price signal sufficient to support drilling and exploitation in dry gas locations must eventually be detected. Based on our analysis of producer costs since 2009, we believe that a minimum price to support dry gas drilling investment in many locations is $3.50-4.00; many others will require a higher gas price. The increase in drilling and completion costs resulting from the recovery of oil prices will further support the need for a higher gas price as will the need for better technology and completion practices required to develop lower productivity acreage, without which expected gas demand growth might not be fully satisfied with domestic resources by the mid-2020s.

IMPLICATIONS FOR U.S. LNG EXPORTS

It is useful to discuss several scenarios to capture the intricacies of how North American and global

market forces can interact in the future (Figure 2). The "Attraction" of U.S. LNG exports since 2010 was realized in an environment of low Henry Hub prices (represented as $3/MMBtu) and high natural gas prices in Europe (around $10 at National Balancing Point in the UK) and very high spot LNG prices in the Asia-Pacific market, driven by Japan's need to substitute for shut-down nuclear generation. Note that U.S. LNG would not have been competitive today even with $3 Henry Hub given landed prices averaging around $4 in recent months and $4 breakeven price for the Gorgon facility in Australia unless one treats the take-or-pay liquefaction fees as sunk cost. Henry Hub price has been below $2.5 since the beginning of 2016, which helps shipments from Sabine Pass be competitive. Also note that shipping costs are roughly half of what they were in 2014.

However, per our North American demand-supply discussion above, we do not expect the Henry Hub price to stay low in the long-term. Given our expectations of increased gas use in the power and industrial sectors, increasing exports to Mexico and via LNG, and pressures on the upstream segment, $3 by 2017 and $4 by 2018 are strong possibilities. Without the support of higher oil and liquids prices, operators' need for higher natural gas prices became more acute. An increasing number of analysts are suggesting, and our work indicates, that a $3-$3.5 price range could emerge by the summer of 2017. The CME forward curve (April 28, 2016) reflects a similar market view, staying around $3 +/-0.25 between December 2016 and March 2018. Interestingly, to the extent that expected growth in natural gas demand from electric power and industrial sectors and exports to Mexico are realized within the next few years, any sustained volumes of LNG exports within the same timeframe will likely have a disproportionately strong impact on the Henry Hub price as they will represent marginal volumes, undermining their global competitiveness.

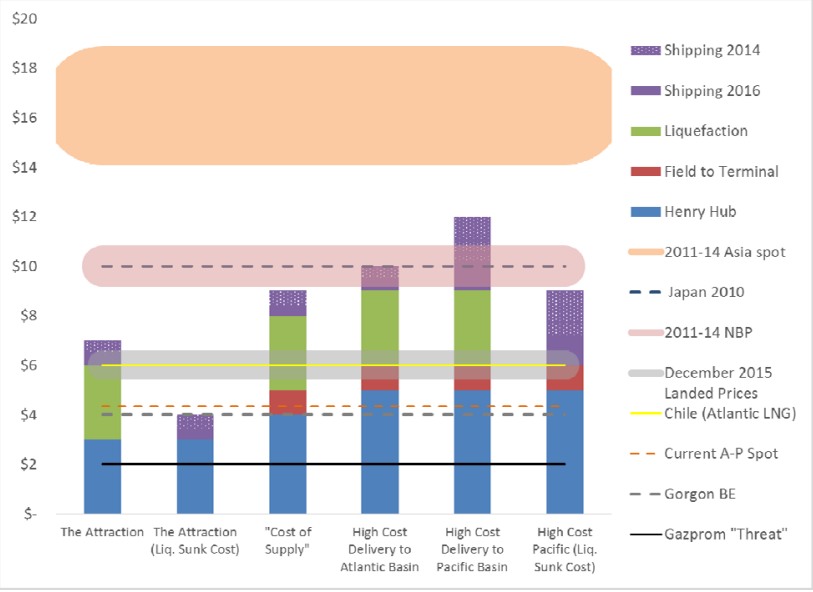


Figure 2. U.S. LNG Scenarios

Accordingly, we evaluate scenarios of $4 ("Cost of Supply") and $5 (High Cost). In these scenarios, it is difficult to see how U.S. LNG can compete even if one treats liquefaction fees as sunk cost unless the oil price recovers to $80 or more. Even then, the global LNG market will be in excess supply until the early 2020s. There has been a surge in new liquefaction capacity in recent years with more facilities planned. Projects under construction will take global LNG supply to 388 million tonnes by 2022, an increase of 140 million tonnes compared to capacity in 2015. In contrast, demand growth has been less stellar and there are signs that natural gas demand cannot reach levels expected in some forecasts. Emerging economies have been growing at slower rates with attendant negative multiplier effects on the rest of the global economy and energy demand. More directly, investment in coal, nuclear, and renewables have been increasing or at least maintained, constraining the need for natural gas in power generation (e.g., gas-fired plant utilization in China has been 30% or less in recent years). Our in-depth review of natural gas market development in China and India confirm these trends and raises questions regarding the expansion of gas use in other sectors given regulatory and physical infrastructure shortcomings.

Often, contracted volumes are seen as evidence of actual volumes that will be exported out of the U.S. facilities. However, 15-20% of liquefaction capacity remains unsubscribed and about half of the contracted volumes are not tied to specific destinations. Global LNG trade has a sizable short-term market, representing about 28% of the total volumes since the Fukushima accident. The share of the short-term market grew from zero in 1994 to 20% just before Fukushima. As Japan re-powers its nuclear fleet as expected, short term deliveries will decline; slower economic performance already led to a drop in Japanese LNG imports.

Access to U.S. LNG might be a good option to have at hand for global LNG traders to take advantage of arbitrage opportunities that appear throughout the year. As always, "optionality" must be financed, and it is not cheap. Thus, a persistent question as the LNG industry evolves is which market participants

have and will have the strongest balance sheets and sources of financing to engage in such risk-taking for commercial portfolios. Even the state-owned buyers such as GAIL (India) and KOGAS (South Korea), which are often driven by energy security concerns, have traded some of the volumes they contracted at U.S. terminals. These actions are taken at least partially because gas demand has not grown as expected and can stagnate in the future (e.g., because of new coal and nuclear capacity in South Korea).

In this excess LNG supply environment, not only do short-term prices fall, oil indexation also is renegotiated to reduce the impact of the oil price on the price of delivered LNG. In the European market, which is emerging to be more attractive for U.S. LNG, price competition by Gazprom cannot be ruled out (see Gazprom "Threat" in Figure 2).

In conclusion, market forces in the North American natural gas and global LNG markets are moving in opposite directions. It is likely that North American prices will increase while global LNG will be under strong downward pressure until the early 2020s even if oil prices recover sooner. In that case, the U.S. LNG exports will likely be seasonal with low capacity utilization through the early 2020s and the U.S. could well find itself serving as host for surplus LNG that needs a market in which to land. It has long been thought that LNG cargo receipts could serve to shave peaks in U.S. gas prices. Such a turnabout would be a boon to U.S. customers, but a surprise for many others.

Footnotes

[1] See CEE Research Snapshot "Upstream Matters! 2015 Update" at http://www.beg.utexas.edu/energyecon/thnk-crnr.php.

[2] See Bureau Shale Studies at http://www.beg.utexas.edu/research/programs/shale.

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.

Analyzing the Geopolitics of Natural Gas with the Global Gas Model: Subsidized LNG Exports from the U.S. to Eastern Europe

By Fabian Stähr and Reinhard Madlener

In the course of the crisis in Ukraine, most leading politicians in the Eastern European countries, such as Poland, the Baltic States and Ukraine itself, identified the high dependency on natural gas imports from Russia as a threat to the security of the energy supply. Following the U.S. "shale gas revolution" and the substantial resource estimates for Polish shale gas, hopes began to rise of reducing the energy import dependency through the extraction of domestic gas resources.

