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

IAEE Energy Forum

Third Quarter 2012 International Association for Energy Economics

President's Message

At the time of writing I am about to leave Stockholm for Perth and the 2012 IAEE International Conference. This means that I will experience midwinter in Australia instead of taking part in the very traditional Midsummer celebrations in Sweden. However, the program that Ron Ripple, Tony Owen and the rest of the Perth team have put together is certainly full compensation for missing these festivities. And to be honest, midwinter weather in Perth is probably better than midsummer weather in Sweden.

However, the conference in Perth does not only coincide with Midsummer celebrations in Sweden. It also coincides with the final stages in a process within the EU decision making institutions, aimed at imposing a cap on total EU energy consumption. The aim is not to hamper economic growth, but to create strong incentives for more efficient use of energy. As is well known, one of EU:s so called 20-20-20 targets is to increase energy efficiency in EU by 20 percent by 2020. The new policies are designed to make reaching these targets possible.

It is hard to believe that the 20-20-20 goals can be reached without significant technological development combined with rapid implementation of new energy efficient technologies. One of the many challenges for our profession is to help design the institutions and set of incentives that foster development and use of new energy efficient technologies. Thus it is good to know that several papers to be presented in Perth deal with various aspects of "energy efficiency". I am sure that "energy efficiency", in particular energy efficiency that does not come at the expense of economic efficiency, will be one of the major topics in energy economics for many years to come and a theme that will occupy a prominent place in the program at future IAEE conferences.

The 20-20-20 targets and the ensuing policies are but one example of the increasing focus on energy and energy related environmental issues in national and international policy-making. On the one hand there is concern about the availability and cost of energy from the point of view of economic growth and prosperity. On the other hand, there is concern about the environmental, and in some cases geopolitical, aspects of energy consumption. This kind of duality makes the economics of energy complex and the need for sound analysis as a base for energy and environmental policy obvious.

The role of IAEE is to inspire solid analysis of pertinent issues in the field of energy and environmental economics, to organize conferences where scholars and practitioners can meet and discuss, and to publish new and relevant findings. Given these aims it is really gratifying to see that IAEE is becoming an increasingly global association, attracting an increasing number of young scholars to participate in an important process of knowledge creation. After Perth the process continues in Venice, and then in Austin, Montevideo, Daigu, Anchorage and many more places.

Lars Bergman

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

CONTENTS

Editor: David L. Williams

With your phone, visit IAEE at:

International Association for Energy Economics

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.

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

We conclude our focus on the various aspects of wind energy in this issue with five articles along with one challenge to an article in the second quarter issue and a response from that author.

Orvika Rosnes discusses the importance of flexibility of the power systems for wind power integration and how market design and subsidy design can enhance the flexibility.

Richard Green summarizes two recent articles in IAEE journals on the economics of wind power. Nicholas Vasilakos and he showed how Denmark uses international trade as a kind of storage for fluctuating wind output (*The Energy Journal*, vol. 33 no 3). An article in *Economics of Energy and Environmental Policy* (vol. 1 no 2), written with Adonis Yatchew, discusses government policies to support renewable energy.

Gürcan Gülen and David Bellman evaluate the impact of CREZ transmission projects in West Texas on wind capacity expansion using an economic dispatch model within the context of new EPA regulations, potential carbon taxation and a cyclical natural gas price forecast.

Jacob Ladeburg and Sanja Lutzeyer note that offshore wind farms at near shore locations generate visual disamenity costs. The properties of these costs are reviewed and a number of recommendations are put forward in relation to future planning.

Kyle Herman compares the Danish wind energy innovation system with the system employed by the U.S. government. The underlying assumption about innovation systems in the U.S. is that they are technologically driven, and past technological advances can be built upon leading to break-through innovations. However, in Denmark, innovation was driven from citizens and relied on no break-through technologies, but rather a piecemeal process of collective, smaller innovations. For wind energy, this process was far more successful than the technologically driven innovation system in the U.S.

Jean Balouga notes that despite its hydrocarbon wealth, Nigeria has remained a poor and technologically backward nation. He details why this had happened and points to a way forward that will allow his country to reap some benefits from its in ground wealth.

In the last issue of the *Energy Forum*, Julian Silk presented an article on the *Welfare Analysis of Offshore Wind*. In this issue, Richard Green comments on that presentation and Silk responds.

DLW

Newsletter Disclaimer

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

Edited by Hillard G. Huntington and Eric Smith

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

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

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

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

ORDER FORM • Special Issue from the IAEE

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

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

Total enclosed________________

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

Credit Card ☐ Visa or ☐ Mastercard

Card No __________________________ Exp. Date ____________ CVC2 ________

Signature____not valid without signature

NAME: ____

TITLE: ____

COMPANY: ____

ADDRESS: ____

CITY,STATE,MAIL CODE: ____

COUNTRY: ____

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

CONTENTS

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

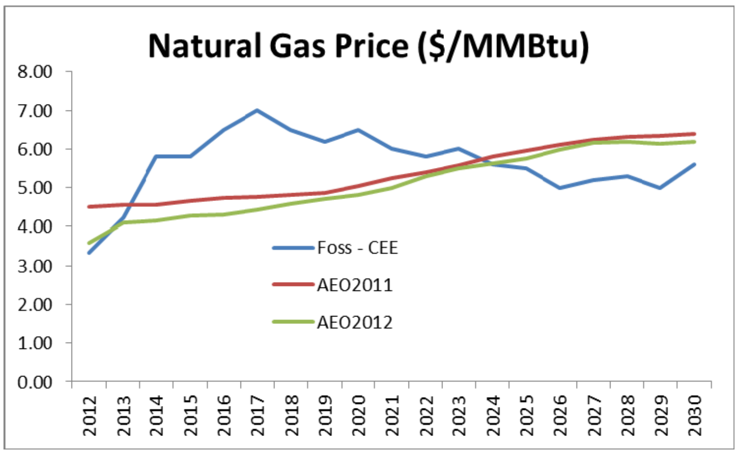
Transmission and Wind Capacity in Texas

By Gürcan Gülen and David Bellman*

Texas has become a leader in installed wind capacity since the early 2000s. As in many other parts of the U.S., the rapid wind expansion was based on the state's mandates but would not have occurred at the rate it did in the absence of federal production tax credits, high quality resources and high natural gas prices.[1] Since most of the wind capacity was built in West Texas, away from major load centers, new transmission lines were needed. The Public Utilities Commission of Texas decided to encourage the construction of the optimal facilities with the competitive renewable energy zones (CREZ) program. The CREZ lines, originally estimated to cost $4.9 billion, but now expected to cost about $7 billion, are now under construction and scheduled to be finished by the end of 2013. One developer did not want to wait for CREZ lines to be completed and built its own transmission connection.[2] The CREZ lines are designed to have a capacity of 18 GW as compared to about nine GW of wind currently built in West Texas. Note, however, that given the competitive market structure in Texas, the grid is open access and any type of facility can be connected to these lines as long as they follow the proper interconnection procedures.

We wanted to test whether the CREZ lines with their 18 GW of capacity will lead to additional wind investment. We used the AURORAxmp software to evaluate their impact but did not want to conduct such an analysis in isolation from several key developments: the impact of Cross-State Air Pollution Rule (CSAPR), and Maximum Achievable Control Technology (MACT) and its implementation standards for power plants, Mercury and Air Toxic Standards (MATS), to control hazardous air pollutants such as mercury on the generation portfolio. Although currently there is no federal law on limiting greenhouse gases, such legislation is possible within the time frame of our study. Already, some states are pursuing their own restrictions. We tried to capture this "threat" of GHG regulation via introduction of a CO_2 price ($14/ton in 2018 to $40/ton in 2030). We also assumed a renewable incentive of $15/MWh; federal production tax credit historically amounted to more than $20/MWh but it has not been available every year. In years after the Congress let PTC expire, renewables expansion fell significantly. It may be allowed to expire again in 2012. Although there are other incentives such as federal investment tax credits or grants, state-level funds and renewable energy certificate markets, these, too, fail to provide consistent, predictable support for all renewables. For example, in Texas, REC prices fell to $1-2/MWh. All of these programs benefited wind projects the most since wind has the lowest cost structure among the renewables.

We used the latest new build cost estimates from the EIA for all types of generators.[3] The model was tested based on the EIA 2010 actuals for calibration purposes; the model slightly underestimated gas demand in 2010, indicating that it is somewhat more conservative than the actual market but otherwise a good fit. For all cases, we assume regional growth rates, primarily based on historical trends and growth projections from RTOs. In fast growth regions such as ERCOT, annual electricity demand growth is estimated at above two percent; in MISO and other growth areas 1.2 to 1.3 percent is common; less than 0.5 percent is used for some regions in the Northeast. Our growth assumption allows for some efficiency improvements but not as aggressive as that of the EIA, the forecast of which is based on an average growth rate of 0.8 percent, which is much lower than the historical annualized growth rate of about 1.5 percent for the U.S (between 1990 and 2010).

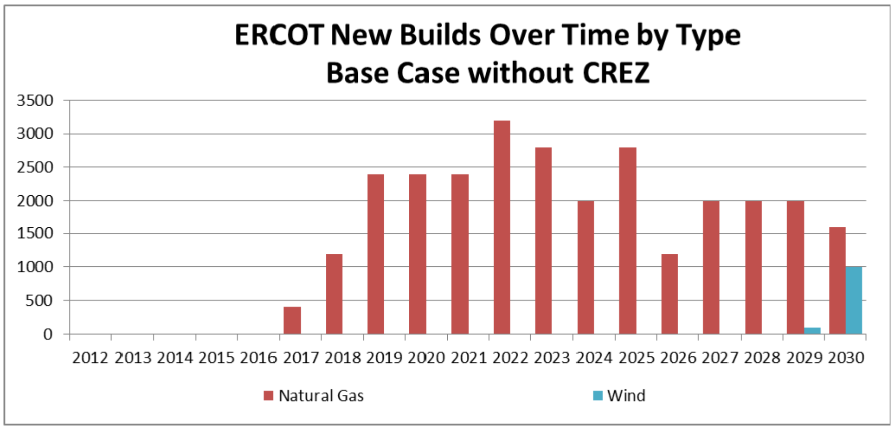


Finally, we used a price trajectory developed from other CEE work.[4] The current price of less than $3/MMBtu is too low for many producers to generate acceptable revenues and continue investing in new gas development. Oil field service costs remain strong, pushed by persistent high oil prices and other factors such as technical challenges, work force shortages and so on. In the low natural gas price environment that is expected to prevail through 2013, producer margins will be heavily pressured. The industry is in the process of adjusting; consolidation, write downs, and other actions will eventually restore balance, as will stronger gas consumption in response to the lower price signal. The historical pattern of price cycles is expected to return with an initial increase from the current levels to about $7/MMBtu, adjusted for inflation, by the middle of this decade.

* Gürcan Gülen is a Senior Energy Economist and David Bellman an Advisor with the Center for Energy Economics, Bureau of Economic Geology, the University of Texas. Dr. Gülen may be reached at gurcan.gulen@beg.utexas.edu
See footnotes at end of text.

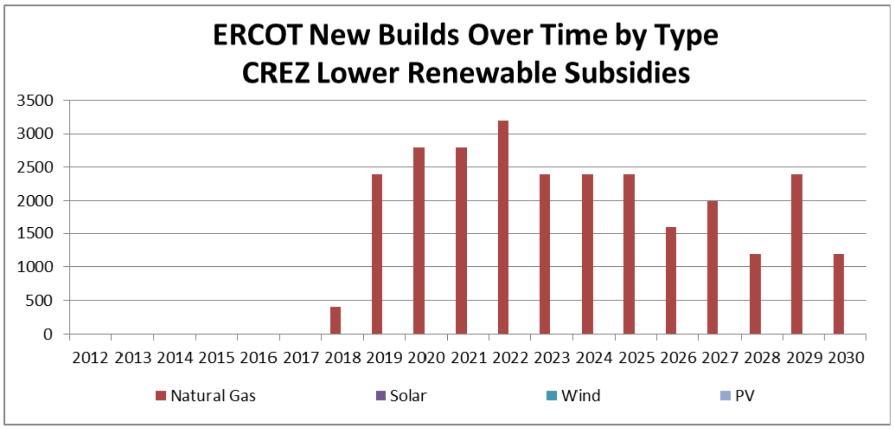
The Base Case

We simulated Eastern Interconnect and ERCOT regions since the 27 states covered by CSAPR are located in these regions. We accounted for trading of emissions allowances across states for the first two years as allowed in the program.[5] Although much retirement of coal capacity is predicted, for the most part, gas-fired capacity (more than 28 GW) will replace them and meet growing electricity demand, with additional wind (1.1 GW) becoming a factor later in our time frame. It is likely that the prospects of wind are hurt with the low price of natural gas in later years of our cyclical forecast.



The ERCOT system came close to wide-ranging outages in the summer of 2011; and there are concerns about shortages in peak summer days going forward. Despite these concerns, no new capacity is expected to be built until 2017. ERCOT does not have a capacity market and energy prices are capped at $3,000/MWh. The price signals are not strong enough for new builds although the model implies demand side curtailment (i.e., shortages) picking up over these initial years.[6]

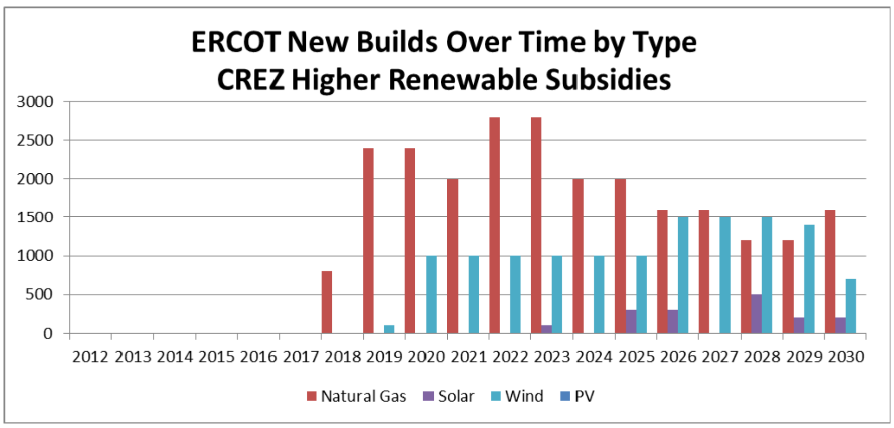
The ERCOT CREZ Case



In order to evaluate the impact of additional CREZ lines, we increased the capacity of lines to the planned 18 GW limit in the Western part of the ERCOT grid. The additional transmission capacity in West Texas with some of the best wind resources did not lead to any new wind (or any other renewable capacity) in ERCOT. A little over 27 GW of gas-fired capacity will be needed to compensate for lost coal capacity and to meet demand growth. The $15/MWh renewable subsidy is not sufficient for dispatch economics to favor wind over gas-fired generation given our gas price forecast.

However, CREZ yielded benefits in the form of reduced congestion, which allowed more wind generation from the West to get dispatched in the ERCOT market. In the base case without CREZ, we observe wind builds in 2029 and 2030 but these occur in Houston and North zones. With CREZ lines, these units are no longer necessary.

Next, we increased the incentives to $25/MWh for wind, which is more consistent with support provided by federal production tax credits and renewable energy certificates in the past, and to $35/MWh for solar, which remains more costly and requires additional support. These additional subsidies, with an estimated cost of $9 billion from 2019-2030, encourage 12.7 GW of wind and 1.6 GW of solar thermal capacity. Less, but still significant, gas-fired capacity (24 GW) will still be needed.



It is also worth noting that expansion of renewable capacity (as well as gas capacity) speeds up after 2018, the year we introduce a cost on carbon emissions and when MATS is expected to become fully implemented.

Conclusion

With this exercise, we have seen that it is important to capture dynamic interactions among energy and environmental policies as well as industry developments. Analyses that focus on a single factor will likely miss important forces and counterforces. Although CREZ lines may not directly lead to new builds of renewables, they seem to provide additional benefits to the grid by lowering the cost of congestion and allowing the dispatch of more wind power from the West. However, the impact of CREZ lines is dwarfed by the importance of renewables subsidies, the impact of EPA regulations, and potential penalties on carbon emissions. In future work, we plan to introduce technology improvement for renewables that would enhance capacity factors and reduce their costs going forward. Related to ERCOT, we will investigate price signals and demand side curtailment further.

Footnotes

[1] See *Lessons Learned from Renewable Energy Credit (REC) Trading in Texas* (2009), CEE project report to State Energy Conservation Office. (http://www.beg.utexas.edu/energyecon/transmission_forum/tf.php).

[2] For example, see http://www.reuters.com/article/2009/10/26/utilities-wind-texas-idUSN2620354820091026 (last accessed on March 12, 2012).

[3] *Updated Capital Cost Estimates for Electricity Generation Plants*, November 2010. http://www.eia.gov/oiaf/beck_plantcosts/index.html

[4] See Foss, *The Outlook for U.S. Gas Prices to 2020: Henry Hub at $3 or $10?*, Oxford Institute for Energy Studies, December 2011, http://www.oxfordenergy.org/2011/12/the-outlook-for-u-s-gas-prices-in-2020-henry-hub-at-3-or-10/ for a comprehensive review of U.S. natural gas market conditions and prospects.

[5] See *U.S. Gas-Power Linkages: Building Future Views* for a detailed discussion of these factors and their impact on the electricity generation portfolio and gas demand. (http://www.beg.utexas.edu/energyecon/thinkcorner/Think%20Corner%20Gas-Power%20Linkages.pdf).

[6] We will investigate these conditions further in a separate article.

12th IAEE European Energy Conference

Energy challenge and environmental sustainability

Venice, September 9-12, 2012

The **12th IAEE European Energy Conference** is organized by the A.I.E.E - Italian Association of Energy Economists with the support of the Ca' Foscari University of Venice and Fondazione Eni Enrico Mattei in Venice, at the Ca' Foscari University campus of San Giobbe.

