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IAEE ENERGY FORUM

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PRESIDENT'S MESSAGE

Is energy the daily business of the economy?

Energy economists tend to look at the horizon and always look further beyond it.

There are good reasons for doing so: it is true that the lifespan of energy investments is very long, sometimes exceeding a century for some power lines or dams. Such a lifetime requires anticipation in the decision-making process and a need for robust modelling. As a result, energy economists are debating the different world views of energy for 2035-2050, giving the impression that they do not care about the short term.

By the way, what does the short term mean? The next decade? Next year? Next month? Next job?

In my role as President of IAEE, I have the opportunity to meet not only my fellow economists, but also decision-makers from the industrial sector or the Administration or government authorities.

Our discussions on how energy economists could contribute to economic development suggest that economists should report more on short-term changes than in 2035-2050. The horizon that matters for those actors is often different from the one favored by economists, which sometimes leads them to consider that economic research is blind to their specific challenges.

For instance, economic development is affected by international relations. Energy security, price volatility, uncertainties resulting from regulatory developments, can destroy the creative value of entrepreneurship in the short term. The necessary energy transitions implemented in different countries are often confusing for investors. More generally, an increasing number of factors that are inherently short-term affect their environment, and create a demand for economic expertise.

For sure, investors agree that the impacts of climate change will be felt in the very long term, and that, therefore, economists cannot stop looking at this horizon. However, the two perspectives are not necessarily contradictory. Providing investors and decision-makers the short-term analysis they are interested in is also a way of giving economic research more credibility in the eyes of those actors, by ensuring them that our reasoning is able to embrace the challenges they face. Moreover, linking more short-term issues with long-term matters would improve our global understanding of economic development, enabling our analysis to be more relevant even when looking at the long run.

We, energy economists, hear this future need from the global economic sector to enlighten the short term. I suggest that more research be directed towards short-term decision-making in order to maximize short- and long-term development and to advise decision-making in this regard.

The discussion is open.

Christophe Bonnery

Careers, Energy Education and Scholarships Online Databases

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

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

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

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

We look forward to your participation in these new initiatives.

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IAEE MISSION STATEMENT

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

WE FACILITATE:

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

WE ACCOMPLISH THIS THROUGH:

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

Editor's Notes

This issue focuses on electricity autions, but before we begin that area, one of the senior members of IAEE provides some very sound advice as well as cautions in the pursuit of economic anaysis in general and the oil market in particular.

Michael Lynch writes that economic analysis can be very useful in understanding oil market behavior, but historical knowledge and experience are also useful. For example, many superficial arguments, such as "the industry needs to run faster just to stay in place," have been around for decades without having any practical impact. Additionally, all to many believe theories that are not only incorrect, but clearly refuted by historical data.

Lena Kitzing, Vasilios Anatolitis, Oscar Fitch-Roy, Corinna Klessmann, Jan Kreiß, Pablo del Río, Fabian Wigand, and **Bridget Woodman** describe key auction design characteristics, highlight best practices and pitfalls and report on surprising lessons learned from 20 in-depth case studies.

Ewa Lazarczyk and **Lisa Ryan** report that Ireland has recently changed its electricity market design and introduced capacity auctions. Although carefully planned, the move was not smooth as one of the crucial Dublin suppliers was unsuccessful in securing capacity payments. They highlight some challenges and lessons in the smooth transition to capacity auctions.

Jan Kreiss writes that In recent years auctions became the predominant instrument to promote renewable energies. More and more auctions are open to participants with different technologies, so called technology-neutral auctions. However, it remains unclear what technology-neutral means and how such an auction should be designed. He assesses the influencing factors for technology-neutral auctions.

Noah Dormady discusses how auction rules and mechanisms can influence the efficiency of auctions. He provides a summary of recently-published research on carbon auctions with a focus on California's consignment mechanism, noting that the consignment mechanism has been observed to distort auction efficiency

Philip Walsh writes that an emerging debate has appeared around whether a cap and trade program or a carbon tax contributes more to reducing GHG emissions and climate change. He examines the results of an abbreviated cap and trade program in Ontario, Canada and the vulnerability of carbon-revenue programs to the winds of political change.

Roland Magnusson, Kimmo Ollikka and **Pekka Ripatti** note that Finland implemented a technology neutral RES pay-as-bid auction at the end of 2018. Eligible technologies were wind power, biogas, combined heat and power from forest biomass, solar and wave, but only bids from wind power were submitted. The auction was, however, successful: the oversubscription rate was three and the volume weighted average of the accepted premiums was 2.52 EUR/MWh, which can be considered as a relatively low premium price.

Ewa Lazarczyk and **Chloé Le Coq** discuss how information disclosure rules differ across electricity auctions, even when markets are integrated as in the European Union. They argue that, in line with the IO literature, differences reflect the existing trade-off between the level of information aggregation and the delay with which the information is published.

Javier Bustos-Salvagno reports that Chile introduced electricity auctions for long-term contracts in 2005, with unsatisfactory results until 2014, when a regulatory change allowed more competition and new technologies could participate. Auctions are recognized as a successful tool for adequacy at competitive prices but new challenges in electricity markets have to be taken into consideration.

Andres Alonso notes that the application of a public policy coming from the Chilean mining industry will allow the regulated consumers in Chile to save more than twenty million dollars compared to the level of prices they had in 2013

DLW

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.org/usaee2019/

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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.

37TH USAEE/IAEE NORTH AMERICAN CONFERENCE

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PLENARY SESSIONS

The 37th USAEE/IAEE North American Conference will attract noteworthy energy professionals who will address a wide variety of energy topics. Plenary sessions will include the following:

Geopolitics of Energy Transition • Decarbonisation of North American Power • Challenges to Energy Infrastructure Development in U.S., Canada and Mexico • Government Policies Promoting Low Carbon Transition • U.S. Energy Trade • Paths to a Sustainable Future • Changing Oil and Gas Company Investment • Global Decarbonization of Road Transport • Energy Entrepreneurship and Finance • Energy Transitions - Learning Through History

SPEAKERS INCLUDE

Douglas Arent
Deputy Associate Laboratory Director, NREL

Sara Banaszak
Senior Advisor, Exxon Mobil Corporation

Luis Serra Barragan
Executive Director, Tecnologico de Monterrey Energy Initiative at the School of Government and Public Trasnportation

Morgan Bazilian
Director, Payne Institute of Public Policy, Colorado School of Mines

Fred Beach
Research Associate, Energy Institute, University of Texas

Stephen Berberich
President and Chief Executive Officer, California ISO

Mark S Berg
Executive Vice President, Pioneer Natural Resources

Amitai Bin-Nun
Vice President, Autonomous Vehicles and Mobility Innovation, Securing America's Energy Future

Chris Birdsall
Manager Economics & Energy, Corporate Strategic Planning, Exxon Mobil Corporation

Kevin Book
Managing Director, ClearView Energy Partners

Shannon Bragg-Sitton
Manager of the Systems Integration Department in the Nuclear Systems Design & Analysis Division, Idaho National Laboratory

Carol Dahl
Senior Fellow, Payne Institute of Public Policy, Colorado School of Mines

Jean-Denis Charlebois
Chief Economist, National Energy Board

Robert Fenwick-Smith
Founder and Managing Director, Aravaipa Ventures

Mark Finley
GM Global Energy Markets, BP America Inc

R Dean Foreman
Chief Economist, American Petroleum Institute

Lewis Fulton
Director, STEPS (Sustainable Transportation Energy Pathways), UC Davis Institute of Transportation Studies

Andreas C Goldthau
Franz Haniel Professor for Public Policy, Willy Brandt School of Public Policy, Research Group Lead, Institute for Advanced Sustainability Studies

Hal Harvey
CEO, Energy Innovation

Horace Hobbs
Chief Economist, Phillips 66

Amy Jaffe
Senior Fellow and Director, Council on Foreign Relations

Jesse Jenkins
Postdoctoral Environmental Fellow, Harvard Kennedy School and Harvard University Center for the Environment

Marianne Kah
Senior Research Scholar, Columbia Center on Global Energy Policy

John Kingston
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Kate Konschnik
Director, Climate and Energy Program, Duke Nicholas Institute

Sarah Ladislaw
Senior Vice President; Director and Senior Fellow, Energy and National Security Program, CSIS

Paul Leiby
Distinguished Research Scientist, Oak Ridge National Laboratory

Consul General Stephane Lessard
Consul General, Consulate General of Canada

Debra Lew
Senior Technical Director, GE Energy

Amory Lovins
Cofounder, Chief Scientist, and Chairman Emeritus , Rocky Mountain Institute

John Minge
Chairman, Study on Carbon Capture, Use & Storage, National Petroleum Council

Richard Newell
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Per Magnus Nysveen
Senior Partner, Rystad Energy

Ambassador Robert C Perry
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Dear Members,

We are pleased to inform you that IAEE is reinforcing its presence on social media to offer you shortcuts to the major developments in energy economics and connect you with other professionals in the field.

We hope this will facilitate an easy and friendly way to learn about our upcoming events and publications, while engaging in lively discussions with our members worldwide.

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There are many ways to get involved with IAEE and drive the debate by sharing knowledge and spreading new ideas.

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IAEE is offering support to its Student Members to showcase their research and most interesting activities online.
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Lessons of an Oil Market Analyst (and the value of an IAEE membership)

BY MICHAEL C. LYNCH

Michael Lynch is a Distinguished Fellow, Energy Policy Research Foundation and President, Strategic Energy & Economic Research. He may be reached at lynch@energyseer.com

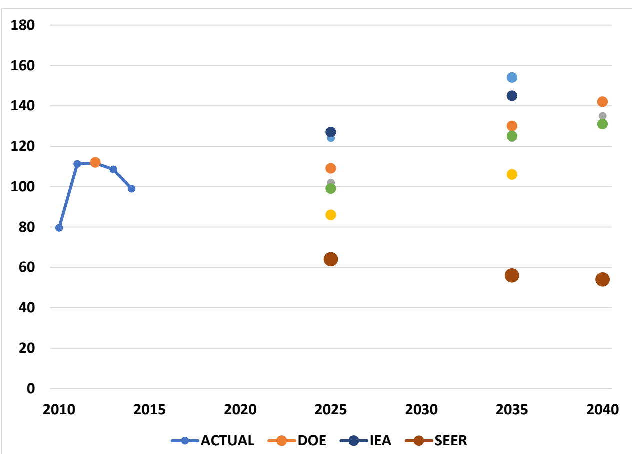
See footnotes at end of text.

Two decades ago, at a strategy meeting for the USAEE, someone remarked apologetically that he wasn't an actual economist, which brought forth the realization that most of the people in the room were not Ph.D. economists, but historians, political scientists (like me), and other professionals. One result was the decision to change the group's name to "for energy economics" from "of energy economists".

I am reminded of this when an academic economist remarks disparagingly that a colleague is more of a historian than an economist, meaning his work was not reliant on higher-level mathematics. While I value much of the complex academic economics, including math that is beyond my comprehension, there is also a significant value to being aware of history and frankly to having lived through a lot of it.

This was quite evident a decade ago when supply disruptions in Iraq, Venezuela, later Nigeria, Libya and others caused prices to rise just as they had in the late 1970s during the Iranian Revolution. Morry Adelman, one of the IAEE's founders and my mentor, laughed about how people persisted in thinking that every price increase was going to be permanent "this time". Few seemed to remember that the vast majority of experts thought in 1980 that oil prices would never decline. Indeed, at Energy Modeling Forum 6 at Stanford, the ten computer models predicted, on average, that the price in 2000 would be $160/bbl (2015$).

Yet right up to the point that oil prices collapsed in 2015, the consensus was that oil prices would continue rising. Figure 1 shows the 2014 survey DOE made of forecasts, and when mine was far below the others, I was told that people jokingly asked if I was drunk. This despite the fact that my forecast was for prices to be roughly twice the historical mean price—and no nonrenewable resource has experienced sustained long-term prices above historical means. The same point that Adelman made, and which was widely ignored, in the early 1980s.



DOE Oil Price Survey 2014 (2012$/bbl)

Source: Annual Energy Outlook, 2014.

The very blatant reality is that, just as short-term supply problems drove prices up in the 1970s, so they did in the 2000s, yet very few experienced déjà vu. Instead, cliché's like "the easy oil is gone," "the industry is running faster just to stay in place," and "oil is finite" were all trotted out to explain that higher prices had a geological basis, rooted in below-ground physical realities not above ground, transient events. When prices returned part of the way towards the historical mean in 2015, the industry was shocked and many companies sustained major losses. Promoters of competing energy sources also found the market competition from oil much tougher than they expected.

Historical Context

The lack of experience shows in both the manner in which so many seem unaware of the fact that arguments such as "oil is finite" and the industry must offset depletion refer not to new developments but factors that are eternal, and also in the degree to which current events and arguments echo past ones. Those arguing recently that depletion meant high prices were sustainable regularly pointed out that "Steep falls in oil production means the world now needed an amount of oil equivalent to Saudi Arabia's oil production every two years."[1]

Not only did those statements not explain how this differed from past industry needs, few seemed aware that in 1977, President Carter had made a near identical argument, stating, "that just to stay even, we need the production of a new Texas every year, an Alaskan North Slope every nine months, or a new Saudi Arabia every three years. Obviously, this cannot continue."[2]

Of course, it can and has continued, as the industry has always replaced depletion and managed to raise production at the same time. Numerous analysts published a graph showing future capacity needs including the amount required to offset depletion, but without showing how depletion was offset in the past, or even its historical existence.

Status not the Same as Expertise

Quite a number of senior industry people have spoken at IAEE conferences, including OPEC-Secretary-Generals, energy ministers and secretaries and numerous industry CEOs. But in my experience, all walked in, spoke, took a few questions, and left, with the exception of then-OPEC Secretary-General Dr. Subroto who attended some panels at the 1993 Bali meeting. (One young academic was embarrassed to deliver a paper on the possibility of a market without OPEC with the Secretary-General in the front row, but he laughed and assured her he was open-minded.) One wonders what other officials might have learned if they had listened to some of the research.

And actually, one of the best lessons I've learned came from ad-libbed comments from Richard Gordon at the Bali IAEE Conference in 1993, where he received the IAEE award for Outstanding Contribution to the Profession. After hearing various other speakers complain that oil prices, tanker rates, and LNG prices were too all low to allow sufficient investment to keep the market balanced, he said, as memory serves me, "If we've learned anything as energy economists it's that markets always clear and they usually clear faster and at lower prices than anyone expects."

Yet decision-makers have tended to treat episodes of tight markets and high prices as the new norm, or more recently a "new paradigm," that will not be reversed, generally demonstrating a level of knowledge that could be gleaned from cable TV. The common claim that $100 was the new oil price floor because that was the marginal cost of production was a serious misinterpretation of microeconomics, but it seems unlikely that many executives or top-level decision-makers ever questioned it, apparently thinking their status implied expertise.

The reason important people often have minimal expertise and/or knowledge can be found in the work of Herbert Simon, who talked about bounded rationality, the concept that individuals did not have the capacity to seek perfect information.[3] Senior executives are obviously even more constrained and have to rely on subordinates with expertise or a superficial review of media comments. It would be nice to think that the latter was why so many in the industry believed that $100 was the new floor price. Turning again to Adelman, in his 1986 article in *The Energy Journal*, "The Competitive Floor to World Oil Prices," he explained that operating costs constituted the short-term marginal cost, a basic concept of microeconomics.

Superficial Analysis

The problem is worsened by the fact that he media is dominated by comments from people who are not actually expert on petroleum economics. The problem is worsened by the cyclical nature of academic and expert interest in oil which rises sharply when prices go up and there is more funding for petroleum economics research but also a greater willingness to publish articles on the subject. As Anas AlHajji once noted, in 1972 only one American economist had published refereed articles on petroleum economics, but after the 1973 Oil Crisis, a dozen newcomers entered the field. (The same appears true of climate change economics and other "hot" topics.)

This becomes clear when considering two theories that have been embraced by many, the Hotelling Principle and the Hubbert Curve. The Hotelling Principle is based on a 1931 article by Harold Hotelling and reinterpreted by Robert Solow to suggest that prices of nonrenewable resources should rise exponentially.[4] Later authors refined this to indicate the oil prices should rise at the rate of interest. The Hubbert Curve is a bell-shaped curve applied to regional oil production trends by geologist M. King Hubbert. Both have been used to forecast prices and oil production, respectively, by numerous authors.

Unfortunately, both are counter-historical and clearly so. While neither Solow nor Hubbert had the easy access to price and production data that modern analysts do, these days a few minutes study would show that neither approach is consistent with actual behavior, except in rare cases. And as early as 1963, Barnett and Morse published data showing that mineral prices did not have a natural tendency to rise.[5]

Further, the Hotelling Principle has been shown to be an invalid interpretation by no less than three economists in the pages of *The Energy Journal*.[6] And yet, some economists continue to insist it only needs modification: "The oft-cited fact that the Hotelling model is frequently rejected by the data…must be interpreted with caution."[7] In reality, it should be discarded as having any predictive power for mineral prices.

The Hubbert curve is a more egregious case because its use led to the rise of the "peak oil" movement, advocates who claimed that scientific research proved that the ultimate and irreversible peak global oil production was imminent, causing economic collapse and the possible extinction of mankind. The bell curve was used both to predict oil supply trends and estimate recoverable resources in any given area.

Unfortunately, it consisted of nothing more than curve-fitting with no scientific foundation whatsoever, as Hubbert himself originally admitted. However, when it proved relatively prescient in forecasting the 1970 U.S. oil production peak, it became codified to some as being scientific. This is roughly the same as making a good prediction of the stock market and then insisting the method would always work.

By the time of the 1998 publication of "The End of Cheap Oil," there was ample data available to show that oil and gas supply rarely followed a bell curve. The lack of independent variables was made glaringly obvious by Hubbert's own assessment of U.S. natural gas production, when he extrapolated the production decline after the 1970s to imply cessation of production by about 2000, when it actually represented demand weakness due to high prices.