However, several important factors are now dimming any hopes of copying the U.S. shale gas revolution in Eastern Europe. First, international companies, such as Shell, ExxonMobil, or Chevron, have withdrawn from Poland and Ukraine due to poor exploration results. Additionally, because of more restrictive environmental legislation and higher population density, the obstacles (including public acceptance) to commercial shale gas production within Europe are, compared with those in the U.S., very high.

In Eastern Europe, the importance of natural gas in the energy mix varies from country to country. Figure 1 shows the primary energy consumption mix of Poland, Ukraine, the Baltic States (Lithuania, Latvia, and Estonia), and Germany for comparison. The natural gas consumption values are based on EIA (2015). In Poland, similarly to Estonia, natural gas plays only a minor role due to the overarching importance of coal, accounting for more than half of the domestic energy consumption, whereas the share of natural gas was only 12.8% of the current energy mix (or 18 bcm in absolute values) in 2012. In Ukraine, natural gas represents the main energy source (in 2012, demand summed up to about 52 bcm); some 40% of the primary energy consumption comes from natural gas, which is mainly used as a heating fuel in private households and for electricity generation. In Lithuania and Latvia, the share of natural gas in the primary energy mix is about one third, with 2012 consumption levels of 3.3 bcm in Lithuania and 1.5 bcm in Latvia. Furthermore, it is conspicuous that almost no coal is used and that the category "other" represents one third of the energy mix. This is partly due to the heavy use of firewood for heating, which is still a very common phenomenon in Latvia and Lithuania. In Estonia, in contrast, the share of coal accounted for almost two thirds of primary energy consumption, at a natural gas consumption level of 0.6 bcm (or a share of only 11.1%) in 2012.

Fabian Stähr is an analyst with BGR, Hannover, Germany. **Reinhard Madlener** is a Full Professor of Energy Economics and Head of the Institute for Future Energy Consumer Needs and Behavior (FCN), School of Business and Economics / E.ON Energy Research Center, RWTH Aachen University, Germany. Madlener may be reached at RMadlener@eonerc.rwth-aachen.de

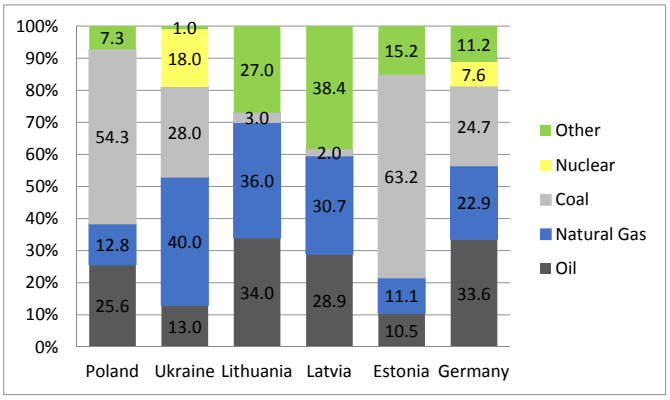


Figure 1. Primary energy consumption by energy resource in Poland, Ukraine, Lithuania, Latvia, Estonia and Germany as of 2012, in % (Data source: IEA, 2013a).

In our study, we use the Global Gas Model (GGM) (Egging, 2013) to simulate possible future patterns of the Eastern European gas supply. Two reference scenarios are contrasted with U.S. LNG subsidy scenarios: in the Base Case Scenario, the GGM is calibrated to the New Policies Scenario of the World Energy Outlook 2013 (IEA, 2013b), whereas the so-called Disruption Scenario is based on assumptions made in Richter and Holz (2015), presuming the total disruption of the natural gas trade from Russia to Europe, which would cause major repercussions on the natural gas supply to Eastern Europe. A geopolitically motivated LNG subsidy on transportation costs granted by the U.S. government to U.S. LNG supplied to Eastern Europe is imposed that ranges from 5-100%. The results obtained are discussed with a particular focus on natural gas supply diversification. In parallel, we also conduct some scenario analysis of possible shale gas production in Eastern Europe. We find that Poland and the Baltic States, by ramping up annual domestic shale gas production to 8 billion cubic meters (bcm) (Poland) and 2 bcm (Baltic States), would be able to reduce their import dependency by about 40%. Conversely, this means that failure to produce shale gas domestically would lead to continued high dependency on

natural gas imports. In Ukraine, at annual gas consumption levels of up to 60 bcm, the potential shale gas production of 5 bcm per year would not have any major consequences. In our Base Case Scenario, U.S. LNG exports barely reach the Eastern European gas market. Only during the projected period between 2035 and 2040 does Poland receive some 4.9 bcm of U.S. LNG. However, the Polish natural gas market turns out to be very sensitive to the subsidies provided: A 30% subsidy on transportation costs increases the total amount of U.S.-exported LNG to Poland by up to 8 bcm. In contrast, the Ukrainian and Baltic natural gas markets barely react to LNG subsidies from the U.S. A minimum subsidy level of 60% is needed to export U.S. natural gas under economically rational conditions to both regions. The modeling results show that, in order to meet the increasing natural gas demand, the interest in LNG-based imports rises in light of the low probability of a significant shale gas production in Eastern Europe. Due to the rising demand for natural gas, the Polish market shows the highest sensitivity to LNG subsidies from the U.S.

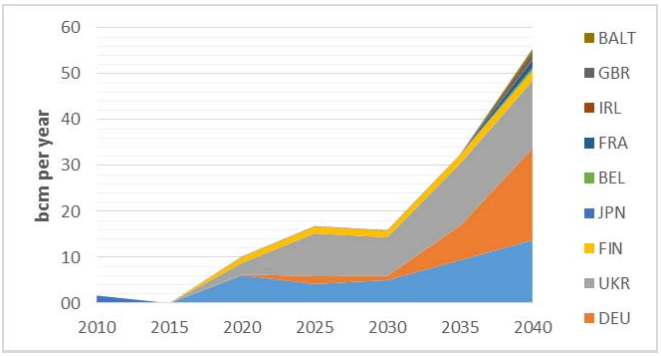


Figure 2. Global U.S. natural gas exports, 2010-2040, including a transportation subsidy rate of 100% to Poland, Ukraine, and the Baltic States.

Additionally, the model results demonstrate a possible problem concerning politically motivated subsidies on natural gas exports. As Figure 2 shows, in the 100% Subsidy Scenario, natural gas is also exported to Germany (20 bcm in 2040). This is not the case in the Base Case Scenario. Hence, subsidized natural gas exports to Poland are resold to Germany. This happens due to Germany's higher willingness-to-pay compared to other gas imports to Poland, the latter country then optimizing its own profits and satisfying its domestic demand from other sources.

References

Egging R. (2013). Benders decomposition for multi-stage stochastic mixed complementarity problems – Applied to a global natural gas market model'. European Journal of Operational Research 226: 341-353.

EIA (2015). International Energy Statistics, U.S. Energy Information Administration (EIA) Washington, D.C. http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=3&pid=26&aid=2. (retrieved Feb 12, 2015).

IEA (International Energy Agency) (2013a). Energy Statistics Division 08/2013, OECD/IEA, Paris.

IEA (International Energy Agency) (2013b). World Energy Outlook 2013, OECD/IEA, Paris.

Richter P.M., Holz F. (2015). All quiet on the Eastern front? Disruption scenarios of Russian natural gas supply to Europe, Energy Policy 80: 177-189.