The Conference aims at providing a forum for an analysis of the new developments and a new vision of the future. No better stage can be imagined for this discussion than the magic and fragile environment of Venice, one of the most beautiful cities in the world.

500 participants will meet in

8 plenary sessions and 80 concurrent sessions

to discuss about:

- Energy supply and security
- New energy policies in European countries
- Climate change
- Energy access; energy and poverty
- Financing the transition to a low-carbon economy
- Energy Markets
- Extending the horizons of energy regulation in Europe
- Learning by doing: cost reductions for RES
- Technological development: the roadmap approach
- Energy storage and its effects on the market
- Changes in the geo-political situation after North Africa
- Smart grids and smart meters
- Unbundling in the gas sector
- Market instruments for energy efficiency
- Non-conventional hydrocarbon supplies
- A sectorial approach to energy efficiency in industry
- The European automotive industry and the challenge of energy for transportation
- The NIMBY syndrome for RES
- The formation of prices in gas and electricity markets
- Energy from biomass and the EU agricultural policy
- Energy poverty in developed countries
- Access to energy in developing countries
- Nuclear industry after Fukushima
- The impact of PV on the merit order
- Renewable energy policies
- Sustainable communities and citizen-led activities
- The "resource curse" - Energy innovation and patenting

For detailed information regarding the programme, organisation, registration fees, accommodation, students' programme and scholarships, please visit:

www.iaeeu2012.it

A highly professional programme and very entertaining social events: a gala dinner with a boat trip in **Torcello** Island and a conference dinner in the courtyard of the Ca' **Foscari Palace** offering a suggestive Venetian environment and excellent cuisine to the conference participants.

We welcome you in Venice!

for any questions regarding the Conference you can contact:
AIEE Conference Secretariat:
Phone +39-06-3227367 - Fax +39-06-3234921, e-mail: assaiee@aiee.it; info@iaeeu2012.it

conference sponsors

media partners

How Denmark Manages Its Wind Power

By Richard Green*

Introduction

Denmark was an "early adopter" of wind power and generates an unusually high proportion of its electricity from wind – 21% in the country as a whole in 2010, and 24% in the region of West Denmark. Almost all of the rest of the country's electricity is generated in CHP plants, a mix of "primary" stations (58%) and "local" plants (21%). The key difference between these is partly one of scale, and partly that until 2005 electricity distributors had to buy the power produced by the local plants at a fixed price (IEA, 2008). They accordingly tended to run to meet their heat load, with electricity as a by-product. The central stations, on the other hand, faced the market prices set by Nord Pool and it was changes in their output, together with the flows on international interconnectors, which ensured total generation matched demand.

Denmark is well-connected to its neighbours, Germany, Norway and Sweden, with a total interconnector capacity of 5.5 GW (importing, or 4.5 GW for exports), compared to a peak demand in 2010 of 6.3 GW. The Nordic countries have a high proportion of hydro generation (95% in Norway and 46% in Sweden). Germany has installed a large absolute amount of wind capacity, but it provided just 6% of the country's overall generation in 2010.

Financial Support

Wind power offers two key challenges. The first is financing the stations when their costs are typically greater than the market price for the power that they produce. The economics of supporting renewable energy are discussed in an article in the IAEE's new journal, *Economics of Energy and Environmental Policy* (Green and Yatchew, 2012). For its onshore wind farms, Denmark has adopted a system of Feed-in-Tariffs. These offer fixed prices for up to 20 years. The relative simplicity of this instrument means that smaller companies and co-operatives are able to develop wind farms. A number of studies have concluded that countries with "well-adapted" Feed-in-Tariffs have supported wind generators at a lower cost per MWh than those using the main alternative policy used in the EU, a quantity obligation (which is typically called a renewable portfolio standard in the U.S.) enforced through some kind of tradable green certificate scheme (see, e.g., European Commission, 2008). The renewable generator is given certificates for its output, which it can sell to retailers (or other market participants) who are required to procure these in proportion to their electricity sales, or pay a penalty. The prospect of avoiding this penalty gives value to the certificates, and the generator thus has a second income stream alongside the market value of its power. These schemes are typically more complex to administer than Feed-in-Tariffs, deterring smaller companies, and the generator may be exposed to volatility in the price of both its electricity and the certificates, raising its risk and its cost of capital. A long-term contract with a retailer might mitigate this volatility, but countries with certificate schemes have typically found that they have developed less of their wind resource, at a higher cost, than those using Feed-in-Tariffs.

The greatest disadvantage of a Feed-in-Tariff is the risk of getting the price wrong. Too high a price could trigger a gold rush that produces more capacity than the government wanted, unless there is a well-designed mechanism that can reduce the price (for new schemes) as the capacity connected rises. It is easier to correct a price that was too low to trigger investment, but the initial mistake will create a delay. The risk of setting the tariff at the wrong level may be quite low for a mature technology, but rises with technical uncertainty.

Denmark has responded to this risk by using auctions to set the level of the tariff for offshore wind generators. Furthermore, to reduce the risk of the winner's curse (which implies that the auction is won by the most optimistic bidder, who later discovers that it was too optimistic and cannot deliver the project for the promised price), the auction is for projects that are nearly "shovel ready". In particular, environmental assessments and grid connection studies have been completed and the results are available to the bidders

Variability

The second major problem with wind generation is that it depends on wind speeds that vary and cannot be predicted far in advance. The relative unpredictability of wind output forces system operators to carry extra reserves of con-

* Richard Green is the Alan and Sabine Howard Professor of Sustainable Energy Business at Imperial College Business School. This paper includes research supported by the UK Research Councils and our industrial partners through the Supergen Flexnet Consortium, grant EP/E04011X/1. This paper draws on joint work with Nicholas Vasilakos and Adonis Yatchew, and he would like to thank them for enjoyable collaborations. The views expressed are his alone.
See footnote at end of text.

ventional plant, both when operating and in terms of total capacity. The costs of this are noticeable but manageable; Gross et al (2006) estimated them at 0.5 to 0.8 pence per kWh of intermittent renewable energy (in UK conditions with up to 20% of wind power). More recently, the Committee on Climate Change (2011) suggested that the cost would only be around 1 p/kWh, even with the share of (all kinds of) renewable generation approaching 80%.

The main focus here, however, is on the volatility of wind output, which would have impacts even if it could be predicted perfectly, and is studied by Green and Vasilakos (2012) in a forthcoming article in *The Energy Journal*. In 2010, Denmark had an average (mean) wind output of 892 MW, with a standard deviation of 742 MW. Wind output was below 100 MW for just under 10% of the year, and greater than 2000 MW for almost 11%. Its maximum was 3342 MW at a time (midday on 11 December) when the total demand was 4682 MW. A few days later, at 6pm on 15 December, the total demand was 6312 MW and the wind output just 76 MW. That produced a maximum for the demand net of wind output of 6236 MW; the minimum (at 5 am on 25 August) was just 33 MW.

The Interaction Between Wind and Hydro Stations

Denmark is fortunate in its neighbours, however. Norway and Sweden have large amounts of hydro-electric generation which is ideally suited for balancing wind power. Hydro stations need little notice to start and stop generating, allowing them to respond quickly if the wind changes. The variable cost of hydro generation is an opportunity cost – if a station generates power now, it forgoes the chance of using that water at a later time. The value of the opportunity forgone is the expected price of power at that time. The station will try to operate in a way that keeps the price of power stable[1] over a hydrological cycle, as explained by Førsund (2007). This cycle is the period from one large seasonal inflow (a rainy season or a spring thaw) to the next. This means changing the hydro stations' output in line with changes in demand, so that the output from thermal stations changes relatively little from hour to hour or day to day. (If the thermal output did vary, and a hydro generator had some spare capacity at the times when the more expensive thermal stations were running, the hydro station could replace some of that output. Even though it would then have to generate less at some other time (to avoid running out of water), this could be at a time when there was spare capacity among the cheaper thermal stations. Shifting output from expensive to cheaper thermal stations reduces the overall costs.)

While power prices may not vary very much over short periods (except when operating constraints make it hard to reallocate enough hydro output between hours to stabilise them), they do vary from year to year, depending on the overall inflows of water. In a wet year, the hydro stations will be able to meet a high proportion of the countries' demand for power, and the remainder can be met while (generally) using only the cheaper thermal stations. This means that the price of power will be relatively low. In a dry year, much more power is needed from the more expensive thermal stations, and prices are higher.

Figure 1 extends Figure 1 of Green and Vasilakos (2012). Every line gives the average value of its series over the previous twelve months, to smooth out seasonal patterns. The top lines show that hydro generation in Norway and Sweden closely follows the amount of water flowing into the reservoirs, with a bit of a lag (an unusually large inflow in one month is followed by an increase in generation in each of several following months). The lower lines relate to Denmark, and show that the country's exports are greatest when hydro generation in its neighbours is low. The middle line, which gives Denmark's generation by thermal plants, clearly shows that these produce more in years of above-average net exports. The correlation between lines on a figure cannot, of itself, prove causation, of course, but the causation from water inflows to hydro generation should be obvious, and fluctuations in hydro output (not matched by changes in demand) then create a need for corresponding changes in trade patterns, and hence Danish generation. There is practically no relation-

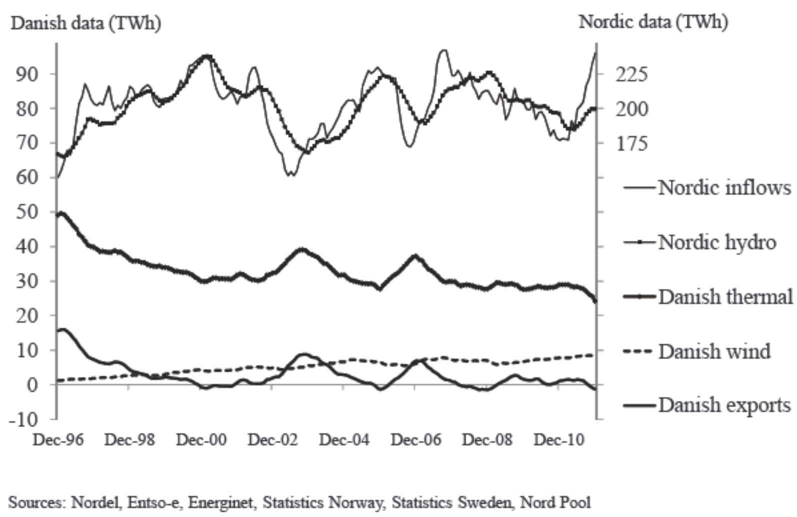


Figure 1. Danish Power and Nordic Hydro

ship between Denmark's annual trade in power and its annual wind output. Our paper was written in response to claims that a large proportion of Danish wind power was exported (which the claimants seemed to believe meant that it was "wasted"). While such claims can have no basis in physics (it is impossible to tell which electrons are moving in response to which power station), they would make economic sense if Denmark's net exports had risen in line with its wind generation. This has clearly not happened.

There is a strong relationship between trade and wind patterns over short timescales, however. If wind generation is unusually high, Denmark faces the choice between reducing thermal output to low levels, increasing demand for power (perhaps by using electricity to heat the water for district heating schemes) or raising its net exports of electricity. If it does the latter, Norway and Sweden generate less, keeping more water available for later use. This water can then be released and the resulting electricity exported to Denmark at times when wind output is unusually low, and high-cost thermal plants would otherwise have to start generating.

Changing hydro output in this way means that the thermal stations in Denmark and nearby countries do not have to vary their output so much in response to changes in wind generation. This is just an extension of the way in which the optimal allocation of water between periods, discussed above, aims to minimise variation in thermal output in a "traditional" hydro-thermal system.

Green and Vasilakos (2012) show that Denmark uses variations in its net exports in exactly this way. There is a strong correlation (of 0.673) between excess wind generation (compared to the average for a given hour of the day in a given month) and excess net exports. This is not costless – the prices paid for Denmark's excess net exports at times of additional wind generation are lower than the prices the country has to pay for excess net imports at times when wind generation is below average. The resulting cost of storing wind in Norwegian reservoirs is equal to 4% of the value of the wind output. Denmark would be better off if its wind output did not fluctuate around its average levels. But given that the wind does vary from day to day, using trade to help accommodate the variations is a cost-effective response.

Footnotes

[1] When we remember that income earned now is more valuable than the same amount of money earned in a few months' time, it should become apparent that prices expected to rise at the rate of interest would in fact be needed to offset this incentive to generate now.

References

Agnolucci, P. (2007). "Wind electricity in Denmark: A survey of policies, their effectiveness and factors motivating their introduction." *Renewable and Sustainable Energy Reviews* 11(5): 951-963

Committee on Climate Change (2011) *The Renewable Energy Review*, London: Committee on Climate Change

European Commission (2008). *The support of electricity from renewable energy sources: Accompanying document to the proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources* SEC(2008) 57, Brussels, Commission of the European Communities.

Førsund, F.R. (2007) *Hydropower Economics*, New York, Springer

Green, R.J. and N. Vasilakos (2012) "Storing Wind for a Rainy Day: What kind of electricity does Denmark export?" *The Energy Journal*, vol. 33, no. 3, pp. 1-22

Green, R.J. and A. Yatchew (2012) "Support Schemes for Renewable Energy: An Economic Analysis" *Economics of Energy and Environmental Policy*, vol. 1, no. 2, pp. 83-98

Gross, R., P. Heptonstall, D. Anderson, T.C. Green, M. Leach and J. Skea (2006) *The Costs and Impacts of Intermittency: An assessment of the evidence on the costs and impacts of intermittent generation on the British electricity network*, London, UK Energy Research Centre

International Energy Agency (2008) *CHP/DHC Country Score Card: Denmark*. Paris: International Energy Agency.

IAEE/Affiliate Master Calendar of Events

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

Date	Event, Event Title and Language	Location	Supporting Organizations(s)	Contact
2012				
September 9-12	12th IAEE European Conference *Energy Challenge and Environmental Sustainability*	Venice, Italy	AIEE/IAEE	Edgardo Curcio e.curcio@aiee.it
November 4-7	31st USAEE/IAEE North American Conference *Transition to a Sustainable Energy Era: Opportunities and Challenges*	Austin, Texas	USAEE/CTAEE/IAEE	USAEE Headquarters usaee@usaee.org
2013				
April 8-9	4th ELAEE Conference *Energy Policy in Latin America: Regional Integration and the Promotion of Renewables*	Montevideo, Uruguay	LAAEE/IAEE	Marisa Leon melon@adme.com.uy
June 16-20	36th IAEE International Conference *Energy Transition and Policy Challenges*	Daegu, Korea	KRAE/IAEE	Hoesung Lee hoesung@unitel.co.kr
July 28-31	32nd USAEE/IAEE North American Conference *Industry Meets Government: Impact on Energy Use & Development*	Anchorage, Alaska	USAEE/IAEE	USAEE Headquarters usaee@usaee.org
August 18-21	13th IAEE European Conference *Energy Economics of Phasing Out Carbon and Uranium*	Dusseldorf, Germany	GEE/IAEE	Georg Erdmann georg.erdmann@tu-berlin.de
2014				
June 15-18	37th IAEE International Conference *Energy to Survive 2020*	Prague, Czech Republic	CZAEE/IAEE	Jan Myslivec janmyslivec@yahoo.com

Wind Power Requires Flexible Market and Subsidy Design

By Orvika Rosnes*

Wind power – the preferred renewable energy source in many countries – may be challenging to accommodate in existing power systems due to its unique characteristics. How easy it is to integrate wind power in an efficient way depends on the flexibility of the rest of the power system. Technology mix and size of the power system, the possibility for trade and flexibility of demand play a role in flexibility. However, market design and regulation can contribute substantially to increase the flexibility of a given power system by conveying correct price signals. Moreover, subsidy schemes to wind power are important for flexibility.

Wind power represents a variable – or intermittent – energy source: it is only possible to produce wind power when the wind is blowing. Thus, the available wind power production in a given hour may vary substantially during the day and is often significantly lower than the nominal installed capacity. The variation in wind power production must be immediately accommodated by other producers in order to maintain the system balance.

Conventional coal-fired and natural gas-fired thermal power plants are relatively inflexible in the short term due to the costs related to starting the plant. In the presence of start-up costs, production does not necessarily occur according to merit order. Instead, a thermal power plant will occasionally produce, even when the electricity price falls below the operational marginal cost, in order to avoid a shutdown; similarly, it might choose not to start production, even when the price exceeds the operational marginal cost (Rosnes, 2008).

Due to low marginal production costs and the possibility to adjust production easily and without cost within the limits of the available wind, one would expect wind power to be produced up to those limits at all times. However, from the system point of view, it would sometimes be cheaper to keep a thermal power plant running in order to avoid the shutdown and reduce wind power production instead.

Market Design Should Enhance Flexibility

Therefore, market design should promote efficient dispatch by incorporating the shadow price of a start-up in the market price. This can be done through negative power price. As the thermal power producers would be willing to carry a short-term loss in order to avoid shutdown (that implies a start-up later), negative price signals the shadow price of a start-up to other producers.

A wind power producer has no reason to carry on producing with negative prices. Wind power producers are perfectly flexible within the limits of the available capacity: they can stop and start costlessly when the price exceeds marginal cost.

Negative prices have been introduced at several European power pools: European Energy Exchange (EEX) introduced negative prices in September 2008 and the Nordic power pool, Nord Pool, in October 2009 (at day-ahead market).

Wind power has priority of dispatch, i.e., assured access to the grid (EC, 2001). This means that whenever wind power is available, it must be accommodated by the grid companies; wind power production can be curtailed only if it endangers the system security. Originally, this rule was meant to promote development of renewables by providing security to investors. However, this also means that the dispatch is not necessarily optimal: when wind power production is high compared to demand, thermal power plants must be turned off, implying a start-up later. An efficient dispatch would often imply that wind power production is reduced instead. This typically happens during low demand periods (nights and week-ends), but not necessarily. As more wind power capacity is developed, situations when wind power can meet a large share of demand alone become more frequent.

