Second Quarter 2019

Issn 1944-3188

IAEE ENERGY FORUM

CONTENTS

Editor: David L. Williams

Published By:

IAEE
WWW.IAEE.ORG
International Association *for* Energy Economics

PRESIDENT'S MESSAGE

Our diversity is our strength.

The 7th IAEE Latin American Conference has just ended. It brought together more than 200 participants in Buenos Aires under the theme "Decarbonization, Efficiency and Affordability: New Energy Markets in Latin America". It showed that Latin American countries have major energy policy challenges to solve. The debates will soon be available on the IAEE website and in the next Energy Forum.

These challenges are not specific to Latin America. Several countries are seeking to decarbonize their economies, make energy use more efficient and provide affordable energy for all. However, the diversity of starting situations must be taken into account.

Yes, the world is changing. Argentina, Latin America, the American continent, Europe, China, India, Africa, at all scales, in all geographies, in all directions, the world of energy is changing. IAEE, which is present in more than 100 countries, is observing this movement. Albert Einstein said, "Life is like riding a bicycle. To keep your balance, you must keep moving." Transformations in the energy sector are necessary.

The diversity of views of IAEE members is our strength. In all these countries where IAEE is present, we observe that energy is always a source of well-being, comfort and development. However it can be abundant or rare for residential or industrial consumers. This availability is due to natural resources but also to historical conditions and sometimes to the economic situation of both. For instance, Norway and the Gulf countries contain considerable hydraulic or fossil resources on their territories that are far greater than the needs of their populations. On the opposite, many EU Member States are forced to import massive amounts of energy, which distorts their trade balance. Alongside these natural resources, Man has also taken two ways: "manufacturing" his own energy by trapping diffuse and poorly concentrated natural resources, such as wind, through his engineering talent, or "enhancing" primary sources through technology, such as nuclear power. Finally, in some other cases, opportunities have mixed both paths by opportunely combining technology and a state of nature: haven't jet turbines offered high-efficiency turbines to gas-fired power generation. Similarly, the decrease in the cost of horizontal drilling has made it possible to develop competitive shale gas in the USA.

We can see that the different countries have to respond to very different situations in order to define their own energy policy. Whatever these configurations, governments have a common objective: to ensure the economic development of their countries by making energy accessible. The effort and methods are different in each case. However,

continued on page 2

President's message (continued)

there are some successful experiences and others less so. IAEE's role is precisely to share good practices through our conferences and publications. A new challenge is emerging under the term "energy transition". These words have different meanings in different governments precisely because of different starting situations and objectives. These disparities reinforce the cross-fertilization mission that I wish to strengthen within IAEE.

These contrasting situations and specific ambitions nevertheless make it possible to identify similarities between countries: market opening, intended or imposed depending on the country, does not resolve competitiveness issues. The market is not enough to create the utilities of the future. The market often creates innovations by opportunism: short-term technologies appear, market mechanisms favouring few stakeholders are in the spotlight. States, but also metropoles and some major visionary industries are becoming aware of the role of regulation and long-term planning in sending the economic signal to guarantee competitive access to energy in a context of sustainable development, respecting equity, solidarity and the environment. Utilities of the future must act with the real needs of the consumer in mind in the long term. Economic growth no longer requires an increase in consumption. Utilities that think so will not survive.

And because we are different, it is up to IAEE to identify trends and seek long-term solutions adapted to each context. The business model of the utilities of the future will be diversified and will not be created without cross-fertilization and public interventions: let's think about it together!

Several opportunities will allow us in the coming weeks to continue discussions on the transformations of the energy sector, and in particular:

- Montreal, Canada,
- Ljubljana, Slovenia,
- Astana, Kazakhstan,
- Dhaka, Bangladesh,
- Riyadh, Saudi Arabia,

as well as several symposiums: Athens, Monaco, Bucharest or Abu Dhabi. See you soon at these events or in our publications.

Christophe Bonnery

IAEE Council Approves Membership Dues Increase

In December 2019 IAEE Council approved an increase of $20 in member dues. The last increase in dues occurred seven years ago in 2012.

Regular, direct member dues were increased from $100 to $120 a year effective immediately. Affiliate member dues will increase from $90 to $110 on January 1, 2020. Student dues were increased $10 to $60. Institutional Member dues were raised from $2500 to $3000 a year.

In commenting on the increase, IAEE Executive Director David Williams noted that it is extremely unusual for an association to be able to go seven years without a raise in dues; eventually operational costs overtake income and a change has to be made.

IAEE President Christophe Bonnery notes that the Council as a whole embraces the concept that the cost of membership is to be kept as low as possible while providing the greatest value to members through the excellent quality of IAEE publications, events and services.

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 have a potpourri of energy related articles in this issue. Geographically we move from Australia to the U.S., to China, to Nigeria. We look at peak oil, at the possibility of zero marginal cost electricity and what its impact might be. We hear an argument for considering corporate social responsibility in future governance of energy systems and how that same CSR is having a most unwelcome impact on the health of some of our fellow humans. We see how the U.S. energy doctrine has changed over the post world war II period and what the future impact may be. All in all a quite varied issue. We hope you'll enjoy reading it is as much as we did editing it.

Douglas Reynolds gives a peak-oil analysis for China and the U.S. in "A Tale of Two Peaks," where he separates unconventional oil from conventional oil in order to better understand the overall trend for each type of oil. He suggests the XL pipeline may soon be exceedingly advantageous

Dong Wang illustrates his findings on the relationship between energy transition and capital deepening in China. Energy transition policy design would take the capital intensity increase into account. He argues that greening capital while greening energy would be a feasible option for many developing countries.

Adewale Mould notes that electricity and tele-communications in Nigeria started within ten years of each other. Both have had extensive reforms in recent times. However, reforms in telecoms have been more visible. Using a discourse approach, he makes an examination of relevant lessons from the telecom success story applicable to the electricity sector.

Amro Zakaria traces the U.S. role in world energy from the era of whale oil to the modern day. He notes that the post-World War II doctrine of the U.S. was focused on Energy Independence and Security. The new doctrine of Energy Dominance, begun during the Obama Administration and fueled by development of the shale oil industry, has been fully embraced by the Trump Administration. Zakaria looks at some of the implications of what this new dominance may mean.

Tilak Doshi asks what Adam Smith would say about the rush by banks to stop funding coal power plants. The rush to "save the climate" at the expense of the millions of vulnerable human beings in Southeast Asia and elsewhere in the developing world who depend on these coal power plants is having an appalling impact on human health. The time-honored path followed by all developed countries to raise standards of living and achieve rapid growth has now been blocked to the developing countries by these developed countries. What would Adam Smith say about the "haves" blocking the "have-nots"?

Werner Hediger writes that corporate social responsibility is key in designing future governance of energy systems. It calls for an assessment of investments in energy systems and corporate contributions from a sustainable development perspective, and involves further issues related to market structure, property rights and the distribution of resource rents.

Tom Walker, Suzanne Falvi and **Tim Nelson** explore a possible option to improve the efficiency by which supply and demand are matched in the Australian National Energy Market (NEM): a mechanism by which consumers are compensated by their retailers if they are load shed as a result of insufficient supply of electricity to meet demand.

Phil Thompson notes that a combination of batteries and intermittent renewables may become the dominant source of electricity generation in the future. Zero marginal cost electrical energy would have important implications for current regulatory approaches. Three important policy areas will be pricing and rate design, wholesale market design, and the evaluation of energy efficiency.

DLW

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

A Tale of Two Peaks

BY DOUGLAS REYNOLDS

"It was the best of times; it was the worst of times," wrote Charles Dickens. And that may be true of the oil dependent world economy and oil market where the price of oil was down, then up, then down again, but could go up again soon since we may have already surpassed peak oil depending on how the term "oil" is defined and on the trends in its production. Although, a close scrutiny of the world's oil production may reveal some discrepancies in the statistics, requiring a tale of individual producer characteristics in order to understand where the peak has or will occur.

As the late, well esteemed Maugeri (2007) wrote, "all current evaluations of the world's oil resources … do not take into account the so-called unconventional oils." However, even coal could be construed as a hydrocarbon and an "unconventional oil" reserve if coal-to-liquids are included. Plus Maugeri' predicted 2 million barrels a day (mbd) of $25 per barrel tars-sands, which didn't expand appreciably at a price of $100. So, to decrease confusion about potential energy liquids production, it may be appropriate to use an old Italian saying and "divide and conquer" the definitions of oil in order to understand the energy markets better. Accordingly, the question is: is shale-oil or tar-sands conventional oil? They are not because they are within completely different geological time scale structures, rather like the difference between whale-oil and crude-oil, and where understanding their differences can help our understanding of the cost trends in the over-all liquids market. For example, a large increase in shale-oil production outside of the U.S. may require a correspondingly large increase in oil prices due to the lack of a dynamic, U.S.-style, integrated shale-oil and shale-gas market structure over most of the world.

Thus, if we narrow the definition of oil to conventional oil, then the term "peak-oil" is contingent on conventional oil production reaching the height of its potential, whereupon expensive alternatives, including non-U.S. shale-oil, can still adversely affect the world's economy. Looking only at conventional oil in Figure 1, based on BP's statistical data, but where tar-sands and shale-oil are removed from the statistics as thoroughly as possible, we notice that during the ten years before 2005, world conventional oil was increasing at close to 2% per year whereas during the ten years after 2005, it was almost on a plateau. And that was when post-2005 real oil prices were averaging over three times what they were in the pre-2005 time frame. This is typical of the extractive industries, as explained in Reynolds (2016a), where the *information effect* (of aggregating clues as to where the underground resources reside) is so dominant early on that even low oil prices do not hinder oil production increases, whereas once peak oil occurs, the (underground) *depletion effect* (of declining remaining reserves available to find) is so dominant that no matter how high oil prices are, production still plateaus and declines. It is not only about technology, but the resource base available.

Douglas Reynolds is Professor of Petroleum and Energy Economics, Department of Economics, University of Alaska Fairbanks. He may be reached at dbreynolds@alaska.edu

Based on every conceivable Hubbert lambda trend from Reynolds (2009), as opposed to Hubbert's (1962), Campbell's (1997) or the recently departed Deffeyes' (2001) traditional mid-point trend, the world's conventional oil production looks to have ultimately recoverable reserves of about 3 trillion barrels of oil. Otherwise, we would not have seen the relative plateau of conventional oil production, starting at the 1 trillion barrel cumulative production mark in 2005 that was ostensibly forecast in Reynolds (1999).

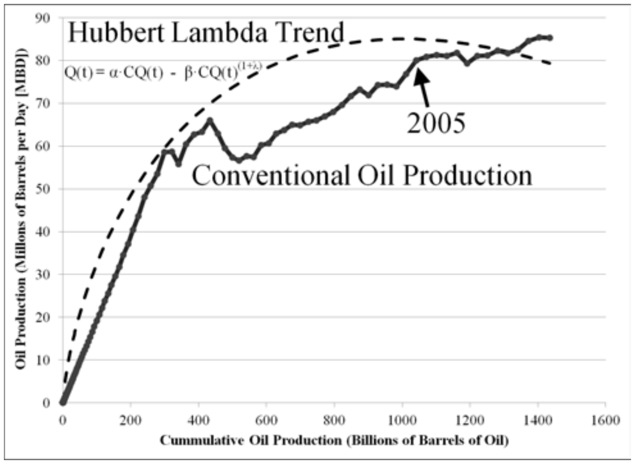

FIGURE 1. Trend and Production of Oil (MBD) versus Cumulative Production (BB)
Source: Data from BP Statistical Review, U.S. Energy Information Administration and the Canadian Energy Board

Nevertheless, upon close inspection of the trend, clearly the world's oil production goes above it, or any other potential Hubbert Lambda-type trend that can be devised and fitted into the data, after 2013, which could mean that the trend is meaningless or that some outlying increases in production must be more closely scrutinized. For example, since the rise in U.S. shale-oil production has helped to reduce prices over the last four years, along with demand side weakening, then the lack of oil revenue for OPEC members may have induced higher than normal production in order to cover budget short falls, which could mean Ezzati (1976), Cremer and Salehi -Isfahani (1991) and Teece's (1982) target revenue models are pertinent to the discussion.

However, normally, the trend should take into account changing producer institutions, just as Hubbert expected the trend would take into account all small incremental changes in technology, and therefore individual oil producer increases or decreases should all wash out. See for example Reynolds (2011), for more on institutions. If one producer increases production, others should decrease theirs, if the trend is to be believed. Indeed, the only time such a Hubbert trend has ever significantly changed was when there were either large changes in institutions or a revolutionary technology, such as Colonel Edwin Drake's oil wells. In this case, there would have to have been a worldwide change, along the lines of the changes in the former Soviet Union where both huge changes in technology available and huge changes in institutions occurred simultaneously (see Reynolds and Kolodziej 2009 and 2007). Such profound changes for conventional oil is not likely to have occurred all at one time for the entire world in 2013 and therefore, the Hubbert trend in Figure 1 should still hold true after 2013, but where the trend definitely looks to have been broken. Hence, the need for a tale.

There have been a lot of tales about various oil producers such as Russia (e.g., Gustafson 2012) and Saudi Arabia (e.g., Simmons 2005), although some of those may need revisiting. Still, new tales may be required to explain the glaring discrepancy. For instance, upon close inspection of the statistics of large producing countries, two peculiar countries jump out: China and the United States of America.

Interestingly, China's oil production increased by about 1.5 mbd from 2009 to 2017 according to BP statistics. The odd thing was that the production increased in 2015, just when according to Reynolds (2016b) China was probably in a recession and more importantly when world oil prices were falling, whereupon in 2016 China's production was curiously down to exactly 3.99 MBD. It could just be a fluke that the number is so precisely near an even number, but then there is another instance where from 2011 to 2012, again according to BP's worldwide oil statistics, China's oil production increased by 1.99%, which is almost exactly 2%. While it is possible to have two such fastidious numbers, it is unlikely, but what adds to the tale is that China has set up its own futures oil market, which suggests a need to purchase a lot of imported oil. Put together, China's oil production may be lower than the statistics suggest, and therefore one of the reasons for Chinas' new futures market, denominated in Yuan, is in order to prop up China's currency. The Chinese will undoubtedly need to buy increasing amounts of imported oil and not want to injure their foreign currency holdings. They would rather pay for that oil in Yuan than in dollars. That is, the new Chinese future's market is a currency enhancement mechanism rather than just a simple oil exchange.

However, China's peak oil situation is actually quite transparent compared to, of all countries, the United States of America. Reading "between the lines" so to speak is not just important for countries that are considered to be opaque, but it is even important for countries that seem transparent. Consider, then, both the U.S. conventional oil production and its tight sands (including shale) production, where one side of the U.S. story may be a part of the answer to the other side of the world story. Start with the U.S. shale-oil side of the story, which is important in its own right, but which will also lead to the conventional oil production side of the story.

Consider two contradictory headlines, "Permian Oil Production Requires Additional Pipeline Infrastructure," and "Permian, We Have a Gas Problem." The first headline suggests that the U.S. will have a lot more shale-oil available if only a pipeline were put in place, which is a curious concept in the history of the petroleum industry. Historically, there have been many instances of huge oil strikes in the U.S. where oil production was increasing quickly, even as fast as 10% per year, and with no pipeline access available, such as early Pennsylvania, Spindle Top, East Texas and even today's Bakken shale-oil. They all are instances where producers were able to increase their production quickly and without the need of pipelines, although certainly with a loss in value and safety. This is because oil's energy content is dense enough that trucks, trains or oil tankers can transport such a compact fuel easily and cost effectively enough that, even though there have been instances of a lack of pipelines, nevertheless, oil production was able to increase. So, the question is why the intense need for a pipeline to increase oil production in the Permian Basin, unless the oil we are talking about is not exactly a dense liquid? This brings us to the second headline which contrasts substantially with the first in explaining what may or may not be the problem with getting Permian oil to market: gas.

The whole issue with shale-oil is the question of what exactly the definition of a hydro-carbon is, where the American English term "oil" can mean a heavy liquid or solid of 55 carbon atoms (C55) or a light "liquid" with as few as two carbon atoms (C2), but where propanes, (C3) and butanes (C4) are very common light components. Then, there are natural gas liquids, those nebulous hydrocarbon components that intermingle with natural gas (methane C1) and that are just on the verge of being between oil and natural gas, but which technically belong in the oil family from about ethane (C2) to pentanes (C5). Well, the problem with natural gas liquids is that they are light enough to be a gas and transporting them is much easier within a pipeline. So, if you produce oil and natural gas, including natural gas liquids, and you only want to minimally process it at the wellhead, then a pipeline is needed to pressurize those NGLs with the heavier oil, and another pipeline for natural gas and some liquids, to cost effectively get all the products to market. Thus, the issue with getting oil out of the Permian is the issue of getting lighter oils and natural gas out of the Permian too, hence the absolute need for pipelines, although this could be a signal that U.S. mid-weight shale-oil is close to its peak.

Furthermore, upon close inspection of BP's oil statistics for the U.S. there is not just increases in shale-oil occurring within the numbers, but a substantial increase in natural gas plant liquids, which are light liquids separated out of wet natural gas. Some light liquids can be used to make gasoline, but most can be better used as a straight propane or butane fuel. So, a lot of the U.S. increase in the production of oil, according to the formulated BP statistics, is the increase in the production of light liquids that are coming, not from conventional oil and gas geological traps, but rather from shale-gas fields, and as such those natural gas plant liquids are not conventional oil at all but shale-oil. Therefore, another reason, besides the potentially high Chinese statistics, for the constructed conventional oil production breaking above the Hubbert tend in Figure 1 is that the statistics subtly include unconventional oil via the shale-gas information, which if subtracted from the overall oil production would put the conventional oil production down another one million barrels a day. Taken together, and possibly with meticulous tales of other countries and other unconventional oils, this suggests that the Hubbert trend may still be valid.

The other aspect of U.S. oil production is being able to predict the path and eventual peak of unconventional U.S. shale-oil production itself, which has been able to increase at the heady rate of 30% per year, not just for one year, but for 10 years, a phenomenal increase in the history of the petroleum industry and indeed in the history of human kind's extractive industries as a whole when considering how large of a regional area this involves. This suggests that an early and severe peak in shale-oil is in store for the U.S. However, the unstated secret to the phenomenal U.S. success is that the information effect for the shale-oil exploration process is being enhanced by the need for natural gas and the substantial natural gas pipeline system that already exists in the U.S., all of which is going to evolve quite differently for the rest of the world. So, the U.S. shale-oil/shale-gas interplay is creating a quickly rising Hubbert shale-oil production trend unmatched in history, and liable to include a much sharper decline than has happened in history, other than the incredible Soviet oil decline after 1989. Clearly, Russia and America have a lot in common. Although, I might give China the edge in infrastructure that can cushion any peak-oil effects.