Stähr F., Madlener R., Hilgers C., Holz F. (2015). Modeling the Geopolitics of Natural Gas: The Impact of Subsidized LNG Exports from the US to Eastern Europe, FCN Working Paper No. 15/2015, Institute for Future Energy Consumer Needs and Behavior, RWTH Aachen University, November.

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

The Dynamic Energy Landscape

Proceedings of the 33rd USAEE/IAEE North American Conference, Pittsburgh, PA, October 25 to 28, 2015
Single Volume $130 - members; $180 - non-members.

This CD-ROM includes articles on the following topics:

Shale Gas Impacts
Wind Energy
Energy-Water Nexus
Modeling Oil and Gas Markets
CO_2 Abatement Policies
Coal, Generation, and the EPA's Clean Power Plan
Emerging Technologies in the Electricity Market
Liquefied Natural Gas (LNG)
Solar Energy
The State of Energy Economics
Renewable Energy Economics
Greenhouse Gas (GHG) Mitigation
lectricity Price
Environmental Policy and the Electricity Sector
Evolution of Global Gas Markets
Electric Vehicles: Studies on Pollution, Consumers, and Policies
Energy Investment and Finance
Efficient Lighting and Green Building

Economic, Environmental, Technological and Security Challenges for Energy

38th IAEE International Conference, Antalya, Turkey, May 25 – 27, 2015
Single Volume $130.00 - members; $180.00 - non-members:

This CD-ROM includes articles on the following topics:

Carbon trading and taxation
Climate change and energy industry
Clean energy technologies
Energy prices and uncertainties
Energy and environmental policy
Energy markets and regulation
Geopolitics of oil and natural gas
Investment issues in liberalized markets
Market power issues
Oil and gas transportation and pipelines
Prospects of CCS technologies
Prospects for nuclear power
Prospects for alternative transportation fuels
Power and gas trade under volatile prices
Renewable energy technologies and markets
Shale fuel reserves, economics and sustainability
Technology adoption prospects and policies

****

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 _____

_____ "The Dynamic Energy Landscape" - $130.00 members - $180.00 non-member
_____ "Economic, Environmental, Technological and Security Challenges for Energy" - $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

Skyline of Marina Bay, Singapore. Photo courtesy of the Singapore Tourism Board.

CONFERENCE OVERVIEW

The Energy Studies Institute of the National University of Singapore invites you to participate in the 40th IAEE International Conference, which will be held at the iconic Marina Bay Sands Hotel, Singapore, 18-21 June 2017, with the main theme *Meeting the Energy Demands of Emerging Economies: Implications for Energy and Environmental Markets*.

The ten countries that make up the Association of Southeast Asian Nations (ASEAN) are exerting an increasingly important influence on global energy trends. Underpinned by rapid economic and demographic growth, energy demand in the region has more than doubled in the last 25 years, a trend that is set to continue over the period to 2040. Given Southeast Asia's role as a global growth engine, understanding what is shaping energy markets in this vibrant region and the implications for energy security and the environment is vital for policy makers and anyone with a stake in the energy sector. (IEA, *Southeast Asia Energy Outlook, 2015*).

However, this will be a truly international conference, so the focus will be on energy issues interpreted in their broadest global context. Of course, energy policies cannot be addressed in isolation from their local and global environmental impacts, and many conference sessions will address issues relating to this interdependence.

www.iaee2017.sg

CONFERENCE VENUE

In addition to its convention facilities, the Marina Bay Sands complex also hosts a hotel, a casino, and a large shopping and dining complex, all in a sweeping garden setting overlooking Marina Bay. The hotel itself has the world's largest rooftop pool, which stretches 150 metres across the hotel and offers breath-taking city-skyline views. A room reservation block has been negotiated with the hotel at a very favourable rate, but this is expected to be filled very quickly. Rooms in nearby hotels around Marina Bay will also be offered, as will less expensive accommodation located elsewhere in the city. The Marina Bay Sands complex has its own MRT (train) station, Bayfront, making it easily accessible to those staying off-site. For further information about the venue please refer to: https:www.marinabaysands.com.

The Energy Studies Institute (ESI) was established in 2007 with the aim of conducting policy-related research in energy issues of regional and global significance, with specific reference to Singapore and the ASEAN region. In the 2015 *Global Go To Think Tank Index Report*, published by the University of Pennsylvania, ESI was ranked 8th in the *Energy and Resource Policy Think Tanks* category.

Singapore is a thriving global commercial, transport, and financial hub that offers visitors a fascinating insight into an Asian tiger economy. It has a great diversity of attractions to suit all interests, so why not stay a couple of days beyond the conference to experience these in addition to visiting some of the region's leading cultural and vacation sites en route to or from Singapore.

THE 40th IAEE INTERNATIONAL CONFERENCE

MEETING THE ENERGY DEMANDS OF EMERGING ECONOMIES: IMPLICATIONS FOR ENERGY AND ENVIRONMENTAL MARKETS

CALL FOR PAPERS

TOPICS TO BE ADDRESSED

The conference will address the full range of energy issues that may be expected to be commanding the attention of academics, analysts, policy-makers, and industry participants in 2017. Possible topics include, but are not limited to:

- Security of energy supply: at what price?
- A growing role for nuclear?
- Energy poverty and energy subsidies: how can the link be broken?
- The economics of gas spot trading
- Renewable and alternative sources of energy
- Energy policy options in a carbon constrained world
- Developments in LNG markets
- Energy modelling
- Emission trading schemes
- The econometrics of oil and gas markets
- Energy sector investment
- Liberalised power markets: way to go?
- Oil and gas: global resources, reserves, and production.

Abstract submission deadline

Friday 13 January 2017

www.iaee2017.sg

CONCURRENT SESSION ABSTRACT FORMAT

Those offering to make concurrent session presentations must submit an abstract that briefly describes the research or case study to be presented no later than 13 January 2017. The abstract must be no more than two pages in length, and must include an overview of the topic including its background and potential significance, methodology, results, conclusions, and references (if any). All abstracts must conform to the structure outlined in the template. Abstracts must be submitted online. Please see www.iaee2017.sg for details.

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. Authors will be notified of the status of their presentation or poster by 1 March 2017. Authors whose abstracts are accepted will have until 14 April 2017 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. Therefore, 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 requested to withdraw one (or more) paper(s) or poster(s) for presentation.

STUDENT EVENTS

Students may, in addition to submitting an abstract, submit a paper for consideration in the IAEE Best Student Paper Award Competition.

Students are also encouraged to participate in the Student Poster Session and to submit a paper for consideration in the Special PhD session. The abstract format and submission process for the poster session is identical to that for concurrent session papers.

Students may inquire about scholarships covering conference registration fee. For more information, please visit www.iaee2017.sg.

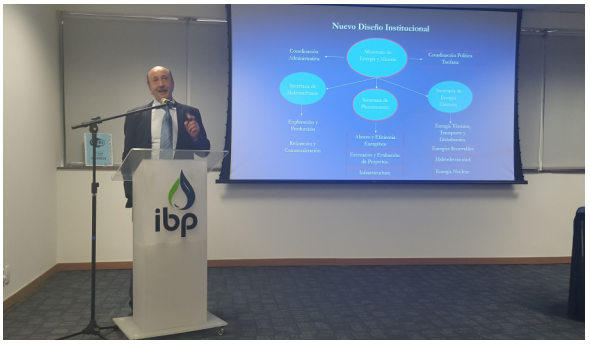
ALADEE warms up to ELAEE 2017 Conference in Rio

The Latin American Chapter (ALADEE) promoted a meeting to discuss new energy challenges for the region with experts as a preparation for the ELAEE Meeting 2017 that will take place in Rio de Janeiro.