Subsidies Should not Blur Market Signals

Wind power, as many other renewable energy sources, is not profitable without subsidies. There are a variety of subsidies used to support wind power: feed-in tariffs (either as a guaranteed price or a guaranteed mark-up on market price), tradable green certificates, investment subsidies. It is somewhat paradoxical that production subsidies have been the most common support mechanism to wind power, even though it is the high investment costs that prevent expansion of renewable capacity.

Even though the principal goal of the support is to promote investments, the subsidy schemes also influence the short-term production decisions once the investment is carried out: the wind power producer may often produce in order to

* Orvika Rosnes is with the Unit for Energy Economics, in the Research Department of Statistics Norway. He would like to thank Berit Tennbakk for valuable comments. Rosnes may be reached at orvika.rosnes@ssb.no
See footnote at end of text.

collect the subsidy, even if the market price is below the producer's marginal costs.

Rosnes (2007) studies the short-term effects of different subsidies to wind power and quantifies the costs of integrating wind power in Denmark. Given its predominantly fossil-fuelled capacity, but with an ambitious goal of boosting wind power to meet 50% of electricity demand by 2025, Denmark provides a highly relevant case for the analysis of the role of flexibility. Rosnes (2007) uses a short-term model, with hourly time steps and one week as time horizon.[1]

The results of the numerical model indicate that total production costs are higher with feed-in tariffs than with investment subsidies. With inelastic demand, wind power replaces thermal production. In the sample week, thermal production is reduced 9% with fixed feed-in tariff, compared to optimal dispatch. However, this reduction does not imply lower costs, on the contrary: thermal production costs (fuel costs and CO_2 costs) are 12% higher. In other words, the same total production level is achieved with considerably higher costs. The reason for that is that wind power produces at the maximum available level (to collect the fixed feed-in tariff) and does not take into account market prices or the impact on other producers. When demand is low, the thermal power plants are forced to stop in order to maintain balance in the market.

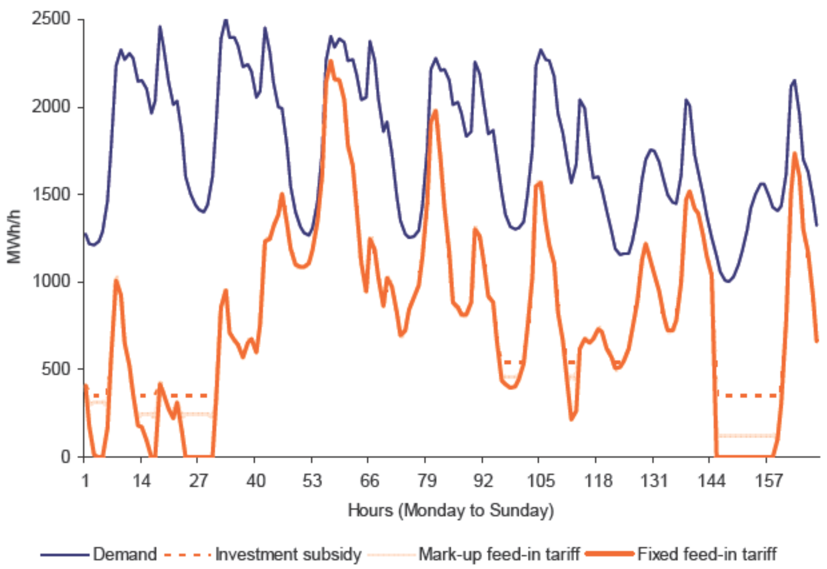


Figure 1. Thermal power production with different subsidies to wind power throughout the sample week

Figures 1 and 2 show thermal and wind power production with different subsidies to wind power throughout the sample week. With investment subsidy (that does not influence the short-term production decision), wind power producers take into account the shadow prices of the start-ups in thermal power plants, signalled through the market prices. When wind power is optimally scheduled (from the system point of view), it is sometimes profitable to reduce wind power production in order to avoid the shutdown of a thermal unit. When the production subsidy is designed as a mark-up on market price, the market signals are distorted, but still visible.

Sensitivity analyses confirm the effects found in the base case, but the effects depend on the wind power capacity. Typically, the additional costs increase with increasing wind power capacity. Clearly, it is easier to accommodate wind power when wind power capacity is small relative to demand. As long as wind power can be accommodated without starting and stopping thermal power plants, only adjusting the production level, the additional costs are relatively low. The model results indicate that the incentives to adjust wind power even slightly would pay off: a small reduction in wind power often saves considerable costs.

It is also worth noting that increasing wind power capacity does not translate into an equal increase in wind power availability. Since the market must be in balance at all times, wind power production must be reduced if it exceeds demand and all thermal plants are already turned off. As wind power capacity increases, situations where wind power production exceeds demand become increasingly frequent. Thus, some of the capacity increase is 'in vain'. Therefore, an increase in wind power capacity by one kWh does not replace one kWh of thermal power – the increase in 'useful' wind power capacity is lower than the nominal increase. In the modelled week, doubling of wind power capacity increases maximum available wind power production by only 50%, compared to the base case.

Price Signals are Important for Investments in Renewables and Grid

Wind power is envisaged to be an important source of renewable energy in many countries (COM, 2011). Large-scale development of wind power requires additional investments in network. The wind parks are often situated in uninhabited areas and new transmission lines must be built in order to get power to the demand centres. This additional investment cost must be borne by consumers.

If market prices are based on the principle of nodal pricing, they convey signals of the profitability of investments in different locations. Hence, market prices are important not only for short-term production decisions, but also long-term investment decisions. Regulation and grid tariffs may complement these price signals. Even though wind resources must be utilized where they are, not all of them will be developed. Which ones will be developed and in which order is important for efficiency.

It may well be that the wind power investment would be more profitable if the wind parks were more sparsely located; then less transmission investments were necessary. It may also be that the investment in transmission is profitable ex post (once the wind park is built); however, the transmission investment would have been unnecessary (or another line would have been more profitable) if the wind park was located somewhere else.

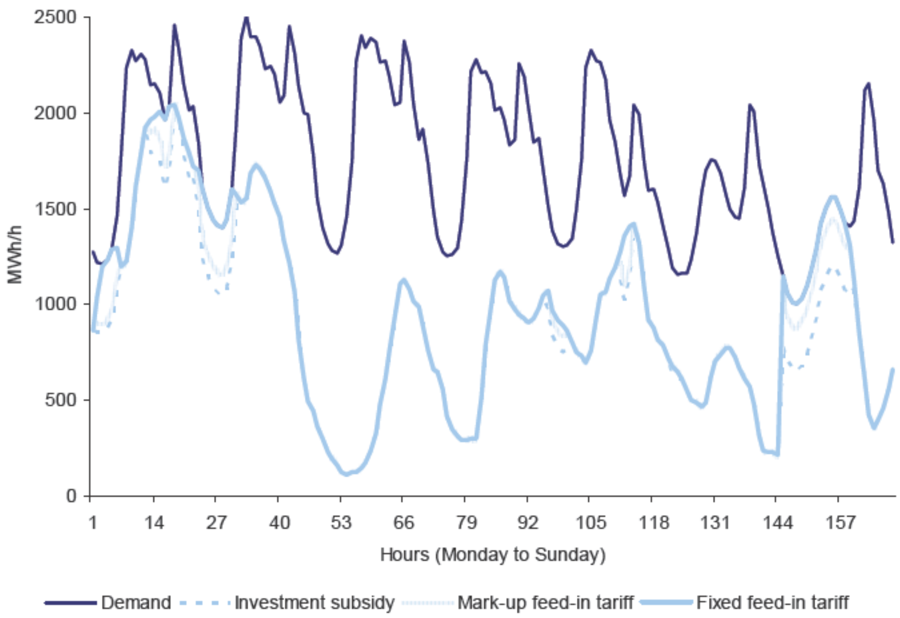


Figure 2. Wind power production with different subsidies throughout the sample week

Concluding Remarks

Flexibility of the power market is important for how costly it is to accommodate wind power in an existing power system. While technology mix is largely given, market rules and subsidy design play an important role for flexibility of the power market. An ill-designed subsidy scheme for wind power (i.e., one that conceals market signals and reduces the responsiveness to market prices), combined with an inflexible system, may amplify the adverse effects of wind power and contribute to excessive cost of emission reductions.

Nonetheless, if wind power or other intermittent power source is the preferred technology in the inflexible system, it is important to promote flexibility. Flexibility can be achieved by technical measures or economic incentives. Measures to increase flexibility may involve increasing the demand response (either technically, by investing in two-way-communication, or economically, by exposing consumers to actual market prices) or on the supply side (investing in more flexible plants or increasing trade possibilities with other regions). A larger system would increase flexibility per se, because it is easier to adjust production in active power plants without shutting down plants in a larger system. Further, trade with a more flexible system that can easily adjust the production level (like hydropower) is even more beneficial. In the longer term, electric vehicles could play an important role as storage capacity. However, these measures to increase flexibility require further investments that add to costs, in addition to the subsidies to wind power.

A market design that conveys correct price signals and an economically sound subsidy design that does not distort the production decision of wind power and promotes flexibility in wind power production may be the cheapest way of integrating wind power.

Footnote

[1] Hence, it differs from and complements the traditional economic models of power markets where time horizon is considerably longer (typically one year with only a few seasons and load periods).

References

EC (2001): Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market

COM (2011): Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A Roadmap for moving to a competitive low carbon economy in 2050. Brussels, 8.3.2011. COM(2011) 112 final

Rosnes, O. (2007): *Short-term effects of long-term policies: Climate policies in power markets*. PhD Dissertation No. 2007:11. Department of Economics and Resource Management, Norwegian University of Life Sciences

Rosnes, O. (2008): The Impact of Climate Policies on the Operation of a Thermal Power Plant. The Energy Journal 29 (2), 1–22

Wind Energy Innovation Systems

By Kyle Stuart Herman*

The recent collapse of Solyndra, a heavily subsidized U.S. Solar energy company, has sparked a highly charged debate surrounding renewable energy. This has pitted liberals against democrats, republicans against greens, and private against public sector. Furthermore, this failure occurred within a year of a very important presidential election in the U.S. Who or what was to blame for the collapse of Solyndra, a company which received $535 million in guaranteed federal loans? Was it the federal government's blind loan guarantees, crony capitalists siphoning money from the system, a doomed industry only sucking U.S. taxpayer's money, or Chinese subsidies undercutting market prices?

Perhaps all these reasons hold some truth, but I suggest they all neglect to understand the bigger picture: innovation systems. However, to understand why innovation supersedes all other ancillary reasons for potential renewable energy failures, one must first understand precisely what innovation should mean in relation to renewable energy, and its dynamic role in our world today. In order to do this, I use the example of the Danish Wind Energy innovation system. A simple juxtaposition of the highly successful wind energy innovation in Denmark to the relatively unsuccessful wind energy innovation in the U.S. sheds some clarity on this subject.

The underlining point is that government cannot pick innovation, especially with a relatively new phenomena such as renewable energy. Innovation typically comes from the ground up and isn't necessarily predicated on the achievement of economic success. Think about Microsoft, Apple, Facebook and Google for one moment; all of these companies can be considered some of the most innovative companies of the past fifty years. However, not one of the four were directly borne out of a heavy government subsidy intended to discover a "break-through" innovation. In fact, the two former companies (Microsoft and Apple) essentially began from garages and open source computing while the latter two (Facebook and Google) developed mostly in college dorm rooms. How could one make the argument that government subsidies or tax breaks guide and promote technological innovation when these four companies demonstrate the opposite is virtually true?

Let's examine some basic numbers comparing the U.S. wind innovation with the Danish wind innovation. From 1974 until 1992, U.S. federal subsidies for wind energy innovation (tabbed for Research & Development) totaled $486 million contrasted with Denmark's $53 million (also R&D); similarly the U.S. market subsidies were $900 million compared with the Danish government's $150 million in direct subsidies.[1] Meanwhile, ironically enough, during the 1980's and 1990's Danish wind energy producers dominated the American market, mostly centered around California (In 1985 Danish Companies sold 2000 wind turbines to California).[2] "Despite deploying significant intellectual and financial resources, participants in the U.S. were unable to create a viable technological path [...] In contrast, actors in Denmark pursued a process that deployed modest resources to progressively build up a viable wind turbine path."[3] The major difference was that "Denmark sought modest yet steady gains. In contrast, participants in the U.S. pursued a path that we label as breakthrough."[4] On the one hand the U.S. government appeared to believe in the idea that "breakthrough" technologies could be bought, while the Danish government understood the importance of communication channels and subsidized wisely.

While the Danish subsidized citizens to become wind turbine owners cognizant of the technology and its implications, some of whom also became developers, the U.S. subsidized investors to gain tax credits, many of whom "never saw a wind turbine. [American investors] were doctors and dentists, and once they got their tax credits, they were satisfied. By contrast, the Danish system required investors to generate electricity."[5] In other words the Danish used an investment subsidy and guaranteed high power prices (from generated wind energy) as opposed to the U.S. model which employed a depreciation and tax credits—this severely limited crucial partnerships in the U.S. development.[6] The innovation system in Denmark garnered public support and interest by encouraging public participation in the development of wind turbines via the ability to invest in turbines within eyesight of homeowners (local citizens living within 3 km. from the turbine were required to be offered shares in the local wind farm[7]). This also alleviated the backlash from NIMBY (Not In My Back Yard) arguments whereby public outrage results from windfall wind energy profits rewarding little or nothing to the local community.[8] Because many citizens in Denmark owned, and sometimes operated, wind turbines, innovation naturally sprung from below because owners actively tried to build and invest in the most innovative designs.[9]

Involving the local level allowed Danish customers to communicate problems or successes with the turbines. This information was widely distributed in Naturlig Energi Magazine (Natural Energy), which listed all wind turbines and their product development tested and rated by users (typically ordinary citizens who purchased or built their own turbines near their homes). "This definitely had a positive effect on development. The turbine owners themselves then had the opportunity to explain how

* Kyle Stuart Herman is with CREEE (The Coalition for Renewable Energy). He may be reached at hermanks@gmail.com
See footnotes at end of text.

well or how badly their turbines produced. The manufacturers discovered that their own turbines quickly became either a good or a bad advertisement for their business."[10] Meanwhile the U.S. innovation system was mostly a failure because of the disconnect between manufacturers, customers, researchers, and government policy: "A separation of ownership from usage [that the incentive structure created] led to dampened and delayed feedback from those operating turbines to firms that designed and produced them."[11] In other words the U.S. model depressed innovation systems because communication channels were logistically severed; users and customers didn't have a resource to learn about the latest innovations in wind technology (such as the Danish Natural Energy Magazine), and, therefore, the knowledge base in the U.S. was effectively delimited, lying outside the scope of a viable innovation platform.

Another important point to underscore, aside from the fact that wind energy innovation came largely from below in Denmark, is the idea that technological breakthroughs are not a necessary prerequisite for innovation systems. Innovation does not equate to technology; innovation can simply be social innovation or innovation in the marketplace allowing renewable energy to enter into the arena. For example, a technological breakthrough in wind energy, though considered innovative, could be rendered useless if it fails to deliver the primary objective: reliable and renewable energy at the lowest possible cost, to both society and government. A technological breakthrough that delivers the most powerful wind turbines in the world but with dangerous consequences to society because it is too large, or its costs are prohibitive, should not be considered an innovation.

Again, while the Danish used a local, communicative, and social-based approach to wind energy innovation, the U.S. relied on a high-tech innovation breakthrough approach. "A high-tech breakthrough approach may possess inherent disadvantages. Specifically, an approach that attempts to generate a breakthrough can end up stifling micro-learning processes that allow for the mutual co-shaping of emerging technological paths to occur. That is, participants in the U.S. may have failed, not despite, but because of their pursuit of a breakthrough."[12] At the same time, Danish researchers, manufacturers, and producers were horizontally and vertically integrated to provide a dynamic innovation system approach that allowed open channels of communication, collaboration, and expert synthesis. "[In Denmark] the researchers operated on the same cognitive level as the turbine producers and shared the same frame of meaning regarding wind energy. In this way, they supported the step-by-step learning and technology development process of the turbine producers."[13] This piecemeal process saved the Danish government a substantial amount of money, while driving innovation from below and allowing citizens to gain vast amounts of knowledge regarding wind energy.

The U.S. government should learn from the Danish government's acute awareness of fostering innovation in the renewable energy industry. Denmark, a country with less than five million citizens, today maintains some of the top wind energy companies in the world including LM Wind Power, NEG Micon, Siemens Wind Power (split German), and Vestas (the largest global producer). Clearly the Danes developed a wind energy innovation system that far outpaced their American counterparts, even though many in the U.S. were highly experienced in the aeronautics and space industries already. The idea of social innovation and collaboration, along with deft governmental foresight into a quickly paced and innovative industry, should be carefully considered by the U.S. federal government. It would behoove the U.S. government to carefully deduce innovative systems from the Danish model in order to avoid Solyndra-like episodes in the future. This will also help avoid the pressures of citizens and politicians so adamantly opposed to renewables in America.

Footnotes

[1] (Raghu Garud: 278)
[2] (Kamp : 1633)
[3] (Raghu Garud: 278)
[4] (Raghu Garud: 280)
[5] (Business Week Online, 06/11/2001: 294)
[6] (Business Week Online, 06/11/2001: 294)
[7] See the International Network for Sustainable Energy's 100% Renewable Energy by 2030 vision: http://inforse.org/europe/VisionDK.htm
[8] These turbine users were mainly farmers and small companies who were in favor of wind energy. This created trust and a joint frame of meaning with the turbine producers. (Kamp: 1634)
[9] More than 80 per cent of the 6,300 wind turbines in Denmark are owned by wind energy co-operatives, or individual farmers. 150,000 Danish families own wind turbines or shares in wind co-operatives (Krohn: 6).
[10] (Tranaes: 10)
[11] (Raghu Garud: 288)
[12] (Raghu Garud: 296)
[13] (Tranaes : 6)

The Properties of Visual Disamenity Costs of Offshore Wind Farms – the Impact on Wind Farm Planning and Cost of Generation

By Jacob Ladeburg and Sanja Lutzeyer*

Introduction

Global offshore wind power capacity has expanded rapidly in the last few years, with unforeseen rates of planning and construction of new wind farms.