This is often seen in other supply forecasts, where the drop in British production after the 1988 Alpha Piper disaster and the collapse in the Soviet Union's production were both extrapolated by Colin Campbell with disastrous results. And the role of overlooked independent variables, like fiscal regimes, meant that country after country has surpassed previous peaks despite the supposed impossibility.

The fact that peak oil arguments were never mathematically valid is apparently unknown to most who concentrate on the surprise growth of U.S. shale oil production, again ignoring not just the production shut in by OPEC and other producers in support of the prices, but the political disruptions of supply from Iran, Libya, Nigeria, Venezuela and others. Conventional oil production has proved weak in the past decade, but has grown despite these problems.

Supply

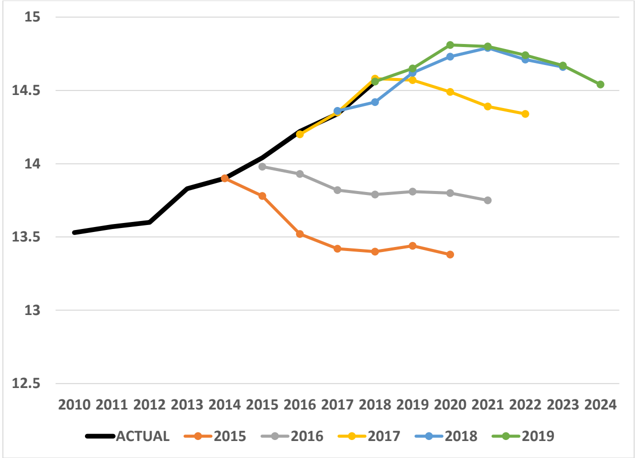
Predicting oil supply has always bedeviled forecasters because of the huge impact of both geology and politics. Geological uncertainty can be reduced somewhat through aggregation, but clearly a dollar spent drilling for a well in the Persian Gulf yields much more supply than a dollar spent in New Mexico, which helps explain the sustained higher prices in the 1970s.

After the first price spike in 1973, forecasters used the simple method of applying a price elasticity, which suggested soaring prices would lead to much higher supply. Unfortunately, three complicating factors rendered this invalid: taxes absorbed much of the higher revenue from higher prices, a rise in resource nationalism led to a shift in capital from high-yield resource to low-yield resources (from the Middle East to the U.S., especially). Additionally, the upstream investment boom caused costs to rise cyclically.

But knowledge that resource depletion raises costs over the long term has been a major factor in both bullish oil price forecasts and bearish oil supply forecasts, reflecting the simplicity of the analysis or, to put it in more formal terms, omitted variables. As Adelman pointed out in 1986, "Diminishing returns are opposed by increasing knowledge, both of the earth's crust and of methods of extraction and use. The price of oil, like that of any mineral, is the uncertain fluctuating result of the conflict."[8]

Unfortunately, most seemed to ignore this effect, with technological improvements widely remarked on only with the revolutionary development of hydraulic fracturing of shales. For conventional oil, the dominant tendency has been to produce pessimistic oil supply forecasts for all but the most resource-rich countries. Figure 2 actually shows the IEA's recent medium term forecasts for production from the Former Soviet Union, with the typical pattern of a brief increase, peak and decline, when actual production rose consistently.

Since 1982, most official long-term forecasts have projected flat or declining production in nearly every country and region, regardless of how mature the



IEA Forecasts By Year Of FSU Oil Production (mb/d)

resource base. In a 1990 paper delivered to the Calgary IAEE conference, I noted that the non-OPEC Third World, which had experienced steady production growth and had experienced minimal drilling, was repeatedly and incorrectly to be facing a near-term peak and lengthy decline.[9] Any number of individual countries, from Colombia to Oman to Venezuela, have gone through unexpected production booms—following fiscal reforms and yet it remains rare to find projections of increasing conventional oil production outside of the Middle East.

Basics

It is somehow extremely hard for people to recognize that oil markets are complex and that forecasters, formal or informal, are human. Not only is it hard to predict oil supply, demand and prices, but forecasters are prone not just to errors but bias. And bias is easy to satisfy when an issue is complex such that this is an enormous amount of information that can confirm nearly any viewpoint.

But the history of forecasting has been one of avoidable errors, specifically, believing theories that are not well-founded and actually contradict real world behavior, whether the Hubbert curve or the so-called Hotelling theory.

And it is somewhat bizarre that so many can ignore short-term problems such as the Arab Spring that take supply off the market rapidly and drive prices higher, instead insisting that long-term trends militate for higher prices. Similarly, the fact that forecasts have shown a repeated bias towards rising-price and declining non-OPEC supply projections has failed to impress all too many, in the industry and without.

There is no doubt that the long-term oil market development will depend not just on uncertain political developments and technological advances, rendering significant uncertainties, but recognizing and correcting past errors is a first step. The industry and market's repeated ability to do what many consider impossible should be the first lesson learned.

(See foototes on page 24)

Energy in Transition

Nau mai, toia mai, piki mai, toia 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 Grids
- 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.

Auctions for Renewable Energy Support: Lessons Learned in the AURES Project

BY LENA KITZING, VASILIOS ANATOLITIS, OSCAR FITCH-ROY, CORINNA KLESSMANN, JAN KREISS, PABLO DEL RÍO, FABIAN WIGAND, BRIDGET WOODMAN

Market-based, competitive bidding processes, i.e., auctions, are becoming a dominant policy instrument for securing future electricity production from renewable energy sources (RES) around the world. The rapid growth is striking: in 2005, only six countries employed RES auctions, and by 2017 at least 84 countries had adopted the mechanism [1,2]. This article outlines the rationale for the shift, describes some of the key design characteristics of auctions, together with best practices and potential pitfalls, and briefly considers the future of auctions in the face of declining support needs.

The research underpinning this article was developed by AURES, a European Horizon 2020 project. Between 2015 and 2017, it supported the implementation of RES auctions in EU Member states. Through theory-based work, empirical analysis of auctions in 12 European and 8 non-European countries, model simulations and economic experiments, AURES generated new insights on the applicability of specific auction designs under different market conditions and policy goals. A second phase of the project (AURES II) is currently ongoing (aures2project.eu).

A RES auction is usually a procurement auction (or tender), where a certain volume of new RES is demanded by a government (or private) entity. Bidders compete to be selected to deliver (part of) the volume based on the financial support they require (often a premium in EUR/MWh). Typically, the projects with the lowest required support win the auction and are then granted the right to receive support payments for a given period of time.

Non-discriminatory volume control mechanisms with competitive price determination

Two main arguments are often identified as driving the use of RES auctions: First, they allow an efficient allocation of support at a level that is competitively determined and reflects realistic cost for the selected projects at the time when they are built. Second, they allow for non-discriminatory and competitive volume control of RES deployment (i.e., avoiding first-come-first-served schemes) and thus control of total support budgets. Both of these can be attractive to policymakers faced with growing support commitments that burden consumers/taxpayers. Additionally, the maturing of many renewable technologies means that exposure to more competitive mechanisms might now be more appropriate than previously when more protective feed-in tariffs were the support mechanism of choice [3].

Auctions are also extremely flexible allocation mechanisms, allowing policymakers to specify when to call for a certain amount of new RES deployment, what technologies are to be supported, which type of support they receive and when projects should be delivered. As with other RES support schemes, the success of auctions depends on the design elements chosen and how well they address specific characteristics of the technologies and markets.

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See footnote at end of text.

The switch to auctions entails several new implications through the introducing of direct and immediate competition between RES projects. Not all 'good' projects can be developed anymore – competition only arises if there are more projects bidding than are awarded. RES developers are thus forced to move from a rather 'technocratic' focus on optimising their own projects, into becoming 'strategic' competitors, where the success of one's projects depends on the strength (or weakness) of others. This is also a challenge for policymakers: They now have to take care of 1) ensuring sufficient competition for a well-functioning price formation, 2) avoiding undesired incentives, collusion and other market distortions, and importantly 3) dealing with risk of low realisation rates, e.g., caused by underbidding or the existence of non-cost barriers (such as timing or permits).

Mixed results with RES auctions so far due to challenging design compromises

Renewable energy auctions have had a difficult history. Some early experiences showed either very low project realisation rates or lack of competition (too few bidders), which resulted in high costs due to flawed design [4,5]. We have found that auctions can only successfully contribute to achieving effective and efficient RES deployment if they are designed to match the specific market environment in the area where the auction is conducted. In addition, certain design choices pose trade-offs, e.g., prequalification rules can increase realisation rates but also the risks and costs for bidders, potentially lowering competition and cost-efficiency. At a broader level, policymakers often pursue several policy goals with a single mechanism, and are, for example, concerned with encouraging local industries or actor diversity through auctions. Finding a balance between different policy goals without compromising on well-functioning price formation is a challenging task. However, improved understanding of the pitfalls of auctions led to more carefully designed auctions using appropriate safeguards. Today, many auctions have delivered on their policy goals and achieved renewable energy deployment at low costs.

When not to auction?

Auctions might not always be the best choice. There is strong empirical basis for considering alternatives to auctions in situations where 1) reasonable competition cannot be expected, 2) project costs are particularly uncertain due to external factors or 3) secondary policy goals, such as ensuring local added value or actor diversity, are being pursued. These situations occur often when policymakers are seeking to promote immature or innovative RES technologies. The empirical insight that immature technologies in small markets are best supported outside of competitive auction mechanisms is also supported by recent theoretical work [6].

What influences auction design?

The design of a RES auction needs to reflect several aspects, including political priorities, technology characteristics, the country's market and socio-institutional context and the auctioneer's capabilities. Policymakers pursue policy goals with different priorities, which influences the optimal choice of design elements. For example, it is by now commonly agreed that prequalifications are a must in any RES auction (see below), but their stringency is directly affected by policy priorities. Compared to strict prequalifications, lenient ones may lead to lower support costs, but also lower realisation rates. This illustrates one of the trade-offs policymakers face when designing an auction.

Many design choices, such as auction format (single- or multi-unit), volumes and frequency, depend on technological characteristics, including unit sizes and cost structures. RES technologies have diverse characteristics (e.g., regarding planning procedures) and are therefore impacted in different ways by the same design elements (e.g., realisation periods).

Market characteristics that must be considered when designing auctions are the expected market potential and how this relates to the auction volumes, as well as long-term project pipelines compared to deployment targets. The expected number of bidders and bids, potential bidder structure, competitive positioning of bidders and risk of collusion, the distribution of project costs among bidders (how asymmetric they are), and the relative strengths of bidders and how familiar they are with each other (how well they can assess each other's costs), are all important aspects that policymakers need to consider for successful market facilitation.

Not to be neglected are institutional resources and capabilities. Policymakers designing the auction and auctioneers undertaking the auctions must have sufficient resources to deal with the challenges that auctions imply. Often, the required design solutions are highly context-specific and what works in one market is not necessarily applicable to another. The optimal design of an auction in a certain market therefore may be very different from the optimal design in a different market or even time period. In fact, occasional small changes to auction design over time are helpful, as bidders have less chance of becoming too familiar with one particular design. This helps avoiding implicit collusion.

Setting auction volumes is challenging

Setting an appropriate volume level is a challenging, but critical issue. Auction volumes can be defined in terms of capacity (MW), generation (MWh), or budget (million €). Each of these options has benefits and drawbacks. So far, capacity caps have been the most common, while budget caps have been introduced in three of the countries analysed in AURES [7,8]. A budget-based volume provides certainty on the upper level of support costs, but not on the total amount of capacity deployed or electricity generated. A capacity-based volume provides the strongest signal about the future market size (for project developers and equipment manufacturers) and it allows for early auction result assessment (as soon as the capacity is commissioned). But it does not provide certainty on the exact amount of RES production, which is the typical measure in political RES target setting (i.e., as a percentage of electricity demand) [2]. Generation-based auction volumes make it easier to plan and monitor political target achievement, and also facilitate grid management. However, the variability in production of some RES makes it difficult to make definitive contractual arrangements regarding the support payments.

Auction formats and pricing rules are less problematic

The choice between auction format (single-item or multiple-item), auction type (dynamic or static), and pricing rule (uniform or pay-as-bid) is inarguably intertwined. Policymakers often discuss at great length which auction type and pricing rule to choose. Complex auction types (i.e., dynamic ascending or descending clock) may seem, depending on the technology and format, most desirable for achieving efficient outcomes. However, during the work in AURES, we have found that they also attract fewer eligible bids, and are less favourable especially in the early phases of auction introduction, when some policy learning must be expected: due to the very context-specific design requirements, RES auctions are predestined for unforeseen strategic incentives and loopholes that later need to be mitigated. This is generally much easier in a simple static format. Simpler designs are also more robust against unclear market situations and irrational actions of inexperienced bidders.

Uniform pricing is regularly referred to as the theoretically favourable option due to its incentive compatibility, i.e., the bidders' optimal strategy is to bid according to their true costs. Indisputably, this is a much-desired characteristic for both the auctioneer (to learn from the bids) and bidders (easily calculated bids). However, this characteristic only holds under particular (theoretic) assumptions that almost never materialise in realistic auction implementations. As soon as bidders participate with more than one bid, in more than one auction round or their costs have some common components (e.g., PV-module prices), uniform pricing is no longer incentive compatible, and thus cannot be expected to automatically lead to superior results as compared to pay-as-bid. Most countries analysed in AURES used pay-as-bid, which is relatively robust against irrational actions.

Maybe surprisingly for some, the choice of pricing rule is not nearly as significant for efficient results as other factors such as the level of competition, or whether ceiling prices, prequalifications and penalties are designed well. Experiences with PV pilot auctions in Germany have, for example, shown that alternating between uniform pricing and pay-as-bid pricing rules seemed to have no significant influence on the resulting price.

Technology focus: Separate or pooled?

The question of whether to conduct separate auctions for each RES technology or to pool them together is a much debated topic. From a static perspective, combining several technologies in one auction is more allocatively efficient than separate technology-specific auctions: requiring all relevant projects to compete with each other will result in awarding the projects with the lowest costs. However, from a dynamic system perspective, one must take into account the prospect of technology learning: supporting technologies which are *currently* more expensive can help them become the most cost-efficient ones in the *future*. The extraordinary price decreases of solar PV are evidence for this.

Furthermore, the competitive pressure in multi-technology auctions may result in stop-and-go development for certain technologies, which is particularly challenging for smaller, single-technology project developers (e.g., in the Netherlands, onshore wind and PV were crowded out by cheaper RES heat technologies in the 2012-2013 auctions).

Multi-technology auctions are often adopted on the basis that they would lead to lower support costs. However, the opposite is often the case: in technology-specific auctions, support levels can be better differentiated by technology. This is a direct effect under uniform pricing where technology-specific auctions result in different prices per technology instead of one overall price, so that prices become more tightly linked to the costs of each technology. The reduction also materialises in pay-as-bid auctions through competitive effects where bidders with cheaper technologies tend to bid more aggressively when only competing against each other in their own separate auction.

In recent years, the concept of 'technology neutral' auctions has emerged. In fact, it is very difficult to design an auction that is actually neutral to all eligible technologies within it. The different technologies have diverse characteristics (e.g., regarding planning procedures) and are therefore impacted differently by the same prequalification criteria and realisation periods. To avoid favouritism, the auction design tends to be very complex (and ultimately specific per technology). Ensuring a level playing field when setting design elements such as ceiling prices, material and financial prequalifications, penalties and realisation deadlines can therefore become challenging.

Reliable long-term auction schedules are indispensable

A long-term auction schedule ensures a degree of certainty for investors to avoid both unnecessary investor risks and unfavourable auction outcomes. An auction undertaken without any envisaged repetition for the future could potentially push bidders to underbid in an attempt to limit their losses especially when they already are in late project development phases. Auctions may then seem successful as they result in low support levels, but this may eventually lead to low realisation rates and the failure to achieve RES targets. Empirical analysis carried out in AURES shows that continuity in auction rounds, rather than "stop-and-go" implementation, increases long-term planning certainty for market players [7]. Visibility of upcoming auction rounds with fixed dates enables the supply chain to plan for participation, and develop projects accordingly. This can add to high auction participation, as seen e.g., in California [9].

A main lesson from AURES is that auction frequency is context- and technology-dependent. In general, a lower auction frequency is appropriate for technologies with potentially fewer bidders and larger project sizes (such as offshore wind) and more frequent rounds in the case of technologies (or technology groups) with more potential participants (such as solar PV). If markets are large enough, it can be beneficial to undertake auctions several times a year but it is also common that, in small markets, auctions are undertaken once a year or even less often [10].

Realisation safeguards are a must

The primary aim of prequalification criteria and penalties is to secure high project realisation and reduce delays. Material prequalifications such as requiring a certain project development stage or permits have proven to be an important safeguard for project realisation. They also reduce the risk of the Winner's Curse (where winning bidders are struck by higher than expected costs), because they force bidders to develop projects well before entering an auction, thus improving cost estimates. But they also increase sunk costs for project developers and increase non-allocation risk.

Penalties and connected financial prequalifications (through bid bonds) are also an important safeguard for project realisation, and can reduce incentives for underbidding and delays. However, they increase bidder risks, potentially leading to higher prices. If penalties are high and financial guarantees difficult to obtain, they may deter project developers from participating in the auction, which reduces the level of competition and may increase bid prices [11].

Protecting actor diversity is possible but needs to be applied with caution

Auctions can lead to higher market concentration, as smaller market actors and private investors are less able to cope with the complexity and competiveness of auctions. We have seen some examples of policymakers trying to protect small community actors by designated rules that reduce the auction risk for certain bidder groups. AURES analysis showed that auctions can use the following means to protect certain actor groups: 1) reduced financial/material prequalification, 2) implementing different pricing rules (e.g., favoured actors are granted the highest accepted bid even in pay-as-bid auctions), 3) creating contingents (quotas). Nevertheless, those measures should be applied with caution, since they can affect and distort the auction outcome significantly. Also, defining 'small' or 'community' actors is challenging and favourable treatment creates an incentive for all actors to try to be deemed eligible for it (e.g., in Germany, preferential rules led to the creation of artificial citizen energy communities for onshore wind who were awarded more than 90% of the auction volume in 2017).