The seminar titled: *New Energy Landscape: Impacts for Latin America* was held on Friday, April 8th 2016 at the Brazilian Petroleum, Gas and Biofuels Institute (IBP) in Rio de Janeiro. A hundred participants attended the seminar which was organized by ALADEE with support from IBP, AB3E (the IAEE's Brazilian Chapter) and IAEE. The seminar took place one day after the first meeting of the organizing committee for the VI Encuentro Latinoamericano de Economía de la Energía 2017 (ELAEE) with the same title that will take place in Rio de Janeiro, Brazil. A number of energy experts were invited to be part of this committee, defining which are the region's most critical topics in the field of energy economics.

During the seminar, the guiding topics for discussion were energy challenges and opportunities for Latin America.

With a warm welcome the President of ALADEE, Ms Marisa Leon, initiated the seminar emphasizing the importance of such events in a region which energy policies are diverse but energy issues are very similar. According to the General Secretary of IBP, Mr. Milton Costa Filho there are a lot to discuss about energy policy and markets in Latin America, especially in those days when energy exporting countries are facing a deepening crisis.



The President of IAEE, Mr. Gürkan Kumbaroglu, presented the international landscape on world's oil and gas geopolitics. In the oil sector the strategic positioning from Middle East countries is gaining more and more attention, with a direct impact on international oil market prices and on the expectations. He also points out big changes in international gas markets with increasingly LNG capacity over the world and competitive US gas being traded already in Europe. The president-elect of IAEE, Mr. Ricardo Raineri, broadened the international overview considering main trends on world's energy portfolios against world's energy consumption.

From ALADEE, Mr. Gerardo Rabinovich emphasized the oil and gas landscape for Argentina. In a political transition, Argentina faces macroeconomic challenges which affects directly how energy policies are undertaken there. While from GEE-UFRJ, Mr. Edmar de Almeida discussed a changing Brazilian oil and gas market with his main company, Petrobras, in a fragile financial situation and stated the need for new players to invest

and participate in all oil and gas segments.

Regarding the power market landscape, Professor Ronaldo Bicalho from GEE-UFRJ, highlighted different dimension of supply and demand in an ever changing power market, with technological innovations being pushed by climate change objectives.

The Vice president of ALADEE, Issac Dyner presented the Colombian power market and policy measures to fight against the tight power capacity due El Niño climate conditions. While Professor from FGV, Joísa Dutra and Professor from GEE-UFF, Luciano Losekkan discussed regulatory changes and crisis at the Brazilian power market. From Abeeólica, Rosana Santos, stated that wind power generation will be a solution for the region especially in Brazil as it is complementary with large hydro capacity already installed, being less intermittent than expected.

The former director of ANP and Professor from GEE-UFRJ, Mr. Helder Queiroz Pinto Jr. and the Economic Analysis Manager at IBP, Luciana Nunes closed the session reinforcing the importance of those topics and inviting all to participate at the VI ELAEE 2017 the from April 2nd to 5th in Rio.

GEE Grupo de Economia da Energia

ibp BRAZILIAN PETROLEUM, GAS AND BIOFUELS INSTITUTE | The home to our industry.

IAEE INTERNATIONAL ASSOCIATION for ENERGY ECONOMICS
WWW.IAEE.ORG

AB3E ASSOCIAÇÃO BRASILEIRA DE ESTUDOS EM ENERGIA
WWW.AB3E.ORG.BR IAEE AFFILIATE

The 2016 IAEE Summer School in Bejing,China

Energy Finance: Risk and Opportunities

July 10-17, 2016

Outline

Energy Finance: Risks and Opportunities

Day 1 – Intro to energy finance – mostly specialized energy economics – importance of cash flows – capital asset pricing model – time value of money – escalation and inflation

Day 2 – NPV and IRR – energy investment decision tools – discounted cash flows

Day 3 – Futures – valuation and hedging instruments in energy markets

Day 4 – Options – valuation and hedging instruments in energy markets

Day 5 – Real options – enhancement to discounted cash flow, net present value methods

Day 6 – Foreign exchange – import to risk mitigation for international investments

All these classes will do capital budgeting, some theory on futures and options, and some real options valuation. Examples of economic evaluation of coal versus natural gas plant investment will be involved, which will incorporate the importance of thermal efficiencies in such evaluation.

Course Leader

Dr. Ronald D. Ripple is the Mervin Bovaird Professor of Energy Business and Finance in the School of Energy Economics, Policy, and Commerce in the Collins College of Business at The University of Tulsa. He is also Vice President of IAEE.Ron took up his current position lecturing in the TU Master of Energy Business Program in 2013 after spending nearly fourteen years in Australia, with another year in Hong Kong. Dr. Ripple has studied oil and natural gas markets for over 34 years, getting his start in the Office of the Governor of Alaska. He wrote his PhD dissertation on Alaska North Slope natural gas, and recently authored a chapter on the Geopolitics of Australia Natural Gas Development for the joint Harvard-Rice Geopolitics of Natural Gas Study. In between these two studies, Ron has published numerous peer-reviewed journal articles, trade press articles, and reports, typically focusing on oil and natural gas markets and the financial derivatives markets that support them.

Content and Schedule

July 10
Registration whole day
Reception 19:00

July 11-13 and July 15-17
Classes 08:30-11:30; 13:00-16:00

July 14
Seminar 08:30-11:30; 13:00-16:00
Title *Energy Finance Research in China*
Speakers: **HAN Liyan, JI Qiang, ZHANG Dayong, WANG Yudong, WEI Yu, Li Ping**

July 17
Closing remarks 16:00-16:20

Sponsored by

International Association of Energy Economics (IAEE)

School of Economics and Management, Beihang University (BUAA)

With Assistance of

Center for Energy and Environmental Policy Research, Chinese Academy of Sciences (CEEP-CAS)

Committee for Low Carbon Development Management, Chinese Society of Optimization, Overall Planning and Economic Mathematics (CLCDM)

Cost and expenditure

Students: USD250;

Non-students: USD 350.

Certificate

•All participants who successfully finish the course will receive a certificate signed by IAEE President.

Registration and payment methods

- Participants must be IAEE members. If you are not, please go to the IAEE website to join (www.iaee.org).
- Participants need to send the registration form to Meng Hui (menghui@buaa.edu.cn) or Li Fangfang (lifangfang@buaa.edu.cn) before May 30, 2016. After the selection, we will send confirmation emails to applicants before June 10, 2016.
- For international participants, the registration fee needs to be paid to IAEE directly before June 30, 2016.
- For Chinese participants, the payment method will be notified in confirmation emails.

New Main Building of BUAA

Host University and Conditions

- The summer school will be held in the New Main Building of BUAA, Beijing, China.
- Student dormitory: The hosts can help to arrange students to stay in the student dormitories.
- Student dormitories include the following facilities:
  - High speed internet
  - Free hot water
  - Laundry service
  - Public bathroom
- Canteen: There are 10 dining rooms (including two Muslim dining halls) in BUAA. The meal is delicious and cheap, which can meet the needs of a variety of tastes.