Offshore wind farms typically offer the benefits of both stronger and more consistent wind resources than are found onshore. Moreover, large scale offshore wind projects (100MW+) will often be less intrusive – both from a visual and a noise perspective – than their onshore counterparts. When asked, people thus typically express preferences for offshore rather than onshore wind farm development (Campbell et al., 2011; Ek, 2006), suggesting that the non-monetary or 'external costs' borne by the consumers and society are smaller for offshore wind energy development.

The main disadvantages of developing wind energy offshore are higher investment and generation costs. These can be substantial, and increase as development sites are moved further from the coast or into deeper waters (with deeper waters often accompanying further distances from the shore). For example, keeping distance from the shore constant, investment costs of a specific project can increase by up to 25% when water depth is increased from 10-20m to 30-40m (European Environment Agency, 2009). Given the multibillion dollar nature of the investments needed for offshore wind farm construction, 25% higher investment costs are far from being trivial. Investors, therefore, have a strong incentive to push development agendas that increase the probability of near shore development. Similarly, in an effort to attract investors and keep consumer utility prices low, energy authorities might also have a relative preference for near shore locations.

While consumers naturally prefer lower utility costs, near shore locations might not be an optimal solution for the consumer. The reason is that near shore wind farms are more visible from coastal landscapes that in most cases have previously been undisturbed by wind turbines. The location of an offshore wind farm close to shore might thus be seen as an intrusive and unwanted element (Bishop and Miller, 2007) and thus cause external costs to society.

The energy planner will thus have to trade-off the benefits of lower investment and utility costs resulting from near-shore locations with the benefits of greater public acceptance and reduced external costs accompanying locations further offshore. In order to accurately weigh these trade-offs, and find the optimal distance to locate wind farms from shore, the different costs described above need to be defined on the same, monetary scale. This in turn necessitates that the visual impacts resulting from offshore wind farm development are quantified in economic terms and that the true marginal external cost function is identified. If this is not done, the missing information on the benefits of reducing the visual cost of offshore wind farms could lead to inefficiently high costs associated with sub-optimal wind farms locations. The areas A and B in Figure 1 illustrate the welfare losses that would accompany suboptimal location choices (in this case at distances of *a* or *b* km from the shore) resulting from incorrect expected marginal benefits functions.

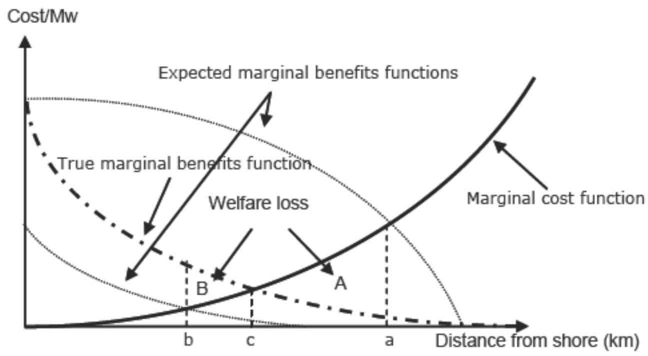


Figure 1: Comparison of the welfare effects associated with the assessment of the true and false benefit function (based on Ladenburg 2007).

The present article focuses on economic studies that have assessed the external costs of the visual impacts from offshore wind farms and will bring forth the most relevant highlights.

Visual Disamenity Costs from Offshore Wind Farms

To date, all published economic studies strongly indicate that given the choice, consumers, on average, prefer offshore wind farms to be located at larger dis-

* Jacob Ladenburg is an Associate Professor at the Danish Institute of Governmental Research (AKF). Sanja Lutzeyer is a Ph.D. scholar in Environmental and Natural Resource Economics at North Carolina State University. Ladenburg may be reached at jal@akf.dk Lutzeyer at lutzeyer@gmail.com

tances from the coast and in some cases completely out of sight. More specifically in two studies from Denmark (Ladenburg and Dubgaard 2007;2009; Ladenburg et al. 2011), one from France (Westerberg et al. 2011) and two from the USA (Krueger et al. 2011; Landry et al. 2012), samples of respondents are asked to state the preferences in terms of willingness to pay for reducing the visual impacts from offshore wind farms. This is done by presenting survey respondents with different visualizations in which wind farms are located at different distances from the shore, and pairing these visualizations with different prices the consumer would face for each scenario. Though the studies are relatively different in terms of the number of turbines, number of wind farms and the distances to the shore, all studies suggest that general public preferences are positively influences by locating a wind farm at a larger distance from the shore. These preferences are expressed either as a willingness to face higher electricity prices when wind farms are moved further offshore, or as a need to be compensated in terms of lower prices of beach recreational activities if wind turbines are located closer to shore.

For example, a study surveying North Carolina coastal tourists (Landry et al. 2012) finds that building an offshore wind farm at 1 mile rather than at 4 miles from the shore would reduce the propensity of visitors travelling to the particular beach from which the wind farm would be visible. This would reduce the economic activities in the specific area, and would result in a loss of revenue and consumer welfare. Similar conclusions can be drawn from the other studies.

Another element common to most studies is that visual impact costs of offshore wind farms decrease at an increasing rate as wind farms are moved further from shore (Krueger et al. 2011; Ladenburg and Dubgaard 2007; Ladenburg et al. 2011). In other words, consumers are willing to pay more to move a wind farm location from 5 miles to 8 miles from shore than they are for moving a wind farm from 12 to 18 miles from shore. This suggests that while society at large might be best served by moving wind farms further offshore than might be in the interests of investors, the increasing infrastructure costs, and decreasing visual impact costs accompanying a movement further offshore might result in a situation where the optimal location for a wind farm is indeed within visible range.

While, as discussed above, the studies reviewed here come to similar conclusions, the same studies also suggest that preferences for reducing the visual disamenities are very different between consumers. Some consumers have very strong preference for visual impact reductions and are willing to pay considerably higher energy prices for the wind farms to be located at large distances from the shore. The same consumers would require a considerable reduction in the costs associated with beach recreational activities if wind farms are built close to shore. In contrast, some consumers are apparently indifferent to the visibility of offshore wind farms and apparently do not perceive the wind farms as a visual intrusion. Still others view wind farms as a visually positive element in the coastal landscape. For this group of consumers, locating wind farms relatively near shore might increase the propensity to visit a specific beach, thus acting as a tourist attraction and not a repellant. Interestingly, in studies in which positive preferences for near shore locations have been found, approximately 20% of the sample seems to hold such preferences (Ladenburg and Lutzeyer 2012). These results clearly indicate that the size of the welfare costs associated with the visual impacts of offshore wind farms are far from being uniformly distributed among the population.

The studies examined have also found some interesting correlations between preferences for reducing the visual impacts of offshore wind farms and specific demographics (such as age, sex and education) as well as factors accounting for experience with different wind farm establishments. The most policy relevant correlations found of are those of age as well as wind farm experience.

The "age effect" is identified in three of the above papers (Ladenburg and Dubgaard 2007,Krueger et al. 2011; Westerberg et al. 2011). More specifically, these papers find that younger respondents appear to hold weaker preferences for reducing visual impacts. The interesting question in this regard is whether the age effect is permanent (a generation effect) or not. If the age effect is permanent, the external cost of locating wind farms at near shore locations will be smaller in the future. Accordingly, if the location decisions of offshore wind farms are based on the preferences of the current generation only, the wind farms might be located further from the shore than would be optimal if future generations are also considered, resulting in utility prices that are inefficiently high. Consequently, it would be beneficial from a power generation point of view, to take this into account when placing future offshore wind farms.

Finally, studies have also found that preferences differ depending on previous experience with offshore wind farms. In general, people who live close to wind farms located onshore, express a stronger preference for siting turbines offshore (Krueger et al. 2011). Moreover, those people who live close to existing offshore wind farms express a stronger preference for moving wind farms to locations further from shore, than those without such experience (Ladenburg and Dubgaard 2007). This suggests that optimal wind farm placement depends strongly on the experiences impacted populations have with wind farms – both on- and offshore. Accordingly, the external cost in the longer run might not just be a simple function of the distribution and the demographic characteristics of the relevant population, but also a function of the choice of the onshore and offshore wind power development mix.

Conclusion

Results from existing studies suggest that higher levels of visual impacts can be expected to have a negative influence on both the direct and welfare economy. As a result, an economic analysis of these costs is critical when evaluating the trade-offs associated with finding the optimal location for future offshore wind farm development. The results also suggest that while, on average, consumers prefer siting wind farms further from shore, these preferences become weaker at further distances from the shore, suggesting that optimal wind farm locations are likely to be within view. Moreover, preferences differ significantly among the population, implying that the optimal location of offshore wind farms depends, among others, on the age structure of the affected population as well as the population's previous experience with existing wind energy structures. This heterogeneity makes generic policy prescriptions difficult, and demonstrates the importance of extensive economic analysis by offshore wind energy developers.

References

Bishop ID, Miller DR. Visual assessment of off-shore wind turbines: The influence of distance, contrast, movement and social variables. Renewable Energy 2007;32; 814-831.

Campbell D, Aravena CD, Hutchinson WG. Cheap and expensive alternatives in stated choice experiments: are they equally considered by respondents? Applied Economics Letters 2011;18; 743-747.

Ek C, 2006. Quantifying the envinmental impacts of renewable energy, In: Pearce DW (Ed), Environmental Valuation in Developed Countries: Case Studies. Edward Elgar Publishing, Northampton, MA; 2006. pp. 181-200.

European Environment Agency, 2009. Europe's onshore and offshore wind energy potential - An assessment of environmental and economic constraints, EEA Technical report, No. 6/2009. European Environment Agency.

Krueger AD, Parsons GR, Firestone J. Valuing the Visual Disamenity of Offshore Wind Power Projects at Varying Distances from the Shore: An Application on the Delaware Shoreline. Land Economics 2011;87; 268-283.

Ladenburg J. Attitudes and preferences for the future wind power development in Denmark and testing the validity of Choice Experiments. Ph.D. Thesis, Institute of Food and Resource Economics, University of Copenhagen, Denmark 2007.

Ladenburg J, Bonnichsen O, Dahlgaard J-O. Testing the effect of a short Cheap Talk in Choice Experiments. Nationaløkonomisk Tidsskrift (Danish Journal of Economics) 2011;149.

Ladenburg J, Dubgaard A. Willingness to pay for reduced visual disamenities from offshore wind farms in Denmark. Energy Policy 2007;35; 4059-4071.

Ladenburg J, Dubgaard A. Preferences of coastal zone user groups regarding the siting of offshore wind farms. Ocean & Coastal Management 2009;52; 233-242.

Ladenburg J, Lutzeyer S. The economics of visual disamenity reductions of offshore wind farm – Review and suggestions from an emerging field. Article in review, 2012.

Landry CE, Allen T, Cherry T, Whitehead JC. Wind Turbines and Coastal Recreation Demand. Resource and Energy Economics 2012;34; 93-111.

Westerberg VH, Jakobsen JB, Lifran R, 2011. Offshore wind farms in the Mediterranean Sea - A tourist appeal or a tourist repellent ?, 18th Annual Conference of the European Association of Environmental and Resource Economists, Rome, June 29th - July 2nd.

Council Announces Dues Increase

At its June 24 Meeting the IAEE Council voted to increase regular Affiliate and Direct member dues $20.00, Student member dues $10.00, and Institutional Member dues $500.

This is the first dues increase in five years and reflects the ever increasing costs of operating the Association as well as the costs of bringing on the new publication, *Economics of Energy and Environmental Policy.*

The dues increase is effective immediately, however, outstanding dues invoices will be honored at the old rate.

David Newbery Honored

David Newbery, CBE

David Newbery, IAEE President-elect, has been named a *Commander of the Most Excellent Order of the British Empire* (CBE). The honor was bestowed by Queen Elizabeth in her list of birthday honors.

The Most Excellent Order of the British Empire is an order of chivalry established almost a hundred years ago by King George V. Honorees are recognized for the meritorious impact they have made on the United Kingdom.

David is Research Director, Electricity Policy Research Group, University of Cambridge. He has served widely in academic and governmental positions and is a Fellow of the Centre for Economic Policy Research, the Econometric Society and the British Academy.

Adam Sieminski

Adam Sieminski Named to EIA

Adam Sieminski has been named Administrator of the U.S. Energy Information Administration. He is EIA's eighth administrator and as such is responsible for directing the nation's primary energy statistical and analytical agency.

Adam is well known to many IAEE/USAEE members, being a Senior Fellow of USAEE, and having served as USAEE's president in 2003. From 2005, until his EIA appointment he was Chief Energy Economist for Deutsche Bank.

In addition to his long service with Deutsche Bank, Adam has served in various advisory capacities with the Center for Strategic and International Studies, the U.S. National Petroleum Council, Johns Hopkins/SAIS, the Independent Petroleum Association and the Council on Foreign Relations. He is a past president of the National Association of Petroleum Investment Analysts.

Fereidun Fesharaki Recognized at Perth

Fereidun Fesharaki

Long-time IAEE member and Past President (1993), Fereidun Fesharaki, was honored at the Perth International Meeting in June with the 2012 *Outstanding Contributions to the Association Award.* This prestigious award is given to an individual deemed to have contributed to the betterment of the Association over his or her years of membership. Fereidun's citation acknowledged his years of distinguished service and ceaseless efforts on behalf of the organization.

Fereidun is Chairman and President of FACTS Global Energy Group of Energy Market Consultants (UK) Ltd. In the 1970's he served as Energy Advisor to the Petroleum Minister of Iran. His directorships are many, including the Dubai Mercantile Exchange and the American-Iranian Council; he was elected a member of the Council on Foreign Relations in 1989. He has authored dozens of books and many more articles published in academic and industry journals around the world.

Nigerian Local Content: Challenges and Prospects

By Jean Balouga*

Introduction

The need for resource-rich Nigeria to assume control of the exploration, exploitation and production activities in the oil and gas sector and to harness the potentials of this most strategic industry in order to generate more value-added, seems to be receiving much desired attention from all the stakeholders.

This need is equally expressed in Nigeria's desire to domicile a substantial amount of the average $18 billion per annum exploration and production spending and stem the tide of capital flight which, over the years, has made Nigeria a junior partner in her joint venture arrangements with the International Oil Companies (IOCs).

For a country with over four decades' experience in oil and gas exploration and production activities and proven recoverable reserves of about 37 billion barrels, her inability to use the resource wealth as a means for national development and poverty reduction has perhaps been the greatest challenge facing successive administrations.

These challenges have their expression in how Nigeria can derive maximum benefits from oil and gas operations through optimal use of local competences and resources as practiced in Indonesia, Brazil, Norway and Venezuela, for example. Although these countries started oil exploration and production activities after Nigeria they have largely recorded remarkable success in their efforts to grow the local content in this strategic industry. The question is: why has Nigeria been unable to surmount her own challenges?

The Policy

The Nigerian Oil and Gas Development Law 2010 defines local content as "the quantum of composite value added to or created in Nigeria through utilization of Nigerian resources and services in the petroleum industry resulting in the development of indigenous capability without compromising quality, health, safety and environmental standards". It is framed within the context of growth of Nigerian entrepreneurship and the domestication of assets to fully realize Nigeria's strategic developmental goals. The scheme, which has the potential to create over 30,000 jobs in the next 5 years, is geared to increaseing the domestic share of the $18 billion annual spending on oil and gas from 45% to 70%, in addition to enhancing the multiplier effects on the economy, through refining and petrochemicals.

The local content policy action started in 1971 through the establishment of the Nigerian National Oil Corporation, (NOC). NOC was established as a vehicle for the promotion of Nigeria's indigenization policy in the petroleum sector. It later became Nigerian National Petroleum Corporation (NNPC) in 1977 through NOC's merger with the petroleum ministry. NNPC flagged off the actual local content initiative through acquisition of interests in the operations of the IOCs. These interests grew to about 70%, with the responsibility of controlling all acreages and other activities.

Although conscious efforts were made in the past through Regulation 26 of the 1969 Petroleum Act, enforcement of local content policy, the springboard for sustainable economic transformation of Nigeria, was mere paper work. For an industry that contributes 80% of Nigerian government revenues and 95% of its foreign exchange this is entirely unacceptable to the Nigerian government hence the clamor for change.

Objectives

Government's objectives for the local content policy initiative are quite noble but have remained unrealized. These objectives include the expansion of the upstream and downstream sectors of the oil and gas industry, the diversification of the sources of investment into the sector such that some of the funds would begin to come from local sources, the promotion of indigenous participation and the fostering of technological transfer. Other objectives are the increase in oil and gas reserves through aggressive exploration; employment generation for all categories of Nigerians; increased production capacity, and perhaps most importantly, the integration of the oil and gas industry into the mainstream economy through local refineries and petrochemicals

Challenges

Nigeria's rising profile in oil and gas production was rather fast and steady such that she soon became a formidable force within OPEC. Oil exploration, which started onshore has tremendously improved the nation's daily production capacity to about 2.3 million barrels per day, and raised her proven reserves to about 37 billion

* Jean Balouga is a research assistant in the Economics Department of the University of Lagos, Lagos, Nigeria. He may be reached at balougaje@live.com

barrels.

However, despite Nigeria's ever-growing profile and wealth, the country remains one of the poorest, and technologically backward, nations in the world. This is basically because the much-taunted wealth has not translated into improved welfare. One reason for this is that over 90 percent of the yearly industry expenditures escape the domestic economy as capital flight.

Despite the ever growing number of local oil service companies the latter's annual gross earnings still account for less than 5 percent of the sector's aggregate annual contracting budget. Even the local media has been denied the much desired opportunity to advertise the activities of upstream companies in Nigeria. Some of these companies, including Nigeria LNG prefer to spend huge media budgets running into millions of dollars on foreign media like CNN, upstream journals and magazines. They hardly spend 20 percent of such annual budget on Nigeria media.