Desirable projects and/or actors can also be favoured outside an auction, for example by providing them with additional legal and advisory support during participation, or by exempting them from participating in the auctions altogether and instead supporting them with administratively-set tariffs.

Auctions, a suitable and effective RES policy tool for now and the future

RES auctions can be a suitable instrument for allocating support under budget and volume limitations and can achieve significant short-term efficiency gains. However, auctions are not the silver bullet superior to any other support allocation mechanism. The success of any given auction depends on how well is it tailored to national market conditions and policy goals, and synchronised with project development activities by the industry. This requires certain institutional capacity.

Auctions are extremely flexible and their design can be adapted to local circumstances and reflect changes in the broader context. As the costs of renewable technologies decline, there is increasing attention on the possibility of eliminating support for some technologies. In this context, it would be possible to conduct 'subsidy free auctions' where there is no premium payment, but the support comes from a guaranteed buyer for a project's generation or from the cost-free provision of the necessary infrastructure, e.g., the site or the grid connection. Moves towards this can be seen from recent offshore wind auctions in Germany (2017) and the Netherlands (2018). As familiarity with auctions grows, also new actors are entering the arena. While current RES auctions are typically conducted by government entities on the grounds of national interest, they may also become the mechanism of choice for other actors such as large industrial companies to procure long-term renewable electricity in a cost-efficient manner. The flexibility of the mechanism suggests that it will remain popular with policymakers and the energy industry as the shift towards greater decarbonisation continues.

Footnote

[1] Estimates can be derived using average values per technology (e.g., annual full-load hours).

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Transition to a Capacity Auction: a Case Study of Ireland

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See footnotes at end of text.

Introduction

Modern electricity markets are characterized by increasing shares of intermittent production which has almost zero marginal costs. The effect of introducing large amounts of cheap power into the system is known as the merit order effect – a shift of a supply curve to the right which delivers lower equilibrium prices. The lower prices and the fact that fossil-fuel generators are used less often exacerbate adequacy problems – there is a threat that not enough generating capacity will be available in the system since generators´ revenues are low and investment needs are not met. This and the fact that energy markets are often capped in order to prevent market power leads to the so called "missing money problem" (Teirila and Ritz, 2018, Bublitz et al., 2019). One possible remedy is to supplement the energy only markets with capacity markets (Newbery, 2016; Cramton et al, 2013; Joskow, 2007).

Recently the electricity market on the island of Ireland has been completely restructured, a change that affected also the capacity mechanism, transforming it from an administrative decision-based to a market-based mechanism, an auction. The move however has not been a smooth one, with a supply of Dublin put at risk as one of the main suppliers in the area wanted to withdraw from the market as a result of not being able to successfully secure the operation of its two units. Since Irish electricity demand is forecast to grow by between 15% and 47% over the next ten years, with over a quarter of all electricity consumed by data centres, many of which will be in the Dublin region (EirGrid, 2018a), the threat of losing one of the suppliers become even more serious.

In this case study we show how even with considerable analysis and preparation, the introduction of an auction system is not without risk.

Capacity mechanism in EU

The first explicitly designed capacity market in EU was established in 2015 in the UK (Newbery, 2016).[1] While capacity markets were relatively common in the U.S. and part of the original market design in many states, they are more recent in Europe. The EU Single Electricity Market is designed as an energy-only market but increasingly European countries are including capacity payment schemes into their power systems in response to the rising penetration of renewable generation and the impact of this on system reliability (Bublitz et al., 2019; CRU, 2015). Ireland had long argued in the previous electricity market design (the Single Electricity Market or SEM) that a capacity payment mechanism was needed due to the small size of the all-island electricity market, the relatively high share of intermittent renewables, and the limited amount of interconnector capacity, leading to a vulnerability to outages.

The European Commission (2016) distinguishes between two types of Capacity Remuneration Mechanisms: volume- and price-based. Bublitz et al. (2019) provide a description of generic types of CRM and give an overview which solutions are used around the world. They distinguish six types of mechanisms: tender for new capacity, strategic reserve, targeted capacity payment, central buyer, de-central obligation and market-wide capacity payment. The reliability option design with a central buyer format was chosen as the design of the new Irish capacity remuneration mechanism after a consultation process in 2014 and 2015.

From capacity payments to reliability options

The Irish Single Electricity Market (SEM) was established in 2007 as a mandatory, centrally dispatched pool where the system operator[2] calculated a marginal system price for each trading period (Teirila and Ritz, 2018). From its inception, the energy-only market was accompanied by the Capacity Payment Mechanism (CPM) – payments that were centrally distributed by the regulator among all generating units. The CPM was a system of fixed revenue payments for participants offering generation capacity in the SEM. A pot of money was calculated annually by the Commission for Energy Regulation and the System Operators, as a function of the volume or capacity needed to service market demand and the annualized fixed costs of a best performing entrant peaking plant. The fund was collected through capacity charges levied on market participants who purchase electricity through the pool.[3] It was paid out to market participants who provided generation capacity to the market and the average total value was approximately €550 million in the last years of the scheme (EirGrid, 2018b).

In October 2018, the SEM was transformed to become compatible with the EU Third Energy Package which aimed to create an integrated electricity market based on market principles (Teirila and Ritz, 2018). The new Integrated Single Electricity Market (I-SEM) consists of several markets of different time horizons: forward, day-ahead, intraday and balancing markets. In order to calculate day-ahead interconnector flows and market prices, a new algorithm, EUPHEMIA, is used to couple the I-SEM and UK and hence European electricity markets. [4 5]

In the early consultation on the design of the new integrated single electricity market (the I-SEM), the option to discontinue the capacity payments was considered. The SEM committee decided that to avoid the risk of generation shortfall some form of capacity payment should remain. However, in line with the EU integrated market, a more competitive process should be put in place and capacity payments would be made through an auction (SEMC, 2019).

The capacity mechanism has been transformed into a mandatory Capacity Remuneration Mechanism (CRM)[6]. It uses reliability options (ROs) which are purchased in an annual uniform auction with two types of auctions planned: T-4 and T-1 when auction is held four and one year before delivery, respectively. As a preparation for the auctions EirGrid has issued Capacity Market Codes with detailed instructions for CRM participants. One of the concepts discussed in this document are locational capacity constraints (LCC) which may be introduced by the system operator and which determine geographical areas that require that a minimum capacity is cleared in the area for the purpose of system security (SEM, 2017). To date, three capacity auctions have taken place and they all made use of the locational constraints. The first T-1 auction was run on 15 Dec 2017 with Level 1 LCC Areas of Ireland and Northern Ireland; and a single Level 2 LCC Area of Dublin. The same LCCAs were present in the second T-1 (on 13 Dec 18) and the first T-4 auction which was run recently (28 March).

Reliability Options

A Reliability Option (RO) is a financial instrument that entitles the System Operator (the buyer) to "receive a difference payment from a generator if the price in the electricity market exceeds a pre-defined strike price" (Teirila and Ritz, 2018). Therefore, the load is hedged against high prices in the spot market.[7] As a first step EirGrid establishes how much capacity is needed to secure the supply of electricity in the market, then in an auction it purchases the requisite amount of ROs to cover that capacity. The auction clears at the minimum price that is needed to procure the desired amount of RO capacity (Teirila, 2016).

First RO auctions

The first Irish capacity auction took place in December 2017[8] for delivery in May 2018 - September 2019[9 10]. The second capacity auction took place in December 2018 for delivery 2019-2020[11 12]. 105 generating units were qualified to participate in the auction, out of these 100 submitted offers and 95 were successful. A third auction for delivery 2022 – 2023 is planned in March 2019 (SEM, 2018).[13]

In the first (T-1) auction, 100 generating units participated in the auction and 93 were successful with 7774MW of capacity auctioned for €333 million in total. The second T-1 auction a year later secured 8266MW of capacity for a total cost of €345 million. This compares with the annual capacity payment sum in 2016 of €515 million for a capacity requirement of 7070MW under the old capacity payment mechanism and shows a significant saving for electricity customers. The clearing price was €40.65 per kW per year, which dropped from the first auction clearing price of €41.80 per kW last year. In the old Capacity Payment mechanism, the price was set by the best new Entrant price and was €72.82/kW/year in 2016 (which was already lower than in previous years) (EirGrid, 2018a, 2018b).

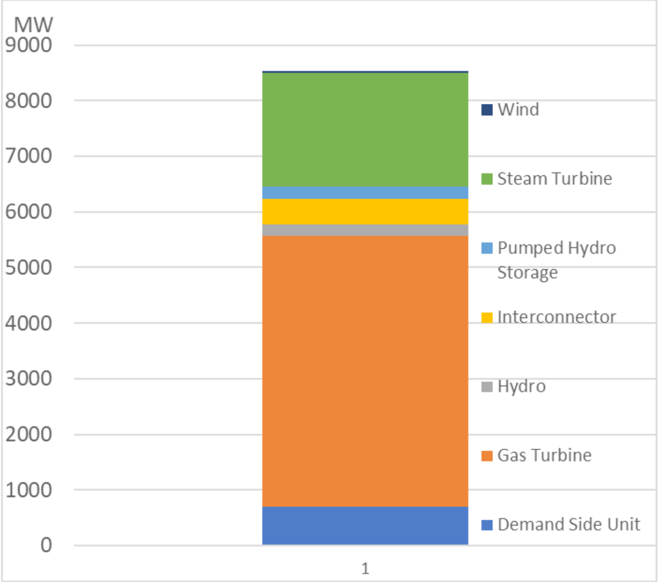

Figure 1. The range of technologies and energy sources bid in the second T-1 auction (EirGrid 2018b)

The range of technologies and energy sources bid in the auctions was diverse, as illustrated in Figure 1. As expected, most capacity was bid by gas and steam turbine generators. Of the new capacity qualified for auction (400 MW), the majority was offered by Demand Side Units (397 MW).

Total Capacity (MW)

	Northern Ireland	Ireland	Greater Dublin	Total
De-Rated Quantity Offered	1999.5	6397.0	1492.4	**8396.5**
De-Rated Quantity Successful	1997.4	6268.5	1492.4	**8266.0**
De-Rated Quantity Unsuccessful	2.062	128.5	0	**130.6**

Table 1. Total accepted capacity in MW
EirGrid (2018b)

In the 2018 T-1 auction, capacity was secured across the three locational zones (Table 1). However, notwithstanding the LCC rules, no new capacity was bid

When the results of the first capacity auction were announced on 26th January 2018, it was found that only one of two Viridian plants in Huntstown was awarded a reliability option. Viridian immediately indicated that it wished to exit the Irish electricity market as soon as possible and informed their shareholders that they would place "relevant Huntstown staff on protective notice of redundancy for an initial period of eight weeks".[14] The company Viridian Power and Energy Holdings is a 747MW gas-fired power station with 2 units located in Huntstown, north Dublin. When only one of the two plants was successful in the first (T-1) auction, they stated that without the reliability option the I-SEM market would not adequately remunerate the Huntstown plants and were therefore not viable. They subsequently applied for a derogation of the Grid Code requirement of 3 years notice to close.[15] This outcome then initiated a significant amount of further analysis by the SEM Committee and EirGrid/Soni to determine whether the generating units were viable without a reliability option; whether the derogation could be granted; and the operational viability of the Dublin LCCA should they close. This was also tested in court via a separate dispute that Viridian raised with the Commission for Regulation of Utilities (CRU). The final outcome has been an agreement between the CRU and Viridian outside the market for the next 3 years to secure both their units.

Box 1. Capacity market participation and the firm business model – the case of Viridian

in the Greater Dublin area.

The Viridian situation and lack of new capacity in Dublin has led the CRU to issue a note in October 201816 calling for more generation in the Dublin LCCA saying that should any new generator be successful in the T-4 auction they would be guaranteed a connection. This has led to a large amount of new generation in Dublin qualifying for the T-4 auction. The CRU decision to "issue a connection offer to any generator located within the Dublin region Level 2 Locational Capacity Constraint area that is successful in the T-4 capacity auction for 2022/23" (CRU, October 2018) is unprecedented - especially from a network planning and development perspective.

Conclusions

The Irish capacity auction results to date demonstrates the complexity of operating a competitive capacity market in such a small market where there are few market participants. The additional problem of transmission constraints which divide the market into subareas makes the situation even more difficult and highlights the necessity to include locational capacity constraints into the market setup. Nonetheless, the capacity auction In Ireland today has secured more capacity and at lower cost than the previous capacity payment scheme in which all market participants received payment regardless of whether they were run.

The Irish case has shown that even though the transition to an auction scheme has been largely successful, the failure of an individual participant can cause instability in the market. Capacity markets will likely remain a necessity in isolated, small systems like the Irish case, where additional supply must be secured nationally and participants may not cover their costs through energy-only markets alone. As this case demonstrates, good design of capacity markets is needed to ensure that market stability is increased rather than the converse.

Footnotes

1 However, the capacity market has been paused since November 2018 and the scheme mechanism is currently under investigation by the EU Commission for compatibility with EU state aid rules. In 2018, the General Court annulled the 2014 decision in favour of the scheme, as it considered that the Commission should have opened an in-depth investigation to gather more information on certain elements of the scheme relating to the participation of energy consumers offering to reduce their electricity consumption in times of supply disequilibrium in the electricity market http://europa.eu/rapid/press-release_IP-19-1348_en.htm

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4 http://www.eirgridgroup.com/__uuid/f110639e-9e21-4d28-b193-ed56ee372362/EirGrid-Group-I-SEM-Quick-Guide.pdf. See also https://www.nordpoolgroup.com/message-center-container/newsroom/feature/2018/10/nord-pool-welcomes-power-coupling-with-ireland/

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(See references on page 35)

Polish Association for Energy Economics Holds First Student Paper Competition

The Energy Economy Forum Kraków 2019 (FGE2019) was organized by the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences (MEERI PAS) and in cooperation with the Polish Association for Energy Economics (PAEE). The conference was held at the Hotel Qubus, Kraków, Poland from the 17th to the 19th of March, 2019. This year, for the first time, the Energy Economy Forum held a student session which was organized and coordinated by the PAEE Student Chapter. Students from across Poland had the opportunity to submit an abstract to enter the FGE2019 student presentation competition or the student paper competition. The student authors of the top nine abstracts were invited to showcase their research work in front of an expert judging panel comprised of industry experts, academics and other conference attendees. The evaluation committee selected the 2019 winners based on the quality of the presentation, originality, and relevance to the energy sector. The prizes were sponsored by one of the leading Polish power companies (ENEA Trading) and the International Association for Energy Economics.

In the student presentation competition, Adam Suski, a MSc. student of the AGH University of Science and Technology took the first-place prize for his research presentation “Optimization of Stand-Alone Hybrid Energy System using a Linear Programming Approach”. The first runner-up was Weronika Nawrot with her presentation “A Study of the Impact of the Deposition of Environmental Pollutants on the Efficiency of a Photovoltaic Module” and the second runner-up was Mikołaj Krupa with his research presentation “Hydrogen, the fuel of the future? Design and construction of a hydrogen-powered boat”. Furthermore, at the end of the Student Session, the expert judging panel was happy to announce the winner of the best paper award. Magdalena Sikorska, a PhD student of the Kraków University of Economics won the 2019 best paper award for her paper “Polish Power Industry During Changes - A Review of Trends that are Shaping the Future of the Polish Power Sector”. The event was a tremendous success in its inaugural year and the Polish Association for Energy Economics is looking forward to the next year. The titles of the all the presentations can be found online at the Energy Economy Forum website https://fge2018.files.wordpress.com/2019/03/program-sesji-studenckiej-2.pdf

Pablo Benalcazar

Student award winners at the Krakow Conference of the Polish Association for Energy Economics

Challenges in Designing Technology-neutral Auctions for Renewable Energy Support

BY JAN KREISS

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Overview

The expansion of renewable energy (RE) sources is a cornerstone of the energy transition in order to achieve the global greenhouse gas emission reduction targets. However, the costs of electricity from RE sources has not yet achieved grid-parity with conventional energy sources and thus RE sources need support in order to achieve the expansion targets. The global trend regarding the promotion of RE sources is to determine the support payments through competitive bidding processes. Such auctions for RE support are, as of today, deployed in many countries around the globe particularly in Latin America and in Europe. Moreover, since 2017 the European Commission requires its member states to deploy auctions in order to promote RE (European Commission, 2014).

There is a large variety of auction designs in the different countries, yet, there is a general development to open up the auction formats. The most recent openings were so-called cross-border auctions, where participants from different countries could participate, e.g., in Denmark and Germany (Kitzing & Wendring, 2016), and technology-neutral auctions, where bidders participate with different technologies. Examples include the Netherlands (Minister van Economische Zaken, 2015) and Mexico (IRENA, 2017). With a more open auction format and thus a larger variety in participating bidders, the complexity of designing an auction increases as well. We analyze the main challenges when designing a technology-neutral auction. We focus on the general differences between different RE technologies and the resulting implications for the bidders and the auctioneer.

Methods

We deploy a three-way approach in order to analyse the specific challenge to design a technology-neutral auction. First, we abstract the technological differences between different RE technologies, especially of wind on- and offshore and photovoltaics (PV). Those differences include construction and planning times, investment and operation costs and cost uncertainties. We listed the most important characteristics of RE which differ across technologies in Table 1. It also provides some examples regarding the differences among technologies.