Getting back to unconventional oil, the definition of oil as including natural gas plant liquids suggests that much of the shale-oil, or light oil produced with the shale-gas, is not particularly predisposed to be turned into gasoline and could more easily be sold as cheap propane or butane for automotive consumption. Although, by using propane or butane directly as an automotive fuel that will still incur transition costs to the world's economies even for the many countries that already use "auto-gas" (propane), and so as the U.S. moves ever closer to its own peak shale-oil maximum, the costs of getting and using liquid fuels will increase. In other words, there is a dichotomy between mid-grade and light-oil liquids production that requires its own tale, and which will affect the world's economy as conventional oil production continues its plateau and decline.

At any moment, then, we can expect an oil price shock and corresponding economic decline not unlike the 1970's stagflation. It might bring about a malaise like that of the Great Recession or Great Depression, but probably more on par with the Fall of the Soviet Union or Ancient Rome's Crisis of the Third Century, whereupon both Empires endured hyperinflation and economic decline simultaneously. Accordingly, to disapprove of the XL pipeline as not having followed the law reduces alternative liquids availability just on the verge of when substitutes for oil will be most required. However, at least tar-sands can more easily be transported by rail or truck, but at a correspondingly higher safety and environmental cost than if it were transported by pipeline and at a higher cost due to the need for liquid fuel to run the trucks and trains.

References:

BP Statistics: Statistical Review of World Energy, https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html, accessed September 2018.

Canada, National Energy Board statistics, accessed September 2018

Campbell, Colin J. (1997). *The Coming Oil Crisis*, Multi-Science Publishing Company and Petroconsultants S.A.

Cremer, Jaczue and Djavad Salehi-Isfahani (1991). *Models of The Oil Market*, Harwood Academic Publishers.

Deffeyes, Kenneth S., (2001). *Hubbert's Peak : The Impending World Oil Shortage*, Princeton University Press.

Ezzati, Ali (1976). "Future OPEC Price and Production Strategies as affected by its capacity to absorb oil revenue," *European Economic Review*, August, 8, pp. 107 -138.

Gustafson, Thane (2012). Wheel of Fortune, The Battle for oil and power in Russia. Belknap Press.

Hubbert, M. King, (1962). Energy Resources, A Report to the Committee on Natural Resources: National Academy of Sciences, National Research council, Publication 1000-D, Washington, D.C..

Maugeri, Leonardo, (2007). The Age of Oil: What They Don't Want You to Know About the World's Most Controversial Resource, Lyons Press.

Reynolds, Douglas B. (2016a) Cold War Energy: The Rise and Fall of the Soviet Union, Alaska Chena.

Reynolds, Douglas B. (2016b). "Is China in Recession? A Cursory Look At Its Energy Statistics," *IAEE Energy Forum*, Fourth Quarter 2016, p. 9

Reynolds, Douglas B. (2011). "What is OPEC? It is Saudi Arabia," in *OPEC at 50: Its Past, Present and Future in a Carbon-constrained World*, March, 2011, conference proceedings, National Energy Policy Institute, The University of Tulsa.

Reynolds, Douglas B. (2009) Chapter 1, "Oil Supply Dynamics: Hubbert, Risk And Institutions," In: Pitt, Edward R. and Christopher N. Leung, Editors, *OPEC, Oil Prices And LNG*, Nova Science Publishers, Inc.

Reynolds, Douglas B. (1999). "Oil Scarcity Should Be a Concern," *USAEE Dialogue*, Volume 7, number 1, pp. 12-13

Reynolds, Douglas B. and Marek Kolodziej, (2009). "North American Natural Gas Supply Forecast: The Hubbert Method Including the Effects of Institutions," *Energies*, 2 (2), 269-306.

Reynolds, Douglas B. and Marek Kolodziej. (2007). "Institutions and The Supply of Oil:

A Case Study of Russia" *Energy Policy*, Volume 35, pp. 939-949.

Simmons, Matthew R. (2005) in *Twilight In The Desert: The Coming Saudi Oil Shock and the World Economy*, John Wiley & Sons Inc.

Teece, David J. (1982). "OPEC Behavior, an Alternative View," in Griffen and Teece, eds. *OPEC Behavior and World Oil Prices*, London, George Allen and Unwin, pp. 64 -93.

United States Energy Information Administration, U.S. Tight Oil Production, accessed September 2018.

CONFERENCE THEME AND OBJECTIVES

Throughout the 150 years of modern energy history, change has been a pervasive driving force in our industry – from the development and deployment of new energy sources to the emergence of more and more diverse uses for energy as fuel and feedstock; the creation of new transport routes and delivery mechanisms to link energy sources to markets, shifting the geopolitical energy map of the world; and the accelerating impact of technological development both increasing our capacity to supply energy as well as to use it ever more efficiently. But in these early years of the 21st century, the pace of change seems to be accelerating as we move ahead into what many have termed the era of energy transitions. Meeting the challenge of providing affordable energy for growing populations while managing the carbon and environmental impact of energy supply and use is a central issue for the 21st century. Solutions informed by the sound application of energy economics will be vitally important in the coming years.

The 37th annual USAEE/IAEE Conference provides a forum for informed and collegial discussion of how these emerging realities will impact all stakeholders – from populations to companies to governments—in North America and around the world.

In 2019, we are taking our conference to the Denver, Colorado area, where oil and natural gas production have been a vital contributor to US energy supply for decades. The state has also strongly promoted energy diversification, particularly into wind and solar power; has worked at collaborative frameworks for energy development embracing the needs of multiple stakeholder interests; and is the home to a strong intellectual and academic tradition of thinking about energy supply, energy technologies and energy markets.

The conference will highlight contemporary energy themes at the intersection of economics, technology and public policy, including those affecting energy infrastructure, environmental regulation, markets, the role of governments, and international energy trade. Participation from industry, government, non-profit, and academic energy economists will enrich a set of robust, diverse and insightful discussions.

www.usaee/usaee2019/

HOSTED BY

USAEE United States Association for Energy Economics

IAEE International Association for Energy Economics WWW.IAEE.ORG

TOPICS TO BE ADDRESSED INCLUDE:

The general topics below are indicative of the types of subject matter which may be considered at the conference. In practice, any topic relating to energy economics, markets, energy policy and regulation, energy trade, energy pricing, drivers of energy demand, adoption of new energy technologies etc. will be considered.

- Global impacts of growing US energy exports
- How are energy markets responding to the shift of U.S. energy policy?
- Pathways to decarbonization of energy and the econony
- Oil prices, the role of OPEC and OPEC/non-OPEC cooperation
- Energy implications of environmental regulations: future and impact
- The role and impact of distributed energy resources in developed and developing countries
- How are digital technologies, including blockchain and artificial intelligence and the Internet of Things impacting energy supply and demand
- What next for electricity storage technologies?
- Drivers and challenges for accelerated electric and autonomous vehicle adoption
- Effective policies to support growth in low-carbon energy
- The role of natural gas in the energy transition to a low-carbon world
- Other topics of interest including shifts in market structures and fundamentals, including those induced by policy and technological forces.

ADVANCE CALL FOR CONCURRENT SESSION PRESENTATION PROPOSALS

We are pleased to announce an advance call for Concurrent Session presentation proposals for the 37th USAEE/IAEE North American Conference, Energy Transitions in the 21st Century, to be held November 3-6, 2019 at the Omni Interlocken Hotel in Denver, Colorado, USA.

THE DEADLINE FOR RECEIPT OF PROPOSALS IS **MAY 31, 2019.**

CONCURRENT SESSIONS

The concurrent sessions at the USAEE/IAEE conference offer opportunities for students, academic staff, as well as energy economists and practitioners in the business, government and research communities to present current analysis, research or case-studies on topics related to energy economics and energy markets. Presentations may be based on academic papers, but this is not a pre-requisite requirement. We stipulate that presentation proposals submitted for inclusion in the concurrent sessions should not have been previously presented at or published by USAEE/IAEE or elsewhere. Presentations are intended to facilitate the sharing of both academic and professional experiences and lessons learned. Presentations should not advertise or promote proprietary products and/or services. Those who wish to distribute promotional literature and/or have exhibit space at the Conference are cordially invited to take advantage of sponsorship opportunities – please see www.usaee.org/usaee2019/sponsors.html Those interested in organizing a concurrent session should propose a topic and possible speakers to David Williams, Executive Director, USAEE (usaee@usaee.org). Please note that all speakers in organized concurrent sessions must pay speaker registration fees and submit abstracts.

Concurrent Session Presentation Proposal Format

Authors wishing to make concurrent session presentations must submit a proposal that briefly describes the topic, research or case study to be presented.

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

a. Overview or summary of the topic including its background and potential significance
b. Description of the context, data used, or illustrative example of the topic
c. Summary of key insights, results or further questions
d. Conclusions: Lessons learned, business or market implications, recommendations for further work

Please visit www.usaee.org/USAEE2019/PresentationProposalTemplate.doc to download a proposal template. All proposals should conform to the format structure outlined in the template. Proposals should be submitted online by visiting www.usaee.org/USAEE2019/submissions.aspx Proposals submitted by e-mail or in hard copy will not be processed.

Presenter Attendance at the Conference

At least one presenter of an accepted concurrent session presentation proposal must pay the registration fees and attend the conference to make the presentation in person. The person submitting the proposal must provide complete contact details—mailing address, phone, e-mail, etc. Presenters will be notified by July 12, 2019 whether their proposal has been accepted. Presenters whose proposal are accepted will have until August 23, 2019 to submit their final papers for publication in the online conference proceedings. While multiple submissions by individuals or groups are welcome, the proposal selection process will seek to ensure as broad participation as possible: any person may present only one topic at the conference. No person should submit more than one proposal as its single author. If multiple submissions are accepted, then a different presenter will be required to pay the registration fee and present each paper.

www.usaee/usaee2019/

STUDENTS

In addition to the opportunities described at left, students may submit a paper for consideration in the **Dennis J. O'Brien USAEE/IAEE Best Student Paper Award Competition** (cash prizes plus waiver of conference registration fees). The paper submission has different requirements and a different deadline. **The deadline for submitting a paper for the Student Paper Awards is June 28, 2019.** Visit www.usaee.org/usaee2019/bestpapers.html for full details.

Students may also inquire about scholarships covering conference registration fees. Please visit www.usaee.org/usaee2019/scholarships.html for full details.

WITH SUPPORT FROM:

USAEE United States Association for Energy Economics
IAEE International Association for Energy Economics WWW.IAEE.ORG
CAEE
AMEE

IAEE/Affiliate Master Calendar of Events

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

Date	Event, Event Title	Location	Supporting Organization(s)	Contact
2019				
April 14-16	*12th NAEE/IAEE International Conference Energy Efficiency and Access for Sustainable Development in Emerging Economies*	*Abuja, Nigeria*	*NAEE*	*Wumi Iledare wumi.iledare@yahoo.com*
May 6-8	*4th HAEE Symposium Energy Transition IV SE Europe and Beyond*	*Athens, Greece*	*HAEE*	*Kostas Andriosopoulos kandriosopoulos@escpeurope.eu*
May 8	*EVER-IAEE Symposium – Grimaldi Forum*	*Monaco*	*IAEE*	*Christophe Bonnery Christophe.bonnery@faee.fr*
May 29-June 1	42nd IAEE International Conference *Local Energy, Global Markets*	Montreal, Canada	CAEE/IAEE	Pierre-Olivier Pineau *pierre-olivier.pineau@hec.ca*
August 25-28	16th IAEE European Conference *Energy Challenges for the Next Decade:*	Ljubljana, Slovenia	SAEE/IAEE	Nevenka Hrovatin *nevenka.hrovatin@ef.uni-lj.si*
October 17-19	4th IAEE Eurasian Conference *Uncapping Central Asia's Potential: How Central Asia can Contribute to Global Energy Security?*	Astana or Almaty, Kazakhstan	IAEE	Vilayat Valiyev *waliyev@gmail.com*
November 3-6	37th USAEE/IAEE North American Conference *Energy Transitions in the 21st Century*	Denver, CO, USA	USAEE	David Williams usaee@usaee.org
2020				
February 9-12	7th IAEE Asia-Oceania Conference *Energy Transitions in Asia*	Auckland, New Zealand	IAEE	Stephen Poletti s.poletti@auckland.ac.nz
June 21-24	43rd IAEE International Conference *Energy Challenges at a Turning Point*	Paris, France	FAEE/IAEE	Christophe Bonnery *Christophe.bonnery@faee.fr*
2021				
July 25-28	44th IAEE International Conference *Mapping the Global Energy Future: Voyage in Unchartered Territory*	Tokyo, Japan	IEEJ/IAEE	Yukari Yamashita *yamashita@edmc.ieej.or.jp*
2022				
February 6-10	45th IAEE International Conference *Energy Market Transformation in a: Globalized World*	Saudi Arabia	SAEE/IAEE	Yaser Faquih *yasser.faquih@gmail.com*
August 7-9	8th IAEE Asia-Oceania Conference *Making the Transition to Smart and Socially Responsible Energy Systems*	Hong Kong	HAEE	David Broadstock *david.broadstock@polyu.edu.hk*
2023				
June 25-27	46th IAEE International Conference *Overcoming the Energy Challenge*	Istanbul, Turkey	TRAEE/IAEE	Gurkan Kumbaroglu *gurkank@boun.edu.tr*

Greening Capital while Greening Energy: Capital Deepening, Biased Technical Change and Energy Transition in China

BY DONG WANG

Dong Wang is with Victoria Energy Policy Centre, Victoria University, Australia and the School of Agriculture and Environment, University of Western Australia. He may be reached at wangdong.anu@gmail.com

If climate change is a consequence of capitalism, energy economists would need to increase our knowledge on the relationship between capital deepening and energy transition in a developing economy. Capital deepening, usually measured by the capital-labor ratio, can indicate the stages of economic development, reflect the comparative advantages of competing energy technologies, and determine the biased technical change which leads to capital-intensive modern energy.

Every stage of the energy life cycle - exploration, extraction, conversion and consumption - is underpinned by the technologies which correspond to different types and grades of fuels (Chakravorty, Roumasset, and Tse 1997). Energy production technology is linked to the capital intensity of the economy as advanced energy technologies tend to only be adopted by energy suppliers in an economy with relatively high capital intensity, due to the requirement for skilled labor and infrastructure. Several examples in historical literature illustrate this assertion. The first one is Cugnot's Fardier. In 1770, a French inventor Nicolas-Joseph Cugnot built a high-pressure steam engine and installed it on a vehicle, but this technology was not successfully used until the invention of rails, the capital-intensive infrastructure, developed in British coal mines (Allen 2009, 153). The second example is Jacques de Vaucanson's automated silk loom, which was never used commercially since it was too capital-intensive (Doyon and Liaigre 1967). It is well documented that China Sichuan province was using natural gas as far back as the Han dynasty (200 BCE). However, large-scale use of natural gas did not occur until capital-intensive technologies like turbines, compressors and pipes were developed in high capital intensity economies, such as Europe and the USA after World War II (Smil 2010, 37).

We have gained the knowledge of energy production that different forms of energy require different combinations of factor inputs. In the view of energy system evolution, energy transition from one form of energy to another would not have happened without a change in input proportions between labor and capital (Kander, Malanima, and Warde 2014, 411). For instance, labor demand in coal mining per unit of energy is usually higher than that in nuclear power plants; likewise, the capital intensity of solar power production is relatively higher than that in generating energy from fuelwood. This phenomenon is due to the attributes of each primary energy source including scarcity, power intensity, energy density, safety, the flexibility of use, and cost of conversion (Stern 2010).

However, technical change in energy production is not neutral but tends to use more capital than labor (Acemoglu 2002). This biased technical change can be driven either by relative factor price changes (the price effect) or by relative factor quantity change, i.e., capital intensity increase (market size effect). The relative factor price change will create incentives to develop advanced technologies using the more expensive factor that is – capital – rather than labor. The relative factor abundance change will promote technological progress by using the more abundant factor, that is, capital. In a competitive electricity market, the prices of different sources of electricity will be converging eventually given the electricity is a kind of homogeneous goods. Thus, in this context, an increase in capital intensity will induce technical change directed to modern energy which is capital intensive. Acemoglu's model implies that technical change in energy transition may be biased towards modern energy (i.e., capital-intensive energy) when there is capital accumulation relative to labor in a developing economy.

China's energy transition during the past four decades shows that the relative production of non-coal electricity and coal electricity is in line with the increase in capital intensity of the country, see Figure 1. There exists a linear relationship between energy transition and capital deepening especially after the year 1984 which is the start of 'High Wave of Reform'. That is, China's economic reform had an underlying

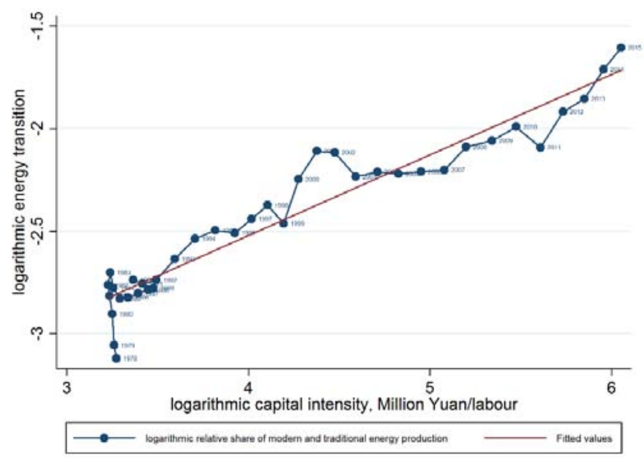

Figure 1 Energy transition and capital deepening in China

transition in 1984. The central government launched the reform in urban area and adopted the decision on 'planned commodity economy' which was starting the process of market liberalisation. Overall, we can see from Figure 1., with an increase in capital intensity, the relative production share of modern energy and traditional energy increases. This pattern implies the structure of energy mix shifting towards capital-intensive modern energy.

In our recent research, we conduct an empirical model is based on China's national level time series from 1978 to 2015 (Wang, Mugera, and White 2019). The results show that the long-run equilibrium relationship and short-run dynamic effects between the energy transition and capital deepening are both significant. The Granger causality test suggests that capital intensity indeed causes energy transition but not *vice versa*.

The results from time series modeling further show that the increase in capital intensity has a long-run effect on China's energy transition and the dynamical adjustment period is around five years which is in line with the National Five-year Plan.

Our results imply that the shift in China's energy mix, from tradition to modern energy, is in line with capital deepening in the long run. With an increase in capital intensity, technical change in the energy sector is biased towards capital as modern energy tends to be capital intensive.