Following enormous investment in human capital by the Nigerian National Petroleum Corporation (NNPC) and some of its joint venture partners over the years, a new crop of highly competent and experienced Nigerian engineers, geologists and geophysicists has emerged. Today, some of them have established private oil prospecting and oil services firms, which are classified as indigenous contracting firms. However, their inability to get a share of the action at the upstream may not necessarily be due to incompetence, but rather due to a dearth of funds.

Nigerian banks lack the financial base to make any meaningful impact on local content development. The biggest Nigerian banks are tiny banks when it comes to energy financing. Most Nigerian banks operate in dilemma-laden territory as most indigenous contractors have no proper business structure. Others are not really in the business because more often than not the person who gets the contract is not the one looking for finance. Other obstacles are a thin industrial base, lack of adequate power, water and other infrastructure to support an expanded manufacturing base, lack of small and medium-sized enterprises and an underdeveloped capital market.

The BGL study notes the argument of some industry stakeholders that over 70 percent of the contracts awarded to Nigerian companies are executed overseas, thereby defeating the primary objective of Nigerian content development which is to develop in-country capacity by executing contracts in Nigeria using Nigerian local resources.

Other problems of local companies revolve around executive capacity and critical mass with technical and financial wherewithal. Generally, most local companies are small, fragmented and incapable of packaging or attracting loans. Few of them can deliver turnkey projects without resorting to some form of partnership agreement for equipment, expertise or technical support.

There exists the so-called "Knowing-Doing gap" in Nigeria, that is the disconnect that exists between policy formulation and policy implementation. This term describes the absence of a critical link between strategy and action. Public policy initiatives and actions in Nigeria have persistently been incapacitated by this gap, with many government programmes and projects ending in downright failure. Inadequate think through, weak institutional capacity, lack of political will to carry through change, inconsistency in government policies, lack of support from relevant stakeholders and corruption are some of the causes of this gap.

The implication of this is that the future of the Nigerian people is currently being controlled by foreigners whose main objective could be to post better returns on investment.

Government's Efforts

The Nigerian local content initiative did not take off until recently. The Obasanjo administration's renewed efforts at making a difference in the appalling state of Nigerian content were evident in the privatization of the Nigerdock and the repositioning of the Nigerian Petroleum Development Company (NPDC), an arm of NNPC. Already the privatization of Nigerdock has proved the company's capability as a serious player in emerging deepwater offshore activities with its success story in constructing the Bonga Buoy (the world's largest).

Another milestone recorded in the effort at growing the nation's local content level is the Globestar yard's fabrication of the jacket for the Amenam platform, Saipem yard's Okpoho platform and ChevronTexaco's Meren-X well jacket and helipad fabricated by Transcoastal Nigeria. These developments have helped to create jobs, build capacity and stimulate the nation's economy.

Fabrication is probably the most developed manufacturing area in the Nigerian petroleum industry. For several years, many structures and parts have been fabricated in yards located mainly in Warri, Lagos and Port Harcourt. This has come to stay, but it suffers a number of limitations. Limited capacity installation and technological innovation could continue to plague the industry even as it is striving to mature into relatively more demanding deepwater fabrication.

Transportation in the oil and gas industry covers road haulage, marine transportation and pipeline transmission. Airline transportation relating to the industry is still firmly in the hands of foreign companies. Local and international companies are active in marine transportation services for swamp and offshore operations. Road haulage is the most popular means of transportation for onshore operations because of the poor state of rail transportation in the country. The full implementation of the *cabotage* law is, therefore, expected to provide more opportunities for local participation.

Investment in Nigeria's oil industry currently amounts to about $18 billion annually. This investment trend is expected to continue annually beyond 2012. The creation of the Nigerian content support fund is timely. This fund is designed to operate a free zone concept and provide working capital for local companies, thereby bringing down the cost of funds.

Post consolidation, Nigerian banks as syndicates have offered between $200 and $600 million in $1.2 billion projects. Other projects have been solely funded by Nigerian banks with no international participation. Pre-consolidation, Nigerian banks were offering $60 million participation in $1.0 billion of the oil majors' key projects.

Based on the directives of the NNPC, Nigerian engineering and service companies, as well as fabrication yards have invested hundreds of millions of dollars on skill acquisition and enhancement, and capacity expansion. Yet despite all these efforts, bottlenecks in the system still prevent meaningful fabrication work being awarded to Nigerian firms. If these projects are awarded to the existing Nigerian yards not only can they demonstrate their ability to deliver to international standards of quality and safety but they also can substantially build long-term industrial capacity, provide employment and global competitiveness which is currently in the hands of the overseas yards.

Perhaps government's most outstanding effort so far is in the development of a unique blueprint for the successful implementation of a Nigerian content policy in the oil and gas industry. This policy is referred to as the Nigerian Oil and Gas Development Law 2010. One of the outstanding features of this blueprint is the conceptualization of a proper definition of Nigerian content, which enjoys general acceptability in the industry. Going by this definition the mistake of confusing local front with local content will be substantially reduced as local content seeks to reward local investment and competence at the expense of mediocrity. This policy, which makes it imperative that exclusive consideration be given to Nigerian indigenous service companies which demonstrate ownership of equipment, Nigerian personnel and capacity to execute jobs in the Nigerian oil and gas industry, is fashioned after the Norwegian model. It presents a template for companies' classification and a value matrix to measure local input. It also spells out the responsibility of the respective institutions charged with the effective delivery of the Nigerian content.

The Way Forward

The high cost of funds is a factor that jeopardizes indigenous oil service companies' ability to compete effectively with their counterparts from Europe and the United States, who are well endowed with capital. This untoward development has reduced Nigerian banks, not yet cut out for long-term projects and with a penchant for quick business and immediate returns, to mere 'cash centres'.

Policy makers in Nigeria's oil and gas industry must seriously consider the idea of establishing a strong energy bank that would empower local contractors/investors. This would increase their level of participation and give them the necessary experience that would engender technology transfer.

Technology transfer should be well programmed and aggressively pursued if economic, military and political advantages are to be guaranteed. So far an increased number of Nigerians in managerial and professional positions in firms involved in upstream and downstream operations has been observed. However, the evidence of technology transfer is yet to be seen. Nigeria, therefore, needs her own unique strategy of technological progress pursued with all seriousness if Nigerians are to make any meaningful impact soon.

Another factor that made nonsense of past efforts at improving local content (and is still a challenge to current efforts) is the nation's inability to develop her infrastructure. Coupled with this is a lack of a sound iron and steel industrial base, lack of foundries and effective machine tool manufacturing. These are all part of the fundamental challenge, which the government must address through its privatization programme.

Government must remove the inconsistencies in the local content act, sincerely respect the local content blueprint and follow its carefully, especially in the awarding of contracts for deepwater and other projects in the oil industry. Such a policy should ensure that the refining sector and indeed the whole of the downstream sub-sector is commercialized and further opened to private sector participation. It should also ensure that the country's existing refineries run efficiently. This will be best achieved if core investors are brought in to acquire majority shares in the plants and to take over their management, following Indorama/EPCL, Nigeria. The policy should pursue the active participation of the private sector in refining, with investors encouraged to set up refineries aimed largely at the export market.

A strategic objective of the local content policy should be to get exploration and production companies already active in the Nigerian upstream, and new entrants, to be committed to downstream business including the development of energy infrastructure and assets. The concept of extended enterprise (virtual integration, outsourcing, collaborative R & D), in short, networking must also be emphasized.

More investments would have to be channeled into the gas sub-sector. More projects utilizing gas to produce energy-based derivatives such as the Escravos Gas-to-Liquids project and the Natural Gas Liquids project are required. Policies in the Gas Master Plan must be pursued vigorously.

The Nigerian Content Consultative Forum (in charge of networking in the oil and gas industry), the Nigerian Content Division (an arm of NNPC) and the newly created Nigerian Content Development and Monitoring Board, NCDMB, (charged with the responsibility of strictly enforcing compliance) must work in tandem for the success of the local content policy.

Historically, the factors which have created the chasm between policy substance and implementation are mainly inadequate think-through, weak institutional capacity, absence of the required political will to carry through change, lack of support from relevant stakeholders and corruption. The NCDMB should not be allowed to become captive to such factors.

Finally, the sincerity of government about the local content issue must be reflected in attractive fiscal policy (see Ghana) or measures such as reduction in import duties for steel and chemicals and other consumables as well as tax holidays for indigenous oil and gas and related firms, all of which may gender a competitive spirit in our local fabrication yards.

Conclusion

The present state of Nigeria's needs is a clear indication that a responsible and dynamic approach to sustainable local content development needs to be adopted by government policy makers and upstream operators to guarantee a better future for the nation's oil and gas industry. Technological development does not occur just by chance; rather it is a product of a nation's sound economic management, policy re-engineering, good governance and a social value system that rewards hard work and creativity.

Having a few companies committed to Nigerian content and pursuing local content programmes is not enough. Support for local content policies must be nation-wide. It must be accepted by all and should become embedded in every operator's business philosophy.

References

Adepetun, S. (2010): "Nigerian Content Act: Thoughts for Consideration", Nigeria's Oil and Gas (NOG), August, pp. 24-27.

Araco, B. (2010): "World Bank says less than 1% Nigerian businesses have access to credit". BusinessDay, 1 September, pp.1, 5.

Bello, O. (2010): "Local content: Firms risk losing over $5bn to lack of patronage", BusinessDay, 6 September, pp.1,4,6.

Bello, O. (2010): "Jonathan inaugurates Nigerian content governing council, orders strict compliance", BusinessDay, 6 September, p.6

BP Statistical Review of World Energy, June 2010, p.6, htpp//www.bp.com/statistics

Coker, C. (2008): "Local content as the springboard for sustainable economic transformation of Nigeria", NOG, October, pp.28-29.

Chikezie, C. (2010): "Making the local content law work", NOG, May-June, 2010, pp.11, 17.

Ellis, C. (2008): "Opportunities are immense with 90% of Nigeria's revenue from oil and gas". NOG, October, pp. 23-24.

Gaius-Obaseki, I. (2002): "Technology transfer: a model for Nigeria's oil industry", NOG, October, pp29-30.

Obasa, R. (2006): "Nigerian content: Removing the knowing-doing gap". NOG, July, pp. 13-15.

Obasa, R. (2009): "Extended enterprise can fast-track local content development", NOG, March, pp. 3-4.

Ogunfuyi, R. (2006): "Nigerian content: SPE's frank talk on capacity building". NOG, September, pp.4, 25-27

Okiti, O. (2007): "Local content in the oil industry". BusinessDay, 10 December, back page.

Ogbodu, S. (2006): "Local content: hope in the horizon?" NOG, April, pp. 12-15.

Reuters (2010): "Nigeria eyes greater share of increasing oil investment", BusinessDay, 26 August, 2010, p.3.

Seriki, W. (2008): "Is the Nigerian content policy on course?" NOG, February, pp. 16-17.

Umeagudosi, C. (2006): "NNPC to float Nigerian Content Support Fund". NOG, December, 2005-January 2006, p. 27.

------------ (2009): "Nigeria earns $300bn revenue from oil in the last 30 years" NOG, December 2008 – January 2009, p.10.

Welfare Analysis of Offshore Wind by Julian Silk: A Comment

By Richard Green*

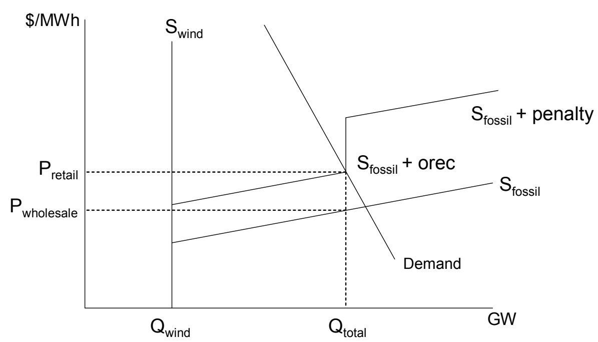
In the I*AEE Energy Forum* for the 2nd Quarter of 2012, Julian Silk offered an analysis of the welfare economics of offshore wind power, motivated by Maryland's proposed scheme and inspired by the tools used to analyse the impact of an import quota on a domestic market. Unfortunately, those tools do not easily transfer from the trade-relevant case of a maximum supply from a cheap source to the energy case of a minimum supply from an expensive one. In the case of trade, once the quota of cheap imports is used up, all other demand must be met from domestic sources, and the price must rise to their marginal cost (if that market is otherwise competitive). This price is also received by importers, despite their lower costs.

The governor of Maryland is currently proposing to source 20% of its electricity from renewable sources, and Dr. Silk argues that the marginal cost of these sources will set the price for all the power sold in the state. "The price going to the wind suppliers will be [the cost of offshore wind]. If the price is higher, more wind supply will come into the market to drive it down. If it is lower, wind suppliers will exit the market … the last, marginal, fossil supplier has a supply price equal to [the cost of offshore wind]. If this fossil supply price is higher, more wind will be purchased, and the price will be driven back down. If it is lower, the electricity market will attempt to purchase more fossil energy, and come upon the binding quota restriction, which will drive the price back up." This is represented by a leftwards shift of their supply curve, and Dr. Silk comments that "[the area between the old and new supply curves] can be considered to be costs for fossil fuel producers." Is the effect on prices the equivalent to the standard analysis of an import quota, in which the ability to sell at a price raised by the quota leads to higher profits for the importing firms? I will argue that neither wholesale nor retail prices will be affected in the way that Dr. Silk suggests. Furthermore, I cannot conceive of a way in which, as in Dr Silk's world, the presence of a quota of high-cost generators somehow raises the costs of every other generator on the system.

To analyse the price impacts, we need to know how the renewable generators will be supported – in Maryland, this is to be through Offshore Renewable Energy Certificates (ORECs). The owner of an offshore wind farm is entitled to sell one OREC (at an administered price) for each MWh it generates, giving up all the energy market (and other) revenues it receives in return. The ORECs are then bought by electricity retailers, in proportion to their sales, and the cost is offset by redistributing the wind farm's energy revenues to the OREC holders. The net cost is thus the difference between the OREC price and the market price for the station's output. A retailer that does not hold enough ORECs pays an (administratively set) penalty.

Dr. Silk discusses these certificates and suggests that "it would be reasonable for generators to purchase the [O] REC, and immediately sell 1 MWH of their own generation." This somehow leads him to conclude that the fossil generators would now have a higher marginal cost than the wind farms and would, therefore, require a subsidy if they were to continue to operate.

Figure 1: A market with a wind quota: short-run equilibrium



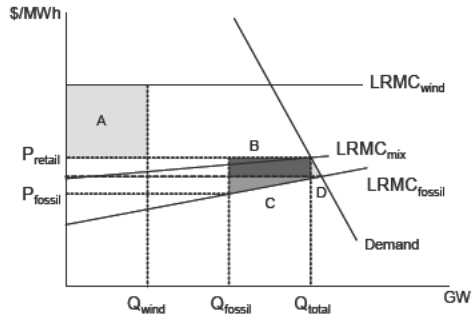
I am not quite sure how fossil-fuel generators could purchase an OREC and immediately sell their own power, since the OREC is only given for output actually delivered. But rather than struggle further with Dr. Silk's article, I thought it might be helpful to present some analysis that reflects the way in which electricity markets actually operate. In the short run, the output from wind farms can be taken as completely inelastic – absent transmission or other constraints, the entire available output will be sold, given its zero marginal cost. Once wind farms have been added to an electricity system, we, therefore, need to shift the supply curve of the fossil-fuelled stations to the right, by the amount of wind production. This can reduce wholesale market prices in the short run, as observed in Germany (Sensfuß et al, 2008) and in Spain (Sáenz de Miera et al, 2008). Figure 1 shows a short-run market equilibrium with the supply curve shifted in this way. The fossil stations produce the difference be-

* Richard Green is the Alan and Sabine Howard Professor of Sustainable Energy Business at Imperial College Business School (r.green@imperial.ac.uk).

tween the total demand for power, Q_{total}, and the amount supplied by wind stations, Q_{wind}. They are paid a wholesale market price ($P_{wholesale}$) equal to the marginal cost of the most expensive unit in operation. In Maryland, this price is actually set on the basis of supply and demand across the entire PJM market (subject to the effects of transmission constraints), making it inconceivable that a renewable policy in one state could raise the price received by all generators to the cost of offshore wind.

The state's policy will affect the retail price in that state, however, and it is this that determines the level of demand. Maryland consumers have to pay the wholesale price plus a charge for the renewable power. If demand is low enough, the wind output will equal or exceed the proportion of demand required by the policy, and the retailer must just pay the OREC price, multiplied by that proportion, per MWh of retail power sold. The figures are drawn with a required proportion of one-third, so that if the OREC price was $30, the addition per MWh of retail sales (labelled "orec" to distinguish it from the price per certificate) would be $10. I assume that certificates in periods of low demand would be banked for future use, and so the price adder would never fall below this level. If retail demand is high, however, then the number of ORECs available will be too low, and retailers will have to pay a buy-out price instead, here labelled as "penalty". The diagram is drawn with a proportion of wind power exactly equal to the requirement, and so the line giving the retailer's marginal cost jumps upwards at the actual level of demand. This is given by the intersection of the retailer's marginal cost with the demand curve, at a price equal to P_{retail}, and the quantity of Q_{total}.

Figure 2: A market with a wind quota: long-run equilibrium



What about the long run, and the calculation of deadweight losses? Figure 2 shows the position, this time measuring both wind and fossil generation from the vertical axis. In the absence of a renewable support policy, the demand for power would be given by the intersection of the demand curve and the long-run marginal cost of fossil power ($LRMC_{fossil}$), just to the left of Q_{total}. As in Dr. Silk's article, the LRMC of wind power is high and constant, while that of fossil energy is lower and upwards-sloping. If retailers are required to source one-third of their power from offshore wind, then the LRMC of this mix will start one-third of the way between the origins of the two LRMC curves, and will have a slope two-thirds of that of $LRMC_{fossil}$. In the equilibrium shown, the total output is equal to demand at the price P_{retail}, with fossil output equal to two-thirds of this, and wind to one-third. This retail price is equal to a 2:1 weighted average of the LRMC of fossil power and that of wind, since the retailer will have to buy one MWh of wind power for every two MWh of (cheaper) fossil energy. In the wholesale market, the fossil energy would earn the price P_{fossil} (equal to $P_{wholesale}$ in Figure 1), its marginal cost.