Second, we empirically analyse the design of already conducted or planned technology-neutral auctions for RE support. Auctions where multiple technologies could participate were conducted in Germany, Mexico, The Netherlands, Slovenia, Spain and the UK among others. The main design characteristics of those auctions are summarized in Table 2. We focus on design elements that address the individual characteristics of the participating technologies and how they impacted the

Cost structure:	Investment costs	High for PV, low for biomass
	Operation costs	High for biomass, low for PV (fuel costs or not)
	Cost uncertainties	High for wind offshore, low for PV (also depending on planning times and remuneration scheme)
Project preparation:	Planning and construction time	Much for wind offshore, less for PV
	Prequalification costs	High for wind, low for PV
	Prequalification benefit	A positive feasibility study for wind does not guarantee the practicability
Generation profile:	Dispatchability	Not for wind/PV but for biomass
	Full-load-hours	Biomass > wind offshore > wind onshore > PV
	Integration costs	Different for technologies but depending on location and country
	Market value	
Project structure:	Typical project size	Wind offshore much bigger than e.g., PV
	Ownership structure	Wind offshore big utilities, while other technologies also community projects
Long-term development		Unclear future cost reduction potential for different technologies

Table 1 Different RE Technology Characteristics

	Germany	Mexico	Netherlands	Slovenia	Spain	United Kingdom
Technologies	Wind onshore, PV	Wind onshore, PV, Geothermal, Hydro	Wind onshore, PV, Biomass, Geothermal, Biogas, Hydro	Wind onshore, PV, Geothermal, Biogas, Hydro, Biomass	Wind onshore, PV, (biomass)	Wind onshore, PV, Hydro, landfill gas, Wind offshore, biomass, ACT, anaerobic digestion, geothermal
Prequalification	Different PQ and realization periods	Same PQ and realization period	Different PQ and realization periods	Same PQ and realization period	Same PQ and realization period	Same PQ and realization period
Discrimination	Regional quota, Technology-specific maximum prices, Price correction factor	Price correction factor, Regional factor	Technology-specific maximum prices	Technology pots	Generation factor	Technology pots, Technology-specific maximum prices
Results	Only PV awarded (3 auctions)	Mainly PV and wind awarded, regional concentration	Mixed results, depending on year biomass, PV or wind predominant	Different technologies awarded; wind predominant	1 auction almost entirely wind, 1 auction PV predominant	Mixed results (depending on pot), focus on offshore wind

Table 2: Overview of technology-neutral auctions in different countries

outcome.

Moreover, we include the findings of previous studies on technology-neutral auctions. Most research of technology-neutral RE auctions is based on more general considerations of technology-neutral support (Aghion, et al., 2009; Azar & Sandén, 2011). This research shows that technology-neutral policies also have set-backs with respect to dynamic efficiency and a desired technology mix. Applied on the actual topic of RE auctions there is research to quantify the monetary effect of technology-neutral auctions (Jägemann, et al., 2013; Jägemann, 2014). Further research does not only quantify the costs of technology-neutral and technology-specific auctions but also considers other effects like integration costs and market failures (de Mello Santana, 2016; Gawel, et al., 2017). Other researchers focus on the cost-effectiveness of technology-neutral auctions (Lehmann & Söderholm, 2017; del Rio & Cerdá, 2014; Kreiss, et al., 2019). That is, are technology-neutral auctions the best choice with respect to support costs.

Third, we apply auction-theoretic concepts on the present data. We deploy the concept of asymmetric auctions (Maskin & Riley, 2000) which corresponds to the different characteristics of the different technologies. Furthermore, the auction-theoretical analyses includes discriminatory auctions (McAfee & McMillan, 1989), integration costs (Joskow, 2011) and common values (Kagel & Levin, 1986).

Results

The results of our analyses show that actual technology-neutrality has never been achieved in the past and is in general hard to achieve. A further question is whether this should be achieved at all. First, there are arguments which speak against multi-technology auctions in general. Deploying technology-specific auctions reduces the uncertainty for both the auctioneer and the bidders. That has two main advantages. On the one hand, less uncertainty reduces the capital costs for investors and thus the costs for the economy. On the other hand, technological predictability helps the government to plan the grid infrastructure in line with the RE expansion and thus reduces integration costs (Hirth, 2013). Furthermore, technology-specific might be sensible with regards to dynamic efficiency (de Mello Santana, 2016), i.e., the technology development could change the costs differently for different technologies and thus their order with respect to the generation costs.

Those arguments are confronted with the biggest advantage of technology-neutral auctions, the (static) efficiency. That is, the bidders with the lowest generation costs are awarded and thus the welfare is maximized. However, it is not clear what technology-neutral actually means. For example, does it mean that all technologies have the same realization period or different periods that account for the different planning and construction times. There are various similar examples to be found. Furthermore, due to the different characteristics of different technologies it would be hard to impossible to conduct an actual technology-neutral auction even if this technology-neutral could be defined. For example, the different number of full load hours, different upfront costs to achieve the permits and different lead times cannot all be taken into account with full compensation. Upfront costs are auction-theoretically considered as sunk costs and influence the bidding behaviour depending on the amount (Levin & Smith, 1994). Additionally, different planning and construction times alter the possibilities to consider technology cost development, e.g., PV module or wind turbine prices, and thus also influence the bidding behaviour (Kreiss, et al., 2017).

Finally, there is the question whether the auctioneer wants a technology-neutral auction. Even though such an auction theoretically results in the welfare optimum, this might not be the outcome with the lowest costs for the auctioneer. The different cost structures of different technologies lead to windfall profits which could be reduced through a discriminatory multi-technology auction (Kreiss, et al., 2019).

Conclusions

The ongoing development of auctions for RE support leads towards open auction formats where bidders from either different countries or with different technologies can participate. However, this development increases complexity and is one of the key challenges for the upcoming years. Although there are reasons to maintain technology-specific auctions, the advantages of multi-technology auctions will prevail. Yet, it is still questionable if such an auction will be designed technology-neutral. Firstly, the term technology-neutral is hard to define. It is ambiguous what "neutral" means in that context. Secondly, even if technology-neutrality is well defined it remains hard to impossible to design such an auction. And finally, it remains unclear whether an auctioneer would actually prefer a technology-neutral auction.

This debate proves once again that a good auction design starts with clear objectives and requires commitment to these goals. Thus, our recommendation is to design an auction with best respect to the actual auction targets. That may lead to a technology-specific, multi-technology or technology-neutral design but technology-neutrality cannot and should not be a target itself. In any case, the special technology characteristics have to be considered.

Acknowledgments

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16th IAEE
European Conference
Ljubljana
25–28 August 2019

IAEE International Association for Energy Economics
SEB School of Economics and Business, University of Ljubljana
SAEE Slovensko Združenje za Energetsko Ekonomiko

Energy Challenges for the Next Decade

School of Economics and Business, University of Ljubljana, Slovenia


Ljubljana castle[2]

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 School of Economics and Business, University of Ljubljana (SEB LU). 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.

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Prešeren's **square**[3]


Lake Bled[4]

The central theme of the conference is Energy Challenges for the Next Decade covered in more than sixty Concurrent and in eight Plenary Sessions 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. You may consult the draft programme here. The conference will start with the opening address by Alenka Bratušek, Minister of Infrastructure. The IAEE President Christophe Bonnery and President- Elect Yukari Niwa Yamashita will chair the opening and closing plenary respectively. 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) and *How to present research in scientific conferences* (by Georg Erdmann and Markus Graebig). Students interested to present during PhD day seminar 2 should submit a full paper and state their interest to the organizers via e-mail by 7 June 2019. Selected students will be notified by 1 July 2019. All conference participants are also invited to attend the seminar *Teaching energy – where does one begin?* by Adonis Yatchew, before the reception on 25 August 2019. On 29 August 2019 Richard Green will deliver lectures in the Post-conference seminar on *Energy Transition and Power Markets*.

Why Slovenia? Why Ljubljana?

The beauty and diversity of nature, stunning architecture, and delicious food are just some of many reasons to visit Slovenia, the country with five different landscapes. The conference offers Social tours to the most interesting places in Slovenia. We would also like to highlight the Technical tours: the first *on Sunday 25 August to Kidričevo Compressor Station and Ptuj Wine Cellar* and the second *on Thursday 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 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. 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 you in the remarkable Ljubljana castle, and the Gala dinner on 27 August 2019 in the Cankar's Hall, the architectural landmark of Ljubljana.

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Important dates
IAEE Best Student Paper and Poster Award Competition application deadline: **22 May 2019**
Deadline for presenters registration: **07 June 2019**
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Post- conference seminar application deadline: **1 July 2019**


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Auction Design Influences Efficiency: California's Consignment Mechanism in Perspective

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See footnotes at end of text.

In our modern economy, auctions are used as a market allocation mechanism to price all manner of commodities. From energy to telecommunications spectrum, from consumer products to treasuries, the benefits of auctions touch on numerous facets of our everyday lives.

Unfortunately, there exists a commonplace assumption among many—particularly among policymakers and regulators—that simply because an auction was held and that a nonzero sum of bidders participated, that the auction results are "efficient." These policymakers and regulators are placed in the unfortunate position of defending auction-determined allocations and prices because, in many cases, they are called upon to certify the results of the auctions as "competitive."

However, it has been known for millennia—yes millennia—that the rules and structure of an auction can greatly affect its efficiency. A little history seems appropriate. Oxford University historian Robin Lane Fox chronicles the use of auctions in the ancient world, as far back as the Ptolemies and into ancient Rome.[1] In the absence of a centralized tax system like the Internal Revenue Service, rulers would engage in the practice of 'tax farming.' Auctions would be used whereby the collection of a particular tax (say a tax on salt) was bid for in advance by contractors. This system was preferred by rulers who sought the assurance of predictable state revenue. Winning the auction gave the contractor the legitimate coercive power of the state, giving them legitimacy in collecting taxes far exceeding the bid-for sum. With these powers, they could extract revenues from provincials with brutality. This practice gave rise to the first use of the phrase "shaking them down" several years later when this practice was continued into Imperial Rome.[2] The auctions were so fiercely competitive that contractors eventually pooled their financial resources to improve their bidding position, forming what was called a 'corpus,' and from them the inception of the modern corporation.

The finding that the design of a market mechanism can influence the market's price and overall market behavior is hardly novel among economists today. From slight modifications of bidding procedures to outright auction format changes, mechanism adjustments can greatly influence the market price. This is an important fact to highlight for policymakers who would argue that simply because an auction was held, the market allocation is efficient. Efficiency should not be considered in relativistic terms—an efficient allocation should be independent of the auction format. This principle is indelibly highlighted by contrasting the auction mechanisms in two regional U.S. carbon auctions.

Carbon markets, also known as cap-and-trade programs, play an important role in influencing electricity markets. Indeed, one of the intended goals behind implementing carbon markets to begin with, was that they would effectively "put a price on carbon" that would influence fuel diversity. Like electricity markets, carbon markets utilize an auction mechanism for price determination.

In the northeastern U.S., the Regional Greenhouse Gas Initiative (RGGI) operates a multi-state carbon market whereby an auction is used to allocate carbon permits/allowances to the electric generation sector. In California (and in recent years joined by Quebec) the Assembly Bill 32 cap-and-trade program operates in much the same way. However, there is one critical difference in the rules of the auction between these two systems. Whereas both auctions utilize a uniform-price auction format, only California utilizes a consignment mechanism for revenue recovery.

What is consignment? A variation of the old Hahn-Noll revenue-neutral auction design,[3] the consignment mechanism returns the revenues from the auction back to the bidders for a small subset of bidders. In California, electric distribution utilities are pre-allocated a quantity of emissions allowances and then are required to consign, or sell, them into the auction. They then receive the revenues obtained from the sale of those allowances, which they are then required to use for the broadly-defined purpose of benefitting their ratepayers. Other bidders in the auction, such as wholesale generation firms or petroleum refiners, etc., do not obtain such an allocation. Without conducting much analysis, it should be clear to a reasonable person—all caveats aside—that one's incentive in bidding in an auction might be distorted if one receives the revenues from that auction. It only makes sense. However, policymakers, particularly in California, hotly dispute this commonsense point.

Recently published research highlights how significant the auction price and allocation quantities can be between these two auction styles. In our recent paper,[4] my co-author PJ Healy (Ohio State Department of Economics) and I design a laboratory experiment to test the influence of the consignment mechanism. We design a four-treatment experiment that includes variation in producers (e.g., fuel types), variation in underlying energy demand, and with it, demand for allowances. We also varied the mix of which generation types were consigning.

The results of the experiments are quite interesting—though they simply confirm the above controversial point that one who receives revenue from an auction will behave differently as a bidder than one who does not. The experimental results find that auction bidding behavior significantly affects the auction clearing price, price and quantity bids, and results in more frequent occurrences of bidders not receiving a sufficient quantity of allowances in the auction necessary for program compliance. In other words, the misallocation problem not only distorts bidding behavior and auction prices—it can also force some firms onto the secondary market to acquire allowances they need to comply with the underlying regulators.

The underlying mechanism for these distortions, the paper finds, are due entirely to the nature of consignment allocation. If the consigning bidders are consigning a share of allowances that exceed the quantity of allowances they themselves need to acquire for program compliance, this makes them 'net sellers.' If, on the other hand, the consigning bidders are consigning a share of allowances that is exceeded by the quantity of allowances they themselves need to acquire, this makes them 'net buyers.' The results of the experiments confirm that net sellers manipulate their bids to inflate the auction price, and that net buyers bid in a manner consistent with a standard uniform-price auction without consignment. In other words, the auction is distorted by bid manipulations of those bidders receiving a rent from the auction.

Further research from non-experimental bidding and auction data is needed to confirm the obvious conclusion identified in the laboratory. However, it should be noted that carbon markets vigorously defend the propriety of their auction participant's bidding information and deny all public records requests on the grounds of trade secrets protections. Internal auditors and market monitors should consider ex-post evaluation protocols for assessing the efficiency of auctions, paying careful attention to the behavior of net sellers.

This begs an obvious public policy question. What motivated the regulators of California's cap-and-trade program, the California Air Resources Board, to pursue such an auction mechanism? One could speculate that it was a necessary carve out to obtain stakeholder approval from the three investor-owned utilities, and those utilities likely argued before the Board, and likely vigorously lobbied, for the use of consignment on the grounds that it would provide protections to consumers. Today, many households in California receive a line-item rebate on their electric bills whereby some of these consignment funds are returned to them. The ultimate question for households is then obvious—given that the carbon price influences the wholesale electric price, does the rebate they receive cancel out the adverse effects of the higher carbon price? Further analysis of the welfare implications of consignment should be pursued.

Footnotes

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Michael Lynch - continued from page 9

Lessons of an Oil Market Analyst (and the value of an IAEE membership)

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Carbon Tax or Cap and Trade? Evidence from the Province of Ontario's Recent Cap and Trade Program

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See footnotes at end of text.

With an exponential growth in greenhouse gas (GHG) emissions from human activities on the planet, it has been argued that we are impacting climate change in a negative way. Therefore combating climate change and the impacts associated with it has become Goal 13 of the United Nations' Sustainable Development Goals. A number of countries have brought forward policies at various levels of government: federal, provincial, state that seek to limit GHG emissions. The introduction of carbon taxes or carbon cap and trade programs are representative of policies to encourage reductions in emissions by putting into place economic disincentives to using carbon-intensive fuels by industry and the general public.[1]

Research literature has compared carbon-revenue programs such as a carbon tax or a cap and trade program with the result being the continual debate as to which program contributes more to reducing GHG emissions and climate change. Supporters of carbon taxes believe that by using a simple tax mechanism to increase the cost of carbon-intensive fuels that demand will dampen and that alternative renewable energy can be encouraged. Their reluctance to accept cap and trade programs is principally driven by concerns regarding manipulation within the trading scheme and the opaque nature that results in less of an obvious financial disincentive.[2] Those who support the use of cap and trade systems argue that the revenue generated can be directly designated towards expenditures supporting green initiatives as opposed to the use of a general carbon tax where receipts are funneled into general revenue accounts.[3] It remains early days for this ongoing debate however as positions emerge and more jurisdictions consider their options the significance of findings from ongoing programs can help policy makers in large emitting nations that may still be considering which is the most suitable carbon-revenue program for them. Regardless as to what side of the debate researchers find themselves, the one generalizable finding is that a significant control factor is the jurisdictionally-specific choice of regulation.

In an attempt to combat climate change and its impacts through the reduction of greenhouse gas (GHG) emissions in the Province of Ontario, the Ontario government passed Ontario Regulation 144/16 under the Climate Change Mitigation and Low-carbon Economy Act, 2016, S.O. 2016, c. 7 that introduced a carbon cap and trade program to the province. The purpose of the program was to require emitters to offset their carbon emissions by purchasing allowances (carbon credits). For the 2017-2020 period, allowances were free of charge to certain industrial emitters in Ontario while other emitters, including natural gas distributors were required to purchase carbon credits. However, on June 7th, 2018 a provincial election resulted in a change of government with the winning Progressive Conservative party having campaigned to repeal the legislation and regulation that allowed for the cap and trade program. True to their word, they passed legislation on July 25th, 2018 that ended the cap and trade program and related spending programs used to distribute the proceeds from the allowance auctions to date.

While the cap and trade program was in existence there were six auctions in total, four restricted to registered Ontario participants and two auctions conducted jointly with the State of California and the Province of Quebec. These latter two jurisdictions had entered into a joint cap and trade arrangement back in January of 2014. The Ontario results of the six auctions are shown in Table 1.

As can be seen in the table, the number of total allowances for sale in the first twelve months was approximately 100 million metric tonnes or two-thirds of the estimated 2015 annual CO_2 emissions for the province.[4] Only once during that time (November 2017) was the number of acceptable bids less than that available. Most of the allowances purchased were by participants who were required to do so under the regulation and who were not eligible for free allowances. For each auction, a minimum reserve price was set and while the results for each auction show some maximum bid prices that are double or triple the reserve or settlement price, the mean and median bid price suggest that the level of competition for the available allowances was insufficient to drive the price of acceptable bids much beyond the reserve price. This is confirmed to some degree by the calculated Herfindahl-Hirschman Index (HHI). When Ontario joined in with California and Quebec that index was reduced to levels that might represent a more reasonable competitive environment however for Ontario-related bids an increase in the maximum bid price did result but the mean and median price remained subdued. Figure 1 highlights the trends provided in the data found in Table 1.

The number of available allowances made available by the Province appear to approximate the amount required by emitters who were mandatory participants and ineligible for free allowances, but who could recover the allowance expenses directly from customers (natural gas distributors and fuel suppliers).