The policy implications of our results are that both capital-enhancing policies and price-regulations can be used to promote energy transitions. However, price-regulation solutions may distort efficient resource allocation, and feed-in tariffs can be inefficient leading to an increase in social cost. In terms of policy recommendations, we favor measures that include tax relief, technology standardization and foster financial security and fair competition between technologies. The industrial policy would be better at reducing the market frictions related to investment in modern energy sector. The appropriate policy instruments may be an inclusion of tax relief, information asymmetry reduction, technology standardization, financial security and rules of fair competition. In so doing, modern energy innovation and factor capital intensity increase will promote the adoption of modern energy technology and gradually displace the traditional energy. In the long run, this will promote the wide-scale adoption of modern energy technology and displace polluting traditional energy. We refer to this process as 'Greening capital while greening energy'.

There are many researches on the relationship between energy and capital adopts the derived demand approach to investigate the inter-factor substitution between these two inputs. The policy insights from this approach may be confined by the assumption that the output level is constant. On the other hand, it would be helpful for many developing countries, if future study could take capital deepening, especially the dynamic condition of capital and labor, of the whole economy into energy transition policy design. Put it differently, beyond factors like GDP per capita, energy prices and scarcity of resources, capital deepening is another critical factor for energy transition. In addition, the dynamical evolution between energy transition and capital intensity needs to be explored further. For example, researchers might need to explore whether there exists a 'threshold' or 'optimal path' of energy transition given the corresponding conditions of capital intensity of an economy. Our study attempts to open a discussion room for this debate.

References

Acemoglu, D. 2002. "Directed technical change." Review of Economic Studies 69 (4):781-809. doi: 10.1111/1467-937X.00226.

Allen, Robert C. 2009. "The British industrial revolution in global perspective." In Cambridge Books, 153. Cambridge University Press.

Chakravorty, Ujjayant, James Roumasset, and Kinping Tse. 1997. "Endogenous Substitution among Energy Resources and Global Warming." Journal of Political Economy 105 (6):1201-1234. doi: 10.1086/516390.

Doyon, André, and Lucien Liaigre. 1967. Jacques Vaucanson, mécanicien de génie: Presses universitaires de France.

Kander, Astrid, Paolo Malanima, and Paul Warde. 2014. Power to the People: Energy in Europe over the Last Five Centuries: Energy in Europe over the Last Five Centuries. 1 ed: Princeton University Press.

Smil, Vaclav. 2010. Energy transitions: history, requirements, prospects: ABC-CLIO.

Stern, David. 2010. "Energy quality." Ecological Economics 69 (7):1471-1478. doi: 10.1016/j.ecolecon.2010.02.005.

Wang, Dong, Amin Mugera, and Ben White. 2019. "Directed Technical Change, Capital Intensity Increase and Energy Transition: Evidence from China." Energy Journal forthcoming.

A Look at the GSM/Telecommunications Revolution in Nigeria. Possible Applications in Nigeria's Electricity Industry

BY ADEWALE EYITAYO MOULD

Introduction

Poor electricity supply has been proven to be the major infrastructure constraint confronting the business sector in Nigeria today. Electricity supply is both un-stable and of very low quality. Black out and brown outs are common features of electricity supply in Nigeria. In fact, the average Nigerian firm experiences power failure or voltage fluctuations about 7 times per week, each lasting for about 2 h, without the benefit of a prior warning (Adenikinju, 2003; Graber, Mong and Sherwood, 2018). This has contributed to the low productivity and low competitiveness of the Nigerian manufacturing sector.

On the other hand, information and communications have always formed the basis of human existence. This fact has driven man to continuously seek ways to improve the processing of information and communicating such information to one another, irrespective of distance and on a timely basis. Perhaps the greatest legacy that the 20th century scientists have bequeathed to mankind is the "Information Revolution" made possible by rapid development and advances in telecommunications and computer technology. That no modern economy can be sustained today without an integral telecommunications infrastructure is widely acknowledged. In fact, World Bank studies indicate that for every US $1 invested in telecommunications infrastructure, more than US $6 is generated in economic returns by its impact on local employment and general economic growth (Ndukwe, 2011; Nwakanma et al., 2014).

Access to telecommunications is therefore critical to the development of all aspects of a nation's economy including manufacturing, banking, education, agriculture and government.

The Nigerian telecommunications industry and the national business landscape has no doubt been revolutionised by the introduction of the Global System for Mobile (GSM) Telecommunications.

The electricity and telecommunications Industries in Nigeria were established within ten years of each other. Both have equally gone through extensive reform processes in the last twenty years.

However, despite the Electric Power Sector Reform Act (ESPRA) 2005 being hailed as the most comprehensive in Africa, (Iwayemi, 2017) its effects are not as visible at the grassroots as the reforms in the telecommunications Industry by way of the Global System for Mobile Telecommunications (GSM).

This write up attempts to examine relevant applicable lessons from the GSM/ Telecommunications success story which can fit into the context of the Nigerian electricity industry and help turnaround that sector.

It also tries to explain why such an Electricity/ Energy dependent venture like Mobile Telecommunications succeeded better than Power supply in an otherwise Energy deficient or Energy poor environment

Adewale Eyitayo Mould is an Independent Energy Analyst with the Centre for Petroleum, Energy Economics and Law (CPEEL), University of Ibadan. He may be reached at adewalemould@gmail.com

Background

Electricity production and supply in Nigeria started in 1896 barely 15 years after its introduction in The United Kingdom when the first power generating plant was installed in Lagos Nigeria by the British Colonial Government of the time (Babatunde,2011, Adenikinju, 2017)

The Nigerian Electric Power Authority (NEPA) established in 1972 was a fusion of both the earlier established Electricity Corporation of Nigeria (ECN) and the Niger Dam Authority (NDA). ECN was responsible for the generation, transmission, distribution and sales of electricity. NDA on the other hand was responsible for the construction and maintenance of dams for hydropower across the country and subsequent sale of electricity to ECN. (Adenikinju et al.2016).This merger made NEPA a wholly state owned monopoly responsible for both policy formulation and regulation of electricity generation, transmission and distribution.

Realising the importance of the critical role of electricity in the nation's economic activities and growth, the Nigerian Government in 1999 set in motion a process of transferring the government owned electricity sector to the private sector introducing the National Electric Power Policy. By March 2005, the Electric Power Sector Reform Act (EPSRA) was passed. This process culminated in the transformation of the Nigerian Electric Power Authority (NEPA) into The Power Holding Company of Nigeria (PHCN) and its subsequent handing over to private investors.

Other entities created from the defunct NEPA include one power transmission company, six power generation companies and eleven power distribution companies.

There have been mixed reactions to the extent to which power supply has improved following this transfer of power to the private sector. (Adenikinju et al 2016).

By way of comparison, telecommunication facilities in Nigeria were first established in 1886 by the colonial administration. This sector has undergone very rapid change and explosive growth in recent years and has been argued to have contributed positively to Nigeria's economic growth (Nwakanma et al 2014).

The Telecommunications revolution transformed the Nigeria society in divers' ways since the dawn of the new millennium. A breakthrough in telephone infrastructure emerged in January 2001 when the sector was totally liberalized with the licensing of MTN and ECONET, now Airtel (mobile phone Company). They injected over a million lines into Nigeria within a year. Also Globacom came into existence later that year. The Global System of Mobile Communication (GSM) spread in a highly competitive manner from state to state and city to-city. (Isabona,2013).

Some stylized facts showing the results pre and post reforms of the Nigerian Telecommunications and electricity industries are presented below:

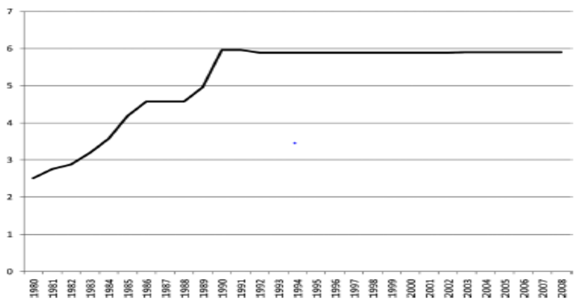

Figure 1.Total Electricity Installed Capacity in Nigeria 1980-2008 (Source: Babatunde, 2011)

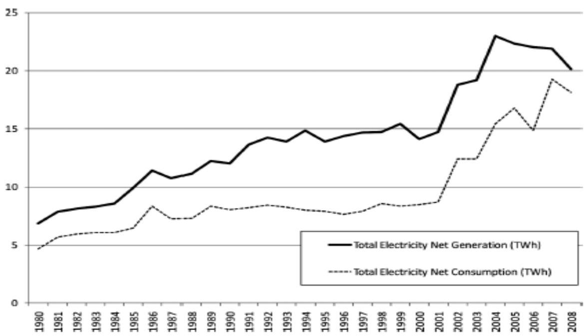

Figure 2.Total Electricity Generation and Consumption in Nigeria 1989-2008 (Source: Babatunde,2011)

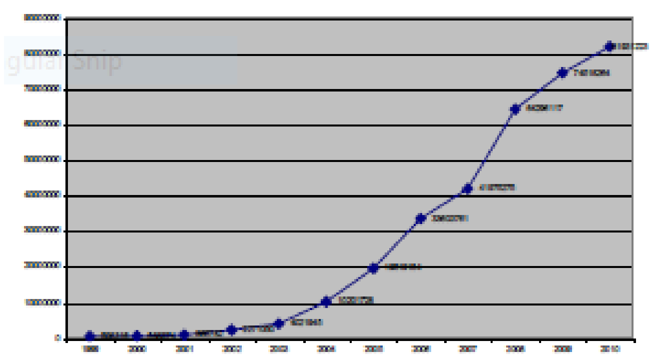

Figure 3. GSM Subscriber Growth in Nigeria 1999-2010
(Source: Hassan,2011).

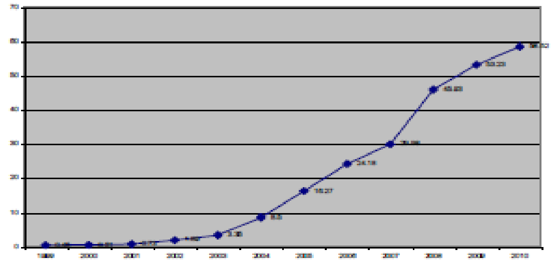

Figure 4.Teledensity Growth in Nigeria 1999-2010
Source: Hassan,2011

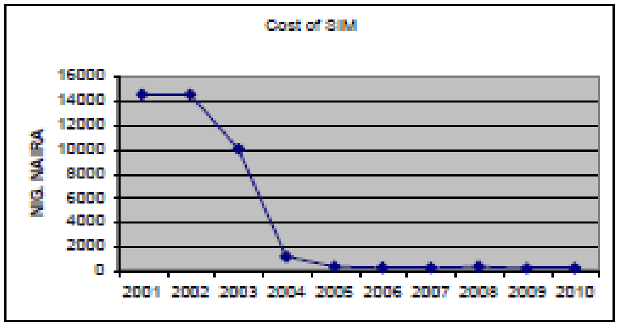

Figure 5.Cost of SIM Cards in Nigeria 2001- 2010
Source: Hassan, 2011

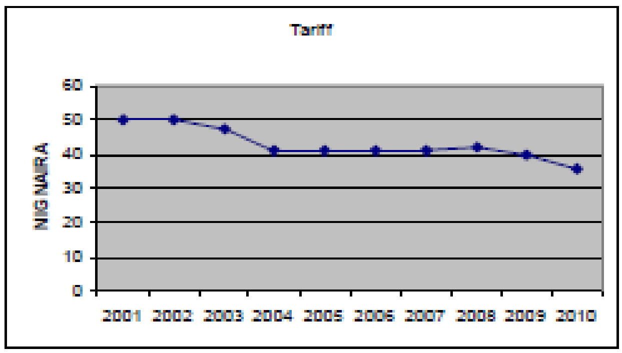

Figure.6 GSM Tariffs in Nigeria 2001-2010
Source: Hassan,2011

These graphs and stylized facts presented above give an indication of the relative success story of the telecommunications revolution in Nigeria by way of the Global System for Mobile Telecommunications as compared with those resulting from the electricity industry reforms in Nigeria.

Discussion

Prior to 1999, Telecommunication services were expensive to acquire, difficult to obtain and expensive to use. Tele-density stood at 0.04% (about 400,000 users) in a country with an estimated population of over 100 million people which was one of the lowest in the world. Investment in the sector was below $50 million U.S. dollars. This state of affairs had adverse consequences on the nation; more pressure on other infrastructure such as roads, inability to make emergency calls in life threatening situations leading to the loss of lives in some cases. Business efficiency was not maximized, social cohesion was reduced, and there was an inability to leverage the potentials being promised by ICTs in different aspects of human endeavour (NCC, 2014)

Some dividends of the Telecommunications GSM Revolution include (Ndukwe, 2004):

- Positive contribution to Nigeria's GDP.
- Foreign capital inflow.
- Stimulation of local investment
- Job creation (direct and indirect).
- Economic empowerment of Nigerians.
- Indigenous skills acquisition and technology transfer.
- Increased tax revenue for the Nigerian government.
- Increased Banking sector turnover through loans, advances, e-commerce and e-banking.

This apparent success of the Telecoms GSM Revolution has been linked to some factors including but by no means limited to the following: (Ndukwe, 2004 &2011)

- A large 'ready-made' market: Nigeria's large well educated and 'tech savvy' population.
- A good business and economic model by the operators.
- Appropriate technology (the GSM and other wireless modes of telecommunications as against the fixed wire service in place at the time.)
- Timely decision making, for example, the prompt response in 1999 by the government in office to calls for reform in the Nation's telecommunications sector.
- Effective regulation by the Nigerian Communications Commission leading to the NCC being widely acknowledged as a model telecommunications regulatory institution in Africa.
- Consumer Protection Revolution by the Telecommunications regulatory Agency (NCC). Examples are the Telecommunications Consumer Parliament (TCP), Consumer Outreach Programs, Customer Care Centres and collaboration with Consumer Advocacy Groups in addition to various CSR Initiatives by some of the Telecommunications Service Providers.

Some Recommendations

It can be seen from the above that reforms in Nigeria's telecommunications sector have been more successful those in the nation's electricity industry. While the reforms in the electricity industry have been lauded to have been very comprehensive in the African context (Babatunde, 2011; Iwayemi, 2017), arguments have also been put forward for further reforms so as to achieve the desired expectations (Iwayemi, 2017).

Bearing in mind the current governance structure of Nigeria's electricity industry/ power sector as provided by the 2005 EPSRA (Electric Power Sector Reform Act), such further reforms should include the following (Dikko and Omisanjo, 2016):

- Re-orientation of the public perception of electricity as a public good.
- Appropriate or cost reflective pricing of electricity services (Graber, Mong and Sherwood, 2018).
- Open access/open transmission access for more eligible market participants. This would involve improving the state of the national grid and/or better integration of the mini-grids utilized by the concerned players to deliver their services.
- Regulation of the National Grid keeping in mind its strategic nature and the need for electricity access by all.
- Appropriate feed in tariffs for independent power producers especially those making use of renewable energy technologies (R.E.T.'s).
- Reforms at the power distribution level. The current structure makes the distribution companies (DISCO's) effectively monopolise their zones of distribution disallowing any competition.
- Introduction of electricity retailing in addition to the currently applicable governance structure of electric power generation, transmission and distribution. This is to further facilitate competition in the Nigerian Electricity Industry/ Power Sector and theoretically give the consumer the ability to choose between service providers. (Biggar and Hesamzadeh, 2014).
- Incorporation/Integration of communications/ telecommunications technology in the provision of electricity services (e.g., the collaboration between MTN and LUMOS to deliver solar generated electricity). (Allgrove, Dajani, Curnow 2018; All-On, 2018).
- Use of communications and telecommunications technology in monitoring electricity use/electricity theft using for example M2M (Machine to Machine Technology, 4G/5G Telecoms Technology, IOT (Internet of things) (Allgrove, Dajani, Curnow, 2018;Wikipedia, 2018 a & b).
- The adoption or development of contextualized Energy Business Technology models such as Bangladesh's Grameen Shakti Model for rural electrification/ provision of affordable sustainable energy (Sovacool and Drupardy, 2011). Such business and technology models should include the adoption of various renewable energy technologies e.g., solar PV and biogas generation (All-On, 2018). They should also seek to involve grassroots financial institutions such as micro-finance banks and co-operative societies in the financing of micro to medium scale energy projects.
- Greater efficiency in the regulation of the Nigerian electricity industry/power sector bearing in mind the internationally acclaimed successes of regulatory bodies such as the Nigerian Communications Commission (NCC) and the National Agency for Food and Drugs Administration and Control (NAFDAC).
- Related to the above is a closer look at the

regulatory governance provided for by the 2005 Nigerian Electric Power Sector Reform Act to determine the necessity or otherwise of more than one regulatory body in the sector (CPEEL, 2014).
- Corporate Social Responsibility (C.S.R.) and Consumer protection initiatives by both the electricity service providers and regulatory authorities.

Conclusion

It is a fact that the telecommunications reforms in Nigeria has been very successful with visible grassroots impact in spite of any real or perceived hiccups.

It can be also be argued that the electricity market in Nigeria needs to be made more competitive especially as the provision of electricity services is very key to industrial development in Nigeria and also the attainment of a number if not all the sustainable development goals (SDG's).

Steps being taken in this direction by various categories of independent power producers should be encouraged however with effective regulation (Biggar and Hesamzadeh, 2014)

Further studies will be needed to critically compare and examine the reforms in the telecommunications and electricity/energy sectors in Nigeria. Studies will also be needed to empirically determine the need and/or effectiveness of current/further reforms in the electricity Industry. These should be done with a view to achieving the goal of clean affordable energy supply and security in Nigeria and Africa as a whole.

References

Adenikinju, A. (2003) Electric Infrastructure Failures in Nigeria: A Survey Based Analysis of the Costs and Adjustment responses. Energy Policy 31(2003) pp. 1519-1530.

Adenikinju,A. (2017). Energy and Nigeria's Economic Development: A Troubled but Indispensable Marriage. An Inaugural Lecture. Delivered at The University of Ibadan on Thursday 13 April 2017.

Adenikinju, A; H.Dikko; G.Sanusi. (2016). Impact of Privatisation on Electricity Supply in Nigeria In: Adenikinju,A; A.Jerome; O.Ogunkola (eds).The Quest for Development. Essays in Honour of Professor Akin Iwayemi at 70.Chapter 23, pp. 639-665.

Allgrove,A.M; M.Dajani, P.Curnow et.al.(2018).Baker McKenzie : The Smart Power Revolution: Opportunities and challenges. Available Online at www.bakermckenzie.com.accessed 06/07/2018.