Student Dormitory

Dormitory Room

Contacts

Meng Hui
Tel (O): 13426202267
Email: menghui@buaa.edu.cn
Li Fangfang
Tel (O): 13810350535
Email: lifangfang@buaa.edu.cn

Canteen

WELCOME NEW MEMBERS

The following individuals joined IAEE from 3/1/16 to 5/31/16

Veronica Acurio Vasconez
Paris School of Economics
FRANCE

SM Hossein Adeli
Gas Exporting Countries Forum
QATAR

Delawar Ahmed
Rice University
USA

Oskar Ahnfelt
Hallvarsson and Hallvarsson AB
SWEDEN

Nabeel Alabbas
University of Delaware
USA

Samer AlAshgar
KAPSARC
SAUDI ARABIA

Mohammed Albrahim
SAUDI ARABIA

Ruli Endepe Alfaizin
Universitas Indonesia
INDONESIA

Waled Alghreri
Saudi Aramco
SAUDI ARABIA

Nada AlHarthi
TAQNIA
SAUDI ARABIA

Harris Aliefendic
OMV AG
AUSTRIA

Mohammed Almehdar
Brandeis University
USA

Ahmed Alshadooki
Research Prodcuts Development Co.
SAUDI ARABIA

Faris Alwohaibi
Saudi Aramco
SAUDI ARABIA

Faisal Alyemni
Saudi Aramco
SAUDI ARABIA

Stefan Ambec
TSE-R / INRA
FRANCE

Serafini Andrea
DNV GL
ITALY

Katherine Macarena Antonio Sanjinez
Univ of NC at Greensboro
USA

Giulio Antuono
University LUISS
ITALY

Sami Aoude
Macquarie University, Sydney
AUSTRALIA

Gianmaria Apa
University LUISS
ITALY

Pritham Aravind
Carnegie Mellon University
USA

Marlene Arens
Fraunhofer Institute ISI
GERMANY

Emmanuel Asane-Otoo
University of Oldenburg
GERMANY

Mohammed Atif
DNV GL
UNITED ARAB EMIRATES

Mohammed Atif
DNV GL
UNITED ARAB EMIRATES

Elham Azarafshar
Natural Resources Canada
CANADA

Frederic Babonneau
ORDECSYS
SWITZERLAND

Huseyin Bahtiyar
The Ohio State University
USA

Robin Baker
Societe Generale
UNITED KINGDOM

Fridrik Baldursson
Reykjavik University
ICELAND

Stephanie Beels
Carnegie Mellon university
USA

Jose Belbute
Univ of Evora CEFAGE UE
PORTUGAL

Andreas Belderbos
KU Leuven - EnergyVille
BELGIUM

David Benatia
Université de Montréal
CANADA

Giacomo Benini
University of Geneva
SWITZERLAND

Alpay Beyla
Beyaz Danismanlik Ltd
TURKEY

Julia Blasch
VU University Amsterdam
NETHERLANDS

Mickael Bokobza
PMP
FRANCE

Nina Boogen
ETH Zurich
SWITZERLAND

Vinicius Botelho
Fundacao Getulio Vargas
BRAZIL

Christine Brandstaett
Jacobs University Bremen
GERMANY

Jonathan Bruegel
Fortum
FRANCE

Kenneth Bruninx
KU Leuven
BELGIUM

Wenbiao Cai
CANADA

Rejean Casaubon
The Inst of Energy Economics Japan
JAPAN

Miguel Castro
Michigan State University
USA

Joakim Cejie
Ministry of the Environment Energy
SWEDEN

Atul Chandra
UWA Business School
AUSTRALIA

Wonjun Chang
UWM
USA

Lanouar Charfeddine
Qatar University
QATAR

Mohamed Chelly
Neoma Business School
FRANCE

Genghua Chen
Duke university
USA

Wen Chen
CSIRO
AUSTRALIA

Xiaoqi Chen
South Western University Fin and Ec
CHINA

Ezgi Pinar Cinar
Darmstadt Technical University
GERMANY

Piero Fabio Cingari
Univ di Bologna
ITALY

Duke Cole
Reserve Bank of Australia
AUSTRALIA

Tine Compernolle
Hasselt University
BELGIUM

Douglas Cook
UNITED KINGDOM

Gonzalo Cortazar
Pontificia Universidad Catolica
CHILE

Emily Cox
University of Sussex
UNITED KINGDOM

Pascal Da Costa
Ecole Centrale Paris
FRANCE

Gregorio Da Cruz Araujo Maciel
Petrobras
BRAZIL

Fernando De Sisternes
MIT
USA

Xavier Degon
EDF
FRANCE

Caroline Deilen
University Duisburg-Essen
GERMANY

Barnabás Máté Derekas
BUTE
HUNGARY

Francesco Di Fratta
SNAM
ITALY

Vincenzo Di Luccia
Di Luccia Advisors
ITALY

Hao Ding
NUAA
CHINA

Sandro Dinser
SWITZERLAND

Geoffroy Dolphin
University of Cambridge
UNITED KINGDOM

Tommi Ekholm
VTT Technical Rsch Ctr of Finland
FINLAND

Alejandra Elizondo
CIDE
MEXICO

Ahmad Emami Meibodi
Shahid Beheshti Univ
IRAN

Katarzyna Ewa Rollert
Lephana
GERMANY

Kenechi Ezeudenna
University of Strathclyde
UNITED KINGDOM

Yohan Favreau
ERDF
FRANCE

Frank Felder
Rutgers University
USA

Bjoern Felten
University of Duisburg-Essen
GERMANY

Pablo Ferragut
ARPEL
URUGUAY

Gioele Figus
University of Strathclyde
UNITED KINGDOM

Markus Flaute
GWS
GERMANY

Gianluca Flego
DG JRC, European Commission
ITALY

Frank Foster
USA

Gillian Foster
Vienna Univ of Econ and Bus
AUSTRIA

Giuseppe Furciniti
University LUISS
ITALY

Denise Fussen Yanque
SWITZERLAND

Veil Gabriel
GERMANY

Swantje Gaehrs
Institut fur Okologische
GERMANY

Riccardo Gallottini
21 Rete Gas Gruppo F 21
ITALY

Christian Gambardella
PIK
GERMANY

John Garcia Caycedo
Sorbonne
FRANCE

Joachim Geske
Imperial College Business School
UNITED KINGDOM

Archana Ghodeswar
MSEDCL
INDIA

Gianfranco Gianfrate
Harvard University
USA

Catherine Girard
Renault SAS
FRANCE

Claudia Gomez
Universita LUISS
ITALY

Panyawat Gomutbutra
EEI Kasetsart University
THAILAND

Mario D. González Ronda
OMIE
SPAIN

Naga Srujana Goteti
Rochester Institute of Technology
USA

Fabian Grabicki
Clausthal University of Technology
GERMANY

Robert Gray
Resource Capital Funds
AUSTRALIA

Elke Groh
Univeristy of Kassel
GERMANY

Robert Grueneis
Wiener Stadtwerke
AUSTRIA

Andree Gunilla
Energikommissionen
SWEDEN

Sarvar Gurbanov
Qafqaz University
AZERBAIJAN

Laura Haar
University of Manchester
UNITED KINGDOM

Manfred Hafner
Enerdata
FRANCE

Clemens Haftendorn
Wood Mackenzie
UNITED KINGDOM

Grete Hakonsen Coldvin
The Norwegian Smart Grid Centre
NORWAY

Sam Hamels
Ghent University
BELGIUM

Yu Hao
Beijing Institute of Technology
CHINA

Chris Harris
National Grid
UNITED KINGDOM

Ebrahim Hashem
UNITED ARAB EMIRATES

Janesha Hassaram
Nicholas School of the Environment
USA

Arild Heimvik
University of Bergen
NORWAY

Knut Helland
University of Bergen
NORWAY

Michael Hellwig
CEER
GERMANY

Seb Henbest
Bloomberg New Energy Finance
UNITED KINGDOM

Mauricio Hernandez
Duke University
USA

Hazem Heswani
Leeds Beckett
UNITED KINGDOM

Nathalie Hinchey
Rice University
USA

Francesco Hipp
University Duisburg-Essen
GERMANY

Claire Hlavacek
Sciences Po Lille
FRANCE

Juri Horst
IZES gGmbH
GERMANY

Eric Omo Junior Idumwonyi
Adewunmi Oil Ltd
LAGOS

Kenneth Igbinoba
Adewunmi Oil Ltd
LAGOS