Table 1 – Results of Cap and Trade Auctions in Ontario 2017-2018

	Ontario Auction				Ont-Calif-Que. Joint Auction-Ontario Only	Ont-Calif-Que. Joint Auction-Ontario Only
	March 17 2017	June 2 2017	Sept. 6 2017	Nov. 29 2017	Feb. 21 2018	May 15 2018
Total Allowances for Sale (Million metric tonnes)	25.30	25.30	25.30	25.30	23.74	23.74
Total Allowances Sold (Million metric tonnes)	25.30	25.30	25.30	20.90	23.74	23.74
Total Qualified Bids/Total Allowances Available	1.16	1.22	1.19	0.83	1.21	1.36
Proportion of Allowances purchased by Compliance Entities	99.1%	96.1%	96.4%	91.5%	92.1%	95.6%
Herfindahl-Hirschman Index	1705	1589	1361	1404	436	668
Reserve Price $CAD	$18.07	$18.30	$16.79	$17.38	$18.34	$18.56
Settlement Price $CAD	$18.08	$18.72	$18.56	$17.38	$18.44	$18.56
Maximum Price $CAD	$49.41	$31.68	$32.84	$31.19	$68.50	$69.33
Minimum Price $CAD	$18.07	$18.30	$16.79	$17.38	$18.34	$18.56
Mean Price $CAD	$23.66	$22.02	$21.19	$20.74	$20.07	$19.81
Median Price $CAD	$19.00	$18.73	$18.50	$19.60	$18.73	$18.73
Median Allowance Price $CAD	$20.25	$20.13	$20.21	$19.98	$18.84	$18.97
Auction Exchange Rate	$1.33	$1.35	$1.24	$1.28	$1.26	$1.28
Auction Proceeds (Current) $CAD MM	$457.36	$473.55	$469.50	$363.21	$437.83	$440.68
Cumulative Proceeds $CAD MM	$457.36	$930.91	$1,400.41	$1,763.62	$2,201.45	$2,642.13

Environment Canada reported the 2016 GHG emissions for the Province of Ontario as 160 million metric tonnes of which approximately 146 million metric tonnes were associated with transportation fuel and the heating of buildings.[5] Arguably nearly all of the allowances purchased under the cap and trade program were likely by participants whose allowance expenses would have flowed directly to individual customers where the impact of the carbon cost would be muted i.e. a line item within their natural gas utility bill or a gasoline

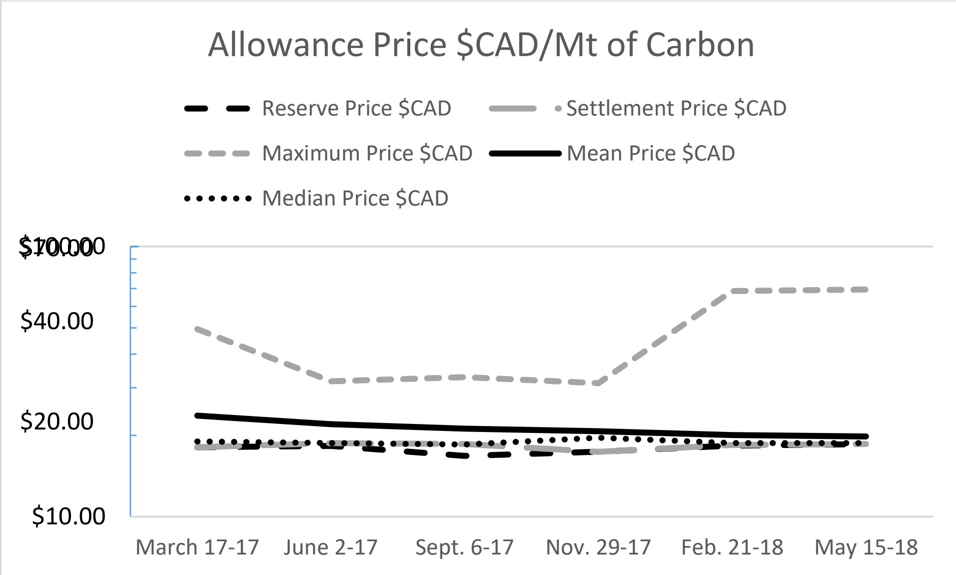

Figure 1 – Results of Ontario's Cap and Trade Program

pump price that fluctuated with the daily market prices for refined products.

The sudden cancellation of Ontario's cap and trade program has meant that the need for longer term data for rigorous statistical analysis is now moot and that the efficacy of such a program on reducing carbon emission remains unclear. What is apparent is that the then-government policy was to implement the program gradually and in doing so may have limited the impact that might have otherwise provided stimulation to consumers to reduce consumption of carbon-intensive products or services. Certainly a significant portion of the revenues ($2 billion) generated by the cap and trade program were, according to the 2018 Ontario Budget, to be spent in 2018-19 on "approximately 57 programs that were reasonably likely to reduce or support the reduction of greenhouse gas emissions".[6] However, it is up to the new government to determine to what extent these investments take place and therefore the effect they may have. When wondering as to whether a carbon tax mechanism would have been a better choice we can now turn our minds to the Canadian government's recent (April 1st, 2019) requirement for a $20 per metric tonne carbon tax for Ontario residents. In a recent analysis, the Financial Accountability Office of Ontario indicated that the federal government carbon tax program would return carbon tax receipts in the form of a carbon dividend to over 80% of Ontario households in order to off-set the cost of carbon pricing.[7] Whether this will result in enough initial stimulation to reduce the consumption of carbon-intensive products or services remains to be seen. Furthermore, this chosen approach to recycling the carbon tax revenue will not have the same effect as the cancelled cap and trade program in terms of investments in "green technology, infrastructure or direct support for businesses".[8] As another federal election looms on the horizon (Fall 2019), and the fickleness of the electorate around the issue of the cost of carbon could result in a change of government, the "carbon tax versus cap and trade" debate in Ontario could continue for some time.

Footnotes

[1] Carl, Jeremy and David Fedor (2016). "Tracking global carbon revenues: A survey of carbon taxes versus cap-and-trade in the real world." *Energy Policy* 96: 50 -77.

[2] Weitzman, Martin L, (2017). "Voting on prices vs. voting on quantities in a World Climate Assembly." *Research in Economics* 71.2:199 – 211.

[3] Carl and Fedor (2016)

[4] Annual Greenhouse Gas Progress Report 2017 – Environmental Commissioner of Ontario

[5] Environment Canada, National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada

[6] Financial Accountability Office of Ontario, Cap and Trade: A Financial Review of the Decision to Cancel the Cap and Trade Program, Fall 2018 pg. 10

[7] ibid

[8] ibid pg. 21

Scenes from the 7th IAEE Latin American Conference March 10-12, 2019

Buenos Aires Conference Overview

The 7th IAEE Latin America Conference was organized by the Latin American Association, Instituto di Tella and Instituto Argentino de la Energía "General Mosconi" from 10th to 12th March 2018.

Held at the Univesidad Torcuato Di Tella, Buenos Aires Argentina.

The theme of the 7th ELAEE was "Decarbonization, Efficiency and Affordability: New Energy Markets in Latin America" and included discussions on the changes of global energy industries and the challenges imposed to Latin America countries. The conference was attended by around 300 participants and was chaired by Daniel Perczyk, Gerardo Rabinovich and Fernando Navajas.

The conference schedule included nine plenary sessions, 31 concurrent sessions, two round tables and two student poster sessions.

Adonis Yatchew presented the opening session, titled "Fake News, Big Ideas – What Everyone Needs to Know About Energy". The presentation included institutional and technological aspects of the energy industry evolution. From the institutional perspective, Yatchew showed how the most relevant question, what is the role of the State? He noted that early on market failures justified government intervention. After the 1970s it has become clear that the government also fails. The lessons from the 20th century are that market failure must not be replaced by excessive intervention but by "competition where possible and regulation where necessary". Prof. Yatchew also gave suggestions for good oral presentations. Personal experiences can be used to illustrate energy economics issues and to create empathy with the audience.

The six thematic plenaries were organized combining presentations of international and regional perspectives. The Oil session analyzed the impacts of energy transition on the sector. Jorge Leon from BP gave an overview and projections of international trends. Helder Queiroz from UFRJ (Brazil) and Victor Padilla from UNAM (Mexico) presented the implications for Latin American countries.

The topic discussed in the power sector plenary was the integration of conventional and renewable energy sources. There were presentations on market design alternatives to minimize the costs of renewable energy diffusion in the energy mix. Giuseppe Montesano from Enel foundation and Reinhard Haas from TU Vienna gave the international perspective. Virginia Parante from USP (Brazil) and Ruben Chaer from UDELAR (Uruguay) presented the situation of Latin American countries.

The third plenary was titled "Energy demand, energy efficiency and Climate Change". Andrea Heins presented the challenge of promoting energy efficiency and Argentinean goals and policies on this issue. Mariana Conte Grand presented the convergence of the concepts of Decoupling and Energy Efficiency in the recent economic literature. David Broadstock, from Polytechnic University (Hong Kong) presented an econometric model that relates CO_2 emissions and economic variables for EU countries.

In the Natural gas plenary Peter Hartley from Rice University presented how diffusion of renewable power generation influences natural gas markets. He also pointed that natural gas prices are positively related with electricity prices. Edmar de Almeida from UFRJ (Brazil) presented the challenge of promoting investments while increasing competition in the Brazilian Natural Gas industry. Raul Bertero, UBA (Argentina), showed how subsidies have increased natural gas prices since 2016. He also indicated some distortions of price formation through gas auctions.

The utilities of the future session discussed how distributed generation impacts the utilities business. Christophe Bonnery, IAEE president from Enedis (France), presented a global overview of the issue. Santiago Urbiztondo (Fiel – Argentina) and Andres Chambouleyron (ENRE, Argentina) showed the challenges for Argentina. Gonzalo Casaravilla (UTE – Uruguay) presented the Uruguayan experience, where renewable diffusion is massive and can represent 100% of total electricity generation.

The Energy and Social Development plenary addressed the problems of energy access and affordability in Latin America. The table was composed of Victor Hugo Ventura (ECLAC – Mexico), Daniel Bouille (Bariloche Foundation, Argentina), Hugo Altomonte (former ECLAC Director – Chile/Argentina) and Isaac Dyner (UTadeo, Colombia).

The plenary Lecture was presented by Jacques Percebois (University of Montpellier, France). Percebois presented the process of energy transition in EU countries. He highlighted that electricity pricing must change to remunerate capacity instead of energy.

The last plenary discussed the relationship of energy and climate change. Hernán Carlino (ITDT, Argentina) explored conceptual aspects in this relationship. Jean Michel Glachant (FSR, Italy) showed the EU targets for decarbonization. Maria Elisa Belfiori (UCA, Argentina) focused on the Argentinean experience on the issue.

Concurrent sessions involved a broad set of issues of energy economics. Round tables were held at the same time as the concurrent sessions. The Monday round table was titled "New Regulations for EV Transport, Electricity Storage and Distributed Generation" and the speakers were: Amela Ajanovic (Technological University of Vienna), Scott Osborne (Wärtsilä, USA & Canada) and Joisa Dutra (FGV, Brazil). The title of the Tuesday round table was "Energy Transition, what can we expect?" and the speakers were: Michel Derdevet (ENEDIS, France), Ron Ripple (IAEE and Tusla University, US) and Luis Rotaeche (IAE "General Mosconi", Argentina).

The conference included a Gala Diner held in "La Rural". The Best Student Posters were announced, and the conference organizers were congratulated by the IAEE president. The participants enjoyed the main attractions of Buenos Aires: an excellent tango show, very good food and tasteful Malbec wine.

There were three intense days, when participants had the opportunity to learn with international and regional experts, to network with the energy economics community and to enjoy the charming city of Buenos Aires. We are all waiting for the next ELAEE in Bogota 2021!

Luciano Dias Losekann

SYMPOSIUM OVERVIEW

The Middle East energy landscape is undergoing a transformation resulting from technological, economic and geopolitical dynamics that have global impacts. In this 1st IAEE Middle East Symposium, leading global experts from industry, government and academia will convene to discuss the evolving dynamics of international energy markets, increased diversification of energy sources and global concerns for climate change that are shaping the Middle East energy outlook.

The Symposium, which will take place at the **Khalifa University of Science and Technology, Abu Dhabi, United Arab Emirates**, on **December 16, 2019**, is being prepared by an International Program Committee consisting of experts with knowledge of the Middle East energy and economic issues most critical to government and industry stakeholders. In this context, a series of plenary sessions are planned that will feature internationally established speakers and provide lively discussions and debates. In addition to its rich program and accompanying social functions, the symposium will provide a unique opportunity for networking among energy professionals from industry, government and academia.

PLENARY SESSIONS

Plenary Session 1: The Future of Hydrocarbons: Changing Demand and Subsequent Impacts

Plenary Session 2: Shaping the Future Energy Landscape: The Role of Climate Concerns and Technology Innovation

Plenary Session 3: Energy Diversification: Renewables and Nuclear in the Middle East

Plenary Session 4: Geopolitics: Issues Facing the Region Today and Tomorrow

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What Do the Results from the Finnish RES Auction of 2018 Reveal About Efficiency?

BY ROLAND MAGNUSSON, KIMMO OLLIKKA AND PEKKA RIPATTI

Roland Magnusson is a Competition Advisor with the Finnish Energy Agency. **Kimmo Ollikka** is a Senior Researcher with VATT Institute for Economic Research and **Pekka Ripatti** is Deputy Director General of the Finnish Energy Agency and an Adjunct Professor at the University of Helsinki.

Short history

In 2011, a scheme for the provision of operating aid for stimulating RES-E investments was established in Finland. Eligible energy sources in the 2011 scheme were wind, biogas and wood-based fuels. The 2011 scheme guaranteed the electricity producer a fixed price of 83.5 EUR/ MWh for a period of 12 years through a sliding premium, which is paid on top of the 3 month average area price of electricity in Finland. However, generation hours for which the market price is negative were excluded. The level of tariff was generous and the capacity limit of the tariff system for wind energy (2500 MVA) was quickly met. Recently, many countries have moved to tender mechanisms in particular because tariff systems have proven to be a relatively expensive means to support renewable energy. Also Finland adopted a tender-based premium scheme for new producers of renewable electricity at the end of 2018.

Auction design

A key design principle for Finnish 2018 auction was to facilitate competition between different generation technologies. Eligible technologies were wind power, biogas, combined heat and power from forest biomass, solar and wave. Notably, hydro power was excluded. In contrast to other recent technology neutral auctions in Europe, such as Germany (April 2018 and November 2018) and Denmark (November 2018), the volume up for bid was defined in generation (MWh) and not in capacity (MW).

Another distinction to other RES-E auctions was the pricing. In Germany, bids were given on reference value, which is used as the basis for calculating the market premium. In Denmark bids are given on the market premium, which paid to the producer as long as the market price is non-negative. As in Denmark, in Finland bids are given on the market premium (EUR/ MWh). However, in Finland the amount of aid that the producer receives is smaller than the market premium if the 3 month average area market price is above 30 EUR/ MWh. Figure 1 shows how the level of operating aid is determined as function of the market price.

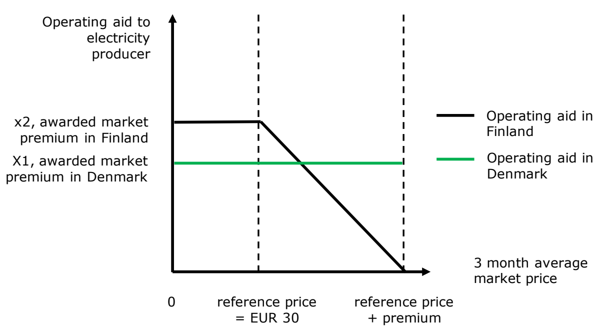

Figure 1: Level of operating aid as a function of market price in Finland and Denmark

The Danish Government provides a fixed premium whereas the Finnish government provides a combination of a fixed and sliding premium. Hence, the Finnish Government carries a smaller share of the market price risk than the Danish Government. Other things being equal, observed premiums should be then larger in Finland than in Denmark.

Auction outcome

The auction was oversubscribed by a factor of 3. Only bids from onshore wind were received. The volume weighted average of the accepted premiums was 2.52 EUR/MWh. For the accepted bids, the price ranged from 1.27 to 3.97 EUR/MWh. These prices were surprisingly low. Even though outcomes cannot be compared directly between different auction designs, in Denmark, for comparison, the auction

	Number of bids	Bid volume, TWh	Technologies	Bid range, EUR	Volume weighted average premium
All bids	26	4.13	Onshore wind	[1.27;23.00]	6.00
Accepted bids	7	1.37	Onshore wind	[1.27;3.97]	2.52

Table 1: Result of the 2018 auction in Finland

was oversubscribed by a factor of 2 and bids were received and accepted from both wind and PV: The volume weighted average of the accepted premiums in Denmark was 3.1 EUR/MWh.