All-On (2018).Lumos Nigeria: Retail Solar for Homes and Small Businesses Impact Energy: Case Studies of Successful Off Grid Energy Businesses in Nigeria. Research conducted by PWC.www.all-on.com.

Babatunde,M.A. (2011) Keeping the Lights on in Nigeria: Is Power Sector Reform Sufficient? Journal of African Business 12:3 pp.368-386.

Biggar,D.R; M.R. Hesamzadeh. (2014). Electricity Industry Market Structure And competition in: The Economics of Electricity Markets. IEEE Press. John Wiley and Sons.

CPEEL (2014). NERC and NEMSA: Options for Effective Regulatory Governance in the Nigerian Electricity Supply Industry. CPEEL (Centre for Petroleum, Energy Economics and Law, University of Ibadan, Nigeria) Policy Brief Vol.2 No.1.

Dikko,H; O.Omisanjo (2016) Ten years of Electricity Sector Reform in Nigeria Progress and Challenges in Tariff Determination In: Adenikinju,A; A.Jerome; O.Ogunkola (eds) The Quest for Development. Essays in Honour of Professor Akin Iwayemi at 70.Chapter 22, pp. 616-638.

Graber,S;P. Mong; J. Sherwood (2018). Under the grid. Improving the Economics and reliability of Rural Electricity Service with under Grid mini grids. Rocky Mountain Institute. www,rmi.org/insight/under-the-grid.

Nwakanma,I; B.Asiegbu; U.Eze;O. Dibia. (2014). A Critical Appraisal of the Telecommunications Industry and Economic Growth in Nigeria. World Journal of Globalization and Technology Development Vol.1, No.1 February 2014 pp.1-18. Available online at http://wigtd.com accessed 01/09/2017.

Isabona, I. (2013) Harnessing Telecommunications Revolution in Nigeria: A Case Study. Wireless and Mobile Technologies, Vol.1,No.1, pp.20-24 Available online at http://pubs.sciepub.com/wmt1/1/14 accessed 01/09/2017.

Ndukwe,E. (2004) Three Years of GSM Revolution in Nigeria. (Online). Available http//www.ncc.gov.ng/speeches_presentations/Evc's (August 20 2005) accessed 01/09/2017.

Ndukwe, E. (2011) The Telecommunication Revolution in Nigeria. Text of the Convocation lecture delivered at The Igbinedion University Okada 2nd December 2011. Available online at www.iuokada.edu.ng Accessed 01/09/2017.

Hassan, A.O. (2011) Telecommunications Reform and Effects of Competition On Availability, Quality and Cost of Services in Nigeria. Public Policy and Administration Research. ISSN 2224-5731 (Paper) ISSN 2225-0972 (Online) Vol.1,No.3,2011 www.iiste.org. Accessed 01/09/2017.

Iwayemi, A. (2017) The Elusive Quest for Adequate, Reliable and Affordable Electricity in Nigeria. Emerging Policy Issues and Agenda for Research. CPEEL Special Seminar Series 11. Thursday 10th Of August 2017.

Nigerian Communications Commission (2014). 2014 Year end subscriber/ Network data report for telecommunications operating companies In Nigeria. Available online at www.ncc.gov,ng.accessed 21/12/2017.

Sovacool,B; I.M. Drupardy (2011). Summoning Earth and Fire: The Energy Development Implications of Grameen Shakti (GS) in Bangladesh. Energy.Vol.36.pp 4445-4459.

Wikipedia (2018 a). Machine to Machine. Available online athttps://en.wikipedia.org/wiki/Machine_to_machine accessed 15/03/2018.

Wikipedia (2018 b). Internet of Things. Available online atttps://en.wikipedia.org/wiki/Internet_of_things accessed 15/03/2018.

U.S. Energy Dominance: from Whale Oil to Shale; How the New U.S. Energy Doctrine will Change the World

BY AMRO ZAKARIA

Amro Zakaria Abdu is a co-founder and Managing Director of *Market Trader Academy USA*. He is an expert in the financial service industry with over 16 years of global financial markets experience. This article is reprnted from a late 2017 issue of Newsweek Magazine Middle East.

See footnote at end of text.

By the mid-1800's, whale oil was the primary source of energy, used principally to illuminate homes and lubricate wheels and machines. The ever-increasing demand for whale oil helped create a vibrant global whaling industry in which the United States was by far its dominant player, with a fleet of 735 ships out of 900 in the world in 1846.

Luckily for the whales, which by the middle of the nineteenth century were hunted almost to the brink of extinction, crude oil was discovered in Pennsylvania in 1859. Kerosene, a crude oil byproduct, rapidly became the preferred source of fuel, replacing the more expensive whale oil and alcohol-based camphene, which had become costly due to a newly introduced tax on alcoholic products.

The discovery of crude oil in the mid-1800s and the subsequent mastery of its refinement into different products precipitated an industrial revolution that led to the advent of many modern industries that we have today. Crude oil distillates like gasoline and diesel transformed the locomotive engine and with it, the automobile, marine, and aviation industries. War and commerce changed drastically in both means and purpose ushering a global race to control this new source of wealth and power that has continued unabated ever since.

Post-WWII Energy Doctrine

The American energy doctrine post-WWII and until recently has focused on energy independence and security. Its primary motive is rooted in two historical events. First was the wave of nationalization that gripped many of the major oil producing regions during the 1950-70s. This development had put most of the oil and gas reserves under the control of governments and consequently, exposed to global geopolitical flux and the whims of national movements ubiquitous at the time.

The second event was the October 1973 oil embargo imposed by the Organization of Arab Petroleum Exporting Countries (OAPEC), which consisted of the Arab member countries of OPEC plus Egypt and Syria. The oil embargo left the U.S. feeling vulnerable and exposed the extent of its dependence on Middle East oil. Prices shot up from $3 to $12, but still, widespread shortages and long lines persisted in gas stations with signs posted "NO GAS TODAY."

For the Nixon administration, the oil embargo could not have happened at a more inconvenient time. The Vietnam war was intensifying, and so was the opposition to it.

The U.S. dollar had been devalued due to the U.S. unilaterally pulling out of the Bretton Woods Agreement in August 1971. Moreover, the U.S. economy was going through a recession, with real GDP growth slowing from 7.2% to negative 2.1% and inflation rates quadrupling from 3.4% to 12.3% between 1972-1974.

Under pressure, the Nixon administration enacted drastic steps to address the economic and national security threat as well as the humiliation and hardship resulting from the oil embargo by announcing the "Project Independence" strategy in November 1973. The strategy, which prioritized American energy independence, has formed one of the main rudders of the American military, energy, and foreign policy strategies for the past four decades. As Amory Lovins of the Rocky Mountain Institute, a Colorado-based think-tank, put it "the oil embargo was the crisis that caused America to lose its energy innocence."

Measures focusing on energy independence and security established by Nixon and expanded by subsequent administrations included improvements in energy consumption, reduction of regulation on domestic production, promotion of overseas exploration, and the development of alternative fuels and renewables. As a result, electricity generation from oil in the United States has decreased from 15% in 1975 to less than 1% today.

Iran under the Shah had continued to produce and supply oil to the United States during the Arab Embargo. The Iranian revolution in 1979 resulted in the loss of a dependable oil supplier and further highlighted the need for proactive engagement in the Middle East, primarily since the new regime was hostile towards the U.S. and represented a credible threat to the regional oil supply. The gravity of those developments prompted President Jimmy Carter to announce during his 1980 State of the Union address that "An attempt by any outside force to gain control of the Persian[1] Gulf region will be regarded as an assault on the vital interests of the United States of America. Such an assault will be repelled by any means necessary, including military force." Eleven years after President Carter's address, the United States deployed boots on the ground to lead the fight in the first Gulf War and has had permanent presence ever since.

The pursuit of energy security and independence led to the formation of close cooperative synergies with most of the major oil producers in the Gulf and around the world. Security constituted the bedrock of those relationships, which developed into intertwined geopolitical agendas lasting for decades resulting in U.S. projection of power to all four corners of the world.

Diplomatically, the U.S., together with other members of the OECD, pushed for the creation of the International Energy Agency (IEA), a member group responsible for coordinating energy policy, security, and development among its members. An example of the IEA requirements geared towards achieving supply assurance and insulation from supply shock is the mandate that its members maintain total oil stock levels equal to at least 90 days of the previous year's net imports. In OECD countries petroleum inventories stood at 2.98 billion barrels by the end of 2016 or roughly 65 days of consumption as per the EIA short term energy report (July 2017). Such measures weaken the invisible hand of the market when the fundamentals favor the producers and help blunt their collective leverage.

The multi-pronged approach to security dependence succeeded in insulating the U.S. from further oil supply shocks for the past four decades. So much so that The U.S. found itself ready and able to draw a new energy doctrine.

In December 2015, President Obama lifted the ban on U.S. crude oil exports which had been in place for over 40 years. The ban was increasingly being viewed as archaic, mainly by the new star of oil production, the U.S. shale industry. Furthermore, the U.S. had enough global diplomatic and military presence that a significant oil supply disruption was less likely to happen.

Dawn of the New Doctrine: Energy Dominance

Although already in motion, the new U.S. Energy Doctrine was stated in unequivocal terms in a June 2017 White House press briefing by the Secretary of Energy Rick Perry. He said for the first time that the U.S. is after energy dominance and the statement was reiterated by President Donald Trump on June 29 at the Energy Department in which he declared the U.S. was on a path to "energy dominance."

It is worthy to note that Secretary Perry is acutely aware of America's energy production prowess, having been the longest-serving governor of the most prolific oil-producing region in the U.S.: the state of Texas. Furthermore, he has a good understanding of geopolitics having served in Europe and the Middle East in the seventies with the U.S. Air Force.

In trying to discern the motives behind the new doctrine, multiple factors present themselves and it is that confluence of factors that lead many to prognosticate its endurance.

Horizontal Drilling and the Shale Revolution

In a recent report, the EIA has put the U.S. oil shale technically recoverable resources at 2.6 trillion barrels with estimated economically recoverable oil reserves at about 1 trillion barrels, more than that of Saudi Arabia, Russia, and Venezuela.

Horizontal drilling leading to the shale revolution is probably the most significant development in the oil and gas sector in recent history and without a doubt, a powerful catalyst for the change in the U.S. energy doctrine. The new technology created hundreds of thousands of new jobs in the U.S. and seemingly reversed the protracted decline in U.S. oil production that started in the early 1970s. Output jumped from less than 5 million b/d to an average of 9.3 million b/d in 2017 and is expected to reach 9.9 million b/d in 2018 according to the EIA. A similar trajectory is taking place in natural gas production which has resulted in the lowest level of liquefied natural gas (LNG) imports into the U.S. since 1998, while exports grew by 30% in 2016 to reach an all-time high.

The resilience of the shale industry was tested when oil dropped from $106 in April of 2014 to below $27 by February 2016. Shale oil producers came under intense financial strain as it was widely believed that the industry's break-even price was between 60-70 U.S. Dollars. However companies, unlike countries, can trim down operational cost fast and they did. The number of oil production rigs bounced back from lows of 404 recorded in May 2016 to 958 active rigs today. Furthermore, the number of Drilled Uncompleted Wells (DUCs) stands at over 6,000, signifying an expanded capacity for rapid production increase.

Continentalism and Protectionism

The Dominance doctrine cannot be decoupled from the rise of American nationalism that helped sweep in Donald Trump to the office of the U.S. presidency. Protectionism and continentalism have rekindled the spirit of manifest destiny in America.

The "America First" slogan has come to represent the administration's willingness to give up America's international leadership role in issues such as climate change, globalization, and free trade if such a position conflicted with American interest as defined by the nationalists presently at the helm of U.S. policymaking.

As it pertains to energy production, it also meant that there should be no barriers to exploiting America's natural resources, aggressively securing market share to America's hydrocarbons overseas, and becoming an energy exporter for the first time since 1953. This paradigm shift marked a change in the status of oil, from a strategic commodity grounded in national security interest to further becoming a significant component of the country's exports and GDP.

The new direction has yielded quick results. For the first time, U.S. crude has found its way to China and India, traditional markets for producers that consider the U.S. the vital ally. The significance of those two markets lies in the fact that they are projected to have the most substantial increases in energy demand in years to come. In India alone, the growth in demand is expected to increase by 333% by 2040. The question becomes, how will the relationship between the U.S.

and its oil-producing allies change when competition for global market share of oil exports turns the U.S. from an indispensable partner to a heavyweight contender and a possible existential threat?

Recent technological advancements in renewable energy are rapidly making them commercially viable competitors in fulfilling the new growth in energy demand, which would have traditionally gone to fossil fuels. Japan is leading the pack with hydrogen cell and molten salt battery technology. In the U.S., Tesla is making electric vehicles competitive and affordable with its Colorado-based Gigafactory and the introduction of the Model 3, which had five hundred thousand pre orders at launch. Not to be outdone, China has adopted policies to open up the automotive industry to electric vehicles encouraging investors and producers with generous subsidies. Additionally, China is diligently trying to shift its energy mix away from fossil fuels primarily for national security and environmental reasons. Recently the world's largest floating solar power plant was inaugurated in Huainan in May. India is not too far behind with the country planning to install 225 GW of renewables by 2022 which will comprise 57% of its electricity generation capacity.

Other forms of energy are increasingly and successfully becoming part of the energy mix such as geothermal energy which is projected to cost only 4.78 cents per kWh in 2020 according to the EIA, and that is lower than a natural gas combined cycle plant.

With a perfect storm of fossil fuel demand destruction and increasingly cheaper alternatives, producers will become ever more aggressive in gaining and keeping market share. The United States will have a technological advantage that will allow it to increase production and export capacity faster and cheaper compared to many producers who will struggle just to maintain current levels of production as their domestic consumption keeps growing.

Astutely, the vanguards of solar energy are some of the major oil producers such as the Kingdom of Saudi Arabia and the United Arab Emirates, with the Emirate of Abu Dhabi holding the current record for the lowest solar electric production cost, at 2.42 cents/kWh in 2016.

Such pragmatic thinking is necessary as their oil consumption keeps increasing to fuel their growing economies. Saudi Arabia today consumes 3.895 million barrels per day, an increase of 4.36% from a year ago as per BP Statistical Review of World Energy Report.

Energy dominance now more than ever, is strategically indispensable for the U.S. as it deals with multiple geopolitical threats such as the adversarial relationship with China and a resurgent Russia that is getting ready create the largest military buildup at the edge of NATO territory when it conducts military drills with 100,000 troops in Belarus this summer. China, on the other hand, is rapidly modernizing its defense industry and projecting its power beyond its immediate vicinity having set up and opened its first ever overseas military base in Djibouti in September of this year.

Oil and gas comprise over 60% of Russia exports, and make up over 30% of its GDP so naturally the Rubble is highly correlated to the price of oil. As such, the United States no doubt gains leverage from any acquired influence over the global price of oil and gas.

On the other hand, geopolitical tensions around vital maritime choke points, such as the Strait of Hormuz and Bab el-Mandeb, implores the U.S. national security policymakers to push for maximum energy self-sufficiency. That will help free up America's military capacity to focus more on emerging threats with higher priority like the new quest for Africa, North Korea, and the South China Sea.

Another geopolitical dynamic that energy dominance will create is that it will turn market share into a diplomatic token of friendship that can strategically be given-up by some exporters, or offered by importers such as India, in return for closer diplomatic and military ties with the U.S., regardless of the economics of such propositions. Internationally, Lines will be redrawn in the global oil and gas trade. Strategic alliances will need to find new common bonds to remain viable. Military doctrines, strategies and by extension equipment will change accordingly.

Domestically, the U.S. economy will be extremely competitive as it will have access to cheap energy which will have a positive spillover effect on jobs, housing, the stock market, and in turn improve the wealth-effect of households.

One thing is for sure, American energy dominance bears massive implications and potentially drastic consequence for friends and foes alike. Presenting the challenging question that behooves political and business leaders to ask and contemplate; "What are the risks and how can they be mitigated, and what are the opportunities and how can they be capitalized on?"

Footnote

[1] Although President Carter said the "Persian Gulf", currently the U.S. and the Arab countries use the term "Arabian Gulf"

16th IAEE
European Conference
Ljubljana
25–28 August 2019

IAEE International Association for Energy Economics
University of Ljubljana Faculty of Economics
SAEE Slovensko Združenje za Energetsko Ekonomiko

Energy Challenges for the Next Decade

Faculty of Economics, University of Ljubljana, Slovenia

FELU[1]

The 16th IAEE European Conference will be held in the charming city of Ljubljana, the capital of Slovenia, and the seat of the EU Agency for the Cooperation of Energy Regulators (ACER), in the premises of the Faculty of Economics, University of Ljubljana (FELU). The conference brings together researchers in the area of energy economics, members of academia, energy industry professionals, policy makers, PhD students and all interested parties wishing to be a part of the debate.

Why decide to attend the 16th IAEE European Conference?

The central theme of the conference is Energy Challenges for the Next Decade, addressing the Europe's energy sector in the global energy industry, prospects for future energy markets, energy in the digital world with changing business models, energy in the final energy use (transport, innovation, technological changes, energy efficiency), energy access and the future role of consumers/prosumers, climate policy challenges and international governance of energy transition, among others. Topics will be discussed in eight (Dual) Plenary Sessions and more than sixty Concurrent sessions. You may consult the draft programme here. The conference will start with the opening address by Alenka Bratušek, Minister of Infrastructure, Christophe Bonnery, IAEE president and other distinguished guests. Plenary session chairs and speakers are among the most respected academics and professionals in the area of energy economics. For more information about the session topics, session chairs and confirmed speakers see the conference website.

PhD students and young professionals are invited to attend the PhD day on 25 August 2019, and are encouraged to take part in the IAEE Best Student Paper and Poster Award Competition. There will be two PhD day seminars offered free of charge : 'How to write papers for publication in scientific journals' (by Adonis Yatchew, Editor-in-Chief of the Energy Journal) and 'How to present research in scientific conferences (by Georg Erdmann, Berlin University of Technology, and Markus Graebig, WINDNode Project Leader). On 29 August 2019 Richard Green, Imperial College London, will deliver lectures in the Post-conference seminar on Energy Transition and Power Markets (please note that deadline for applications is 1 July 2019).

Lake Bled[2]

Why Slovenia?