The deadweight losses from supporting offshore wind are given by the sum of four areas. Three of these (A, B and C) represent the extra costs incurred in producing one-third of the delivered power from offshore wind rather than from fossil energy. They cover the vertical distance between the cost of offshore wind and the cost of an equivalent amount of fossil energy from the stations displaced. Area B and the two rectangles to its left represent the amount of this cost borne by consumers, whereas Area C and the lower two rectangles represent the amount borne by fossil generators. (The four rectangles together have the same area as A.) The remaining deadweight loss, Area D, comes from the lower overall demand for electricity. It is relatively small, given that the demand curve has been drawn to be inelastic, and that the price increase is based on the excess cost of offshore wind, but multiplied only by the proportion of power which it is required to meet. Almost all of this loss comes from consumers – the producer surplus from a small increment of generation with a relatively flat supply curve is tiny. Any other effects, such as employment in the renewable industry, visual disamenity, emissions savings or the costs of dealing with intermittency, should be added to these deadweight losses.

Per MWh of output, low-carbon electricity can cost much more than the pre-externality cost of fossil power. The impact on consumers' bills and welfare, however, depends on the product of the cost per MWh and the proportion of power receiving support. In the UK, the Committee on Climate Change (2011) has shown that this impact is currently low, and I am confident that an appropriate analysis of the Maryland scheme would produce a similar result.

References

Committee on Climate Change (2011) Household energy bills –impacts of meeting carbon budgets, London:

Committee on Climate Change

Sáenz de Miera G., P. del Río González, I. Vizcaíno (2008) "Analysing the impact of renewable electricity support schemes on power prices: the case of wind electricity in Spain" Energy Policy, vol. 36, no. 9, pp. 3345-3359

Sensfuß, F.; M. Ragwitz and M. Genoese (2008) "The Merit-order effect: A detailed analysis of the price effect of renewable electricity generation on spot market prices in Germany" Energy Policy, vol. 36, no. 8, pp. 3076-3084

Response to Professor Green's Comment

I thank Professor Green for his comment on my analysis. My impression, in working through the comment, is that we are making different assumptions. That the short-run supply of wind is absolutely inelastic with respect to price is certainly a different assumption than I was making. That the wind suppliers will enter the market regardless of their receipts is different as well. If the wind suppliers lower the wholesale prices over what they would otherwise be, as in the examples of Spain and Germany that are cited, well and good, but I wonder if there are not some other costs that are being disguised or not counted.

My understanding, which I will be delighted to correct if it is mistaken, is that the wind producers must receive payment to cover their all fixed costs and marginal costs each year, or they will not enter the system at all. Yes, the marginal costs are zero for wind. But the fixed costs in annualized terms are not. In looking at Figure 1, the wind producers just get what they get. But implicitly, it would seem that the marginal cost for the wind producers is as in Figure 2, much higher than the market equilibrium price. If this is the case, and the price is only p_{fossil}, how do we know that p_{fossil} + orec covers the payment for the fixed costs of the wind suppliers? Either the wind suppliers are given a long-term guarantee that their costs will be covered later, which has market value now, or the fossil fuel generators pay for it, or the consumers pay for it. If the wind suppliers were willing to accept less, why would Delaware's offshore wind farm, so similar (almost in swimming distance) to the one proposed for Maryland, be facing the financing difficulties detailed in "Offshore wind 'backbone' still a plus for Delaware", online at http://www.delawareonline.com/article/20120517/BUSINESS09/305170027/Offshore-wind-backbone-still-plus-Delaware? Professor Green accepts a discontinuity at the intersection between supply and demand in Figure 1; I am much more skeptical. My renewable energy certificates are much more expensive than Professor Green's, it seems.

Something similar seems to apply for Figure 2. The wind producers are receiving a much higher payment for the power they produce than are the fossil fuel producers. The wind producers are making an economic profit of zero, yes. But the fossil fuel producers are paying Area C plus the lower two rectangles, as Professor Green rightly notes. Why should they do this in the long run? It was always an implicit assumption in my argument that there was an electricity market as an alternative to PJM to which electricity generators could turn if PJM did not provide at least as much profits as the alternate market. As the fossil fuel producers close up shop, retire plants, or more likely, never build them at all, $LRMC_{fossil}$ moves up. If it moves up until it meets $LRMC_{wind}$, then these payments stop, and that's what I think will be the equilibrium result.

Actual wind production is plagued by the need for spinning reserve, periods of negative pricing and loop flow, in addition to the constant high annualized cost. I have tried to go into this in my "Wind Problems" submission for the IAEE Blog. To cite from there, "There have been various attempts to use batteries as spinning reserve. The latest and most efficient of these is being conducted in Chile (see http://generationhub.com/2012/05/03/aes-combines-advanced-battery-based-energy-storage)." If batteries (as in Chile), can be used as backup for wind, then perhaps we can have an empirical test to see who is right.

Trying to seriously discuss wind on a large scale for the U.S. has an air of unreality now, in the wake of the success of Governor Scott Walker (R-Wisconsin) in the recall election called to replace him. This bodes very well for the success of Governor Mitt Romney, who has made renewable energy a favorite target, in the November U.S. Presidential election. My object is not to generically oppose wind or any renewable energy, far from it. It is to make absolutely sure it delivers on its promises, especially for cost, without special pleading, so as to escape the backlash that is threatening it, and become a significant part of the world's energy supply.

Julian Silk

31ST USAEE/IAEE NORTH AMERICAN CONFERENCE / NOV. 4-7, 2012 / SHERATON AUSTIN, TEXAS

CONFERENCE OVERVIEW

The sustainability of global long term energy demand, supply, and energy diversity is in question in light of growing demand for energy in China, India, Brazil, and other emerging economies, increasing awareness of environmental issues, and the need to find new ways to address related concerns. Further uncertainties are raised by changing world events such as the global debt crisis, the Arab Spring, and the impact of Japan's tsunami and earthquake disasters on the development of nuclear energy. These and other issues challenge the transition toward a sustainable energy era where the current energy needs are met without compromising the energy needs of future generations, and they also create opportunities.

If there is a need to guide this transition, what type of roadmap should be developed to show a desired path to energy sustainability? To what extent will the roadmap be determined by drivers such as public and private investment, government and environmental policy, technological innovation, and research and development funding? Furthermore, what roles will be played in this transition by conventional and non-conventional fossil fuels; renewable energy resources such as wind, solar, geothermal, and biomass; distributed resources and storage; energy efficiency; electric vehicles; and the smart grid?

This conference is intended not only to address these questions but also to address possible challenges and opportunities for the transition to such a sustainable energy era. With its record of energy innovation and accessibility, Austin, Texas is an ideal setting for bringing together key players in the global energy and transportation industries, government, and academia to address questions and concerns raised in several plenary and concurrent sessions. Those interested in organizing sessions should propose a topic and possible speakers to Robert Borgstrom, Concurrent Session Chair (robertborgstrom2@gmail.com). The conference will also provide networking opportunities through workshops, public outreach and student recruitment.

HOSTED BY

Central Texas Association for Energy Economics

TOPICS TO BE ADDRESSED INCLUDE:

Conventional and Unconventional Gas and Oil Supplies

- Changing World Oil Supply/ Demand Balance
- Protection of Offshore Resources Versus Oil Supplies
- Exploration and Drilling Cost Concerns
- Future Utilization of Fossil Resources in Other High Value Added Products

Markets and Drivers of Renewable Energy

- Government's Promotional Role
- Integration of Solar and Wind Generation in Power Dispatch
- Mass Production for End-Use Distributed Renewable Resources
- Capital Markets – Financing Renewable Resources

Energy Efficiency – Defining and Meeting Realistic Goals

- Building Controls and Cost Allocation
- Energy Efficiency Rules for Government Sponsored Home Loans
- Tightening Standards
- The Minimal Energy Society – Danish Model
- New and Improved Automobile Efficiency Standards

Economic Analysis Methods and Assumptions

- Energy Data Sources
- EIA Reliability Amid Shale Gas Data Difficulties
- Private Surveys
- Smart Meter Consumption Data and Analysis

Role of Government in Transitioning to a Sustainable Energy Era

- Issues in Energy Regulation and Uncertainties
- Renewable Portfolio Standards (RPS)
- Goals and Standards Toward Energy Sustainability
- Incentive Mechanism to Enhance Energy Sustainability
- Financial Regulations and their Impacts on Energy Trading
- Market and Exchange Trading Efficiencies

Changing Geography of Energy Demand

- China
- India
- New Industrial Asia and South America
- North America and Europe
- Developing Countries

Climate Change Concerns

- Pros and Cons of Delaying a Decision
- Policies Compatible with Economic Slowdown
- Intergenerational Considerations
- Can Developing World Benefit from Additional Environmental Regulation?

Natural Gas – Bridge Fuel to More Natural Gas?

- Shale Gas Revolution and Water Issues
- LNG Trade
- Global Gas Contracts vs. Spot Market Trading
- Role of Gas in Meeting Renewable Portfolio Standard or CO_2 Emission Standards

Global Petroleum Security and Pricing

- OPEC Policies in a Changing World
- Oil Supply Crisis Due to Political Instabilities in Producing Countries
- Strategic Oil Storage Policies

Electricity

- EPA's New Standards and Coal Power Plant Trade-Offs
- Natural Gas and Wind Generation – Competition or Integration?
- Adequacy of Transmission Capacity to Accommodate Massive Renewable Resource Expansion
- Market Design and Efficiency
- Electricity Pricing, Fuel Pricing and Policy
- Wind and Solar Market Penetration Issues
- Role of Demand Response in Addressing Resource Adequacy and Reliability Issues

Energy Capital Investment & Allocation

- Wind
- Solar
- Nuclear
- End-Use Distributed Resources and Storage
- Infrastructure

Energy Infrastructure

- Capital Investment Requirements
- Costs of Capital
- Pipeline and Transmission Line Financing, Regulatory and Right-of-Way Issues

Energy Technology and Innovation

- Supply Expansion
- New Energy Technologies (Distributed Generation and Storage)
- Cost Reduction
- Demand and Efficiency
- Role of Smart Meters in Enhancing Smart Pricing and Value Added Services

Issues in Moving Beyond Petroleum in Transportation

- Short-Range vs. Long-Range Electric Cars
- Electric Vehicles in Mass Transportation
- Is Natural Gas Fuel of Choice to Replace Gasoline?
- Ethanol and Biodiesel

Energy and Wealth Distribution

- Can Energy Sustainability Be Consistent with Economic Growth?
- Can Developing World Benefit from Additional Environmental Regulation?
- Can New Energy Technologies Reduce the Gap between Industrialized and Developing Countries?

Energy and Water Issues

- Impact of Drought on Energy Generation
- Water Usage of Different Electric Generation Technologies
- Hydro Generation

Energy and Food

- Energy Consumption by Food Industry
- Food Waste Reduction and Energy Savings

WITH SUPPORT FROM

USAEE United States Association for Energy Economics
IAEE International Association for Energy Economics www.iaee.org
CAEE
AMEE

31ST USAEE/IAEE NORTH AMERICAN CONFERENCE

PLENARY SESSIONS & SPEAKERS

The 31th USAEE/IAEE North American Conference will attract noteworthy energy professionals that will address a wide variety of energy topics. Plenary sessions will include the following:

- Putting the "Sustainable" in Sustainable Energy Future
- Future Outlook for Oil & Gas Production
- Electricity Market Design
- Implications of North American Natural Gas Development
- The Future of Electric Markets: New Directions in Sustainable Energy Development
- North American Oil & Gas Infrastructure
- Unleashing the Potential of the Smart Grid
- Where Do We Go From Here? 2013 and Beyond

SPEAKERS INCLUDE:

Ross Baldick
Professor, University of Texas at Austin

Lars Bergman
President and Professor, Stockholm School of Economics

William Bumpers
Partner, Baker & Botts LLP

Ariel Cohen
Senior Research Fellow for Russian and Eurasian Studies and International Policy, Davis Institute for International Studies

H.B. "Tripp" Doggett
President & Chief Executive Officer, ERCOT

Roger Duncan
General Manager (Retired), Austin Energy

Cris Eugster
Executive VP and Chief Sustainability Officer, CPS Energy

Mark Finley
GM Global Energy Markets, BP

R. Dean Foreman
Chief Economist, Talisman Energy

Peter R. Hartley
Professor & Baker Institute Fellow, Rice University

Evan Hillebrand
Associate Professor of Geoeconomic Studies, Patterson School

William W. Hogan
Professor Kennedy School of Govt, Harvard University

John W. Jimison
Managing Director, Energy Future Coalition

Marianne S. Kah
Chief Economist, ConocoPhillips

Rebecca A. Klein
Principal, Klein Energy LLC

James D. Marston
VP of Energy Program, Director of Texas Regional Office, Environmental Defense Fund

Brewster McCracken
Executive Director, Pecan Street Inc.

Ariana McKnire
Natural Gas & NGL Advisor, Enbridge

Richard Morgan
Green Building Manager, Austin Energy

Todd Onderdonk
Senior Energy Advisor, Corporate Strategic Planning, ExxonMobil Corporation

Raymond Orbach
Director, Energy Institute, University of Texas at Austin

Hi-chun Park
Professor, Inha University

Karl R. Rabago
Vice President, Distributed Energy Services, Austin Energy

Benjamin Schlesinger
President, Benjamin Schlesinger & Assoc LLC

Fereidoon "Perry" Sioshansi
President, Menlo Energy Economics

Robert D. Stibolt
Managing Director, Galway Group LP

Samir Succar
Staff Scientist, Natural Resources Defense Council\

Douglas J. Suttles
Former COO, BP

Scott Tinker
Director, Bureau of Economic Geology, Jackson School of Geosciences, University of Texas at Austin

Nat Treadway
Managing Partner, Distributed Energy Financial Group LLC

Jaime Williams
President, CONCAMIN

Pat Wood III
Principal, Wood3 Resources

STUDENTS

Students may submit a paper for consideration in the USAEE Best Student Paper Award Competition (cash prizes plus waiver of conference registration fees). The paper submission has different requirements and a different deadline. The deadline for submitting a paper for the Best Student Paper Awards is July 6, 2012. Visit www.usaee.org/usaee2012/paperawards.html for full details.

TRAVEL DOCUMENTS

All international delegates to the 30th USAEE/IAEE North American Conference are urged to contact their respective consulate, embassy or travel agent regarding the necessity of obtaining a visa for entry into the U.S. If you need a letter of invitation to attend the conference, contact USAEE with an email request to usaee@usaee.org. The Conference strongly suggests that you allow plenty of time for processing these documents.

Since the Austin meeting falls on election day, U.S. members are urged to either vote early or by absentee ballot, depending on the election rules of their state.