Shinsuke Ikeda
Natl Graduate Inst for Policy Stud
JAPAN

Niko Jaakkola
Ifo Institut
GERMANY

Sarah Jaidi
Colombus Consulting
FRANCE

Jaeyoung Jang
KAIST College of Business
SOUTH KOREA

Wonjae (James) Jang
The University of Texas at Austin
USA

Gloria JinaKim
KAIST College of Business
SOUTH KOREA

Knut Anders Kjelaas Johansen
University of Stavanger
NORWAY

Filip Johnsson
Chalmers Tekniska Hogskola
SWEDEN

Bernhard Kalkbrenner
TU Munich
GERMANY

Amin Karimu
Centre for Env and Res Econ
SWEDEN

Yuliya Karneyeva
University of St Gallen
SWITZERLAND

Nozomi Katou
Fujitsu Research Institute
JAPAN

Antonios Katris
University of Strathclyde
UNITED KINGDOM

Suyash Kela
Carnegie Mellon Univ
USA

Aino Mari Keskinen
Finlands Energy Authority
FINLAND

Thomas Josef Ketelaer
Forschungszentrum Julich GmbH
GERMANY

Raafe Khan
Carnegie Mellon University
USA

Eric Gabin Kilama
Universite de Paris
FRANCE

Christian Kile
Rice University
USA

Yeonbae Kim
Seoul National University
SOUTH KOREA

Per Klevnas
Copenhagen Economics
SWEDEN

Henrik Klinge Jacobsen
Technical University of Denmark
DENMARK

Friederike Knust
European University Flensburg
GERMANY

Christoph Kost
Fraunhofer Institute
GERMANY

Alisa Kostrova
University of Bonn
GERMANY

Tomas Krehlik
Faculty of Social Sciences, CUNI CZ
CZECH REPUBLIC

Merla Kubli
Zürich University
SWITZERLAND

Diederik Kuipers
TU Delft
NETHERLANDS

Viktoras Kulionis
Lund University
SWEDEN

Sturla Kvamsdal
NHH
NORWAY

Ville Laasonen
Finnish Energy Authority Renew Ener
FINLAND

David Lara Arango
University of Bergen
NORWAY

Augustine Lartey
Countryway Transport Co Ltd
GHANA

Christine Lauber
Vattenfall AB
GERMANY

Jim Lazar
Regulatory Assistance Project
USA

Florian Leblanc
CIRED
FRANCE

Lionel Lemiale
Universite de Nantes
FRANCE

Todd Levin
Argonne National Laboratory
USA

p.47

Kun Li
Beijing Normal University
CHINA

Ping Li
Beihang University
CHINA

Pierre Lienhart
IFP School
FRANCE

William Lilley
Saudi Aramco
SAUDI ARABIA

Leonardo Lima Gomes
PUC RIO
BRAZIL

Arne Lind
IFE
NORWAY

Karen Byskov Lindberg
NUST
NORWAY

Magnus Linden
Sweco Energuide
SWEDEN

Rodica Loisel
Universite de Nantes
FRANCE

Edson Daniel Lopes Goncalves
FGV - CERI
BRAZIL

Sindre Lorentzen
Univeristy of Stavanger
NORWAY

Melissa Low
National University of Singapore
SINGAPORE

Noura Mansouri
SAUDI ARABIA

Baltasar Manzano
KAPSARC
SAUDI ARABIA

Marija Marot
Plinovodi d.o.o.
SLOVENIA

Ludovica Marsili
University LUISS
ITALY

Paschmann Martin
Univ Koln
GERMANY

Giuliano Masiero
Universita della Svizzera Italiana
ITALY

Gudrun Mathisen
Hordaland County Council
NORWAY

Nils May
DIW Berlin
GERMANY

Jacob Mays
Northwestern University
USA

Lucas McConnell
Invenergy LLC.
USA

Neil McCulloch
Oxford Policy Management
UNITED KINGDOM

Catherine Mertes
RCF Econ and Fin Consulting Inc
USA

Erol Metin
TURKEY

Jose Meza
Universidad Nacional de Ingenieria
PERU

Adebayo Micheal
Kc Finance and Investment Limited
LAGOS

Renan Michel
Mines Paris Tech
FRANCE

Dragan Miljkovic
North Dakota State University
USA

Julia Moeller
First Solar
USA

Ilan Momber
Vlerick Business School
BELGIUM

Evgenii Monastyrenko
Universite Paris 1
FRANCE

Antoine Monnet
CEA
FRANCE

Jose David Montoya Salas
COLOMBIA

Joao Moreira
Universidade Federal do ABC
BRAZIL

Lee Morrison
University of Colorado Denver
USA

Paul Moy
UBS Asset Management
UNITED KINGDOM

Yaqian Mu
Tsinghua University
CHINA

Christophe Muller
Universite Aix Marseille
FRANCE

Francisco Munoz
CHILE

Helene Naegele
DIW Berlin
GERMANY

Linn Camilla Nesvik
NORWAY

Nora Nezamuddin
KAPSARC
SAUDI ARABIA

Lenja Niesen
University Duisburg-Essen
GERMANY

Daniel Nordgren
Vattenfall AB
SWEDEN

Frode Martin Nordvik
BI Norwegian Business School
NORWAY

Alfonso Novales
Universidad Complutense
SPAIN

Luciana Nunes
IBP
BRAZIL

Honorata Nyga Lukaszewska
Warsaw School of Economics
POLAND

Frank Obermueller
EWI Cologne
GERMANY

Christian Oberst
RWTH Aachen University
GERMANY

Mehmet Emre Olmez
Dedas
TURKEY

Jose Antonio Ordonez
Fraunhofer ISI
GERMANY

Kelvin Osemudiamen Oriere
Adewunmi Oil Ltd
LAGOS

Jose Orihuela
Skema Business School
FRANCE

Zafer Ozturk
Bogazici University
TURKEY

Athanasios Papakonstantinou
DTU Electrical Engineering
DENMARK

Christian Pape
University of Duisburg-Essen
GERMANY

Anthony Paris
IFPEN
FRANCE

Candace Partridge
Univ of College London
UNITED KINGDOM

Giuseppe Pastorino
AICEP
ITALY

Louis Magnus Pauchon
NORWAY

Diogo Pereira
University of Beira Interior
PORTUGAL

Eric Perrier
EDF
FRANCE

Chaimie Pewitt
Houston Energy Data Science
USA

Kirk Philipich
University of Michigan - Dearborn
USA

Maria Polikarpova
Norwegian School of Economics
NORWAY

Laura Prawatky
University College London
GERMANY

Martin Pudlik
Fraunhofer ISI
GERMANY

Queena K Qian
Delft University of Technology
NETHERLANDS

Jonah Ralston
University of Wisconsin-Whitewater
USA

Roberto Ravagnani
BRAZIL

Solange Ravagnani
BRAZIL

Fatemeh Razmi
IRAN

Johannes Reichl
Johannes Kepler Universität
AUSTRIA

Austin Rial
USA

Alessandro Riches
University of LISS
ITALY

Hans-Kristian Ringkjob
University of Bergen
NORWAY

Juan Ríos
National University of Colombia
COLOMBIA

Randy Rischard
PointLogic Energy, an IHS company
USA

Diana Roa Rubiano
Norwegian Univ of Life Sciences
NORWAY

Carlos Rodriguez Monroy
UPM
SPAIN

katarzyna ewa rollert
Leuphana
GERMANY

Teresa Romano
Politecnico di Milano
ITALY

Keith Ruddell
University of Auckland
NEW ZEALAND

Massimo Sabbioneda
Alpiq Energia Italia SpA
ITALY

Khalid Saleh
Rice University
USA

Ian Satchwell
University of Queensland
AUSTRALIA

Aurélien Saussay
FEO
FRANCE

Viraj Sawant
Rice University
USA

Daniel Scheitrum
University of California Davis
USA

Tim Scherwath
Technical University Berlin
GERMANY

Moritz Schillinger
University of Basel
SWITZERLAND

Barbara Schmidt
Oesterreichs Energie
AUSTRIA

Hendrik Schmitz