Slovenia with around 2 million inhabitants was declared the world's most sustainable country in 2017. Lonely Planet has released a list of top ten best-value destinations to visit in 2019, picking Slovenia as one of them . In 2018 Slovenia was ranked sixth out of 125 countries on the World Energy Council's Energy Trilemma Index. The beauty and diversity of nature, stunning architecture, and delicious food are just some of many reasons to visit the cuntry with five different landscapes, you can swim in the Adriatic sea in the morning and climb mountains (Julian Alps, Kamnik-Savinja Alps or Charintian-Slovenian Alps) in the afternoon. The conference offers Social tours for accompanying persons to the most interesting places in Slovenia: Ljubljana; Postojna cave, Predjama castle, Piran, and the Lake Bled. We would also like to highlight the Technical tours: the first on 25 August to Kidričevo Compressor Station and Ptuj Wine Cellar and the second on 29 August to Hydro power plant of Brežice and the Otočec Castle. To discover more about Slovenia, you can visit this website, and watch the promotional video.

Ljubljana Castle[3]

Why Ljubljana?

Ljubljana received the prestigious title of the European Green Capital 2016, and truly lives to its reputation. The vibrant city with 50,000 students and around 276,000 inhabitants hosts over 10,000 cultural events annually, including 10 international festivals. The highlight of the summer season is the Ljubljana Festival, an open air international festival with 61 years of tradition. The last weekend in August (this year: 29 to 31 August 2019) the whole Ljubljana hosts vibrant Nights in Old Ljubljana Town, a festival with a packed three-day programme of open-air events (free of charge). Make sure that you are not going to miss the opportunity to experience this atmosphere after the conference! The Social events in the evenings will show the conference participants the best Ljubljana has to offer. The Conference cocktail dinner on 26 August 2019 awaits for you in the remarkable Ljubljana castle, and the Gala dinner on 27 August 2019 in the Cankar's Hall, the architectural landmark of Ljubljana.

Prešeren's square[4]

For more information about the conference and registration fees, please visit: https://iaee2019ljubljana.oyco.eu/ (early bird registration rates apply until 7 June 2019).

Photo credits: [1] The Faculty of Economics, University of Ljubljana: Jure Gubanc; [2] Ljubljana Tourism's photo library; [3] &[4] Turizem Bled

What Would Adam Smith Say About the Rush by Banks to Stop Funding Coal Power Plants?

BY TILAK K. DOSHI

Adam Smith famously said that **"I have never known much good done by those who affected to trade for the public good."** Nowhere is the merit of the great sage's insight more evident than in the veritable parade of banks that have rushed to end the financing of new coal power plants.

The reasoning among banks follows the familiar corporate social responsibility (CSR) route. CSR initiatives by banks call for investment or loan decisions based not on risks and rewards in a competitive market, but on judgment by corporate management on what is in the interest of society.

Larry Fink, chief executive of the world's largest asset management company, BlackRock, with US$6 trillion under management, recently called on the private sector to be more heavily involved in broader societal challenges.

Banks are rushing to end the funding of new coal power plants, based on corporate social responsibility (CSR)

Such challenges include workforce diversity, community engagement and, not least, environmental challenges. Banks seem to have agreed with Fink's call, and in Southeast Asia, this has taken a particular turn against coal power projects.

Over 90 per cent of coal power plants under construction are in Asia. After China and India, Southeast Asia is the region most invested in expanding coal-fired power generation. With a population of 650 million people, the region has some 65 million people without access to electricity and 250 million people still depend on traditional biomass - cow dung, crop residues, foraged wood and charcoal - for cooking and heating.

The region's governments have responded by planning over 170 gigawatts of new coal power projects. Coal represents the cheapest source of power and countries such as Indonesia and Vietnam with large populations have domestic sources of coal and are important exporters of the resource.

Intense campaigning by pressure groups such as the Sierra Club, Greenpeace, 350.org and Friends of the Earth have forced multilateral banks such as the World Bank and the Asian Development Bank as well as their private sector counterparts to stop funding coal power plants under the banner of mitigating climate change.

"If Vietnam goes forward with 40GW of coal, if the entire region implements the coal-based plans right now, I think we are finished," said the World Bank's President Jim Yong Kim. "That would spell disaster for us and our planet."

Perhaps the most pernicious aspect of banks' CSR initiatives is the vilifying of the increased use of fossil fuels to provide grid-based electricity. Development aid, multilateral finance and private sector project funding criteria - guided by a bias in favour of green technologies and notions of sustainable development - are imposing policies that are disastrous for the well-being of the most vulnerable populations in Southeast Asia and elsewhere in the developing world.

Tilak Doshi is a consultant in the energy sector, and the author of "Singapore in a Post-Kyoto World: Energy, Environment and the Economy" published by the Institute of Southeast Asian Studies (Singapore, 2015). This article appeared in the South China Morning Post print edition as: *Anti-coal power policy fuelling health crisis*

The rush to "save the climate" by banning coal power plants is leading to appalling impacts on human health. Indoor air pollution – caused by burning solid biomass for cooking and heating in households that do not have access to grid electricity and cleaner cooking fuels such as natural gas – is a leading cause of deaths in developing countries.

Coal power plants are still needed by many people in the developing economies of Southeast Asia

Close to 4 million people die prematurely from illness attributable to household air pollution each year, according to the World Health Organisation.

Governments in developing countries retain their legitimacy by promoting economic growth and raising the material standards of living for the mass of their citizens. Countries that have achieved rapid growth and higher per capita incomes such as China and India also face pressures to reduce air pollution which have become a major public health problem.

As the experience of the now-developed countries have shown, these problems have been resolved by available technologies, including high-efficiency, low-emission coal and natural gas-fuelled power plants, and cleaner transport and cooking fuels.

But this path is now being blocked by the private banks and their multilateral counterparts which disparage the use of fossil fuels in the cause of mitigating climate change.

This foreclosure to the established pattern of economic development is sanctioned by fulsome support for renewable energy technologies such as wind and solar as part of the "sustainable development" mantra. Private sector banks have become enthusiastic supporters of renewable energy even when such projects require subsidies from developing country governments that can ill-afford them.

It is commonly assumed that intermittent sources of renewable energy are viable substitutes for grid-supplied power based on fossil fuels. Claims are often made that wind and solar power are already competitive with fossil fuels and an endless stream of "green" success stories permeate the media. Yet, modern economic growth has not shown a single instance of a country successfully developing without the concomitant use of fossil fuels.

While many international banks, multilateral agencies and activist environmental groups now insist that less developed countries follow an untenable path to development by curtailing the use of fossil fuels, the competition to fund coal power projects in Southeast Asia is keen among the Chinese and Japanese banks.

It is perhaps instructive that the African Development Bank broke ranks recently with its World Bank and Asian Development Bank counterparts, in supporting coal-fired power projects in Nigeria, Kenya and elsewhere.

It is also encouraging that the current U.S. administration, competing against China's aggressive infrastructure investment drive in Asia and elsewhere, is supporting advanced, low-emission coal-powered projects in a "new energy realism" espoused by Energy Secretary Rick Perry.

One imagines that Adam Smith would have approved.

Corporate Social Responsibility and Governance of Hydropower – New Challenges in Energy Economics and Policy

BY WERNER HEDIGER

Werner Hediger is professor of economics and head of the Center for Economic Policy Research (ZWF) at the University of Applied Sciences HTW Chur, Chur, Switzerland. He may be reached at werner.hediger@htwchur.ch.

This research is part of the National Research Programme "Energy Turnaround" (NRP 70) of the Swiss National Science Foundation (SNSF). Further information on the National Research Programme can be found at www.nrp70.ch.

Nations are increasingly committed to energy transition, be it directly through their own energy and climate policies or indirectly when implementing the United Nations' sustainable development goals (SDGs). In this frame, the decarbonisation of energy systems as well as, in some countries, phasing out nuclear energy are the main goals of contemporary energy transition, along with the SDG of ensuring access to affordable, reliable, sustainable and modern energy for all. Altogether, this calls for structural changes in our energy system: changes with regard to the mix of energy carriers and technologies, as well as institutional changes. The latter involve new policy instruments in addition to changes in market design, governance and property rights. Regarding economic analyses and policy appraisals, these issues are to be integrated in a comprehensive approach of sustainable development. Epistemologically, this calls for new approaches that combine procedural with consequentialist thinking in an economic world characterized by imperfect competition, externalities and distributional conflicts. In addition, it implies interfaces between the firm, economy and societal level and requires an extension of traditional methods in an interdisciplinary setting with strong disciplinary foundations, e.g., in welfare economic theory.

This can be illustrated with the case of hydropower. The latter is to play a key role in the energy transition, especially in mountain areas. Though it is a clean and renewable source of energy, hydropower is not undisputed. Indeed, it can entail substantial impacts on the environment, economy and society. Accordingly, hydropower must be evaluated from a perspective of sustainable development. This involves the evaluation of tradeoffs across the various goals in the social, economic and environmental spheres (Barbier, 1987). For this purpose, new approaches emerged over the past decades. First, on a project and policy level, sustainability assessment is as a new and complementary tool to the established methods of project appraisal, such as environmental impact assessment, life-cycle assessment and cost-benefit analysis, etc. (e.g., Gasparotos et al., 2007). Second, corporate social responsibility (CSR) is the principle frequently applied to integrate the issues of sustainable development into corporate decision-making (McWilliams and Siegel, 2001; McWilliams, 2014).

Though, CSR can be key in this regard, no theoretical basis exists that is common to the various approaches that evolved in practice and in the business ethics, management and economics literature. The latter is either intimately linked to CSR as a strategic management approach (e.g., Bagnoli and Watts, 2003; Baron, 2007; Porter and Kramer, 2006) or to its welfare-economic foundations (e.g., Arrow, 1973; Beltratti, 2005; Heal, 2005; Hediger, 2010). In a comprehensive approach of sustainable development and a modern theory of the firm, these two streams of thought must be combined, such as to align process and outcome orientation in an over-arching governance approach. The latter generally refers to the structures and processes "designed to ensure accountability, transparency, responsiveness, rule of law, stability, equity and inclusiveness, empowerment, and broad-based participation", and thus "represents the norms, values and rules of the game through which public affairs are managed in a manner that is transparent, participatory, inclusive and responsive" (UNESCO, 2018). Ultimately, this implicates new views on corporate and public governance, along with the integrated evaluation of corporate performances from a financial and societal perspective of sustainable development. CSR is a key principle for this purpose.

First, CSR is generally defined as the business world's commitment and contribution to sustainable development. Second, it implicates a shift away from the pure shareholder perspective of maximizing profits and corporate value to a broader understanding of operation that encompasses various conflicting goals and multi-stakeholder concerns. This does neither imply that a company must necessarily fulfil any normative criterion of sustainable development and behave in a socially responsible manner, nor does it make obsolete regulation and legislation about social rights and environmental standards. Rather, CSR calls for shared responsibility between the government and private businesses, a challenge that intimately applies to energy systems, in general, and hydropower, in particular. Indeed, the management of water resources is generally regarded as a joint responsibility of public and private actors (Rahaman and Varis, 2005). Accordingly, the challenge of CSR directly applies to activities in the hydropower industry (Hediger, 2018). The latter is likewise influenced by development of different energy markets and by the institutional settings in individual countries and at different locations. Hence, the strategies and performance of hydropower companies must be developed, evaluated and implemented in the concrete context of the prevailing economic, institutional, cultural, geographical and political spheres.

From a welfare-economic perspective, the externalities and distributional effects going along with corporate activities are core to the concept of CSR (Heal, 2005). Regarding hydropower, they particularly involve the socio-economic and environmental impacts of a firm's undertakings as well as the distribution of water resource rents, profits and taxes among different stakeholders and territorial entities (Hediger, 2018). Apparently, this includes issues of efficiency and equity that need to be addressed when evaluating hydropower projects and assessing the CSR performance of the companies involved. A fundamental concept in this regard is that of resource rent. It is defined as a surplus that results when converting a natural resource (e.g., waterpower) into a marketable product (e.g., electricity). Formally, this corresponds to the difference between the price of the good produced using the natural resource and the unit cost of turning that natural resource into this good (Hartwick and Olewiler, 1997). What remains after netting-out these costs is the value of the natural resource: here, the waterpower. In the first instance, this value (the water resource rent) flows as an income to the holder of property or use rights on that resource: the water. But, since hydropower is capital intensive, some share of the resource rent – i.e., the net revenue from hydropower operations – is also claimed by the capital owners, paid out as dividends or kept back for future investments. Thus, from a theoretical point of view, dividends, royalties and corporate taxes are elements of revenue sharing among different stakeholders rather than cost factors. Accordingly, the CSR framework must explicitly reflect the distribution of resource rents through royalties, dividends and corporate taxes. The regulation of this revenue distribution is an issue of political economics, and cannot exclusively be based on efficiency considerations.

In this context, one must also recognize that social responsibility, transparency and accountability are core sustainability principles (IHA, 2010) that are further involved with the concepts of CSR and corporate governance. The latter involves the classic problems between owners and managers, as well as problems between owners themselves and between stakeholders (Beltratti, 2005; Shleifer and Vishny, 1997; Tirole, 2001). Such problems result whenever some agents coordinate their actions in order to increase their benefits at the expense of other stakeholders' benefits. Thus, corporate governance and CSR are complementary. They can reinforce each other in a modern vision of the firm as an institution that accounts for rather than disregards its impacts on society when searching to increase its corporate value.

Formally, CSR is the key principle to integrate the above concerns in a coherent way. It implies a translation of the normative framework of sustainable development to the corporate level and must account for the impacts of corporate activities on the economy, society and environment. Hediger (2010, 2018) provides a generic framework that formally integrates in a welfare-economic framework the corporate and societal perspectives of a firm's activities, in general, and of hydropower companies, in particular. With the welfare-economic foundation of CSR, we explicitly account for externalities and distributional concerns. Those are above all important when it comes to decisions about investments in hydropower plants from both a corporate and societal (governmental) point of view and the sharing of revenues among different constituencies and territories. Ultimately, this involves the direct and indirect financial incidence through the distribution of dividends, royalties and taxes among the different state entities, which is particularly important in federalist or hierarchically structured political systems.

Building on this background, one can firmly show that investment decisions should not exclusively be based on financial considerations. Societal and wider economic aspects must also be taken into account. Nonetheless, from an economic and societal perspective, investment decisions are primarily to be taken for allocation (efficiency) reasons, rather than involve distributional concerns in the first instance.

Hence, investments into retrofitting and new hydropower plants should be undertaken as long as the total value of hydropower – i.e., its private and external value – exceeds the cost of investment, even if electricity prices and the profitability of such plants are low. Moreover, discussions about the distribution of resource rents and the granting of hydropower concessions must involve a political-economic discourse about the governance and ownership structure of hydropower companies, as well as investments by public entities and philanthropic investors who also care about the societal values of hydropower. This is justified by the fact that CSR calls for shared responsibility between the government (or the regulator) and private businesses running hydropower plants.

Altogether, CSR is a core principle in designing future governance of hydropower, in particular, and energy systems, in general. Above all, this involves the assessment of corporate and an energy systems' contributions to sustainable development, respectively, as well as issues related to market structure, property rights and the distribution of (water) resource rents. Altogether, this shall support better informed decision making on both corporate and policy levels, especially regarding investments in hydropower and wider energy systems, when social concerns are at stake and when discussing alternative energy policy options.

References

Arrow, K.J. (1973). Social Responsibility and Economic Efficiency. Public

Policy, 21, 303–317.

Bagnoli, M., and Watts, S. (2003). Selling to socially responsible consumers: competition and the private provision of public goods. Journal of Economics and Management Strategy 12(3), 419–445. https://doi.org/10.1111/j.1430-9134.2003.00419.x

Barbier, E.B. (1987). The Concept of Sustainable Economic Development. Environmental Conservation 14(2), 101-110. https://doi.org/10.1017/S0376892900011449

Baron, D.P. (2007). Corporate social responsibility and social entrepreneurship. Journal of Economics and Management Strategy 16 (3), 683–717. https://doi.org/10.1111/j.1530-9134.2007.00154.x

Beltratti, A. (2005). The Complementarity between Corporate Governance and Corporate Social Responsibility. Geneva Papers on Risk and Insurance: Issues and Practice, 30(3), 373–386. https://link.springer.com/article/10.1057/palgrave.gpp.2510035

Gasparatos, A., and Scolobig, A. (2012). Choosing the most appropriate sustainability assessment tool. Ecological Economics, 80: 1-7. http://www.gasparatos-lab.org/uploads/7/6/6/1/76614589/gasparatos_and_scolobig_2012_ecological_economic.pdf

Hartwick J.M., and Olewiler, N.D. (1998). The Economics of Natural Resource Use. Second edition, Addison-Wesley.

Heal, G. (2005). Corporate Social Responsibility: an Economic and Financial Framework. Geneva Papers on Risk and Insurance: Issues and Practice, 30(3), 387–409. https://link.springer.com/article/10.1057/palgrave.gpp.2510037

Hediger, W. Welfare and capital-theoretic foundations of corporate social responsibility and corporate sustainability. Journal of socio Economics, 2010, 39, 518-526. https://doi.org/10.1016/j.socec.2010.02.001

Hediger, W. (2018). The Corporate Social Responsibility of Hydropower Companies in Alpine Regions—Theory and Policy Recommendations. Sustainability, *10*(10), 3594. https://doi.org/10.3390/su10103594

IHA (2010). Hydropower Sustainability Assessment Protocol. International Hydropower Association (IHA), London, UK. http://www.hydrosustainability.org/Protocol.aspx (accessed 07-12-2018).

McWilliams, A., Editor (2014). Economics of Corporate Social Responsibility. The International Library of Critical Writings in Economics, Edward Elgar: Cheltenham, UK; ISBN: 9781783471430.

McWilliams, A., and Siegel, D. (2001). Corporate social responsibility: a theory of the firm perspective. Academy of Management Review, 26: 117-127. https://doi.org/10.5465/amr.2001.4011987

Porter, M.E., and Kramer, M.R. (2006). Strategy and society: the link between competitive advantage and corporate social responsibility. Harvard Business Review, 84, 78-92.

Rahaman, M.M., and Varis, O. (2005). Integrated water resources management: evolution, prospects and future challenges. Sustainability: Science, Practice and Policy, 1(1), 15-21. https://doi.org/10.1080/15487733.2005.11907961

Shleifer, A., and Vishny, R.W. (1997) A survey of corporate governance. Journal of Finance, 52: 737–783. https://doi.org/10.1111/j.1540-6261.1997.tb04820.x

Tirole, J. (2001). Corporate Governance. Econometrica, 69 (1), 1–35. https://doi.org/10.1111/1468-0262.00177

UNESCO (2017). Concept of Governance. United Nations Educational, Scientific and Cultural Organization, http://www.ibe.unesco.org/en/geqaf/technical-notes/concept-governance (accessed 07-12-2018).