Some explanation for low prices is provided by the very large supply of permitted wind power projects in Finland, shown in Figure 2. The high amount of permitted wind power projects is partly due to the feed-in tariff scheme implemented in 2011, which attracted lot of new onshore wind projects. Many of the prepared projects were not managed to get in to the feed-in tariff system before it was closed for wind power. In addition, based on the original government proposal, the plan was to conduct two consequential

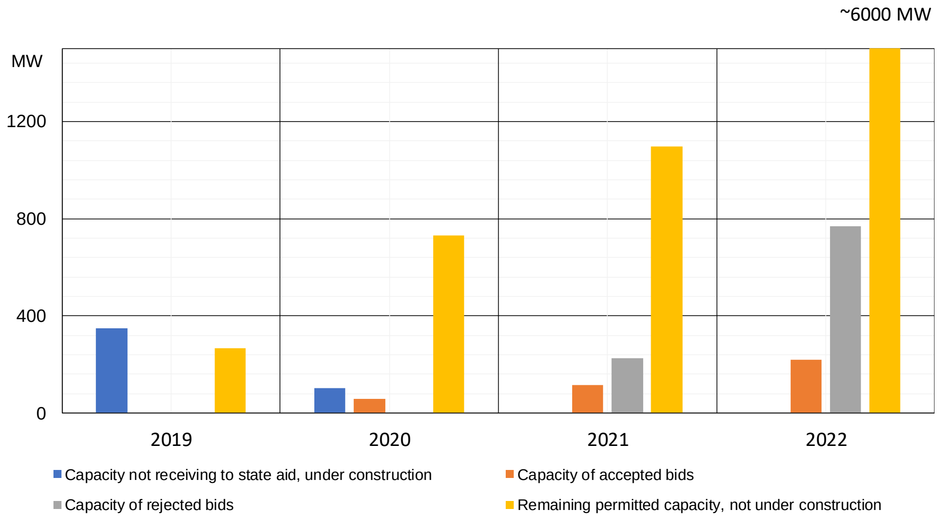

Figure 2. Wind power generation capacity in Finland per planned start of operation. Source: own analysis based on information from Finnish Wind Power Association. Note: the timing of the remaining permitted capacity, not under construction is highly uncertain.

auctions. However, this plan changed in the preparation of the law and only a single auction, with lowered auction volume, was implemented. Hence, presumably the most competitive projects and projects whose preparation was quite complete, participated in the auction.

As a consequence of low levels of premium, the costs of the auctioned premiums will be lower than expected. Figure 3 shows the average support that the state would have paid to the winners of the auction if the premiums were paid on the basis of electricity prices over the last five years. Thus, there would have been support paid only minority of periods and even then, the support would have been relatively moderate.

In addition to cost-effectiveness, well-designed auctions and tenders are effective ways to collect information from the market. The information gathered through the renewable energy auctions will help to better design support for new and cleaner technologies. What can be learned from the Finnish RES-E auction? Wind power is becoming competitive also in Finland. Can we be sure, however, that there will be enough wind power in the market in the future without any support? From the point of view of cost-effective emission reductions and, in particular, learning, it might be important that renewable energy auctions would continue in Finland.

Cost to the government of Finland

The volume weighted average premium in the 2018 auction was 2.52 EUR/MWh. Figure 3 shows the 3 month area price in Finland in the period 2014 - Q1/2019. Assuming that support in accordance with 2018 auction would have been paid in this period, the cost to the government would have been 0.68 EUR/MWh, equivalent to 0.92 million EUR/a for generation of 1.36 TWh/a .For comparison, the support paid for wind power on the basis of the 2011 scheme was 47 EUR/MWh in the same period, equivalent to approximately 140 million EUR/year for generation of approximately 3 TWh/year.

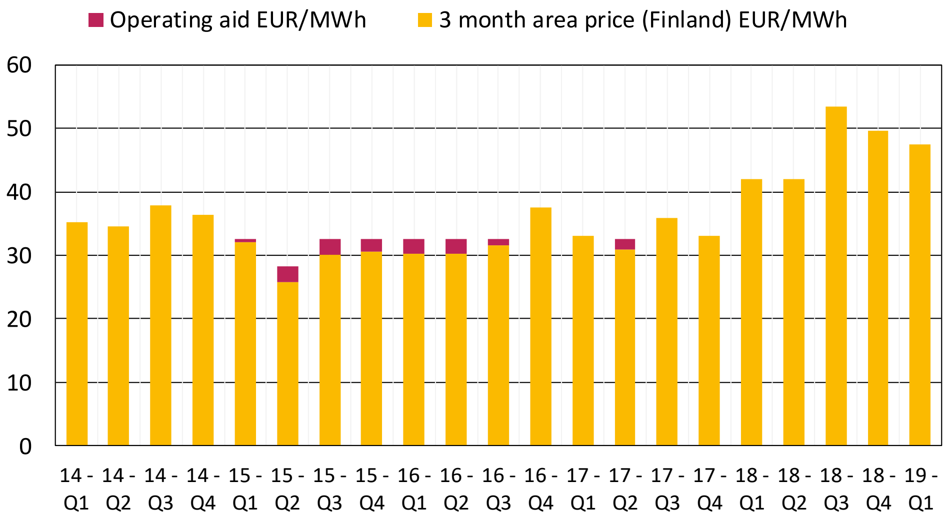

Figure 3. Level of operating aid in the period 2014 - Q1/2019 with the outcome of the 2019 auction.

Information Disclosure Rules and Auction Mechanism: How Much Information on Electricity Auctions?

BY EWA LAZARCZYK AND CHLOÉ LE COQ

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See footnotes at end of text.

The information structure is particularly dense in electricity markets. Because electricity storage is currently limited, demand and supply have to match at all times, and up-to-date information about available capacities, as well as forecasted and actual grid conditions, is essential for market participants. Indeed, both generators and TSOs (along with users and traders) rely on this information to optimize their strategy and make proper risk assessments.

The European Commission has recently introduced a set of new regulations on information disclosure in electricity markets. First, under the REMIT regulation, the electricity generators have to provide detailed transaction records to national regulators and the Agency for the Cooperation of Energy Regulators (ACER) (EU Regulation No 1227/2011 Art.8). Second, under the SPDEM regulation, all the member countries have to provide the European Network of Transmission and System Operators for Electricity (ENTSO-E) with data relating to physical conditions on the grid and their generation. Interestingly, this decision to centralize the information goes against the general view that too detailed information might not be beneficial for the market's efficiency. Especially, in the view of its potential for coordination actions among the generators which could lead to a cartel behaviour as it happened in the case of Italian ancillary services. Three generating companies from Southern Italy have been found to coordinate on the outcomes of auctions for voltage support to Terna – the transmission operator – using the detailed information on grid conditions which allowed them to foresee whether the stability services would be needed. The cartel was effective from April to August 2010 and was found to have increased Terna's costs in this market by 5 percent (Luchetaa and Sama, 2012). Already then, the concerns have been voiced about the increased transparency and its potential negative effects on market outcomes.

The information made available in the electricity auctions can roughly be divided into two categories: information about technical conditions in the system and information related to bid curves where market participants stipulate how much they want to sell/buy and for what price. Following Lazarczyk and Le Coq's (2018) detailed overview, we provide a short overview of the existing information disclosure rules, taking Europe as an example.

Technical information. The technical information varies according to the category of data. Some forecasts have to be available a year ahead of the "operation day". Day-ahead cross-zonal capacities have to be public news one hour before spot market closure. Meanwhile, cross-zonal capacities for longer allocation periods have of course longer publication periods Information about unavailability of consumption, generation and transmission has to be disclosed within one hour from the occurrence of the problem in the case of sudden outages, and "as soon as possible" in the case of planned maintenance. Part of the SPDEM information was already available to market participants in some exchanges before the regulation became binding. For example, in Nord Pool, information about scheduled and sudden outages was already disclosed as public information to all participants in that market in a system called Urgent Market Messages (UMMs). Information about different forecasts and cross-zonal flows was also available in Nord Pool before the new legislation came into effect. However, some information is relatively new and has not been a part of the common knowledge pool. Detailed hourly information about actual generation per operation unit has not been a part of the publicly disclosed data in most markets. This has changed with the SPDEM regulation, which requires that this information is published within five days of the unit's operation. As a result, some countries publish that data with a maximum possible delay of five days, while some make it available the day after the unit's operation

Bidding information. Disclosure rules regarding bidding information vary across power markets. In the electricity market of the Nordic Region – Nord Pool – day-ahead aggregated bidding curves are published with a minimal delay. The data are aggregated to the market level, spanning all participating countries: Sweden, Norway, Finland, Denmark, Latvia, Lithuania and Estonia. Information with the same level of aggregation is also available for instance in the EPEX Germany-Austria, EPEX-France or EPEX-Switzerland. A different approach to data availability has been taken by the Iberian electricity market OMIE where detailed bid information (up to an operation unit level) is published with a few months delay. Another market where bidding curves are available with a high level of detail is Italy. Since April 2009, due to the Decree of the Minister of Economic Development, the information about demand bids and supply offers is disclosed with seven days' delay.

Frequency of the information. The day-ahead market is an important one but the markets that are closer to the real time also grow in significance. The intra-day Single European Electricity Market XBID operates across 12 member countries. It has been modelled after the Scandinavian Elbas market (Newbery, 2016) and it operates in a similar fashion – as a continuous discriminatory market. However, member countries still have their own intra-day markets which often operate as sequential uniform auctions (Spain, Italy) or are also continuous as in the case of Nord Pool. Since the XBID market operates on a continuous basis, market participants know all the standing orders with offered or asked price and volume, matched orders with price and volume and the time of transaction and the product traded (electricity to be delivered at a particular unit of time). Similar information is available to the Nord Pool participants. Since 1st of February 2017 the Italian intra-day market is divided into seven sequential markets where the clearing prices and volumes for each of the six zones are known 30 minutes after the end of auction. However individual bids containing submitted prices and volumes, date and time of when bid was submitted together with participants names and identification of their units are publicly disclosed 7 days after the auction. In Spain the details of the bidding process are also disclosed with information up to the bidding unit, but not immediately after the auction clearing but with a longer delay. In Ireland there are 2 intra-day auctions which are done with coupling with Great Britain[1], one is a local one and additionally a continuous intra-day market is available to Irish generators for the adjustment up to one hour before the trading hour.

Understanding the difference between disclosure rules. It is well known in the industrial organization literature that perfect information among actors may facilitate collusive behaviour among market players (e.g., Tirole, 1989; von der Fehr, 2013). Therefore, an increased amount of data available to market participants might have negative consequences for competition levels. This is particularly relevant when competitors repeatedly interact, as is the case in the power market. Indeed, limiting market information is considered by many policymakers as a way to enhance competitive behaviour among producers. However, it is also the case that increasing power market transparency may promote competition by facilitating customer choice, allowing entry, and even lowering the costs of operating in different national markets (NorReg, 2017 REF). Also, when producers receive more similar information (transparency increases), they decrease their mark-ups – the degree of market competitiveness rises (Holmberg and Wolak; 2015). There seems to be a trade-off between the level of information aggregation and the delay with which the information is published. This is in line with the anti-trust literature pointing out that too detailed information facilitates coordination between market participants and thus enables the exercise of market power. According to that view, disclosing only aggregated industry data should be sufficient to take efficient contracting decisions while not facilitating collusive behavior. The graph below illustrates this trade-off:

Understanding better the impact of real-time information. There are few studies that have investigated the impact of real-time information about changes to market fundamentals on electricity prices (Lazarczyk, 2016 and Lazarczyk and Le Coq, 2019), on the potential of misuse of such information leading to market abuse (Lazarczyk, 2015) or has discussed potential for manipulative use of information (Fogelberg and Lazarczyk, 2014; Bergler et al., 2017).[1] However, the effect of information disclosure rules on market competition has been understudied and therefore not well understood. In particular, the effect of changes in disclosure rules on bidding behavior and how this in turn affects electricity prices remains unsolved.

Moreover, the variety of market rules may suggest that an optimal set of rules has not yet been identified. More importantly countries who share electricity grids and hope for competitive prices, do not always have the same information disclosure rules. In this perspective, it is essential to assess the effect of different rules about information disclosure on the performance of electricity market and therefore auction efficiency and, as far as we are aware, the literature on this issue is scarce. This is especially important as EU countries are moving towards higher transparency[2] and other countries follow in their step – for e.g., Turkey[3].

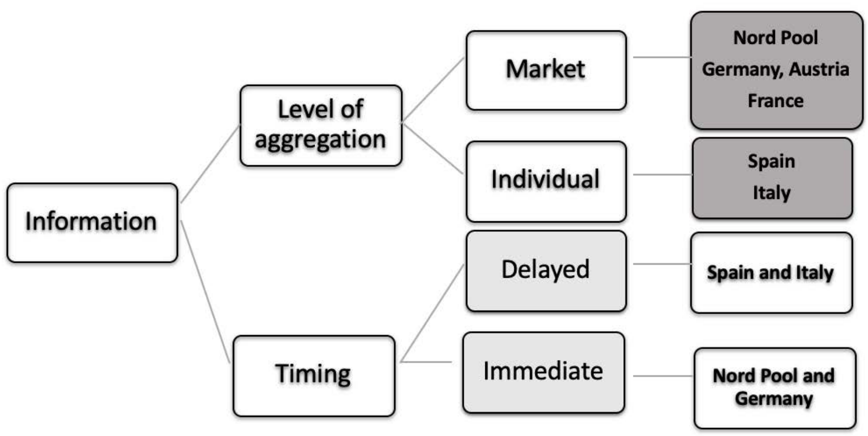

Figure 1. Information type (Lazarczyk and Le Coq, 2018)

Footnotes

[1] There is a large literature on the degree of competition in electricity auctions, taking into account firms' bidding behaviour (Wolfram, 1998, Holmberg and Lazarczyk, 2015), forward contracting (e.g., Wolak, 2007 and 2009, Green and Le Coq, 2010), sequential markets (Ito and Reguant, 2016) or renewables' market shares (Acemoglu et al., 2017).

[2] https://www.entsoe.eu/news/2019/02/01/tsos-increase-number-of-open-data-available-through-entso-e-s-transparency-platform/

[3] Turkey has recently increased the

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Chilean Experience on Long-term Electricity Auctions: Changes and Challenges Ahead

BY JAVIER BUSTOS-SALVAGNO

Introduction

Auctions of long-term contracts (LTC) for electricity supply have become an important energy policy instrument in the past decade.[1] In particular for developing countries, where electricity markets tend to be very volatile and risky to support the construction and financing of new plants that can supply in a rising demand scenario. Undoubtedly, auctions for long-term contracts had become a sustainable form of electricity expansion and a key element of sufficiency of the system. More than a decade of experience in LTC auctions can bring us ideas on how to make this instrument work efficiently and also what are the challenges ahead. Chilean experience can be useful for developing countries in similar conditions but also for developed economies that can use auctions as a powerful tool to replace existing capacity in a sustainable way.

LTC electricity auctions from 2006 to 2013

Chile introduced auctions for LTC in 2005. Until then, all contracts with distribution companies for regulated customers had prices fixed by the National Commission of Energy (CNE). The regulatory change was introduced after Argentina decided to reduce their exports of natural gas to Chile. At that time, natural gas represented one third of electricity generation. Investors in generation faced a type of uncertainty that the market itself could not solve. If it was decided to make an investment in a gas-fired power plant, and no more natural gas came in the future or at very high prices, that investment would be unprofitable. Similarly, if an investment in a coal-fired power plant were decided, and cheap natural gas came in the future, the investment would not be profitable either. This situation caused a lag in the normal generation investment process of the country. For that reason, the government introduced a regulatory reform that replaced contracts under price regulation with LTC auctions with the intention of fostering capacity expansion and optimizing risk allocation.

LTC auctions in Chile where design in a particular way, very different if we compare it to the Brazilian case, according to Moreno et. al. (2010). Bustos-Salvagno (2015) describes the main features of the process. First of all, contracts are allocated by minimum price in a discriminatory first price sealed bid auction. The average weighted winning bid of the auction becomes the power price for all distributors' customers. Even though the prices remain fixed during the entire length of the contract, their value is adjusted with indexes of input prices. Second, the amount of power auctioned does not imply a "take or pay" contract. The amount of power supplied by generators is the one effectively demanded.

From 2006 to 2014, there were other contract considerations in place. A publicly known ceiling price was established for each auction by the CNE. Also, LTC auctions have to be done at least 3 years in advance, in order to foster competition among new entrants and incumbents. Contracts could not be longer than 15 years. Finally, there was a particular setting in the Chilean case. Each distributor had to decide the size and length of each contract to be auctioned. To foster competition, distribution companies coordinate to implement a unique allocation mechanism for each auction where all contracts have to be auctioned. However, the contracts were different between companies in terms of duration, size and supply conditions. Since it was not possible to sum all the demands in a unique supply contract, distribution companies coordinated on a single mechanism for different contracts that allocates the minimum bid for each contract for each distributor. A generator could bid different prices to different contracts, even if they belong to the same distributor. Finally, since several contracts with different distributors were auctioned at the same time, CNE allowed generators to define a limit for the amount of power that they can win in all the blocks auctioned simultaneously.

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See footnote at end of text.

The importance of regulatory changes at the proper time

Although the original purpose of electricity auctions for long-term contracts (LTC) was to attract investment in new capacity, auctions have helped to create competition in the generation market. However, more competition didn't happen immediately in the majority of cases. In the case of Chile, from 2006 to 2013, there were 6 LTC auctions. Over this period, the average price grew from 53.1 USD/MWh to 128.9 USD/MWh and the average participation rate was 3 bidders in each auction and some processes didn't have any bidder at all.

Even though the adequacy mechanism that auctions provided was working well – according to CNE, installed capacity grew from 10,238 MW to 16,688 MW over this period – electricity prices were going up at a fast rate. Moreno et al (2010) pointed out that "although this mechanism is generally seen as a significant improvement in market regulation, there are questions and concerns on auction performance that require careful design". For this reason, a regulatory reform was implemented in 2014. This reform changed several auction's conditions:

The reserve price for the auction was kept under secret to increase competition.

Now LTC auctions have to be done 5 years in advance to bring barriers down to new entrants. Also, if the new entrant faces problems in building her project, the initial date can be postponed.

Contracts can be for 20 years to facilitate access to project finance

To reduce transaction costs, all demand is auctioned by the CNE.