RWTH Aachen University
GERMANY

Jan Schneider
University of Oldenburg
GERMANY

Christian Schuetzenhofer
University of Vienna
AUSTRIA

Ingmar Schumacher
LUXEMBOURG

Valeria Jana Schwanitz
Sogn og Fjordane University College
NORWAY

Ashok Sekar
Rochester Institute of Technology
USA

Gregor Semieniuk
University of Sussex
UNITED KINGDOM

Paola Chiara Sesti
ITALY

Huma Seth
Colorado School of Mines
USA

Katerina Shaton
Molde University College
NORWAY

Raisa Sherif
Max Planck Institute
GERMANY

Min Shi
Southwestern Univ of Fin and Econ
CHINA

David Shin
American Petroleum Institute
USA

Chou Siaw Kiang
NUS
SINGAPORE

Saba Siddiki
Purdue University
USA

Luisa Sievers
Fraunhofer ISI
GERMANY

Sanz Silvia
Durham University
GERMANY

Iskra Sokolovska
Faculty of Economics
SLOVENIA

Stephan Sommer
RWIW
GERMANY

Thanh Son Nguyen
UWA Business School
AUSTRALIA

Simon Spencer
University College Dublin
IRELAND

Francesco Sperandini
GSE
ITALY

Lee Stapleton
University of Sussex
UNITED KINGDOM

Carine Staropoli
Paris School of Economics
FRANCE

Anton Steen
Energikommissionen
SWEDEN

Hlynur Stefansson
Reykjavik University
ICELAND

Arne Steinkraus
TU Braunschweig
GERMANY

Kylie Sterling
Austrade
AUSTRALIA

Karl Axel Strang
ERDF
FRANCE

Bin Su
National University of Singapore
SINGAPORE

Masaaki Suzuki
The University of Tokyo
JAPAN

Noor Syaifudin
UWA
AUSTRALIA

Afshean Talasaz
Chesapeake Energy
USA

Ishaya Tambari
Univ of Portsmouth
UNITED KINGDOM

Yujia Tao
University of Singapore
SINGAPORE

Mats Tedenvall
IIIEE at Lund University
SWEDEN

Bernard Tembo
University College London (UCL)
UNITED KINGDOM

Lennert Thomas
Ghent University
BELGIUM

Justin Thompson
University of Texas at Austin
USA

Oliver Tietjen
PICIR
GERMANY

Sara Tomasics
BUTE
HUNGARY

Asbjorn Torvanger
CICERO
NORWAY

Arjan Trinks
University of Groningen
NETHERLANDS

Michael Troilo
The University of Tulsa
USA

Jordan Tucker
USA

Daniel Tulloch
Smith School of Enterp and Environ
UNITED KINGDOM

Yusuf Turhan
TP
TURKEY

Endre Tvinnereim
Uni Research Rokkan Centre
NORWAY

Miguel Udaeta
GEPEA/EPUSP
BRAZIL

Abu Murad Md Nasir Uddin
PC&E Ltd
BANGLADESH

Takahiro Ueno
Kyushu University
JAPAN

Charlotte Vailles
I4CE
FRANCE

Migle Vakarinaite
Vilnius University
LITHUANIA

Per Valvatne
Olje og Energidepartementet
NORWAY

Desiree Vandenberghe
Ghent University
BELGIUM

Toon Vandyck
European Commission (JRC)
SPAIN

Cristina Vasquez
Saudi Aramco
SAUDI ARABIA

Ioannis Vidakis
University of the Aegean
GREECE

Apratim Vidyarthi
Carnegie Mellon University
USA

Verena Viskovic
University College London
UNITED KINGDOM

Aryestis Vlahakis
ETH Zurich
SWITZERLAND

Duc Vo
Economic Regulation Authority
AUSTRALIA

Stefan Voegele
IEK-STE
GERMANY

Guillaume Voegeli
University of Geneva / HTW Chur
SWITZERLAND

Amandine Volard
Ouest Normandie Energies Marines
FRANCE

Sarah Von Helfenstein
Value Analytics & Design, LLC
USA

Khoa Vu
University of Minnesota
USA

Christian Wagner
TU Dortmund
GERMANY

Mikko Wahlroos
Aalto University
FINLAND

Banban Wang
Huazhong University
CHINA

Mei Wang
NUAA
CHINA

Nan Wang
The University of Tokyo
JAPAN

Xiaoyu Wang
China University of Petroleum
CHINA

Pal Brevik Wangsness
Inst of Transport Economics
NORWAY

Ben Wealer
Technichal University of Berlin
GERMANY

Tyson Weaver
CSES
NORWAY

Sebastian Wehrle
Wien Energie
GERMANY

Richard Weinhold
TU Berlin
GERMANY

Florian Weiser
University of Cologne
GERMANY

Nate Weismiller
USA

Wen Wen
NUAA
CHINA

August Wierling
Sogn og Fjordane University College
NORWAY

Travis Wilson
Rice MEECON
USA

Jun Wu
Chongqing University
CHINA

Rolf Wüstenhagen
University of St. Gallen IWÖ-HSG
SWITZERLAND

Meng Xu
HKUST
HONG KONG

Qing Xue
China University of Petroleum
CHINA

Peifang Yang
China University of Petroleum
CHINA

Yuan Yang
Tsinghua University
CHINA

Mashael Yazdanie
Paul Scherrer Institute
SWITZERLAND

Corey Young
Washington and Jefferson College
USA

Yuyu Zeng
University of Groningen
NETHERLANDS

Xinzhu Zheng
Tsinghua University
CHINA

Vera Zipperer
DIW Berlin
GERMANY

Abdulrasheed Zubair
Cardiff University
UNITED KINGDOM

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
2016				
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
August 28-31	1st IAEE Eurasian Conference Energy Economics Emerging from the Caspian Region: Challenges and Opportunities	Baku, Azerbaijan	TRAEE	Gurkan Kumbaroglu gurkank@boun.edu.tr
September 21-22	11th BIEE Academic Conference Innovation and Disruption: The Energy Sector in Transition	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				
April 3-5	6th ELAEE Conference New Energy Landscape: Challenges For Latin America	Rio de Janeiro	ALADEE	Luciano Losekann luciano.dias.losekann@gmail.com
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 esiadow@nus.edu.sg
September 3-6	15th IAEE European Conference Heading Towards Sustainability Energy Systems: by Evolution or Revolution?	Vienna, Austria	AAEE/IAEE	Reinhard Haas haas@eeg.tuwien.ac.at
November 5-8	35th USAEE/IAEE North American Conference Riding the Energy Cycles	Houston, TX, USA	USAEE	David Williams usaee@usaee.org
2018				
June 10-13	41st IAEE International Conference Security of Supply, Sustainability and Affordability: Assessing the Trade-offs Of Energy Policy	Groningen, The Netherlands	BAEE/IAEE	Machiel Mulder machiel.mulder@rug.nl
September 19-21	12th BIEE Academic Conference *Theme to be Announced*	Oxford, UK	BIEE	BIEE Administration *conference @biee.org*
2019				
May 26-29	42nd IAEE International Conference *Local Energy, Global Markets*	Montreal, Canada	CAEE/IAEE	Pierre-Olivier Pineau *pierre-olivier.pineau@hec.ca*
August 25-28	16th IAEE European Conference *Energy Challenges for the Next Decade:* *The Way Ahead Towards a Competitive,* *Secure and Sustainable Energy System*	Ljubljana, Slovenia	SAEE/IAEE	Nevenka Hrovatin *nevenka.hrovatin@ef.uni-lj.si*