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

A New Approach to Valuing Reliability in Australia's National Electricity Market

BY TOM WALKER, SUZANNE FALVI AND TIM NELSON

Introduction

The Australian National Electricity Market (NEM) is an interconnected electricity market which operates in the five eastern and southern states of Australia, as well as the Australian Capital Territory. Its basic market supply chain involves:

- a competitive wholesale market where market participants (for example generators and retailers) trade electricity through a gross uniform clearing pool, operated by the Australian Energy Market Operator (AEMO),
- a restructured competitive retail market where retailers manage price risks in the wholesale market and provide electricity retailing services to consumers, and
- network services provided by monopoly network businesses, which are economically regulated.

This article focuses on reliability in the competitive parts of the supply chain: the provision of sufficient generation to meet demand at any given point in time and the role of retailers in managing these risks on behalf of customers[1]

The Provision of Reliability in the NEM

In the NEM, reliability is primarily provided through competitive markets. As a gross pool, all market customers are settled at the spot market price for all electricity delivered through the system.[2]

Retailers buy electricity from the gross uniform price pool on behalf of their customers (end consumers). The price can be inherently volatile, rising from $-1,000 to over $14,000 in a half-hour pricing period. Retailers typically enter into retail contracts with end consumers for the delivery of an unknown quantity of electricity at a price which does not vary dynamically with the wholesale market spot price. As a result retailers take spot price risk, arising from the difference between the spot price (highly variable) and the retail price (typically largely fixed through annual or longer-dated contracts).

Retailers then manage this significant financial risk by entering into financial hedging contracts (or vertically integrating) with generators or demand respond providers (or financial intermediaries), which provides revenue certainty to these entities. In turn, these entities manage the risk of their own contractual positions through the physical provision of generation or demand response. The financial contract market is therefore a crucial mechanism through which physical generation and demand response capacity is provided and hence a reliable supply of electricity is delivered to consumers.

No electricity system can guarantee that there will be zero unserved energy (USE), as this would require sufficient generation to be available at all times to meet any conceivable level of demand. Instead, the NEM has a reliability standard of a maximum expected USE in a region of 0.002% of the total energy demanded in a region for a given financial year. The Australian Energy Market Commission's (AEMC's) Reliability Panel recommends to the AEMC the appropriate level for the market price cap (MPC) and other reliability settings with regard to the USE standard.[3] The market price cap limits retailers' and generators' spot price exposure, and so limits their incentives to contract for, and invest in, generation capacity. The MPC is currently $AUD14,500/MWh.

Reliability outcomes in the NEM have historically been high, as measured against the reliability standard. Furthermore, between 2007-08 and 2016-17, only 0.23% of supply interruptions were as a consequence of reliability, as distinct from network or security related interruptions.[4]

Despite this strong historic performance, there has become increasing concern that the reliability framework of the NEM will not remain fit-for-purpose in the future. Rapid technological change in the energy sector and government policy has resulted in material additional very low short-run marginal cost renewable generation. The 'merit-order effect' of an energy-only market design created a comparatively low wholesale electricity pricing environment and economic pressure on ageing surplus coal-fired generation led to 10 coal-fired power stations being permanently retired, with more than 5000 MW of capacity with-drawn from service. The cheapest form of energy in Australia is now wind or solar PV and declining underlying energy demand has resulted in conditions being unsuitable for investment in higher capacity factor thermal plant. Australia is now grappling with the challenge

Tom Walker is a Senior Technical Specialist, Economics at the Australian Energy Market Commission. **Suzanne Falvi** is Executive General Manager of Security and Reliability at the Australian Energy Market Commission. **Tim Nelson** is Executive General Manager of Strategy and Economics at the Australian Energy Market Commission and Associate Professor of Economics at Griffith University. He may be reached at tim.nelson@aemc.gov.au

All views expressed in this article are those of the authors and not those of the Australian Energy Market Commission or Griffith University. The potential mechanism in this paper was first discussed in an Australian Energy Market Commission discussion paper - https://www.aemc.gov.au/sites/default/files/2018-11/Consultation%20paper.pdf

See footnotes at end of text.

of integrating high proportions of large-scale and distributed renewable generation within its electricity system in a manner than ensures reliable, affordable, and low-emissions supply is forthcoming.[5]

Concerns about reliability have led to short-term solutions being adopted. For example, in the summer of 2017/18, for the first time, AEMO procured reserves as a precautionary measure under the NEM's strategic reserve market intervention mechanism (the Reliability Emergency Reserve Trader (RERT)). With the considerable benefit of hindsight, these reserves were not needed. The approximately $AUD52m of direct costs relating to the RERT were ultimately recovered from consumers.[6] Indirect costs due to market distortions may also arise from the use of such interventions.

It is in this context that we consider a new potential longer-term reliability framework reform option: a load shedding compensation mechanism (LSCM).

Possible Issue Due to the Allocation of the Risk of Load Shedding

When there is insufficient generation to meet demand at any given time, the market operator (AEMO) initiates involuntary load shedding of consumers. When this occurs, the spot price rises to the market price cap but retailers are not liable for the electricity that would otherwise have been consumed by their customers. Consumers, not retailers, bear the risk of load shedding for reliability reasons through the loss of value that they would otherwise derive from the consumption of electricity (e.g., not being able to produce widgets or power their homes).

Retailers take account of their expected exposure to the spot price when determining their contractual positions. Given that retailers are not exposed to the spot price for load that is shed, this may be resulting in inefficient under contracting for generation or demand response because retailers may have a financial incentive to hedge with regard to their expected exposure (i.e., the expected load served) rather than with regard to the level of demand including USE. By not contracting for as much generation or demand response than would otherwise be the case, the overall level of reliability may be sub-optimal from the perspective of economic efficiency.

How the Load Shedding Compensation Mechanism Addresses this Issue

Under the LSCM, in the event of involuntary load shedding as a result of reliability issues (i.e., a lack of supply to meet demand), retailers would be exposed to the volume of load that they would otherwise have purchased, at the market price (the MPC).

This would shift risks of load shedding from consumers to retailers, who may be better placed to manage it than end consumers because they are better able to participate in risk management activities such as entering into financial contracts with generators or demand response providers. In order to manage these risks, it is likely that retailers would choose to contract more with generators and demand responders to manage the financial risk, which lessens the probability of load shedding since there would be more resources available in the market.

In the event of reliability related load shedding, a baseline would be used to determine the amount of electricity expected to be consumed by a consumer were it not for the load shedding.

Retailers would be settled on the baseline quantity of electricity, at the spot price (MPC). The actual amount of electricity delivered multiplied by the spot price (MPC) would be paid to generators (as is the case currently), while the difference between the actual and baseline amount multiplied by the spot price (MPC) would be provided to the end users whose load was shed, most likely through a rebate in their next electricity bill. Each consumer supplied via a particular feeder that is load shed might be compensated the average amount related to that feeder, or a more sophisticated division of compensation could be used, particularly in a market where all customer consumption is monitored through digital interval metering.

This mechanism shares many characteristics to an insurance mechanism suggested by Billimoria and Poudineh (2018).[7] Their mechanism involved a third party providing financial insurance to a consumer in the event of load shedding. In the model proposed in this article, it would be the retailer, not a third party, which would provide the insurance.

The LSCM would not compensate consumers for non-reliability related outages such as any outage resulting from network failures. As noted earlier in this article, non-reliability related outages constitute the vast majority of supply interruptions experienced by consumers in the NEM.

Possible Benefits and Issues of the LSCM

As noted above, the LSCM provides an incentive for retailers to manage the financial risk of load shedding. By managing the risk more efficiently than end consumers, a more efficient level of generation and demand response is likely to be forthcoming and thereby facilitate a more efficient level of reliability, or allow for a reduction in prices for a given level of reliability.

While each individual retailer might initially pay compensation to their consumers if they are load shed, they will not ultimately be exposed to the cost of that compensation if they are sufficiently hedged. It is those parties (retailers, generators, or financial intermediaries) which are short in the market which will ultimately pay the compensation, once all the financial positions have been accounted for. Indeed, if no party is short then by definition there will be no load shedding because sufficient generation, demand response or other services will have been provided to meet demand.

There are a number of possible issues with the LSCM that would need to be carefully considered. These include:

- Errors in the baseline would result in inefficient incentives for retailers, although there may be a lower risk of systemic bias in LSCM baselines compared to baselines used in some demand response mechanisms internationally.
- It would have to be possible to accurately distinguish between load shedding as a result of wholesale market reliability and other causes of load shedding, such as network outages or system security events. Retailers should not be liable for any risks that they themselves cannot manage.
- In the current arrangements, there is nothing stopping retailers providing compensation to end consumers in the event of load shedding. Arguably, provided the retail market is sufficiently competitive and end consumers are sufficiently sophisticated buyers, retail offerings which provide compensation (or insurance) in the event of load shedding should emerge, to the extent that consumers value it and are willing to pay for it through an amendment to tariffs. This would suggest a regulatory solution to this issue may not be necessary.

The LSCM may have a number of other consequential impacts on the NEM's reliability framework. For example:

- Since the risks of load shedding would be on retailers, there would be additional costs placed on these parties through entering into more hedging contracts. As a consequence of the increased cost of entering into hedging contracts, it might be expected that retail prices go up if the reliability settings such as the market price cap remain unchanged. It may therefore be appropriate that the market price cap is reduced, to counteract this effect, with the intent of reducing prices for any given level of reliability.
- Providing the level of compensation for consumers was set at the value of consumer reliability (i.e., providing the market price cap was set at the value of consumer reliability), consumers would be indifferent between having their load shed (with compensation) and continuing to have access to electricity. Implementing the LSCM may allow for less reliance to be placed on out-of-market solutions such as the RERT. Retailers and market participants, and not the market operator through the RERT, would be managing the risk of load shedding. Retailers would have financial incentives to manage the risk efficiently, and, to the extent that they do not, it is they and not consumers who primarily bear the cost. As such, the LSCM seeks to allocate costs and risks more efficiently than an out-of-market solution such as the RERT.
- The reliability standard: Under the LSCM, retailers would be incentivised to deliver the lowest cost combination of generation, voluntary demand response and compensation for involuntary load shedding. This in turn should deliver the level of unserved energy that minimises the combined cost of load shedding, demand response and generation. This could effectively deliver the optimal amount of unserved energy. The implications for the reliability standard would require further thought.

Conclusion

A compensation mechanism in the event of involuntary load shedding, paid for by retailers, may better allocate the risk of load shedding to those well placed to manage it. In turn, this may be expected to improve reliability outcomes (or reduce costs for a given reliability outcome), and reduce the NEM's reliance on out-of-market intervention measures such as the RERT.

Footnotes

[1] In the NEM, reliability (the provision of sufficient capacity to meet demand) is distinguished from 'security', which relates to whether the system is operating within certain limits for technical parameters (for example, voltage or frequency). This paper does not consider security or network reliability issues.

[2] The NEM is divided into five interconnected pricing regions, corresponding to the five states. The Australian Capital Territory is an enclave of the state of New South Wales, and so is in the New South Wales region of the NEM.

[3] The AEMC makes and revise the energy rules and provide advice to Australian federal and state governments. The Reliability Panel is comprised of members appointed by the AEMC who represent a range of participants in the national electricity market, including consumer groups, generators, network businesses, retailers and AEMO.

[4] AEMC, Reliability Frameworks Review, Final Report, 26 July 2018, pp. 12-13.

[5] See https://www.sciencedirect.com/science/article/pii/S1040619017303500

[6] https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/RERT-Update---cost-of-RERT-2017-18.pdf

[7] F. Billimoria and R. Poudineh, Decarbonized Market Design: An Insurance Overlay on Energy-Only Electricity Markets, the Oxford Institute for Energy Studies, 2018.

7th IAEE Asia-Oceania Conference 2020
Auckland, New Zealand | 12-15 February

Energy in Transition

Nau mai, tōia mai, piki mai, tōia mai, haere mai.
Welcome, bring your energy, ascend the heights, welcome.

The Energy Centre is delighted to extend a warm invitation for you to join us in Auckland, New Zealand, for the 7th IAEE Asia-Oceania Conference 2020.

The overall theme is to understand and debate the implications of the emerging energy transition for energy markets and consider and debate policies to facilitate the transition.

We are now accepting abstracts presenting research on the following topics:

- Asian Energy in transition by 2040
- Fossil Fuels
- Smart Cities
- Efficient Energy
- Electricity Markets
- Energy Transitions in Transport
- Low-carbon economy
- Policies and regulations

Abstract submissions close 6 September 2019.

For more information about the conference and submission guidelines please visit iaee2020.nz

He waka eke noa tātou. We embark on a journey together.

What Do We Do When Energy Is Free?

BY PHILIP THOMPSON

The phrase "too cheap to meter," attributed to a speech by then AEC Chairman Lewis Strauss in 1954, has been debated as to its actual meaning, has often been used to critically point out the hubris of early nuclear power advocates, and did not escape criticism at the time. One of the criticisms, coming from the president of Cleveland Electric Illuminating, was that the statement did not make sense because fuel costs made up a relatively small share of electric bills (Wellock, 2016).

While even the most fervent renewable electricity advocate does not claim that such generation will be cost free, it is not hard to imagine a future world in which a combination of batteries and intermittent renewables (including hydropower) may become the dominant if not exclusive source of electricity generation. There is an ongoing lively debate over the question of whether flexible fossil fuel generation can still provide value (see, for example, Kane and King, 2017, along with the technical papers cited therein), but it would play a much reduced role, such that marginal generating cost in most hours would depend only on solar or wind.

Favorable government policies such as subsidies and renewable portfolio standards have played a significant role in increasing the proportion of wind and solar electricity on the grid, but the real costs of these technologies (which are essentially all capacity related) have fallen considerably as well. Recent auction results in wholesale electricity markets in the U.S. (see, e.g., Maloney, 2018) indicate that intermittent renewables coupled with battery storage are giving traditional fossil fuel based generation technologies a run for their money. This trend is likely to continue, despite the existing schedule for the gradual elimination of subsidies for renewables.

One potential endpoint of this progression is that a combination of intermittent renewables and batteries becomes the dominant if not exclusive source of electricity generation. In such a system the marginal ("energy") cost of a kilowatt-hour would effectively be zero, including emissions costs. Zero marginal cost electrical energy would raise significant questions regarding the appropriateness of current regulatory approaches. Three important policy areas for regulators in which economic analysis will be critical are pricing and rate design, wholesale market design, and the evaluation of energy efficiency. We consider each in what follows. And while some suggestions will be offered along the way, the primary purpose of this article is to stimulate thinking about some of the more interesting regulatory economics questions that will have to be addressed in a zero variable generation cost world.

Philip Thompson is a professor in the Department of Economics and Institute for Energy Studies, Western Washington University. He may be reached at philip.thompson@wwu.edu

Rate Design

In traditional rate designs, residential and most small business customers' rates consist of a basic ("customer") charge per month and additional per kWh energy charges, which may vary by monthly consumption block or by season. Rates for larger customers also include a per kW demand charge, with the billing quantity dependent on some variation of the customer's peak demand. Most customers are served under tariffs that do not include time-varying prices, despite the fact that marginal generation costs differ considerably over a single day. The historical rationale for these rate designs is that the additional cost of interval metering isn't justified by the welfare gains that would result. Time sensitive prices have therefore not been widely applied, despite the inefficiencies that result from charging the same price in all periods. The rapid increase in the number of so-called smart (Advanced Metering Infrastructure, or AMI) meters, which in 2017 accounted for about 52% of residential and 50% of commercial meters (EIA, 2018), is making time-sensitive or demand related pricing approaches possible for a much larger number of customers. Would the ability to charge time-varying prices become more important or less so in a zero marginal cost world?

The advent of increasing amounts of residential rooftop solar customers has caused a number of state regulatory commissions to rethink the pricing of electricity sold back to the grid by such customers, which in turn has opened a larger conversation about rate design in general. The widespread use of net metering, in which a rooftop solar customer is effectively paid the full retail rate for power sold back to the grid, has been claimed to result in subsidies of solar customers by those without panels on the roof. Whether or not that is true is being debated in many states, with the central question being the value of solar. Regardless of the outcome of that particular debate, it has led to a reconsideration of rate design for customer classes that include increasing numbers of customers who have rooftop solar generation. But that process also has broader implications for future rate designs based on zero marginal cost energy.

One of the tenets of good rate design, following basic efficient pricing principles, is to set rates as close as possible to marginal cost, while recognizing that the regulated utility's required revenues must be made up through fixed charges, since the (average hourly) marginal cost of generation is less than the average total cost of providing service. But if energy costs are in fact zero, efficient pricing would call for a per-kWh price of zero. This would require the entirety of electricity supply costs to be recovered through fixed monthly and demand-related charges.

The imposition of demand charges on residential customers has been considered in multiple jurisdictions, in many cases in response to the aforementioned net-metering issue. One criticism of demand charges is that residential and small business customers are usually unable to adapt usage patterns to control peak demands in a way that would reduce the demand charge portion of their bills, but this criticism will lose validity in the future as more appliances (and especially those that impose high instantaneous demands, such as air conditioners, water heaters, and refrigerators) become “smart” and programmable. Another criticism of demand charges is that a customer’s peak demands do not necessarily occur at the time of system peak (see, e.g., Borenstein, 2016), but that issue can be more easily accommodated with AMI technology, which can tell us what a customer’s demand is at the system peak. (While Borenstein correctly points out that sunk local distribution costs do not change as customers on the local system change their demands, it is nevertheless true that 1) these systems must be built to meet the peak of some localized subgroup of customers, and that 2) if demands in a specific local area increase in the long run, such as would occur with significant increases in electric vehicle charging, distribution capacity would likely have to be increased as well.) A third criticism of demand charges is distributional, in the sense that shifting cost recovery away from the variable rate elements to fixed or demand based elements would harm low-income customers, who typically consume less electricity than higher income households. But many utilities already have low-income assistance measures in place, and there is no reason why similar programs could not be carried out if utility bills are made up entirely of fixed and demand charges.

In short, the debates over rate design in a zero marginal cost world would likely not differ much from those we see today, but they may very well be more intense as more and more revenue will have to be recovered from fixed and demand charges rather than from variable per kWh rates.

Market Design

Markets for wholesale generation have been transformed dramatically over the past 25 years as the old traditional integrated utility model has been dropped in many regions in favor of some form of competitive markets. Regulatory restructuring at the wholesale level has led to the creation of a new set of market participants such as Independent System Operators (ISOs) and Independent Power Producers (IPPs). The recent emergence of significant quantities of low variable cost generation resulting from low natural gas prices and rising penetration of zero marginal generation cost renewables has raised numerous issues in wholesale markets. Low hourly energy prices have contributed to the early retirements of (primarily) large baseload coal and nuclear generating units and have led to some concerns over the adequacy (in terms of both quantity and operational availability) of future capacity additions. What appear to be mostly political concerns have led to efforts at both the federal and state levels to prevent the early closures of plants through various policy approaches, including subsidization and even mandated inclusion of what otherwise would be uneconomic generating units. These problems (if such early retirements are in fact real economic problems) would be exacerbated in a zero marginal generating cost scenario. It is not entirely clear that the capacity markets used in some ISOs, as currently designed, fully alleviate concerns about future capacity adequacy.