VISIT OUR CONFERENCE WEBSITE AT: WWW.USAEE.ORG/USAEE2012/

Welcome New Members

The following individuals joined IAEE from 4/1/12 to 7/15/12

Rachid Aarab
University Autonomous of Barcelona
SPAIN

Bamidele Pereowei Abalaba
Obafemi Awolowo Univ
NIGERIA

Marcellina Abang
NERC
NIGERIA

Dana Abdulbaqi
Saudi Aramco
SAUDI ARABIA

Ozi Abdulkareem
Energy Commission of Nigeria
NIGERIA

Ahmed Abdulla
USA

Aliyu barde Abdullahi
CP and S Division
NIGERIA

Terfa Wiliams Abraham
Usman Danfodio Univ
NIGERIA

Carlos Abreu Federal
Univ of Rio Grande
BRAZIL

Mathew Adagunodo
Osun State Univ
NIGERIA

Olukoya Adekanle
Univ of Lagos
LAGOS

Olubunmi Adeleke
Redeemers University
NIGERIA

Taiwo Aderibigbe
Redeemers University
NIGERIA

Ayooluwa Adewole
Redeemers University
NIGERIA

Joseph Adeyemi
ADCA Consulting Ltd
NIGERIA

Joseph Adeyi
Univ of Lagos
LAGOS

Ayman Afghani
Saudi Aramco
SAUDI ARABIA

Mofolasade Afolabi
Univ of Dundee
CEPMLP
UNITED KINGDOM

C Agabi
PPPRA
NIGERIA

Olasupo Agbaje
PPPRA
NIGERIA

Canbaris Agbay
Ortadogu Teknak University
TURKEY

Khazisyed Ahmed Jeelani
Suadi Aramco
SAUDI ARABIA

Fayosola Aina
Redeemers University
NIGERIA

Ali Aissaoui
APICORP
SAUDI ARABIA

Olaitan Aiyelabola
Redeemers University
LAGOS

Ali Ajder
Yildiz Teknik Universitesi
TURKEY

Folashade Ajibade
Redeemers University
NIGERIA

Olanrewanju Ajogbasile
Redeemers University
NIGERIA

Opowu Akeem
Univ of Lagos
LAGOS

Lanre Akinwunmi
PPPRA
NIGERIA

Ibiyemi Akinyemi
UNITED KINGDOM

Onyedikachi Akomah
University of Lagos
LAGOS

Ahmed Al Ghamdi
SAUDI ARABIA

Ahmed Al Majid
Saudi Aramco
SAUDI ARABIA

Abdullah Al Otaibi
Saudi Aramco
SAUDI ARABIA

Mohsen Al-Ageel
Aramco
SAUDI ARABIA

Hasan Alahmadi
USA

Ijeoma Alajuronye
Univ of Lagos
NIGERIA

Mohanad Alamdar
Saudi Aramco
SAUDI ARABIA

Wael Al-Athram
Gas Exporting Countries Forume
QATAR

Jamal Albassam
Taqat ltd
SAUDI ARABIA

Mohammed Al Douhan
SAUDI ARABIA

Yahya Alfaifi
Sauid Aramco
SAUDI ARABIA

Abdulaziz Al-Falih
Saudi Aramco
SAUDI ARABIA

Cristina Alfonso
Curtin University
AUSTRALIA

Fawaz Alhadlaq
Saudi Aramco
SAUDI ARABIA

Fahad Alidi
SAUDI ARABIA

Fawaz Alkhaldi
Saudi Aramco
SAUDI ARABIA

Suhaim Alkhaldi
Saudi Aramco
SAUDI ARABIA

Fahad Al-Khaldi
Saudi Aramco
SAUDI ARABIA

Zineddine Alla
Ecole Polytechnique
FRANCE

Abdulrahman Almuhrij
Saudi Aramco Oil Co
SAUDI ARABIA

Abdulwahed Alotaibi
Saudi Aramco
SAUDI ARABIA

Naji Al-Otaish
Saudi Aramco
SAUDI ARABIA

Abdulrahman AlQurtas
Saudi Aramco
SAUDI ARABIA

Okla T Al-Rayyes
Saudi Aramco
SAUDI ARABIA

Radia Al-Rehimi
University of Liverpool
UNITED KINGDOM

Mohammed Alsolami
USA

Yousef Althabet
SAUDI ARABIA

Raed Al Thukair
Saudi Aramco
SAUDI ARABIA

Walid Al-Zakri
Saudi Aramco
SAUDI ARABIA

Abdulwasiu Amao
Univ of Lagos
LAGOS

Lewis Nosa Amure
Univ of Lagos
LAGOS

Onyinye Amuta Nwabueze
University of Ibadan
LAGOS

Joel Andruski
Unitil Service Corp
USA

Frederic Ang
Hasselt University
BELGIUM

Heidi Applegate
USA

Petr Apuhtin
ERIRAS
RUSSIA

Hamza Aref
Aramco
SAUDI ARABIA

Violetta Arhipova
MSE MSU
RUSSIA

Ibtayo Arije
University of Ibadan
LAGOS

Tarek Atallah
KAPSARC
SAUDI ARABIA

Ifeoluwa Awopegba
University of Ibadan
NIGERIA

Emmanuel Ayegba
NNPC
NIGERIA

Titilayo Ayolola
Redeemers University
NIGERIA

Jeong Hwan Bae
Chonnam National University
SOUTH KOREA

Ali Audu Baidu
Nigeria Army
NIGERIA

Ladi Raulatu Bala-Keffi
Central Bank of Nigeria
NIGERIA

Oluwayemisi Balogun
Redeemers University
LAGOS

Yetunde Balogun
Univ of Lagos
LAGOS

Richard Barclay
Cogent Policy Research LLC
USA

John E Barnes
Raymond James
USA

Mujidat Bolanle Bawa
Energy Comm of Nigeria
NIGERIA

Etienne Beeker
Centre d"Analyse Strategique
FRANCE

Ala Ben Abbes
EDF R&D
FRANCE

Ojeogwu Benedict
NERC
NIGERIA

Wim Benoot
KU Leuven
BELGIUM

Michel Berthelemy
Mines Paris Tech
FRANCE

Paul Berthomieu
FRANCE

Mahmut Hakan Berument
Bilkent University
TURKEY

Philippe Beyvin
SEA Counseil
FRANCE

Smita Bhatia
American Chemistry Council
USA

A S Bibinu
PPPRA
NIGERIA

John Bistline
USA
Valerie Boch
Renault
FRANCE
Anna Boglay
MRU MPEI
RUSSIA
Mathieu Bordigoni
EDF R and D Mines Paris Tech
FRANCE
Thomas Brinsmead
CSIRO
AUSTRALIA
Nicolas Brizard
FRANCE
John Brown
Brown Williams Moorhead and Quinn
USA
Philipp-Bastian Brutscher
University of Cambridge
UNITED KINGDOM
Lina Buccilli
Ontario Energy Board
CANADA
Laura Burgassi
FSR
ITALY
Thomas Byer
Saudi Aramco
SAUDI ARABIA
Angel Caballero del Avellanal
Gas Natural Fenosa
SPAIN
Nathaniel Cagara
Marubeni Corp
THAILAND
Enrico Cagno
Politecnico di Milano
ITALY
Emmanuelle Carpenter
E ON France SAS
FRANCE
Jerry Carter
SSOE
USA
Olivier Cateura
Ecole de Management
FRANCE
Georges Chabert
Union FE
Sebastien Chaffray
FRANCE
Shankar Chandramowli
Rutgers University
USA
Wei Cami Chen
University of Massachusetts
USA
Xu Chen
USA
Vicki Cheng
USA
Serge Chernavskiy
CEMI RAS
RUSSIA
Aldo Chiarini
GDF Suez Energia Italia
ITALY
Edith Anyaora Chinyelu
University of Lagos
LAGOS
Tai-Ming Chiu
Inst of Nuclear Energy Rsch
AEC
TAIWAN
Chin Ho Cho
Inst of Nuclear Energy Research
TAIWAN
Matthew Clancy
Sustainable Energy Authority of Ire
IRELAND
Femi Coker
SIERRA LEONE
Francois Xavier Colle
CEA
FRANCE
Nathalie Collignon
AREVA
FRANCE
Stephen Colt
University of Alaska Anchorage
USA
Jonathan Cook
USA
Peter Coppin
CSIRO Energy Transformed Flagship
AUSTRALIA
Didier Cordero
EDF
FRANCE
Adam Cox
University of Portsmouth
UNITED KINGDOM
Nicholas Cutler
ROAM Consulting
AUSTRALIA
Leah Cuyno
Northern Economics, Inc.
USA
Adenike Dada
Redeemers University
NIGERIA
Olivier Darne
IEMN IAE
FRANCE
Grace Awajash Dauda
CEPMLP University
UNITED KINGDOM
David Daugherty
USA
Jacques David
CEA
FRANCE
Allan Dawson
Independent Market Operator
AUSTRALIA
Jacques de Mereuil
AREVA
FRANCE
Gildas De Muizon
Microeconomix
FRANCE
Jalal Dehnavi Ferdowsi
Univ of Mashhad
AUSTRIA
Xavier Delaporte
Effigreen Consulting
FRANCE
Jean Luc DeLille
Comite Profesionnel du Petrol
FRANCE
Sophie Deltour
FRANCE
Riza Demirer
Southern Illinois Univ Edwardsville
USA
Jean Baptiste Departe
Supelec
FRANCE
Celine Derrien
FRANCE
Valeria Di Cosmo
ESRI
IRELAND
Ndukwe Agbai Dick
Newcastle University
UNITED KINGDOM
Rien Dijkstra
Infrarati
NETHERLANDS
Vimal Doraj
CANADA
Lioubov Doudareva
FRANCE
Paul Dowling
European Commission Joint Rsch Ctr
SPAIN
Olaniyan Duirotoye
University of Lagos
LAGOS
Ian Duncan
Australian Academy Tech Sci Eng
AUSTRALIA
Christian Durach
Technische Univ Berlin
GERMANY
Miton Echofe
Univ of Lagos
LAGOS
Oleg Eismont
MSE MSE
RUSSIA
Nkiruka Ejimofor
CEPMLP University of Dundee
UNITED KINGDOM
Yulia Elrih
Krasnoyarskenergo
RUSSIA
Michael Enigbokan
Univ of Lagos
LAGOS
Benjamin Enns
CANADA
Raisa Ephina
IAAS MSU
RUSSIA
Anthony Eriksen
AUSTRALIA
Georg Ewerhart
Saudi Aramco
SAUDI ARABIA
Gerald Ezenwa
Redeemers University
NIGERIA
Juliet Falaye
Redeemers University
LAGOS
Dotun Famakinwa
Redeemers University
NIGERIA
Leonardo Faria
Brazilian Oil Nat Gas and Biofuels
BRAZIL
Juan Fernandez
Tesla Eruope Ltd
UNITED KINGDOM
George Filis
Univ of Portsmouth
UNITED KINGDOM
Claude Fischer
Association Confrontations
FRANCE
David Foti
Lone Star College
USA
Paco Leonard Freens
Qatargas
QATAR
Blaise Fremaux
SINGAPORE
Charles Fremond
FRANCE
Jack Fuller
West Virginia University
USA
Sadhvi Ganga
TransGrid
AUSTRALIA
Veera Garimella
Saudi Aramco
SAUDI ARABIA
Genevieve Gauthier
Econoler
CANADA
Claire Gavard
Centre d Economie de La Sorbonne
FRANCE
Ladan Ghodrati
IRAN
Carrie Giles
USA
Louis Gaetan Giraudet
Stanford University
FRANCE
Gonzague Godinot
Indicta
FRANCE
Elvan Gokalp
TURKEY
Aleksandr Goryachev
ERIRAS
RUSSIA
Jan Goslicki
GERMANY
Orife Grace
Addax Petroleum
LAGOS
Christoph Graf
University of Vienna
AUSTRIA
Stephane Gronnier
Credit Agricole
FRANCE
Michael Gucwa
USA
Eshita Gupta
Indian Statistical Institute
INDIA
Saad Haboob
Saudi Aramco
SAUDI ARABIA
Kyle Haemig
CMMPA
USA
Richard Hajzuk
Queenscliff Investments Slovakia
SLOVAKIA
Ghadah Hamidi
Saudi Aramco
SAUDI ARABIA
Sun Han
China University of Geosciences
CHINA
Julia Harvey
USA
M Zahid Hasan
University of Notre Dame Australia
AUSTRALIA
Afeez Hassan
Univ of Lagos
LAGOS
Mhya Adamu Hassan
NNPC
NIGERIA
John Hays
Hays & Owens
USA
Richard Heaney
Univ of Western Australia
AUSTRALIA
Gabrielle Horvath
USA
Yongfu Huang
UNU WIDER
FINLAND
Ronald Huisman
Erasmus School of Economics
NETHERLANDS
Nasser Humaid
Saudi Aramco
SAUDI ARABIA

New Members continued

Jason Hummel
Advanced Resources International
USA

Abdul Jalil Ibrahim
CEPMLP
UNITED KINGDOM

David Idem
Univ of Lagos
LAGOS

Babatunde Idrisu
Pennsylvania State University
USA

Lawrence Igah
CEPMLP University of Dundee
UNITED KINGDOM

Benita Ijeh
Redeemers University
LAGOS

Ulasi Joshua Ikechukwu
University of Nigeria Nsukka
NIGERIA

Omobolanle Ikuomola
Redeemers University
NIGERIA

Oana Ionescu Riffaud
Universite de Nancy
FRANCE

Asmau Isa Sadiq
PPPRA
NIGERIA

Saiful Islam
Inst Tech Brunei University
BRUNEI

Tsai I-Tsung
Masdar Inst of Science and Tech
UNITED ARAB EMIRATES

Parameswaran Iyer
INDIA

Juliet Izedonmwen
Kakawa Discount House
NIGERIA

Matthias Janssen
Frontier Economics
GERMANY

Tanguy Janssen
Supelec
FRANCE

Jana Jauffret
University of Geneva
SWITZERLAND

Alan Jenn
Carnegie-Mellon University
USA

Uduojie John
Univ of Lagos
LAGOS

Olabisi Johnson
Redeemers University
LAGOS

Andrew Joiner
USA

Darko Jus
GERMANY

Abdulkarim Kabir
Energy Comm of Nigeria
NIGERIA

Thierry Kalfon
GRT Gaz
FRANCE

Abubakar Kawu
NNPC NAPIMS
LAGOS

Walter Kemmsies
Moffatt & Nichol
USA

Ufuk Keser
Ires Energy
TURKEY

Claudia Kettner
Austrian Inst of Econ Rsch WIFO
AUSTRIA

Jeff Kijanka
Tavormina and Assoc Inc
USA

Jinmi Kim
University of Delaware
USA

Yasir Kirmani
Baker Hughes
USA

Paul Kishimoto
Massachusetts Inst of Tech
USA

Nikolai Kislenko
Nilgasekonomiki
RUSSIA

Lena Kitzing
DENMARK

William Knowles
Saudi Aramco
SAUDI ARABIA

Philipp Koenig
University of Cambridge
UNITED KINGDOM

Robert Kolb
Loyola University Chicago
USA

Alexandra Kondratyeva
Sakhalin Energy
RUSSIA

Manfredi La Barbera
ITALY

Imisiola Ladele
Redeemers University
NIGERIA

Laure Lampin
FRANCE

Thomas Lamy
FRANCE

Dafne Laurelli
Univ Luiss Guido Carli Rome
ITALY

Rodolphe Le Ruyet
Paris Dauphine
FRANCE

Lisa Lee
United Nations University
JAPAN

Yong Gil Lee
Inha University
SOUTH KOREA

Louis Lienard
FRANCE

Henrik Lindemann
University of Hannover
GERMANY

Matthew Lockwood
Inst of Development Studies
UNITED KINGDOM

Natalia Logunova
NRISTU
RUSSIA

Juan Carlos Lopez
Stanford University
USA

Liwei Lu
USA

Philipp Luckgen
USA

Melissa Lynes
USA

Chunbo Ma
Univ of Western Australia
AUSTRALIA

Batsirai Mabvakure Chinhoyi
Univ of Technology
ZIMBABWE

Donald MacKenzie
MIT
USA

Cosimo Magazzino
Roma Tre University
ITALY

Georgia Makridou
Technical Univ of Crete
ESCP
UNITED KINGDOM

Monti Manuele
GDF Suez Energia Italia SpA
ITALY

Osmel Manzano
Inter American Development Bank
USA

Timothy Martins
Redeemers University
NIGERIA

Kenichi Matsumoto
Univ of Shiga Prefecture
JAPAN

Sofya Matteotti
University of Bern World Trade Inst
SWITZERLAND

Bracke Maximilian
GERMANY

Kreg McCollum
Navigant
USA

Shahryar Mohammadrezaie Omran
Imperial College London
UNITED KINGDOM

Bruce Mountain
Carbon Market Economics
AUSTRALIA

Daniel Munoz
Cornell University
USA

Kashem Muttaqi
University of Wollongong
AUSTRALIA

Anar Najafzade
Qatargas Operating Company
QATAR

Lavinia Nattrass
Water Corporation
AUSTRALIA

Linh Nguyen
Energy Studies Insitute
SINGAPORE

Sinead Ni
Mhuircheartaigh
Accenture
UNITED KINGDOM

Nkechiyere Nnamani
Univ of Lagos
LAGOS

Okezie Nwanchukwu
Univ of Lagos
LAGOS

Amber Nyquist
EES Consulting
USA

Chikwerem Obi
NERC
NIGERIA

Elizabeth O'Connor
Capital Strategy Research
USA

Claudia Octaviano
MIT
USA

Tobi Oduntan
Redeemers University
NIGERIA

Josephine Oduro-Asare
Energy Commission Ghana
NIGERIA

C Ofunyelu
University of Ibadan
NIGERIA

Uche Akubuiro Ogechi
Conoco Philips
NIGERIA

Atle Oglend
University of Stavanger
NORWAY

Samuel Ogundare
Redeemers University
NIGERIA

Simisola Ogunlana
Redeemers University
LAGOS

Modupeola Ogunlolu
Redeemers University
NIGERIA

Fidelis Ogwumike
University of Ibadan
NIGERIA

Ndidiamaka Ohia
Univ of Lagos
LAGOS

Folashade Oje
Fed Ministry of Power
NIGERIA

Olugbenga Ojedapo
Univ of Lagos
LAGOS

NNA M Okechukwu
Univ of Lagos
LAGOS

Emanuel Okpachu
Ctr for Management Development
NIGERIA

Oluwatoyin Olajumoke
University of Ibadan
LAGOS

Olaitan Olaleye
Univ of Mass, Amherst
USA

Emilola Olanrewaju
Watershed Academy Ltd
LAGOS

Bamidele Olatuji
Univ of Lagos
LAGOS

Jones Oleita
Inst for Renewable Energy Dev
NIGERIA

Lawrence Olofinluwa
Univ of Lagos
LAGOS

Oluwatosin Oloruntoba
Redeemers University
LAGOS

Tolulope Olowookere
Redeemers University
NIGERIA

Temitope Olukunle
University of Ibadan
LAGOS

Nathaniel Oluremi
Energy Comm of Nigeria
NIGERIA

Chinedu Samuel Omenka
University of Ibadan
NIGERIA

Adenike Oresegun
Redeemers University
LAGOS

Tolulope Orimogunje
Univ of Lagos
LAGOS

Regina Oroyo
Redeemers University
NIGERIA

Musiliu Oseni
Judge Business School
UNITED KINGDOM

Femi Oshagbami
Univ of Lagos
LAGOS

Helen Osiolo
KENYA

Robin Osmont
CGEMP
FRANCE

Michael Oyebamiji
Redeemers University
NIGERIA

Oyetunde Oyedepo
Redeemers University
NIGERIA
Ebenezer Oyeleye
NNPC
NIGERIA
Tade Oyewunmi
Kola Awodein & Co.
LAGOS
Serhad Ozturk
Anadolu Endustri Holding AS
TURKEY
Uchechukwu Ozughalu
University of Nigerian Nsukka
NIGERIA
Silvia Palma Rojas
BRAZIL
Michael Panfilov
CEMI RAS
RUSSIA
John Parker
CANADA
Thiago Periard do Amaral
Petrobras
BRAZIL
Oyinloye Phillips
University of Lagos
LAGOS
Darla Pindell
USA
Michael Yaw Poku-Marboah
FINLAND
Andrey Postukhov
OIVT RAS
RUSSIA
Marty Provin
Jordan Lawrence
USA
Jessica Raasch
Duisburg Essen University
GERMANY
Mashudu Ramano
Terracotta Resources Pty Ltd
SOUTH AFRICA
Jeff Rambharack
Simon Fraser University
CANADA
Narasimha Rao
Intl Inst for Applied Systems Analy
AUSTRIA
Eran Raviv
Erasmus University
NETHERLANDS
Florian Revellat
Poyry
FRANCE
Joern Constantin Richstein
Delft Univ of Tech TBM EI
NETHERLANDS
Mark Riseley
Project Resources Law Pty Ltd
AUSTRALIA