Calendar

15-16 June 2016, Gas Storage and Transmissions at Holiday Inn Kensington Forum, 97 Cromwell Road, London, SW7 4DN, United Kingdom. Contact: Phone: +4402078276140, Email: vtrinh@smi-online.co.uk, URL: http://atnd.it/50354-0

19-22 June 2016, 39th IAEE International Conference - Energy: Expectations and Uncertainty - Challenges for Analysis, Decisions and Policy at Bergen, Norway. Contact: Phone: 216-464-5365, Fax: 216-464-2737, Email: iaee@iaee.org, URL:www.iaee.org

20-21 June 2016, Meter Asset Management 2016 at Holiday Inn Kensington Forum, 97 Cromwell Road, London, SW7 4DN, United Kingdom. Contact: Phone: +4402078276140, Email: vtrinh@smi-online.co.uk, URL: http://atnd.it/50350-0

21-21 June 2016, Energy 2016: Risk, Resilience and Cyber Security of Global Supplies at Exhibition Centre, Liverpool, Monarchs Quay, Liverpool, **L3 4FP, United Kingdom.** Contact: Phone: 02079731251, Email: eventenquiries@imeche.org, URL: http://atnd.it/51897-2

21-23 June 2016, POWER-GEN Europe at Milan, Italy. Contact: Phone: 01992656646, Email: crispinc@pennwell.com, URL:http://atnd.it/30265-0

26-30 June 2016, ASME Power and Energy at Charlotte Convention Center, 501 South College Street, Charlotte, NC, 28202, United States. Contact: Phone: +12125918390, Email: aslana@asme.org, URL: http://atnd.it/44165-0

27-28 June 2016, Oil and Gas Cyber Security at Movenpick Hotel Amsterdam City Centre, Piet Heinkade 11, Amsterdam, 1019 BR, Netherlands. Contact: Phone: +4402078276088, Email: jrotar@smi-online.co.uk, URL: http://atnd.it/48242-1

27-29 June 2016, 9th Nano Congress for Next Generation at Valencia, Spain . Contact: Phone: 17025085200, Email:nanocongress@insightconferences.com, URL: http://nanocongress.conferenceseries.com/

27-28 June 2016, Platts 13th Annual Bunker and Residual Fuel Oil Conference at St. Regis Houston, 1919 Briar Oaks Lane, Houston, TX, 77027, USA. Contact: Phone: 857 383 5733, Email: christine.benners@platts.com, URL: http://atnd.it/46905-0

27-28 June 2016, Northeast US and Canada Petrochemical Construction Conference 2016 at Marriot Hotel, 112 Washington Place, Pittsburgh, PA, 15219, United States. Contact: Phone: 02073754325, Email: tamsin@petchemupdate.com, URL: http://atnd.it/51878-0

29-30 June 2016, Argus Biomass Asia 2016 at Singapore. Contact: Phone: 65 6496 9977, Email: ashrafe.hanifar@argusmedia.com, URL: http://atnd.it/51864-0

June 29 - July 01 2016, 6th International Conference Offshore Foundations 2016 at Swissotel Bremen, Hillmannplatz 20, Bremen, 28195, Germany. Contact: Phone: +4903020913387, Email: barakaki.vasiliki@iqpc.de, URL: http://atnd.it/49747-1

10-14 July 2016, CleanEnviro Summit at Sands Expo and Convention Centre, Marina Bay Sands, 10 Bayfront Avenue, Singapore. Contact: Phone: 6565428660, Email: info@experiaevents.com, URL: http://atnd.it/29923-0

11-14 July 2016, Intersolar North America Exhibition and Conference at Moscone Center West Hall, 800 **Howard Street, San Francisco 94103, United States.** Contact: Phone: 0049 761 3881 3800, Email: intersolar_us@fwtm.de, URL: http://atnd.it/51771-0

12-14 July 2016, International SAP Conference for Mining and Metals at Frankfurt am Main, Germany. Contact: Phone: +44 (0)121 200 3810, Email: info@tacook.com, URL: http://atnd.it/55838-0

18-20 July 2016, International Congress on Water, Waste and Energy Management at Aula Magna P. Gismondi Sogene Building, Macroarea di Scienze Mathematiche, Fisiche e Naturali Università degli Studi di Roma. Contact: Phone: +44 07467 043350, Email:info@waterwaste.skconferences.com, URL: http://atnd.it/40562-0

18-20 July 2016, 4th Asia-Pacific Global Summit & Expo on Healthcare at Brisbane,Australia. Contact: Email:healthcareasiapacific@omicsgroup.com, URL: http://healthcare.global-summit.com/asia-pacific/

18-20 July 2016, International Congress on Water, Waste and Energy Management at TBC, Rome, Italy. Contact: Phone: +4407467043350, Email: info@waterwaste.skconferences.com, URL: http://atnd.it/40562-0

18-29 July 2016, Oil & Gas Mini MBA at London Hotel, London SW11 3RB, United Kingdom. Contact: URL: http://atnd.it/36772-2

20-22 July 2016, International Congress on Green Chemistry and Sustainable Engineering at TBC, Rome, Italy. Contact: Phone: +4407467043350, Email: info@greenchemistry.skconferences.com, URL: http://atnd.it/40575-0

20-22 July 2016, International Congress on Green Chemistry and Sustainable Engineering at Aula Magna P. Gismondi Sogene Building, Via della Ricerca Scientifica 1, Rome, 00133, Italy. Contact: Phone: +4407467043350, Email:info@greenchemistry.skconferences.com, URL: http://atnd.it/40575-0

25-29 July 2016, HydroVision International at Minneapolis Convention Center, 1301 2nd Ave South, Minneapolis, 55403, United States. Contact: Email: cassiec@pennwell.com, URL: http://atnd.it/54365-0

04-06 August 2016, 2nd World Congress on Biopolymers (User Submitted) at United Kingdom. Contact: Email:biopolymercongress@conferenceseries.com, URL: http://biopolymers.conferenceseries.com/

08-10 August 2016, Euro Global Summit and Expo on Biomass at Birmingham & UK. Contact: Phone: 16503539744, Email:eurobiomass@conferenceseries.net, URL: http://biomass.global-summit.com/europe/

18-19 August 2016, The 6th International Conference on Environmental Pollution and Remediation at Novotel Budapest Centrum, Rakoczi ut 43-45, BUDAPEST, 1088, Hungary. Contact: Phone: +1 613-695-3040, Email: conferences@international-aset.com, URL:http://atnd.it/49879-0

23-24 August 2016, Funding & Implementing Energy Efficiency & Sustainability at Novotel Sydney Central, 169-179 Thomas Street, Sydney, 2000, Australia. Contact: Phone: 0292395747, Email: registration@criterionconferences.com, URL: http://atnd.it/57527-0

23-25 August 2016, Intersolar South America Exhibition and Conference at São Paulo, Brazil. Contact: Phone: 0049 761 3881 3800, Email: intersolar_sa@fwtm.de, URL: http://atnd.it/52187-0

IAEE ENERGY FORUM *Vol. 25, Third Quarter 2016*

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.

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