We normally think of the day ahead and hourly energy markets operated by ISOs as places where *energy* (i.e., MWhs) is traded; prices are expressed in dollars per MWh. But in a system consisting primarily of zero marginal cost sources, how would “energy only” markets work? Generating units with positive marginal costs would probably be employed under certain circumstances, but only in a limited number of hours. How would generators be able to recover the cost of capacity investments in such a pricing environment? Would hourly energy markets evolve into long-term capacity markets while pure energy exchanges account for only a small fraction of total electricity use? Would long-term bilateral contracts become the dominant form of supply arrangements? These and many other related questions will have to be addressed; clearly, wholesale markets will have to be rethought extensively in a zero variable cost world.

Energy Efficiency

A utility recently proposed cutting its energy efficiency targets in large part because the value of electricity use efficiency would decline over time as the penetration of renewable electricity generation increased, since renewables such as wind and solar have very low (if not zero) marginal costs (Walton, 2018). Although energy efficiency is sometimes thought of as (instantaneous) demand reduction, for the most part efficiency in electricity use emphasizes a reduction in kWh. When a consumer evaluates a potential energy efficiency investment such as adding insulation or buying a more efficient air conditioner, per kWh prices loom large in the calculations, in part because of the current rate designs that are in place. And while some utility efficiency programs are targeted at reducing system peak demands, their overall emphasis tends to be on lowering kWh usage.

How would zero marginal cost energy change the evaluation of energy efficiency from a social standpoint? Efficiency values from the vantage point of a consumer depends on rate design more than on actual upstream generating costs, which often do not correspond very well, especially given potentially large short term variations in the latter. From a social standpoint, however, the value of energy efficiency derives from the avoidance of both capacity and variable energy costs. If variable energy costs fall effectively to zero, "energy" efficiency measures will have value only insofar as they allow the avoidance of capacity (either from generation or storage facilities) costs. While it is true that many energy efficiency measures also reduce the peak demands resulting from a given energy use (lighting, space conditioning, etc.), the avoided fuel cost element of energy efficiency values will be essentially zero. Demand management activities such as pricing strategies (e.g., critical peak pricing and rebates) or the direct load control through smart meters and appliances that are aimed at peak shaving and increasing load factors will take center stage in efficiency efforts, but merely saving a kWh of usage will be of little value.

Conclusion

Energy economists rightly spend their time examining the multitude of technical and policy issues associated with various aspects of today's energy usage, production processes, and markets. But it is worthwhile to occasionally ask what the future holds and how technological advancement can affect the way we think about energy. There are many important ramifications of a zero marginal cost future that have not been considered in this article; our intent has been to touch on just a few that will have important implications for regulators. While these issues may be thought of as problems to be solved, they would seem to be the kinds of problems we would like to have as we learn how to take advantage of the free energy sources nature has provided. To aid in this effort economists should continue to help tailor policies that will best accommodate transformed energy systems, and think about how people will react to them.

References

Borenstein, Severin, 2016. "The Economics of Fixed Cost Recovery by Utilities." Energy Institute at Haas WP 272, July 2016. https://ei.haas.berkeley.edu/research/papers/WP272.pdf

Energy Information Administration, 2018. "Table 10.10.Advanced Metering Count by Technology Type, 2008-2017." Accessed Nov. 24, 2018. https://www.eia.gov/electricity/annual/html/epa_10_10.html

Kane, Daniel, and Anthony King, 2017. "Fighting Global Warming and Climate Change Requires a Broad Energy Portfolio," UC San Diego Deep Decarbonization Initiative, http://deepdecarbon.ucsd.edu/policy-and-tech/energy-portfolio.html , Accessed Dec. 1, 2018

Maloney, Peter. 2018. "Renewable plus storage bids in Xcel Colorado solicitation could set low-price benchmark," Utility Dive, Jan. 16, 2018. Accessed Jan. 16, 2018. https://www.utilitydive.com/news/renewable-plus-storage-bids-in-xcel-colorado-solicitation-could-set-low-pri/514566/

Walton, Robert, 2018. "Lower Rocky Mountain Power efficiency targets put tradeoff with renewables into focus," Utility Dive, Nov. 6, 2018. Accessed Nov. 6, 2018. https://www.utilitydive.com/news/lower-rocky-mountain-power-efficiency-targets-put-trade-off-with-renewables/541437/

Wellock, Thomas, 2016. "Too Cheap to Meter": A History of the Phrase. NRC Blog; (https://public-blog.nrc-gateway.gov/2016/06/03/too-cheap-to-meter-a-history-of-the-phrase/) Accessed Dec. 1, 2018.