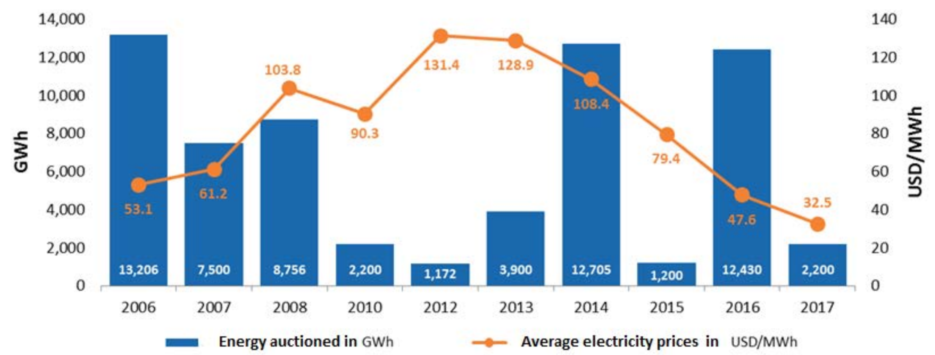

Figure 1: Energy auctioned and average prices in Chile from 2006 to 2017
Source: Ministry of Energy, Chile

Results of this regulatory changes can be seen in Figures 1 and 2. Prices peaked in 2012 and from 2013 to 2017, average winning prices dropped 75%, reaching levels even below the 2006 auction.

Competition increased to levels never seen in Chile. From an average of 3 bidders in 2006-2013 period to an average of 41 bidders in 2014-2017 period. It is important to remember that renewable cost also dropped over this last period, in particular solar PV and wind turbines. For that reason, it is not possible to say that all the success in terms of prices is due to more competition. However, it would not have been possible to take advantage of this drop in cost without the regulatory changes that where introduced at that time. In 2015, bidding conditions changed from the standard 24-hour block to three time-blocks with certain amount of energy. This is a more suitable scheme for intermittent power generation from non-conventional renewables like wind or solar. The major reduction in renewables' cost led to 2017 auction winners to be only renewables. In conclusion, it is important to do regulatory changes at the proper time to take advantage of technological change.

Remaining issues of LTC auctions and future considerations

As the Chilean experience shows, LTC auctions can be a powerful energy policy mechanism. From one part, it attracts investment on capacity and on the other, it allows an increase in competition in the generation market. In general, new capacity auctions have attracted the interest of both domestic and foreign investors. Potential suppliers have included a wide range of technologies, fostering technological change. Although the use of LTC auctions cannot fully mitigate price volatility, it gives investors the opportunity to control part of the risks by setting the volume contracted and the price. As a result, it is possible to have a market-based mechanism that provides adequacy at competitive prices.

The experience shows that it is better to have centralized auctions, with homogeneous products and rules that reduce barriers to entry. However, the devil is in the details. In this section I will focus in some of the key issues that LTC auctions have to consider, in particular, for the case of Chile, but with important lessons elsewhere.

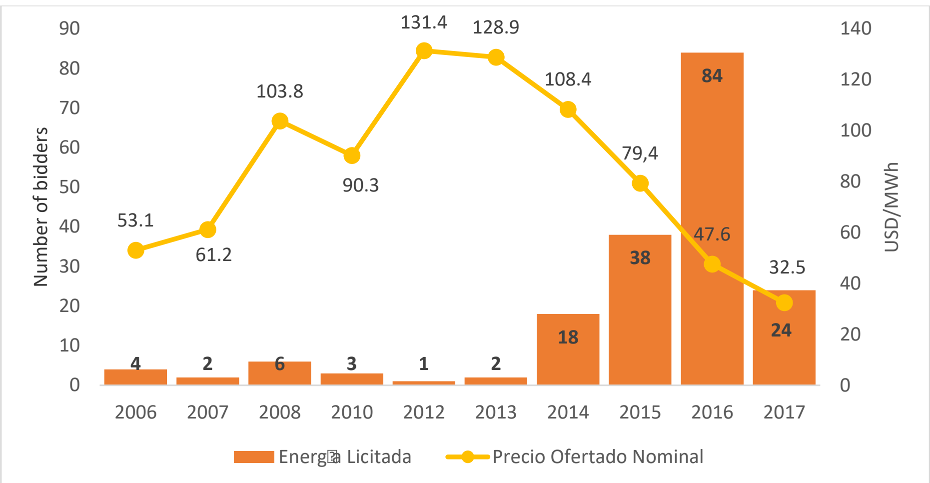

Figure 2: Number of bidders and average prices in Chile from 2006 to 2017
Source: CNE, Chil

First of all, conditions that reduce uncertainty to bidders reduce offered prices. For this reason, the possibility to delay the initial date of a contract can be very important for a new entrant. However, in the case of Chile LTCs are not "take-or-pay" contracts. This introduces demand uncertainty to potential bidders if auctioned demand is not in line with the real or effective demand. This is an increasing problem in Chile. For customers between 500 Kw and 2 Mw it is optional to be a regulated customer or a "free" client that can have a direct contract with a generator or a distributor. Since regulated prices have remained over the free clients' average price, plenty of consumers in this range have opted to move from regulated to free contract conditions. This effect has exacerbated the demand uncertainty for new entrants in future auctions. It is efficient that the agent that can mitigate the uncertainty has to face it in order to internalize it. Since generators, in particular new entrants, cannot cope with this kind of demand uncertainty, it is important that the regulator can establish conditions where the value of the contract is not diminished because of a sudden reduction in expected demand.

The problem of demand uncertainty led us to the second issue: how LTC auctions can live with a retail market. Auctions were designed as an adequacy tool that can bring competitive prices to the contract market. Retail markets are introduced to increase competition in the distribution sector and allow for new services to final customers. If electricity prices are determined in LTC auctions, that left a small room to retail companies if they want to compete in prices. In the case of Chile, where the introduction of retailers is under discussion, the CNE acts as a large buyer that minimize the transaction cost of contracting supply for the long term. As experience shows, when distributors were in charged of auctioning LTC results were disappointing. How to bring the best of both instrument to the electricity sector? It is likely that the best combination is to keep an LTC auction mechanism to supply the minimum amount of adequacy to the system and introduce retail in the form of medium and short-term contracts. A well-designed transition period is key for the success of this policy and having the opportunity to introduce changes along the way.

A third problem, in the case of Chile is related to the characteristics of the new renewable technologies. Since LTC auctions were design to increase competition, they have to be done with years in advance to effective supply. However, since technological change had made solar PV and wind very competitive, they are winning all recent LTC auctions and the amount of time needed to install them does not require more than two years. For that reason, renewable developers are betting on what could be the development cost of these technologies in five more years. If there is any kind of "winner's curse", some of these developers can go bankrupt and projects will not be built. It is necessary to have a good balance between a mechanism that reduces barriers to entrants but does not increases market uncertainty.

Also, the arrival of intermittent renewables at low cost have displaced baseload technologies in LTC auctions. As the share of these renewables grow, auction design will have to consider more features than just minimum price since a rising demand for flexibility in the electricity systems could not be covered by LTC auctions.

In sum, LTC auctions have been proven as a useful tool for current problems in electricity markets. How to have an efficient amount of adequacy at competitive prices is one of the most difficult problems that electricity regulation has to face. However, as technology changes and policy challenges appear, it is important to re-think its design. There is no doubt, that LTC can be a powerful mechanism in a decarbonization strategy where old units are replaced by renewables that need contracts to finance their investment. However, auctions have to be compatible with the decentralization process we are living at the distribution level as well as to cope with the new developments in terms of technologies for electricity supply, in particular non-conventional renewables.

Footnote

[1] Maurer and Barroso (2011) give a good description of the auction experience in different countries before the renewable boom

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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				
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*
September 6	*2nd IAEE Southeast Europe Symposium*	*Bucharest, Romania*	*IAEE*	*Ionut Purica* *puricai@yahoo.com*
October 17-19	4th IAEE Eurasian Conference *Energy Resources of the Caspian and Central Asia: Regional and Global Outlook*	Astana or Almaty, Kazakhstan	IAEE	Vilayat Valiyev *waliyev@gmail.com*
October 17-18	*4th APEEN Conference* *Energy Demand-Side Management and Electricity Markets*	*Covilha, Portugal*	*APEEN*	*Carlos Pinho* *cpinho@ua.pt*
November 3-6	37th USAEE/IAEE North American Conference *Energy Transitions in the 21st Century*	Denver, CO, USA	USAEE	David Williams usaee@usaee.org
December 10-12	4th Symposium on Energy Security	Rome, Italy	AIEE	Carlo Di Primio *assaiee@aiee.it*
December 16	1st IAEE Middle East Symposium *The Impacts of Economic Diversification, New Technologies and Climate Concerns on the Middle East Energy Outlook*	Abu Dhabi, UAE	IAEE	David Williams *iaee@iaee.org*
2020				
February 12-15	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*
November 1-4	*38th USAEE/IAEE North American Conference* *Theme TBD*	*Austin, TX, USA*	*USAEE*	*David Williams* *usaee@usaee.org*
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*
2024				
May-June	47th IAEE International Conference *Forces of Change in Energy: Evolution, Disruption or Stability*	New Orleans	USAEE	David Williams *usaee@usaee.org*

Electric Bidding Processes: a Contribution of Mining to Public Policies in Chile

BY ANDRÉS ALONSO

In November of 2017, in Chile, the bidding process for electricity supply of distribution companies was awarded in accordance with the framework established by Law No. 20,805 approved by the National Congress in 2015. The result of this bidding process was once again very successful, as the first bidding process had already been held with this framework in August 2016, reaching lower energy prices than the previous year and historically low.

Undoubtedly, the main reason for the achievements in the aforementioned bidding processes was the increase in the competition that occurred in the electricity generation sector as a result of a series of factors. The greatest contribution to the observed competition was the market design developed for the bidding processes and its reduction of the entry barriers to the potential bidders, a design deeply influenced by the experience that the Chilean mining industry had used in its own electricity supply bidding processes for their operations.

Indeed, in 2005, Minera Escondida, which exploits the largest copper mine in the world and whose electricity consumption represents 8% of the total consumption of Chile, confronted a severe risk to its electricity supply, both from the point of view of security of supply, as well as the cost thereof. In the 2000s, this company had contracted electricity supply at very convenient prices with the power generation company Gas Atacama, which was supplied with Argentine natural gas to produce its electricity. However, in 2004, the supply of Argentinian gas to Chile gradually began to have shortfalls because Argentina favored its domestic gas consumption, which experienced an exponential growth as a result of its policy of freezing prices to local consumers. This caused Gas Atacama to operate with gas oil when there were interruptions, fuel with a much higher operating cost and higher probability of failure for the power plants.

Given this situation, the management of Minera Escondida decided to carry out a strategy that consisted mainly on calling an international bidding process for electricity supply with a market design that included a tender process of at least one year, with a start of supply in a term of 5 years, through a long-term contract greater than 15 years and bankable characteristics, which allowed it to be financed as a "Project Finance", which means that the economic flows of the project could guarantee the payment of the debt. In addition, during the bidding process, Minera Escondida would manage the sectoral and environmental permits of a power plant, the Central Kelar, which was made available to potential bidders in the bidding process as an alternative to competitive backing and, in the last case, to build it directly if they did not find adequate price and security conditions for their electricity supply.

All of the above was designed with the aim of increasing competition by reducing the entry barriers in the bidding process, in order to obtain the best technical and economic conditions for electricity supply of the company.

The result of this process was announced in 2007 and the supply of Minera Escondida was awarded under very convenient conditions to the Angamos Plant, a project of the generation company AES Gener, which was already operating in the Chilean electricity sector. The Angamos Power Plant started its operation in 2011.

This strategy based on the principles of: international bidding through a process of at least one year, a start of supply in the fifth year, a bankable long-term contract and an alternative supply of competitive backing was also followed by the mining company Codelco for the supply of its operations in the center-north area of Chile in 2007, which represented 50% of its consumption. Codelco is the largest copper producer in the world and its electricity consumption represents 12% of the total consumption of Chile. In that instance, the competitive backup alternative was the Energía Minera power plant. This process concluded with the awarding of the supply to the Santa María Power Plant in 2010, a project of the electric generation company Colbún, which was already operating in the Chilean electricity sector. The Santa María Power Plant started its operation in 2012.

It is necessary to emphasize that due to the awards to companies that were already operating in the electricity sector, there were voices that criticized making so much effort in the competitiveness of the process to finally end up signing a supply contract with existing companies. Over time, and in the face of

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See footnote at end of text.

the results achieved, it was evident that the criticisms reflected a lack of vision regarding the objectives of a supply bidding process, because they did not consider the conditions that these large mining companies would have had to accept if they had not had real alternatives of supply product creating the necessary competition.

At the beginning of 2014, mining companies brought these experiences to the attention of the incoming government, given that in the supply bids for the distribution companies of 2013, the values obtained were much higher than the results previously obtained by the mining companies.

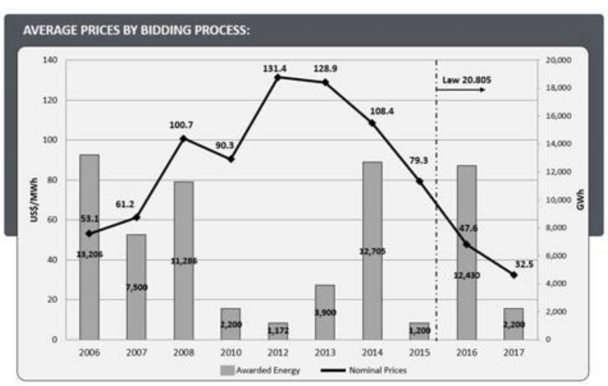
The government predicted how powerful a public electricity supply policy based on the aforementioned principles could be for electricity distribution companies. To implement such principles, it was required to make a legal modification and also to find which would be the alternative competitive backing.

The decision was to advance in the legal modification that led to the enactment of Law No. 20,805, which was treated in the National Congress in the record time of 8 months, with a majority support from all political sectors. The backup alternative was raised by the state-owned Empresa Nacional del Petróleo, ENAP, through its own project, the Nueva Era plant, and another alternative that was negotiated with Codelco, the Luz Minera power plant. Given the lack of experience of ENAP in the generation of electricity, to develop this process a strategic partner was sought in a tender process, and finally, the chosen one was the Japanese company Mitsui.

To carry out the strategy of a legal modification and to make in parallel an international call, with road shows included, and a design of competitive bidding rules in a limited period of time was a titanic task, carried out with great success by its executors.

The results obtained were impressive. The average price reached in the 2017 tender was 32.5 dollars per

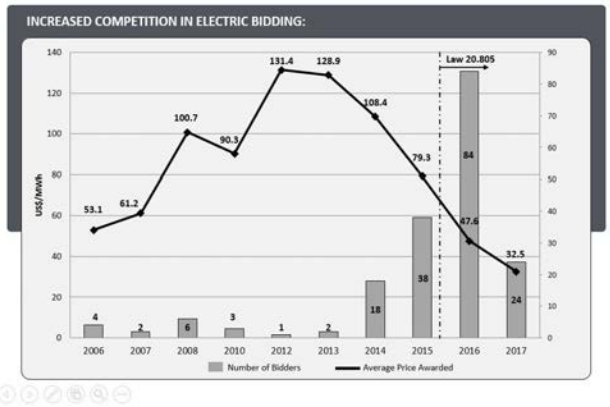
ELECTRIC SUPPLY BIDDING



MWh, 32% lower than the 47.5 dollars per MWh in 2016 and 75% lower than the value obtained in the 2013 tender, which was awarded at 128.9 dollars per MWh.

More than 100 bidders participated in the processes

ELECTRIC SUPPLY BIDDING



described. The entire supply was awarded, the bids received were seven times the energy tendered, over 50% of the energy came from new entrants to the electricity generation market, and about 40% was awarded to –wind and solar– renewable energy plants. This has led to multiple recognitions to the Chilean model, and to the publication of the experience as an example of a good public policy[1].

It is not possible to believe that the success of the 2016 and 2017 bidding processes is only the result of the application of the electricity supply strategy of the large Chilean mining industry. Undoubtedly, there are many other factors. Especially, it is important to consider the significant cost reductions of wind and solar renewable energy as a result of technological development, as well as other factors, such as: greater risk accepted by the owners of wind and solar technologies, reduction of costs and transmission risks for electric generators, support for investors to obtain sectoral and environmental permits, etc. In addition to the above, the establishment of participatory processes between the sectoral authorities and the different stakeholders of the national energy market, was undoubtedly another key factor.

The achievements are remarkable. In these last two supply bidding processes for electricity distribution companies, regulated consumers in Chile will save more than 20,000 million dollars compared to the level of prices in 2013 and, as a result of such processes, this country will have in the future one of the lowest energy prices in the world. This is fundamentally the product of an effective execution of a well-designed market strategy, which was largely proposed by the Chilean mining sector, as a result of its experience in its own electric supply processes.

Footnote

[1] "Nueva ley chilena de licitaciones de suministro eléctrico para clientes regulados: un caso de éxito". Comisión Nacional de Energía y Banco Interamericano de Desarrollo. June 2017. "La Revolución Energética en Chile". Máximo Pacheco (Editor). Universidad Diego portales. 2018.

IAEE EVER Monaco 2019 Symposium

On May 8, 2019, the IAEE organized the symposium "Interactions between electrical vehicles and renewable energy at a local level" during the international conference EVER Monaco 2019 in the principality of Monaco. Besides the presence of delegates from the international scientific community, many important actors coming from the energy, automotive, political and legal sectors were also present during the discussions.

The debate was divided in four main sections: First the opening speech introducing the general problematic made by the IAEE President Mr. Christophe Bonnery, followed by the supporting words coming from the plenipotentiary Minister of Monaco in charge of sustainable development affaires, S.E.M. Bernard Fautrier. The second part, mediated by Mr. Yannick Perez, professor at Paris-Saclay University and researcher at the Florence School of Regulation, was focused on discussions about international experiences using electrical vehicles (EVs) and mobility projects. Diversified keynotes were in the core of the debate during the third part of the conference. Finally, the fourth and last part was dedicated to the feedbacks from international experiences on the local governance of electrical vehicles and the deployment of renewable energies, under the mediation of Mr. Gurkan Kumbaroglu, president of the Electromobility Turkish association.