Amber Rivera
Castalia
USA
Scout Robinson
USA
Francisco Rodriguez Lopez
E-on Spain
SPAIN
Nikolai Rogalev
MRU MPEI
RUSSIA
Wilko Rohlfs
RWTH Aachen University
GERMANY
Alberto Romano
Univ LUISS Guido Carli
ITALY
Zahra Rouhani Neghab
IRAN
Stephane Rouhier
AREVA
FRANCE
Thomas Rouyre
AREVA
FRANCE
Suriya Ruangpattana
SPRU Sussex Energy Group
UNITED KINGDOM
Andreas Rudinger
IDDRI
FRANCE
Jan Rudowski
FRANCE
Larry Ruff
USA
Guy Rul
BULL Computing Solutions
FRANCE
Daniel Rymarz
Mazowian Gaz Distribution Company
POLAND
Tahsin Saadi Sedik
International Monetary Fund
USA
Jose Saavedra
Curtin University
AUSTRALIA
Roxana Sacaplan Pop
EDF
FRANCE
Motolani Sanni
Redeemers University
NIGERIA
Jeremiah Boachie
Sarpong
GHANA
Radhakrishna Sattuluri
OIlmax Energy Pvt Ltd
INDIA
Yayan Satyakti
Institute Tropics and Subtropics
INDONESIA

Vincenzo Savoca
Univ Bocconi Milan
ITALY
Annie Beatrice
Schlumberger
FRANCE
Martin Schwarzbichler
OMV Ag
AUSTRIA
Ian Scott
Energy Exemplar
UNITED KINGDOM
Siddhartha Sen
INDIA
Michail Shalagin
MF OAO
RUSSIA
Basil Sharp
Uiversity of Auckland
NEW ZEALAND
Anastasia Shcherbakova
Penn State University
USA
David Sherburne
Savannah River Remediation Ltd
USA
Xunpeng Shi
Economic Research Inst for ASEAN
INDONESIA
Ibrahim Shittu
Abubakar Tafawa Balewa Univ
NIGERIA
Vlad Shkolyar
Independent
CANADA
Jide Shokunbi
Univ of Lagos
LAGOS
Ahmad Shukr
SHUKR Capital Ltd
UNITED KINGDOM
Andrzej Sikora
Energy Studies Institute Ltd.
POLAND
Adrian Sikorski
AUSTRALIA
Christian Skar
Norwegian Univ of Sci and Tech
NORWAY
Aleksey Skovoronskyi
NRU SPbSPU
RUSSIA
Brian Smith
Baker Hughes
USA
Minyoung Sohn
Arrowpoint Partners
USA
Michael Soni
USA
Sergey Sorokin
ERIRAS
RUSSIA

Viraf Soroushian
Johns Hopkins SAIS
USA
Iain Staffell
Imperial College London
UNITED KINGDOM
Roger Stern
The University of Tulsa
USA
Thiagarajah Subramaniam
University of Arizona
USA
Asha Sundaram
Univ of Cape Town
SOUTH AFRICA
Nicolas Swetchine
AREVA
FRANCE
Thomas Swift
American Chemistry Council
USA
Simon Sylvester-Chaudhuri
NYU
USA
Mojtaba Taali Pasand
GERMANY
Fumiko Takeda
University of Tokyo
JAPAN
Zayeed Hasan Talukdar
University of Dhaka
BANGLADESH
Simon Taylor
Univ of Cambridge
UNITED KINGDOM
Frederic Thebault
EDF
FRANCE
Paul Thorsnes
University of Otago
NEW ZEALAND
Anastasia Timoshenko
Sakhalin Energy Investment Co Ltd
RUSSIA
Alfredo Tolon-Becerra
University of Almería
SPAIN
Shigeki Toriumi
Chuo University
JAPAN
Obasi Torti
Univ of Lagos
LAGOS
Andrea Trianni
Politecnico di Milano
ITALY
Aliya Tskhay
KAZAKHSTAN
Veysel Turkel
IGDAS
TURKEY
Akiner Tuzuner
Kemerburgaz University
TURKEY

Paul Twomey
Univ of New South Wales
AUSTRALIA
Eke Uchechukwu
Petroleum Training Inst
NIGERIA
Helen Ugwu
Univ of Lagos
LAGOS
Cladius Ukutegbe
Univ of Lagos
LAGOS
Uche Ulasi
Univ of Lagos
LAGOS
Abdullahi Isyaku Umar
NNPC NAPIMS
LAGOS
Onyeka Ifeoma Uzowulu
Univ of Lagos
LAGOS
Wim van der Veen
NETHERLANDS
Nicholas Vasilakos
University of East Anglia
UNITED KINGDOM
Frank Venmans
UMons
BELGIUM
Raquel Wayand Soares
Brazilian Oil Nat Gas and Biofuels
BRAZIL
Manfred Weissenbacher
MALTA
Julie Weisz
USA
Muhammad Ery
Wijaya Kyoto University
JAPAN
Simon Chike Wori
University of Dundee
UNITED KINGDOM
Jiang Yang
CNPC
CHINA
Jun Yang
Chongqing University
CHINA
Ying Yang
JAPAN
Thomas Yeung
Saudi Aramco
SAUDI ARABIA
Ka Ho Yu
Global Studies Institute
HONG KONG
Emre Yucel
University of Texas at Austin
USA
Eduardo Zana
Brazilian Oil Nat Gas and Biofules
BRAZIL
Abdel Zellou
Colorado School of Mines
USA

Scenes from the 35th IAEE International Conference (June 24 - 27, 2012)

IAEE/USAEE CONFERENCE PROCEEDINGS - ORDER FORM

Institutions, Efficiency and Evolving Energy Technologies

Proceedings of the 34th IAEE International Conference, Stockholm, Sweden, June 19 to 23, 2011
Single Volume $130 - members; $180 - non-members.

This CD-ROM includes articles on the following topics

- Markets vs. regulation in the implementation of new energy technologies
- The future of world oil markets
- The economics of smart grids
- Command and control policies vs. economic incentives in demand management
- R&D and innovation
- Energy storage
- Biofuels policy and land-usage
- The effect of political institutions on natural resource management
- Rebound effects of energy efficiency subsidies
- Economic growth
- Electrification of developing countries

Redefining the Energy Economy: Changing Roles of Industry, Government and Research

Proceedings of the 30th USAEE/IAEE North American Conference, Washington, DC, October 9-12, 2011
Single Volume $130 - members; $180 - non-members.

This CD-ROM includes articles on the following topics:

- OPEC & Crude Oil Market Issues
- Smart Grid Technology & Economics
- Alternative Energy Investment and Evaluation
- World Natural Gas Market: Issues & Trends
- Comparative Electricity Market Analysis
- Renewable Energy Policy Evaluation
- Environmental Policies and Impacts
- Macroeconomic Impact of Energy & Oil Prices
- Energy Security Risk Assessment
- Renewable Portfolio Standards & Programs
- Public & Legal Concerns on Carbon Capture and Sequestration
- Modeling the Impact of Energy Options on the Economy
- Regional Environmental Impact Assessment
- Economics of Nuclear and Unconventional Energy Resources
- Economics of Wind Energy & Power Production
- Upstream E&P Industry Performance Analysis
- Energy Modeling for Policy Analysis
- Carbon Emissions: Cap & Trade System Review
- Emerging Technologies in the Electricity Market
- Reducing U.S. Greenhouse Emissions in a N-C-T World
- Gas and Oil Futures Market Analysis
- Environmental Policy Impact on Green Technologies
- Fuel-Market Modeling Issues

Energy Economy, Policies and Supply Security: Surviving the Global Economic Crisis

Proceedings of the 11th IAEE European Conference, Vilnius, Lithuania, August 25 to 28, 2010
Single Volume $130 - members; $180 - non-members

This CD-ROM includes articles on the following topics:

- Energy Supply Security (political, economical and technical)
- Sustainability of Energy systems, Mitigation of Global Warming
- Role of Renewable Energy Sources and Biofules
- Energy Demand Forecasting
- Energy Sector Analysis and Modeling
- Energy Policy
- Geopolitics of Energy Supply (gas, oil, nuclear and etc.)
- Price of Security
- Road Map for Energy Efficiency
- Market Integration and Liberalization
- Energy Sector Risk Analysis
- Specific Energy Sector Problems of CEE Countries
- Nuclear Energy: Hopes and Realities
- Environment

****

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 ______________

_____ "Institutions, Efficiency and Evolving Energy Technologies" - $130.00 members - $180.00 non-members
_____ "Redefining the Energy Economy: Changing Roles of Industry, Government and Research" - $130.00 members - $180.00 non-members
_____ "Energy Economy, Policies and Supply Security: Surviving the Global Economic Crisis" - $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

Publications

Annual Oil Market Forecast and Review 2012. Julian Lee (2012). Price: £650. Contact: Marketing Department, Centre for Global Energy Studies, 17 Knightsbridge, London, SW1X 7LY, United Kingdom. Phone: 44-020-7309-3610. Fax: 44-020-7235-4338. Email: marketing@cges.co.uk URL: www.cges.co.uk

Calendar

4-5 September 2012, Hydropower Africa 2012 at Cape Town, South Africa. Contact: Nicolaas Loretz, Programme Information, CTICC. Phone: 27-21-700-3500 Email: nicolaas.loretz@spintelligent.com URL: http://www.hydropowerafrica.com/en/index.php

9-12 September 2012, 12th IAEE European Conference at Venice, Italy. Contact: Edgardo Curcio, AIEE, Italy Email: e.curcio@aiee.it

9-12 September 2012, Transmission Pipeline Projects Summit 2012 at Beach Rotana Hotel. Contact: Negin Bagherian, Marketing, International Quality and Productivity Center (IQPC), Abu Dhabi, United Arab Emirates. Phone: 0097143642975. Fax: 0097143631938 Email: Negin.Bagherian@iqpc.com URL: http://www.transmissionpipelinesprojects.com/Event.aspx?id=7369

10-12 September 2012, ICCE 2012: International Conference on Clean Energy at Quebec city, Canada. Contact: ICCE2012@iaemm.com, Quebec, Quebec, Canada URL: http://iaemm.com/ICCE_Home

16-19 September 2012, Cyber Security for Energy & Utilites Qatar 2012 at Renaissance Doha, Qatar. Contact: Negin Bagherian, Marketing, International Quality and Productivity Center (IQPC), Dubai, United Arab Emirates. Phone: 0097143642975. Fax: 0097143631938 Email: Negin.Bagherian@iqpc.com URL: http://www.cybersecurityforenergyandutilitiesqatar.com/

19-20 September 2012, BIEE 9th Academic Conference at St Johns College , Oxford, UK. Contact: Debbie Heywood, BIEE, United Kingdom. Phone: +44 (0)1296 747916 Email: admin@biee.org URL: www.biee.org

26-27 September 2012, Heavy Oil and Oil Sands Summit 2012 at Manama, Bahrain. Contact: +97146091570 Email: ajay.nimbalkar@fleminggulf.com URL: http://www.fleminggulf.com/conferenceview/Heavy-Oil-And-Oil-Sands-Summit/190

4-5 October 2012, Water & Energy: Upstream Supply & Demand Strategies at Houstonian Hotel, Houston, TX. Contact: Monique Hardy, Event Coordinator, WestWater Research LLC, 805 W. Idaho Street, #310, Boise, ID, 83702, USA. Phone: 208-433-0255. Fax: 208-433-5596 Email: hardy@waterexchange.com URL: www.waterenergystrategy.com

9-11 October 2012, 2nd Annual Plant Shutdown & Turnaround Management at Doha, Qatar. Contact: Ajay Nimbalkar, Mr., Fleming Gulf, Doha, Qatar, Qatar. Phone: +97146091570 Email: ajay.nimbalkar@fleminggulf.com URL: http://www.fleminggulf.com/conferenceview/2nd-Annual-Plant-Shutdown-and-Turnaround-Management/229/Programme/435

11-11 October 2012, The Solar Future: Italy at Milan. Contact: Paul van der Linden, Marketing Manager, Solarplaza, PO Box 2299, Rotterdam, 3000CG, Netherlands. Phone: +31102809198 Email: p.vanderlinden@solarplaza.com URL: www.thesolarfuture.it

15-18 October 2012, International Pittsburgh Coal Conference (IPCC) at Pittsburgh, PA. Contact: Heidi M. Aufdenkamp, Conference Coordinator, Pittsburgh Coal Conference, University of Pittsburgh, Swanson School of Engineering, 1249 Benedum Hall, Pittsburgh, PA, 15261, United States. Phone: 412-624-7440. Fax: 412-624-1480 Email: ippc@pitt.edu URL: http://www.engineering.pitt.edu/pcc

15-16 October 2012, Master Class Gas Pricing Strategies at Düsseldorf, Germany. Contact: Thiska Portena, Energy Delta Institute, Netherlands. Phone: +31 (0) 50 524 8317. Fax: +31 (0) 50 524 8301 Email: portena@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/specific-programmes/master-class-gas-pricing-strategies

17-18 October 2012, Global Smartfields Summit 2012 at Abu Dhabi. Contact: Ajay Nimbalkar, Mr., Fleming Gulf Conferences, United Arab Emirates. Phone: +97146091570 Email: ajay.nimbalkar@fleminggulf.com URL: http://www.fleminggulf.com/conferenceview/Global-Smartfields-Summit/29

18-18 October 2012, Conferencia de la Industria Solar - España 2012 at Madrid, Spain. Contact: Amelie Wachner, Solarpraxis AG (Berlin, Germany), Melia Barajas, Avda. de Logroño 305, Madrid, 28042, Spain. Phone: +49 (0)30/72 62 96-405 Email: amelie.wachner@solarpraxis.de URL: http://www.solarpraxis.de/en/conferences/conferencia-de-la-industria-solar-espana-2012/general-information/

22-25 October 2012, Master Class LNG Chain at The Netherlands. Contact: Thiska Portena, Energy Delta Institute, Netherlands. Phone: +31 (0) 50 524 8317. Fax: +31 (0) 50 524 8301 Email: portena@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/specific-programmes/master-class-lng-chain-lng-training-course

22-23 October 2012, Solar meets Glass at Dusseldorf, Germany. Contact: Miriam Hegner, Solarpraxis AG (Berlin, Germany), CCD Ost, Messe Düsseldorf, Stockumer Kirchstr. 61, Düsseldorf, 40474, Germany. Phone: +49 (0)30/72 62 96-304 Email: miriam.hegner@solarpraxis.de URL: http://www.solarpraxis.de/en/conferences/solar-meets-glass/general-information/

October 29, 2012 - November 2, 2012, International Gas Value Chain Course at Amsterdam, The Netherlands. Contact: Joel Darius, Course Manager, Energy Delta Institute, Netherlands. Phone: +31 (0) 50 524 8316. Fax: +31 (0) 50 524 8301 Email: darius@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/introduction-programmes/international-gas-value-chain

30-31 October 2012, PV Module and PV Power Plant Workshop - China 2012 at Shanghai, China. Contact: David Gaden, Solarpraxis AG, China. Phone: +49 (0)30/72 62 96-373 Email: david.gaden@solarpraxis.de URL: http://www.solarpraxis.de/en/conferences/pv-module-and-pv-power-plant-workshop-china-2012/general-information/

4-7 November 2012, 31st USAEE/IAEE North American Conference - "Transition to a Sustainable Energy Era: Opportunities and Challenges" at Austin, Texas. Contact: David Williams, Executive Director, USAEE, 28790 Chagrin Blvd., Suite 350, Cleveland, Ohio, 44122, USA. Phone: 216-464-2785. Fax: 216-464-2768 Email: usaee@usaee.org URL: www.usaee.org

12-16 November 2012, Underground Gas Storage Course at The Netherlands. Contact: Thiska Portena, Energy Delta Institute, Netherlands. Phone: +31 (0) 50 524 8317. Fax: +31 (0) 50 524 8301 Email: portena@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/specific-programmes/underground-gas-storage-course

12-14 November 2012, 7th International Renewable Energy Storage Conference and Exhibition (IRES 2012) at Berlin. Contact: Valentin Hollain, Scientific Director, EUROSOLAR e. V., Kaiser-Friedrich-Str. 11, Bonn, North Rhine-Westphalia, 53113, Germany. Phone: 0049-(0)228-2891446. Fax: 0049-(0)228-361279 Email: IRES@eurosolar.de URL: http://www.eurosolar.de/en/index.php?option=com_content&task=view&id=520&Itemid=143

22-23 November 2012, 13th Forum Solarpraxis at Berlin, Germany. Contact: Anja Kleppek, Solarpraxis AG (Berlin, Germany), MARITIM pro Arte Hotel Berlin, Friedrichstraße 151,, Berlin, 10117, Germany. Phone: +49 (0)30/72 62 96-305 Email: anja.kleppek@solarpraxis.de URL: http://www.solarpraxis.de/en/conferences/13th-forum-solarpraxis/general-information/

26-27 November 2012, Gas Transport and Shipping Course at The Netherlands. Contact: Thiska Portena, Energy Delta Institute, Netherlands. Phone: +31 (0) 50 524 8317. Fax: +31 (0) 50 524 8301 Email: portena@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/specific-programmes/gas-transport-shipping-course

27-28 November 2012, LatAm Plant Shutdown & Turnaround Summit at Rio de Janeiro, Brazil. Contact: Ajay Nimbalkar, Mr., Rio de Janeiro, Brazil. Phone: +97146091570 Email: ajay.nimbalkar@fleminggulf.com URL: http://www.fleminggulf.com/conferenceview/LatAm-Plant-Shutdown---Turnaround-Summit/304

IAEE INTERNATIONAL ASSOCIATION *for* ENERGY ECONOMICS

WWW.IAEE.ORG

IAEE ENERGY FORUM

Volume 21, Third Quarter, 2012

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

Advertisements: The *IAEE Energy Forum*, which is received quarterly by over 3800 energy practitioners, accepts advertisements. For information regarding rates, design and deadlines, contact the IAEE Headquarters at the address below.

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

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

PRSRT STD
U.S. POSTAGE
PAID
Hanover, PA
Permit No. 4