WELCOME NEW MEMBERS

The following individuals joined IAEE from 1/1/2019 to 2/28/2019

Yakubu Abdul-Salam
Heriot Watt University
UNITED KINGDOM

Tatsuya Abe
Waseda University
JAPAN

Malcolm Adams
Adams Dunlap Capital Management
USA

K M Mehedi Adnan
Huazhong Agricultural University
CHINA

Yaw Ahali
University of Reading
UNITED KINGDOM

Andrew Akweny
Xiamen University
CHINA

Foqoruddin Al Kabir
North South University
BANGLADESH

Zulfiya Alizada
Embassy of Azerbaijan
BULGARIA

Naif AlSaleh
Ofgem
UNITED KINGDOM

Mohamed Aly Abdel-Raheem
EGYPT

Ke An
Nagasaki University
JAPAN

Tiho Ancev
University of Sydney
AUSTRALIA

Petya Andonova
EWRC
BULGARIA

Goril Louise Andreassen
NMBU
NORWAY

Marco Andreozzi
PegasoCanton Ltd.
ITALY

Jordanka Angelova
Sofia University
BULGARIA

Nicolas Anjinho
EY
SOUTH AFRICA

Carl-Philipp Anke
GERMANY

Andi Aranitasi
Power and Energy, EBRD
BULGARIA

Travis Atkinson
Purdue University
USA

Alexandre Auffret
TOTAL E&P Bulgaria BV
BULGARIA

Frida Hugaas Aulie
Norwegian Water Resource and Energy
NORWAY

Ridvan Aydin
IGDAS
TURKEY

Dina Azhgaliyeva
National University of Singapore
SINGAPORE

Martin Bader
GIZ
BANGLADESH

Yunyan(Ava) Bao
USA

Edito Barcelona
Asia Pacific Energy Research Centre
JAPAN

Alexandre Baule
FRANCE

Antoine Bavencoffe
GRT gaz
FRANCE

Munkhsoyol Bayaraa
Huazhong university
MONGOLIA

Robin Beer
RWTH Aachen
GERMANY

Christophe Beguinet
ENEDIS
FRANCE

Thomas Bel
PwC
FRANCE

Fateh Belaid
FRANCE

Derrick Bell
Lehigh University
USA

Marten Bergman
Svenska Kraftnat
SWEDEN

Lukas Bistry
GERMANY

Jens Bjoorn
Fortum Sverige AB
SWEDEN

Antonino Bonfiglio
ITALY

Pascal Bovy
LeanBia
FRANCE

Martin Boyadjiev
University of Mining and Geology
BULGARIA

Martin Boyadzhiev
AES Bulgaria
BULGARIA

Ivan Breshkov
Sofia University
BULGARIA

Marc Brueil
EnR Pro Conseil
FRANCE

Jacques Buchet
FRANCE

Ines Carrilho Nunes
Instituto Superior Técnico
PORTUGAL

Alain Castinel
UFIP
FRANCE

Pauline Caumon
EDF
FRANCE

Gurkan Caylak
SOCAR
TURKEY

Dongfeng Chang
Shandong University
CHINA

Liu Chang
Southwestern University
CHINA

Christine Chapuis
EDF
FRANCE

Thierry Chapuis
Assoc Francaise du Gaz
FRANCE

Nicolas Chaste
Popcycle Solutions
FRANCE

Ziqiao Chen
Syracuse University
USA

LIi Chengyu
handong University
CHINA

Franck Chevallier
UFIP
FRANCE

Eunsol Cho
KAIST
Republic of Korea

Bianca Cid Bouzas
Univ da Coruna
SPAIN

Gregoire Collin
FRANCE

Matthew Cude
Chevron
USA

Amaya De Ayala Bilbao
Univ del Pais Vasco
SPAIN

Antoine de la Faire
ENGIE
FRANCE

Vincent Delalande
ENEDIS
FRANCE

Nikola Delev
Overgas Mrezhi AD
BULGARIA

Zulal Denaux
Valdosta State University
USA

Galya Deyanova
University of Sofia
BULGARIA

Luis Ramiro Diaz Lopez
VECTIA
SPAIN

Nikola Dimitrov
Sofia University
BULGARIA

Svetoslav Dimitrov
Sofia University
BULGARIA

Iglika Dokova
US DOE ERO
BULGARIA

Comfort Doo Vingil
PPPRA
NIGERIA

Wolfgang Dopf
Linz AG
AUSTRIA

Michael Dowling
Rennes School of Business
FRANCE

Yajuan Du
Zhongnan University
CHINA

Na Duan
Tianjin University
CHINA

Ivo Dyulgerov
Sofia University
BULGARIA

Jerzy Dzieza
AGH Univ of Sci and Tech
POLAND

Wael Elshamy
CTMC
EGYPT

Tasko Ermenkov
Bulgarian National Assembly
BULGARIA

Giacomo Falchetta
FEEM - Fondazione Eni Enrico Mattei
ITALY

Anne Veronique Faure
FRANCE

Shi Fengyu
CUG
CHINA

Stephane Ferdrin
Credit Agricole
FRANCE

Marta Irene Feria Cerrada
SPAIN

Anna Filipova
Equity House
SOUTH AFRICA

Peter Ajonghakoh Foabeh
THAILAND

Elizabeth Fox
CA Public Utilities Commission
USA

Franck Freycenon
Freycenon
FRANCE

Kam Fai Fung
The Hongkong Electric Co., Ltd.
HONG KONG

Sylvain Gaignard
EDF
FRANCE

Lucile Gailliard
OCDE
FRANCE

Zhuangfei Gao
Zhejiang University of Technology
CHINA

Cyrille Garetier
TEREOS
FRANCE

Henrik Gaveryd
Sweco Energuide AB
SWEDEN

Assia Gekova
Edison Spa
ITALY

Jiangbo Geng
Zhongnan University
CHINA

Hubert Gentou
FRANCE

Iva Georgieva
EWRC
BULGARIA

Dominique Girardot
ENEDIS
FRANCE

Monica Giulietti
UNITED KINGDOM

Angelika Goliger
EY
SOUTH AFRICA

Felipe Gonzalez Venegas
Centrale Supelec
FRANCE

Seshadri Gopalakrishnan
SINGAPORE

Lyubomir Grozdanov
Sofia University
BULGARIA

Gildas Guillosseau
ExxonMobil
FRANCE

Youyi Guo
Fujian Jiangxia University
CHINA

Atul Gupta
Indian Oil Corp Ltd
INDIA

Mustafa Yalcin Haberdar
IGDAS
TURKEY

Kristina Hadziyska
Bulgarian Academy of Sciences
BULGARIA

Sudhanshu Haldar
Galway Group
USA

Evgenia Haritonova
Energy and Water RC
BULGARIA

Umit Herguner
Herguner Avukatlik
TURKEY

Quintin Hobbs
EY
SOUTH AFRICA

Nikolay Hristov
University of Mining and Geology
BULGARIA

Yayun Huang
China University of Geosciences
CHINA

Sebastien Huclin
Basque Center of Climate Change
SPAIN

Sam-Dih Hwang
INER
TAIWAN

Abdullateef Ibrahim
China University of Geosciences
CHINA

Jukka Ilomäki
Tampere University
FINLAND

Petyo Ivanov
Bulgarian Energy Holding EAD
BULGARIA

Amit Jha
Indian Inst of Mgt Lucknow
INDIA

Sih-Ting Jhou
Tamkang University
TAIWAN

Li Jiashuo
Huazhong University
CHINA

Wu Jiaxian
Southeast University
CHINA

Oliver Johnson
Stockholm Environment Inst
SWEDEN

Joseph Jones
Tundra
USA

Ivana Jovovic
University of Ljubljana
SLOVENIA

Jihyeok Jung
Seoul National University
Republic of Korea

Sebastian Just
Aurora Energy Research Ltd
UNITED KINGDOM

Marta Kamola-Martines
ENGIE
BULGARIA

Xuhua Kang
Shanxi University
CHINA

Conrad Kassier
UNIDO
SOUTH AFRICA

Guillaume Kerlero
ENEA
FRANCE

Farhan Khan
South Asian Network on Econ Mod
BANGLADESH

Aras Khazal
NTNU Business School
NORWAY

Hyunjun Kim
Sofia University
BULGARIA

Samuli Kivipelto
Icecapital Securities LTD
FINLAND

Andrea Kollmann
Energieinstitut an der JKU Linz
AUSTRIA

Athanasios Konstantopoulos
DEPA SA
BULGARIA

Mirjam Kosch
ETH Zurich
SWITZERLAND

Kristina Kostadinova
EWRC
BULGARIA

Konstantinos Kounetas
Univ of Patras Dept of Econ
GREECE

Kremena Krasteva
Darik Radio
BULGARIA

Maria Krasteva
Sofia University
BULGARIA

Piraye Kuranel Basol
Herguner Avukatlik
TURKEY

Dimitar Kuyumdjiev
Bulgarian Energy and Mining Forum
BULGARIA

Ruben Lado Sestayo
SPAIN

Karin Lagerstrand
Handelsbanken
SWEDEN

Lawrence LaPlue
New Mexico State University
USA

Remi Lauvergne
RTE
FRANCE

Remi Le Tenier
Imperial College
UNITED KINGDOM

Yeonjeong Lee
Seoul National University
Republic of Korea

Taneli Leiskamo
Fingrid Oyj
FINLAND

Jean-Marc Leroy
ENGIE & GIE
BULGARIA

Jeanne Lesigne
FRANCE

Jing Li
Beihang University
CHINA

Ke Li
CHINA

Ianlan Li
Hefei University of Technology
CHINA

li li
CHINA

Xiangyang Li
China University of Geosciences
CHINA

Yaoming Li
Academy of Chinese Enegy Strategy
CHINA

Zhenghui Li
Guangzhou Intl Inst of Finance
CHINA

Renee Lidin
EDF
FRANCE

Yun Seng Lim
Universiti Tunku Abdul Rahman
MALAYSIA

Xiaojie Liu
Chinese Academy of Sciences
CHINA

Xin Liu
Chongqing University
CHINA

Xu Liu
LBNL
USA

Lina Mahdi
EC National Assembly of the RoB
BULGARIA

Jukka Makkonen
Finnish Energy
FINLAND

Denitza Mantcheva
US DOE ERO
BULGARIA

Lyuben Marinov
Kozloduy NPP - New Build Plc
BULGARIA

Marin Marinov
Sofia University
BULGARIA

Iliyana Marinova
Sofia University
BULGARIA

Sylvia Marinova
Sofia University
BULGARIA

Milena Marquet
Yele
FRANCE

Giuseppe Mastropieri
REA SRL
ITALY

Veselin Mavrodiev
Sofia University
BULGARIA

Paul McManus
IHS Markit
UNITED KINGDOM

Gabriel Menchen glesias
Omi Polo Espanol SA
SPAIN

Judit Mendoza Aguilar
Universidad de La Laguna
SPAIN

Balagopal Menon
SCMS School of Eng and Tech
INDIA

Marco Merler
Dolomiti Energia
ITALY

Jonas Meyer
ENEDIS
FRANCE

Alexandra Mirchevska
Sofia University
BULGARIA

Antoine Missemer
CNRS CIRED
FRANCE

Esther Mkhwebane
CSIR Energy Center
SOUTH AFRICA

Irena Mladenova
Resalta Bulgaria EOOD
BULGARIA

Ashanti Mogosets
UNIDO
SOUTH AFRICA

Usman Umar Mohammed
Colorado School of Mines
USA

Eugeniusz Mokrzycki
Mineral and Energy Econ Rsch Inst
POLAND

Danail Monov
Sofia University
BULGARIA

Resmun Moonsamy
UNIDO
SOUTH AFRICA

Xavier Moreau
Nuvve
FRANCE

Siti Indati Mustapa
Universiti Tenaga Nasional
MALAYSIA

Nasiru Abba Mustustapha
China University
CHINA

Nastaran Naseri
University of Cologne
GERMANY

Ivaylo Naydenov
Sofia University
BULGARIA

Mojtaba Nedaei
AUSTRIA

Alexander Nenkov
EC, National Assembly of the RoB
BULGARIA

Plamena Nenkova
Sofia University
BULGARIA

Krassimir Nenov
ContourGlobal Maritsa East 3
BULGARIA

Caitlin Newey
Utilities Kingston
CANADA

Hongguang Nie
Changchun University
CHINA

Yan Nie
LanZhou University Of Technology
CHINA

Valentin Nikolov
EC, National Assembly of the RoB
BULGARIA

Ntombifuthi Ntuli
CSIR Energy Center
SOUTH AFRICA

Anthony Nyangarika
Beijing Institute of Technology
CHINA

Fabian Ocker
GERMANY

Murat Odabasi
IGDAS
TURKEY

Jennifer Uju Okonkwo
University of Kiel
GERMANY

Slav Okov
Bloomberg News
BULGARIA

Innocent Okwanya
Federal University Lafia
NIGERIA

Fernando Omegna Rocha Ferreira
Rapidan Energy Group
USA

Mikael Palmgren
Fortum
FINLAND

Noemie Papon
GREENFLEX
FRANCE

Max Parness
Toyota Motor North America
USA

Aimilia Pattakou
ETH Zurich
SWITZERLAND

Dobrina Pavlova
Gugushev & Partners Law Office
BULGARIA

Teodora Peneva
Bulgarian Academy of Sciences
BULGARIA

Theodosios Perifanis
University of Piraeus
GREECE

Eric Perray
ENGIE
FRANCE

Viktor Petrasovsky
Embassy of the Slovak Republic
SLOVAKIA

Lachezar Petrov
Sofia University
BULGARIA

Petko Petrov
Sofia University
BULGARIA

Renaud Piot-Mahyer
ENEDIS
FRANCE

Tsvetelina Popova
Sofia University
BULGARIA

Borut Rajer
Borzen, d.o.o.
SLOVENIA

Christiane Reinert
GERMANY

Brian Rivard
Ivey Business School Western Univ
CANADA

Winston Robotham
Office of Utilities Regulation
JAMAICA

Alejandro Rodriguez Zuniga
Basque Centre for Climate Change
SPAIN

Amelie Sales
EDF Trading
FRANCE

Swati Anindita Sarker
Chinese Academy of Sciences
CHINA

Colin Sasthav
University of Tennessee Knoxville
USA

Konstantin - Kiril Savov
Bulgarian Academy of Sciences
BULGARIA

Michael Schack
ENGIE
FRANCE

Abibou Seck
FRANCE

Blake Shaffer
Stanford University
CANADA

Anam Shehzadi
University of Kassel
GERMANY

xue shuangjiao
cug
CHINA

Sultana Easmin Siddika
Beihang University
CHINA

Li-Chen Sim
Zayed University
UNITED ARAB EMIRATES

Kostadin Sirleshtov
CMS CMNO LLP
BULGARIA

Corey Slosburg
Johns Hopkins University
USA

Robert Slovacek
Verbund Trading GmbH
AUSTRIA

Olusoga Sofolahan
USA

Maria del Mar Sola
BC3
SPAIN

Birger Solbert
Norwegian University of Life Sci
NORWAY

Jean-David Sta
EDF
FRANCE

Konstantin Stamenov
BFIEC
BULGARIA

Yordan Stankov
Sofia University
BULGARIA

Andrew Stanley
CSIS
USA

Kaloyan Staykov
Sofia University
BULGARIA

Evo Stefanov
Methodia AD
BULGARIA

Ruslan Stefanov
Center for the Study of Democracy
BULGARIA

Daniel Steinberg
National Renewable Energy Lab
USA

Bissera Stoeva
AES Bulgaria
BULGARIA

Dimo Georgiev Stoilov
Technical University of Sofia
BULGARIA

Lingran Su
Renmin University of China
CHINA

Theresia Betty Sumarno
University of Dundee
UNITED KINGDOM

Kege Sun
Fudan University
CHINA

Ting-Jui Sun
ITRI
TAIWAN

Ting-Jui Sun
IREI
TAIWAN

Sanna Syri
Aalto University
FINLAND

Galina Tchalakova-Todorova
Sofia University
BULGARIA

Bilyaminu Tijjani
Nigeira Defence Academy (NDA)
NIGERIA

Veselin Todorov
EWRC
BULGARIA

Manuel Angel Tomas Garcia
Univ de Castilla La Mancha
SPAIN

Bilal Topcu
EPIAS
TURKEY

Tsvetelia Tsolova
Reuters News Agency
BULGARIA

Tuan Ab Rashid Tuan Abdullah
Universiti Tenaga Nasional
MALAYSIA

Oisin Patrick Tummon
Statkraft
NORWAY

Deniz Tuncel
Herguner Avukatlik
TURKEY

Serkan Tutay
STEAG
TURKEY

Stefan Tzakov
KAMBOUROV & PARTNERS
BULGARIA

Ivan Tzankov
AES Bulgaria
BULGARIA

Plamen Tzvetanov
Bulgarian Academy of Sciences
BULGARIA

Heidi Uimonen
Fingrid Oyj
FINLAND

Wolfgang Urbantschitsch
E Control Austria
AUSTRIA

Antoine Vallet
SERCE
FRANCE

Menno van Benthem
SEO Amsterdam Economics
NETHERLANDS

Jeremy van Dijk
Univ Neuchatel
SWITZERLAND

Momchil Vanov
Bulgarian Energy Holding EAD
BULGARIA

Severin Vartigov
Bulgarian Energy Holding EAD
BULGARIA

Krasimir Velchev
El Ex Corporation
BULGARIA

Maria Velikova
Emerging Markets Consulting
BULGARIA

Alanda Venter
Univ of Pretoria
SOUTH AFRICA

Francois Verdier
FRANCE

Carlos Vergara Munoz
Universidad Austral de Chile
CHILE

Jiqiang Wang
TIANJIN UNIVERSITY
CHINA

Wentao Wang
Beihang university
CHINA

Thorstein Watne
Vattenfall AB
SWEDEN

Hongjian Wei
Huazhong University
CHINA

Wen Yu Weng
FTI Consulting
UNITED KINGDOM

Neil Wilmot
University of Minnesota Duluth
USA

Fabien Wloch
ENEDIS
FRANCE

Joanna Wrobel
POLAND

Dexiang Wu
Beihang University
CHINA

Yujiao Xian
Beijing Institute of Technology
CHINA

Bowen Xiao
BUAA
CHINA

Hanchen Xiao
University of Dundee
UNITED KINGDOM

Gu Xin
Southeast University
CHINA

Guangyue Xu
Henan university
CHINA

Libo Xu
University of San Francisco
USA

Mariyana Yaneva
SeeNews
BULGARIA

Wenju Yang
Chongqing University
CHINA

Zili Yang
SUNY-Binghamton
USA

Sangmin Yeo
Seoul National University
Republic of Korea

Bowen Yi
Beihang University
CHINA

Mehmet Haluk Yilmaz
EPIAS
TURKEY

Ivan Yordanov
Ministry of Energy
BULGARIA

Kentaro Yoshida
Kyushu University
JAPAN

Ivan-Petar Yovchev
Sofia University
BULGARIA

Maja Zarkovic
University of Basel
SWITZERLAND

Fang Zhang
Beihang University
CHINA

Hongjun Zhang
China Universit
CHINA

Hui Zhang
NanJing Tech University
CHINA

Junhuan Zhang
Beihang university
CHINA

Zengjie Zhang
China University of Petroleum
CHINA

Feng Zhao
CHINA

Shuhong Zheng
China University of Geosciences
CHINA

Jingran Zhu
Zhongnan University
CHINA

Josef Zoechling
Wien Energie
AUSTRIA

Calendar (continued from page 39)

05-07 August 2019, Electricity Economics in Changing Electricity Markets at Singapore. Contact: Email: vincs@infocusinternational.com, URL:http://www.infocusinternational.com/electricityeconomics

25-28 August 2019, 16th IAEE European Conference, Energy Challenges for the Next Decade at Ljubljana, Slovenia. Contact: Email: iaee2019ljubljana@oyco.eu , URL: https://iaee2019ljubljana.oyco.eu/page/64

26-29 August 2019, Mastering Renewable & Alternative Energies - Dubai at Dubai, UAE. Contact: Email: vincs@infocusinternational.com, URL:http://www.infocusinternational.com/renewable/index.html

03-06 September 2019, Power Purchase Agreement (PPA) for Renewable Energy - Johannesburg at Johannesburg, South Africa. Contact: Email:vincs@infocusinternational.com, URL: http://www.infocusinternational.com/pparenewable/index.html

06-06 September 2019, 2nd IAEE Southeast Europe Symposium at Bucharest, Romania. Contact: Email: puricai@yahoo.com, URL: www.iaee.org

09-13 September 2019, Gas & LNG Markets, Contracts & Pricing - Port of Spain at Port of Spain, Trinidad and Tobago. Contact: Email:vincs@infocusinternational.com, URL: http://www.infocusinternational.com/gaslng/

09-13 September 2019, Gas & LNG Markets, Contracts & Pricing at Port of Spain, Trinidad and Tobago. Contact: Email: vincs@infocusinternational.com, URL:http://www.infocusinternational.com/gaslng/

18-18 September 2019, FT Digital Energy Summit | London, 18 September 2019 at etc.venues St Paul's, 200 Aldersgate, London, EC1A 4HD, United Kingdom. Contact: Email: james.rankin@ft.com, URL: http://go.evvnt.com/367480-0?pid=204

06-10 October 2019, Gas & LNG Markets, Contracts & Pricing - Dubai at Dubai, UAE. Contact: Email: vincs@infocusinternational.com, URL:http://www.infocusinternational.com/gaslng/

07-09 October 2019, Forum of Revolutions in Renewable Energy in 21st Century at Rome,Italy. Contact: Phone: 4083521010, Email: renewableenergy@foren21.org, URL: https://foren21.org/

15-18 October 2019, Power Purchase Agreement (PPA) from Commercial Perspective - Kuala Lumpur at Kuala Lumpur, Malaysia. Contact: Email:vincs@infocusinternational.com, URL: http://www.infocusinternational.com/ppacommercial/index.html

16-17 October 2019, 10th World Energy Congress at Singapore. Contact: Phone: +6531080483, Email: energycongress@insightsummits.com, URL:https://www.meetingsint.com/conferences/Holiday

4th IAEE EURASIAN CONFERENCE CALL FOR PAPERS

We are pleased to announce the Call for Abstracts for the 4th IAEE Eurasian Conference.

"Energy Resources of the Caspian and Central Asia: Regional and Global Outlook" to be held **October 17 -19, 2019, in Nazarbayev University, Astana, Kazakhstan.**
The deadline for receipt of abstracts for Concurrent Sessions is **Friday,May 17, 2019.**

SUBMIT YOUR ABSTRACT ONLINE at registration.ccevent.org/astana2019

EURASIAN CONFERENCE SERIES

Oil and gas producing countries in the Caspian basin and Central Asia region have experienced rapid economic growth over the last decade under high energy prices, while suffering from highly volatile global energy prices. These countries have rich hydrocarbon, hydro, renewable and alternative energy resources and geopolitical advantages. There are issues with rational use and effective management of these energy resources. Playing an important role for Europe's energy security, the efficient use of investment and innovative opportunities in the energy sector of these countries and the formation of a regional energy market are among the most crucial issues.

To address the energy challenges in Eurasia region, the IAEE has started conducting a series of Eurasian conferences. The 1st IAEE Eurasian Conference on the topic of the "Energy Economics Emerging from the Caspian Region: Challenges and Opportunities" was held on 28-31 August, 2016 in Baku, Azerbaijan. The 2nd IAEE Eurasian Conference on the topic of the "Energy in Eurasia: Economic Perspectives on Challenges, Risks and Opportunities" was held on 13-14 October 2017, in Zagreb, Croatia. The 3rd IAEE Eurasian Conference on the topic "Implications of global developments within the energy industry in the Caspian and Central Asia Region" was held on 18-20 October 2018, in Baku, Azerbaijan.

ABSTRACT FORMAT & SUBMISSION

In order to learn abstract format and important dates, and to download Abstract Sample & Abstract Template, visit www.eurasianconference.com/abstractformat

Abstracts submitted by e-mail or in hard copy will not be processed.

Paper submission is optional.

TOPICS TO BE ADDRESSED INCLUDE:

The general topics below are indicative of the types of subject matter to be considered at the conference.

- Petroleum Economics
- Economics of Gas Trading
- Geopolitical Competition in Caspian Basin and Middle East
- Energy Modelling
- Energy Markets and Regulation
- Challenges in Gas Supply and Transportation
- Energy Poverty and Subsidies
- Regional Energy Markets
- Energy Policy for Sustainable Development
- Energy Supply, Demand and Economic Growth
- Security of Energy Supply
- Regional Electricity Trade
- Energy Efficiency and Storage
- Regional Strategies for Alternative and Renewable
- Energy Finance and Asset Valuation Risk Management in Energy
- Eurasian Energy Outlook

Calendar

02-04 April 2019, 2019 International SAP Conference for Oil and Gas at MiCo, 1 Piazzale Carlo Magno, Milano, 20149, Italy. Contact: Phone: 01212003810, Email:k.lenihan@tacook.com, URL: http://go.evvnt.com/341566-0?pid=204

04-05 April 2019, Argus South America Motor Fuels Conference at InterContinental Sao Paulo, 1123 Alameda Santos, Jardim Paulista, 01419-001, Brazil. Contact: Phone: 7133607566, Email: bel.cevallos@argusmedia.com, URL: http://go.evvnt.com/324654-0?pid=204

08-09 April 2019, 2019 SPE International Conference on Oilfield Chemistry-Galveston, Texas at Moody Gardens Convention Center, 7 Hope Blvd., Galveston, 77554, United States. Contact: Email: gesmith@spe.org, URL: http://go.evvnt.com/361251-2?pid=204

09-11 April 2019, SPE Oil and Gas India Conference and Exhibition at Renaissance Mumbai Convention Centre Hotel, #2 And 3B, Near Chinmayanand Ashram, Powai, Mumbai, 400087, India. Contact: Phone: 97144575800, Email: registrationdubai@spe.org, URL: http://go.evvnt.com/331647-0?pid=204

09-10 April 2019, Solar and Storage Finance and Investments in Texas - April 2019 at Hyatt Regency Austin, 208 Barton Springs Road, Austin, 78704, United States. Contact: Email: jandrews@solarmedia.co.uk, URL: http://go.evvnt.com/302217-0?pid=204

15-17 April 2019, Oman Downstream Exhibition And Conference 2019 at Oman Convention And Exhibition Centre, Muscat, Oman. Contact: Phone: 02073847978, Email: emma.dinwoodie@wraconferences.com, URL: http://go.evvnt.com/355871-0?pid=204

16-17 April 2019, Wind Operations Dallas 2019 (April 16-17 TX) O&M, Asset Management, Storage at The Westin Galleria Dallas, 13340 Dallas Parkway, Dallas, 75240, United States. Contact: Phone: +44(0)2073757537, Email: benm@newenergyupdate.com, URL: https://go.evvnt.com/314610-3?pid=204

24-25 April 2019, Oil and Gas Supply Chain Compliance at Inter Continental Houston, 6750 Main street, Houston, 77030, USA. Contact: Phone: +1 713 554 8380, Email: info@hansonwade.com, URL: http://go.evvnt.com/339879-0?pid=204

24-25 April 2019, PV India Tech Conference in Delhi - April 2019 at TBC, Delhi, 110 012, India. Contact: Email: jandrews@solarmedia.co.uk, URL:http://go.evvnt.com/302219-0?pid=204

28-29 April 2019, The International Offshore Development Congress at The Jumeirah Etihad Towers Hotel, Etihad Towers, Abu Dhabi, United Arab Emirates. Contact: Phone: 97143619616, Email: BASMA.T@maarefah-management.org, URL: http://go.evvnt.com/325830-0?pid=204

29-30 April 2019, Smart Water Systems at Holiday Inn London - Kensington Forum, 97 Cromwell Road, London, SW7 4DN, United Kingdom. Contact: Phone: +442078276164, Email: nhoward@smi-online.co.uk, URL: http://go.evvnt.com/320624-0?pid=204

06-08 May 2019, 4th HAEE Conference: Energy Transition IV SE Europe and Beyond at Athens, Greece. Contact: Email: kandriosopoulos@escpeurope.eu, URL:https://www.haee.gr/events/international-events/2019/4th-haee-international-conference/

07-09 May 2019, The Battery Show Europe 2019 | Stuttgart, Germany | Trade Fair And Conference at Messe Stuttgart, 1 Messepiazza, Stuttgart, 70629, Germany. Contact: Phone: +441273916300, Email: info@thebatteryshow.eu, URL: http://go.evvnt.com/267913-2?pid=204

08-10 May 2109, Monaco 2019: Ecologic Vehicles - Renewable Energies at Forum Grimaldi, Monaco. Contact: Phone: +377 97 77 54 21 , Email:arianefavaloro@ever-monaco.com, URL: http://www.ever-monaco.com/en/

14-14 May 2019, SPE Norway One Day Seminar | 14 May 2019, Bergen, Norway at Quality Hotel Edvard Grieg, 50 Sandsliåsen, Ytrebygda, Bergen, 5254, Norway. Contact: Phone: 4402072993300, Email: kdunn@spe.org, URL: http://go.evvnt.com/321308-0?pid=204

15-17 May 2019, Power Uzbekistan at Tashkent , Uzbekistan. Contact: Phone: +998901688644, Fax: gmax.energyconsulting@mail.ru, Email: www.energy.uz, URL:http://www.power-uzbekistan.uz/

20-22 May 2019, LEAP HR: Oil and Gas Conference, Houston 2019 at JW Marriott Houston by the Galleria, 5150 Westheimer Rd, Houston, Texas, 77056, United States. Contact: Phone: +1 713 554 8380`, Email: info@leap-hr.com, URL: https://go.evvnt.com/365919-0?pid=204

23-24 May 2019, ISEFI 2019: 7th International Symposium on Environment & Energy Issues at Paris, France. Contact: Email: s.atan@ipag.fr, URL:http://isefi.sciencesconf.org

May 29 - June 01 2019, 42nd IAEE International Conference, Local Energy: Global Markets at Montreal, Canada. Contact: Email: info@iaee2019.org, URL:http://iaee2019.org/

10-11 June 2019, US Offshore Wind 2019 at Boston Marriott Copley Place, 110 Huntington Avenue, Boston, 02116, United States. Contact: Phone: +442073757239, Email: adam@newenergyupdate.com, URL: http://go.evvnt.com/308731-0?pid=204

12-13 June 2019, Connected Customer: Utilities 2019 at Amsterdam. Contact: Phone: 01212003810, Email: info@tacook.com, URL: http://go.evvnt.com/372626-0?pid=204

13-14 June 2019, International Conference on Renewable Energy & Emerging Technologies at Aston Priority Simatupang Hotel & Conference Center, Jakarta, Indonesia. Contact: Phone: 8056040722, Email: info@icreet.com, URL: http://icreet.com

24-25 June 2019, Oil and Gas Council, Africa Assembly, Paris 2019 at To Be Confirmed, Paris, France. Contact: Phone: +27210013885, Email:samantha.boustred@oilcouncil.com, URL: http://go.evvnt.com/351717-0?pid=204

24-25 June 2019, Oil and Gas Council, Africa Assembly, 2019 at The Westin Paris - Vendome, 3 Rue de Castiglione, Paris 75001, France. Contact: Phone: +27210013885, Email: samantha.boustred@oilcouncil.com, URL: https://go.evvnt.com/351717-0?pid=204

27-27 June 2019, FT Energy Transition Strategies Summit 2019 | London | 27 June at Hilton London Tower Bridge, 5 More London Place, Tooley Street, London, SE1 2BY, United Kingdom. Contact: Phone: +44 (0)207 775 6653, Email: ftlive@ft.com, URL: http://go.evvnt.com/366989-0?pid=204

01-05 July 2019, Mastering Energy Storage & Charging Electric Vehicles (EVs) - London at London, UK. Contact: Email: vincs@infocusinternational.com, URL:http://www.infocusinternational.com/energystorage/index.html

02-05 July 2019, Power Purchase Agreement (PPA) from Commercial Perspective - London at London, UK. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/ppacommercial/index.html

08-11 July 2019, Mastering Solar Power at Singapore. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/solar

16-19 July 2019, Power Purchase Agreement (PPA) from Legal Perspective - Sydney at Sydney, Australia. Contact: Email: vincs@infocusinternational.com, URL:http://www.infocusinternational.com/ppalegal/index.html

See more Calendar listings on page 37

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

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

IAEE ENERGY FORUM – Vol. 28, Second Quarter 2019

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