The introductory speech made by C. Bonnery highlighted the numerous past and upcoming conferences organized by IAEE during 2019 and the high impact scientific journals organized by the association. There are still uncertainties about the world future energy-related emissions due to the different scenarios that can exist according to the policies established. It was as pointed out by him that new policies are necessary to reduce the growth of CO2 emissions and EVs will play a very important role, not only to decarbonize the mobility sector, but also to help the development of intermittent renewable generation. Then, the conference participants had the opportunity to hear the minister, Bernard Fautrier, on the Monaco's government behalf, fully agreeing with the initiative taken by EVER and IAEE organizers to contribute towards a cleaner future.

The second part was initiated with Mr. Paul Codani's, project manager at Nuvve Corporation, presentation about implemented and on-going projects where electric vehicles are providing services to the grid. Nuvve, in this context, is an aggregator responsible for controlling charging and discharging patterns of EVs fleets via Vehicle-to-Grid (V2G) concept, monetizing their flexibility on the energy markets and integrating renewable generation. The GridMotion project, idealized by PSA group, Nuvve and their partners, is an on-going project in France where the vehicle charges when EPEX spot electricity prices are low and can discharge to provide frequency control services, which is already a successful reality according to P. Codani. Another important project, Eco2Charge, was presented by Bouygues Energy Solutions. The core of this project is to provide a system integrating different distribution energy resources (DERs), including EVs, stationary batteries and local generation to match user needs and reduce the total building cost of electricity. A second project named Flovesol on the same DERs management problematic was introduced by Mr. Alain le Duigou from the French Alternative Energies and Atomic Energy Commission (CEA). This project showed importance of synergies between electric vehicles and buildings equipped with solar energy to reduce total electricity cost. The following presentations was given by Icaro Silvestre Freitas Gomes, working at Vedecom, a private-public French research institute dedicated do clean mobility, he presented the remaining techno-economic barriers for electric vehicles grid services development. To provide frequency containment reserves (FCR), EVs face technical barriers mainly related to systems, actors and customer confidence. The specific meter required to provide the service, the suboptimal TSO-DSO cooperation and the unequal performance of each part of the system can jeopardize the entire business model. Regarding market barriers, the actual low product granularities are the main problem identified, furthermore, an increase of those would enhance the revenue obtained per EVs providing this kind of service. Lastly, to close the section, Mr. Vincent Schachter, head of global energy services of ENEL X e-Mobility, spoke about EVs managed by the JuiceNet. This platform aggregates flexibility from EVs and small DERs to deliver energy services, ranging from local optimizations to enable customer savings on bills until the provision of services to the energy market. The participation of a first large-scale commercial EV batteries, accounting more than 30 MW as a virtual battery, in Californian wholesale market was possible thanks to the platform.

After the continuous discussions during lunchtime, the conference restarted with keynotes from experts in e-mobility. The first to present was Mr. Willett Kempton, professor at University of Delaware, CTO of Nuvve Corporation and pioneer on V2G experiments. Always present on electric mobility conferences around the world, Mr. Kempton resumed the actual status of grid services options provided by EVs and the remaining policy barriers to overcome. The future of grid services provided by EVs is quite optimistic, although, work on the electric system regulatory issues, standards and business aspects are required to happen in a faster pace, as pointed out Kempton. The second speaker, Mr. Thierry Plouvier, Vice President, ABB France-Benelux Power Grids, affirmed that welcoming renewables are linked to bidirectional solutions once they can restore the energy produced intermittently and ABB is ready to feed the market with those products. Technologies are there, but there is a highly dependence on grids (transmission and distribution) to introduce the products massively. Then, it was Hervé Rivoalen's, head of strategic marketing and smart charging department at EDF (Electricité de France), turn to present the Electric Mobility plan. The plan aims the leadership in four major markets (France, UK, Italy and Belgium) regarding three key fields: energy supply for EVs with a carbon-free electricity; charging infrastructure operation and smart charging development. Closing the session, Mr. Eric Lalliard, PSA Group Chief Scientific Officer, highlighted the importance of vehicle electrification given by car manufacturers. Groupe PSA, for example, aims to provide electrified versions of all models produced, including pure electric, hybrid and plug-in hybrid by 2025.

The last session was initiated with G. Kumbaroglu's speech about the Turkish local EV governance and renewable deployment. Different scenarios for EV infrastructure and CO2 emission were shown with a special focus on how carsharing could create a leverage in Turkish EV market and reduce carbon emission coming from mobility sector. Then, Mr. Didier Chabaud, Professor at Sorbonne Business School, was invited to present an academic approach of autonomous EVs business models in smart cities. Those models try to define who owns and who operates the fleet and what are the consequences of such adoption. Then, Didier Lafaille, the French energy regulator (CRE), performed a very interesting presentation, especially for those actors dealing with V2G, since a summary of the CRE's recommendation report done in 2018 and the legal framework about EV development in France were presented. The energy regulation authority encourages all actors involved to adopt good behaviors towards EVs to limit useless investments to the community. The law project "TURPE 6" will deal with energy reinjection into the grid and the standardization of a meter capable to cope with the adapted granularity of measurements needed to provide FCR services. The French legislation will evolve side-by-side with the European legislation to avoid a fragmented legal framework, however, it is known that the juridical rules are not adapted to electric vehicles providing services to the grid. To encourage a faster changing in the legal environment, more experiments using V1G and V2G are needed, according to him. Cécile Goubet, AVERE France secretary-general, alerted that notwithstanding France has more charging stations per vehicle than the number recommended by the European union, many barriers slowing electric mobility adoption are still there. EV coupled with renewables, carsharing and V2G services will accelerate EV adoption, according to AVERE. Changing the focus from big smart cities, Mr. Alain LeBoeuf, president of the Vendée Department Energy Syndicate, has shown how EVs could also be a clean and efficient way of transportation also in countryside areas. In France, the Vendée department deploys EVs infrastructure in coordination with solar and wind energy generation and uses innovative power connections methods, like the one linking the charging station to the public illumination grid system.

The EVER-IAEE 2019 conference served well the purpose of being an environment where academics, industrial players and regulators could exchange information, experiences and contribute to the clean mobility evolution. Gathering world-renowned experts during an international conference around the decarbonization of the mobility sector concomitantly with the power one, is an example to be followed to make a sustainable future to everybody.

Icaro Silvestre FREITAS GOMES,
PhD student at Paris-Saclay University

IAEE President Christophe Bonnery with his Excellency Bernard Fautrier, Miniter of Monaco, Sustainable Development

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Member-Get-A-Member Campaign

IAEE Members:

IAEE's Member-Get-A-Member campaign continues in 2019. IAEE believes you well know the value of membership in our organization. Furthermore, membership growth is one of the Association's top strategic initiatives. With your knowledge of our organization's products/services, publications and conferences, we know that you are in the ideal position to help us grow. The process to win rewards for yourself is quick and easy!

Here's How the Program Works:

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

Membership Recruitment Period and Additional Incentive:

- This special program will run from April 1, 2019 – September 1, 2019.
- The Member that refers the most new members to IAEE during this timeframe will receive a complimentary registration to attend the 37th USAEE/IAEE North American Conference in Denver, Colorado, USA – November 3-6, 2019 (this prize may be assigned by the winner to another member, yet must be used for complimentary registration to attend the Denver conference only).

IAEE Tips for Success:

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

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

Thank you for making IAEE the great organization that it is!

CONFERENCE OVERVIEW

The 43rd IAEE International Conference takes place in Paris, France, at the Palais des Congrès 21 – 24 June 2020, with the main theme **« Energy and Climate Change, Working hand in hand »**.

An ideal climate and energy policy regime should simultaneously address possibly conflicting objectives: ensuring energy security, promoting universal access to affordable energy services, and fostering greener and sustainable energy systems.

These policies notoriously have heterogeneous impacts on states, consumers, factor prices, energy technologies and existing assets like fossil reserves and carbon-intensive capital stock. Building credible and effective policies is a difficult task and needs to take into account geopolitical, economic and environmental realities to make them acceptable.

Against this background, the pressing quest for credible and sustainable solutions imposes to rapidly develop deep and broad analyses of policy instruments and institutions. It requires a broad mobilization of the concepts and notions used in economics, natural sciences, humanities or other social sciences to inform the numerous public policy debates affecting international energy trade, environmental regulation, markets vs. government intervention, energy infrastructure and technology choices.

The conference provides a unique platform for academics, policy-makers and business leaders from around the world from all over the world to present and discuss the latest economic research on pressing energy issues in an open and nonpartisan setting. The conference also sends a particular welcome to the many environmental and natural resource economists working on these topics.

Paris has a distinctive identity that makes it an ideal location to foster these discussions. The city has been an academic hot spot for centuries and the 2015 United Nations Climate Change Conference made it an epicenter of climate policy. As a vibrant business capital, Paris is also home to a diverse energy sector and a unique collection of leading international organizations and think thanks.

For further information please contact: iaee2020@oyco.eu


Palais des congrès Paris

CONFERENCE VENUE

The conference will be held at the Palais des Congrès, the leading venue for international congresses in Paris. On the first conference day, our delegates are welcome to join the welcome reception at the Conference hotel: Le Meridien. The Hotel interior is inspired by mid-century modern design, with clean lines accentuated by sculptural forms and rich fabrics, that are unmistakably reflective of Paris.
Conference`s Gala dinner will be hosted by the City of Paris at the Hôtel de Ville. This unique venue will open its doors only for our delegates to guarantee an exclusive experience of the French hospitality and cuisine.

Paris is an international city with many centuries of history, offering an excellent starting point for travelling to France and exploring the beauty of the most fascinating city in Europe.




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WHO'S INTERESTED?

The conference is intended for:

- Academics and scholars working in the fields of energy, natural resources or environmental economics,
- Policy makers and officials in governments, international institutions and regulatory agencies,
- Energy analysts working for local authorities, development agencies, consumer bodies, NGOs,
- Business leaders and practitioners.

From a methodological perspective, the conference welcomes contributions based on: analytical models, econometrics, experiments, surveys, rigorous institutional analyses and case studies, simulation models, equilibrium models, optimization models. Interdisciplinary works with all areas of the natural, social or engineering sciences are also welcome.

TOPICS TO BE ADDRESSED

The general topics below are indicative of the subject matters to be considered:

- Blockchain experiments and regulation
- Disruptive business models in energy sector
- Economics oil and gas markets, Developments in LNG markets
- Electricity demand response, Self-consumption, Electricity tariffs and smart meters, Nudges in electricity consumption
- Emissions Trading Schemes, Energy efficiency
- Energy and climate change mitigation and adaptation
- Energy and emission modelling
- Green Innovation, Biofuels and Bioenergy
- Local energy communities, Electric mobility, Big data and energy
- Nuclear energy markets
- Regulation of energy network industries
- Renewable energy sources and industries
- Role of new technologies in Energy Transition
- Smart grid, Microgrids, Energy storage and electrification

CONCURRENT SESSION ABSTRACT FORMAT

We welcome contributions from researchers and industrial sector representatives. Authors wishing to make concurrent session presentations must submit an abstract that briefly describes the research or case study to be presented. We will begin to receive abstracts from September 2019.

PRESENTER ATTENDANCE AT THE CONFERENCE

At least one author of an accepted paper or poster must pay the registration fees and attend the conference to present the paper or poster. Authors will be notified by 6 March 2020 of the status of their presentation or poster.
Final date for speaker registration fee, extended abstracts and full paper submission: 17 April 2020.

Abstract submission deadline:

Friday 24 January 2020

iaee2020paris.oyco.eu

STUDENT EVENTS

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

We also encourage students to participate in the Student Poster Session and to submit a paper for consideration in The Special PhD Session.

Students may inquire about scholarships covering conference registration fees.

For more information, please CONTACT:
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04-05 November 2019, Bioenergy Conferences at United Arab Emirates. Contact: Phone: 2033182512, Fax: biofuels@engineeringeuroscicon.com, Email: biofuels@engineeringeuroscicon.com, URL: https://bioenergy.euroscicon.com

05-09 November 2019, Power Purchase Agreement (PPA) from Legal Perspective - Singapore at Singapore. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/ppalegal/index.html

06-07 November 2019, 5th Solar PV Operations USA 2019 at Hilton San Diego Mission Valley, 901 Camino del Rio South, 92108, San Diego, United States. Contact: Phone: +4402073757512, Email: luke@newenergyupdate.com, URL: http://go.evvnt.com/417987-0?pid=204

November 07 - December 07 2019, 21st International Conference on Advanced Energy Materials and Research at Zurich, Switzerland. Contact: Phone: 7025085200, Fax: advancedenergymaterials@gmail.com, Email: advancedenergymaterials@gmail.com, URL: https://energymaterials.materialsconferences.com/

12-13 November 2019, Energy Capital Leaders at Paris Expo Porte de Versailles, 1 Place de la Porte de Versailles, Paris, 75015, France. Contact: Phone: 27210013891, Email: ryan.barry@oilcouncil.com, URL: http://go.evvnt.com/371624-0?pid=204

18-21 November 2019, Mastering Renewable & Alternative Energies - Singapore at Singapore. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/renewable/index.html

25-29 November 2019, Gas & LNG Markets, Contracts & Pricing - Singapore at Singapore. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/gaslng/

25-27 November 2019, Clean Energy Opportunity & Risk Analysis at Singapore. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/cleanenergy/index.html

02-03 December 2019, Oil and Gas Council, World Energy Capital Assembly, London 2019 at London Hilton on Park Lane, 22 Park Lane, Mayfair, London, W1K 1BE, United Kingdom. Contact: Phone: 00442073848142, Email: eleni.stenzel@oilcouncil.com, URL: http://info.oilandgascouncil.com

09-12 February 2020, 7th IAEE Asia-Oceania Conference, Energy Transitions in Asia at Auckland, New Zealand. Contact: Phone: 216-464-5365, Email: iaee@iaee.org, URL: www.iaee.org

21-24 June 2020, 43rd IAEE International Conference, Energy Challenges at a Turning Point at Paris, France. Contact: Phone: 216-464-5365, Email: iaee@iaee.org, URL: www.iaee.org

25-28 July 2021, 44th IAEE International Conference, Mapping the Global Energy Future: Voyage in Unchartered Territory at Tokyo, Japan. Contact: Phone: 216-464-5365, Email: iaee@iaee.org, URL: www.iaee.org

06-10 February 2022, 45th IAEE International Conference: Energy Market Transformation in a Globalized World at Saudi Arabia. Contact: Email: yasser.faquih@gmail.com, URL: www.iaee.org

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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

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 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 - Port of Spain at Port of Spain, Trinidad and Tobago. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/gaslng/

16-20 September 2019, Power Project Finance at Johannesburg, South Africa. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/powerprojectfinance/index.html

17-19 September 2019, SPE Reservoir Characterisation and Simulation Conference and Exhibition at Jumeirah At Etihad Towers, Etihad Towers, Abu Dhabi, United Arab Emirates. Contact: Email: mramathany@spe.org, URL: http://go.evvnt.com/427675-0?pid=204

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

20-21 September 2019, Climate Change and Global Warming 2019 at Vancouver, Canada. Contact: Phone: 13153255631, Email: climatechnagemeet@gmail.com, URL: https://www.lexisconferences.com/climatechange

23-24 September 2019, 10th International Conference and Expo on Oil and Gas at United Kingdom. Contact: Phone: +3907025085200, Fax: oilgasexpo.conference@gmail.com, Email: oilgasexpo.conference@gmail.com, URL: https://oil-gas.expertconferences.org/

23-24 September 2019, 9th International Conference on Petroleum Engineering at United Kingdom. Contact: Phone: 07025085200, Fax: petroleumengg.2017conference@ail.com, Email: petroleumengg.2017conference@gmail.com, URL: https://petroleumengineering.insightconferences.com/

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, Fax: renewableenergy@foren21.org, Email: renewableenergy@foren21.org, URL: https://foren21.org/

07-09 October 2019, Oil And Gas Council, MSGBC Basin Summit And Exhibition, Senegal 2019 at King Fahd Palace Hotel, Route des Almadies, Dakar, Senegal. Contact: Phone: 27210013885, Email: samantha.boustred@oilcouncil.com, URL: http://go.evvnt.com/430353-0?pid=204

07-08 October 2019, World Congress on Petrochemistry and Chemical Engineering at Madrid, Spain. Contact: Phone: +1-408-429-2646, Email: petrochemistry@pulsusmeet.com, URL: https://petrochemistry.pulsusconference.com/

08-10 October 2019, Coal Association of Canada National Conference, Vancouver 2019 at Westin Bayshore Vancouver, 1601 Bayshore Drive, V6G 2V4, Vancouver, Canada. Contact: Phone: 17807579488, Email: info@coal.ca, URL: https://go.evvnt.com/421474-0?pid=204

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/smartenergy

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

17-19 October 2019, 4th IAEE Eurasian Conference, Uncapping Central Asia's Potential: How Central Asia Can Contribute to Global Energy Security? at Astana or Almaty, Kazakhstan. Contact: Email: waliyev@gmail.com, URL: TBA

20-24 October 2019, Public Private Partnership (PPP): Financing, Projects & Contracts - Dubai at Dubai, UAE. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/ppp/index.html

21-24 October 2019, Power Purchase Agreement (PPA) for Renewable Energy - Dubai at Dubai, UAE. Contact: Email: vincs@infocusinternational.com, URL: http://www.infocusinternational.com/pparenewable/index.html

22-24 October 2019, SPE Russian Petroleum Technology Conference at Holiday Inn Sokolniki, 24 Rusakovskaya St., Moscow, 107014, Russia. Contact: Phone: 74952680454, Email: russianoilandgas@spe.org, URL: http://go.evvnt.com/347787-3?pid=204

03-06 November 2019, 37th USAEE/IAEE North American Conference, Energy Transitions in the 21st Century at Denver, CO USA. Contact: Phone: 216-464-2785, Email: usaee@usaee.org, URL: www.usaee.org

04-07 November 2019, European Refining Technology Conference 2019, Warsaw, Poland at Hilton Warsaw, 63 Grzybowska, Warszawa, 00-844, Poland. Contact: Email: kelly.tea@wraconferences.com, URL: http://go.evvnt.com/364582-2?pid=204

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