THE ICER CHRONICLE

A FOCUS ON INTERNATIONAL ENERGY REGULATION

EDITION 9, DECEMBER 2018

The ICER Chronicle Edition 9 (December 2018)

A FOCUS ON INTERNATIONAL ENERGY REGULATION

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Foreword

Welcome to the 9th edition of *The ICER Chronicle*.

As this is my first ICER Chronicle as chairman of this esteemed organization, I want to take a moment to thank the outgoing chairman, John W. Betkoski III of the U.S. National Association of Regulatory Utility Commissioners and the Connecticut Public Utilities Regulatory Authority, and the team which supported the ICER work. His leadership has been critical to our organization at a time of change and reinvention, and I want to express my appreciation for his service to our community of energy regulators.

Since being elected chair of ICER in March, I have enjoyed engaging with my colleagues around the world in what is a critical time in our work. Changes in markets, technology and our environment are challenging each of us, requiring that we ask fresh questions and explore new areas than we have before.

ICER aims to share articles of general interest for the energy regulators, and *The Chronicle* accordingly seizes on these ideas of exploration and investigation, drawing the future path from leading thinkers on how we understand what's next.This edition explores how blockchain can help the energy sector tackle present and future challenges and how broadband access and energy savings intertwine.

We also look back to identify how we have sought to answer the questions of the past and how those answers can provide lessons learned. This edition examines what lessons can be learned from market liberalization in Austria, how the internal audit adds value to improve organization's operations in Zimbabwe and Peru's experience in empowering consumers in the energy market through app-based channels.

I am also proud to say that we are continuing the important work of the Women in Energy Initiative in this edition, hearing stories of women who have overcome challenges and excelled in our field. Through *The Chronicle* and in other venues, I hope we will work as a team to strengthen this initiative in the following years.

Thank you for your interest and enthusiasm in the cause of improved regulation around the world, and I look forward to working with you now and in the future.

Daniel Schmerler Vainstein
ICER Chairman

The Chronicle, Edition 9

Welcome from the Editorial Board Chair

First, I want to thank the ICER community for their support and collaboration under my chairmanship, and applaud Chairman Daniel Schmerler of Peru's Regulatory Agency for Investment in Energy and Mining for his work as ICER Chairman. I am excited to see the path of the organization in the months and years ahead.

In my role as Chairman of ICER's Editorial Board, I want to thank our authors for submitting thoughtful, engaging work. I also wish to thank our Editorial Board for their review of what you will read in the pages ahead. Their contributions are, as always, important to the vitality of this publication and much appreciated.

The ICER Chronicle is published twice a year and seeks to enhance regulatory knowledge around the world. The articles provide a variety of perspectives on different technical topics, and we continue our commitment to providing articles from and of relevance to developing and transitioning economies. In 2013, ICER Virtual Working Group (VWG) 4: Regulatory Best Practices launched *The Chronicle* as a means to further promote its goals of enhanced exchange of regulatory research and expertise. Following our organization's 2016 restructuring, *The ICER Chronicl*e continues as a foundational project under ICER leadership.

The ICER Chronicle is open to submissions from regulators, academia, industry, consultants, and others. This ensures a variety of perspectives and increases the exchange of information and messages among the various groups. Submissions will be collected on a rolling basis, in addition to formal Calls for Articles. On behalf of the editorial board, I invite you to send your article to chronicle@icer-regulators.net.

Thank you, and if you would like to provide feedback or ask questions about *The ICER Chronicle,* please email chronicle@icerregulators.net.

John W. Betkoski III
Editorial Board Chair

Editorial Board Members

Support Team

Background

In 2013, ICER Virtual Working Group (VWG) 4: Regulatory Best Practices launched the Chronicle as a means to further promote its goals of enhanced exchange of regulatory research and expertise. *The ICER Chronicle* is published twice a year and selected articles enhance regulatory knowledge around the world. The articles provide a variety of perspectives on different technical topics. It is important to include articles from and of relevance to developing and transitioning economies.

The ICER Chronicle is open to submissions from regulators, academia, industry, consultants, and others (such as consumer groups). This ensures a variety of perspectives and increase the exchange of information and messages among the various groups.

Responsibilities of the Editorial Board

The Editorial Board is comprised of a diverse group of international experts drawing from regulators, utilities, academia, consultants, and others. Individuals are nominated by ICER member regional regulatory associations and reviewed by the ICER Chair, Coordinator, and Secretariat to ensure a range of stakeholder perspective from around the world. The Chair is currently filled by Commissioner John Betkoski (NARUC, former ICER Chair). The ICER Coordinator serves as an ex officio member of the Editorial Board. **Note:** The ICER VWGs were realigned in 2016 and *The Chronicle* is now considered a separate standing project.

Members of the Editorial Board review the articles submitted to ICER. Articles are limited to a maximum of 3,500 words in length and must be in the English language. ICER issues two editions per year, so Editorial Board members allocate time twice a year to review the articles and participate in several conference calls regarding the selection process of the articles.

The membership of the Editorial Board will be fluid during the initial stages. Regional Regulatory Associations who did not already submit nominations are able to do so in the future. In addition, if Editorial Board members choose to withdraw or are asked to resign due to inactivity, the ICER Chair, Coordinator, and Secretariat will review new and/or replacement candidates.

Women in Energy
The ICER International Network

Women in Energy Stories

Once again, we bring you Women in Energy stories from around the globe. The story from Zimbabwe (on page 6) makes a comparison between regulation and internal auditing. The second, from Argentina, is one woman's story of making a footprint in energy and climate change issues (see page 8).

Una Shortall
Chair of the ICER Women in Energy Steering Group

Share your story in *The ICER Chronicle*

Share your professional expertise by submitting an article on regulatory issues or tell your story for the Women in Energy Story section. Stories can be about anything relevant to Women in Energy (WIE), such as challenges women have faced in their careers; pioneering work women have undertaken; obstacles women have overcome; and the lessons that can be shared.

Interested in submitting a story to *The ICER Chronicle*?

Submit your paper (as a Word document) to chronicle@icer-regulators.net.

Women in Energy
The ICER International Network

Regulation - An Internal Auditor's Perspective

Rumbidzayi Musiyiwa

December 2014 was my entry point into the energy sector, as well as the regulators' world when I joined the Zimbabwe Energy Regulatory Authority (ZERA). The closest I had been to the energy sector was as a consumer filling up my car at the service station and paying my electricity bill. Suddenly I was learning fast about the concept of regulation: what it was; how it worked; where it was relevant; why it was necessary; as I pondered over who regulated the regulator. The journey had begun. I had a lot to learn to be effective in ZERA. Nevertheless, I was very much excited at the new experience that lay ahead of me.

The deep understanding I have of my own profession (internal audit) enabled me to understand swiftly the concept of regulation. Moreover, it had equipped me to be both dynamic and versatile in a systematic and disciplined approach in energy regulation. Internal audit is an independent, objective assurance and consulting activity designed to add value and improve an organization's operations. Juxtaposed to internal auditing, I interpreted regulation as follows:

- The independent, objective assurance and consulting activity designed to add value and improve an economic sector's operations.
- Internal auditing is conducted in a systematic and disciplined risk-based approach. The same applies to regulation. Regulators execute their mandate in a methodical manner, playing a role in ensuring that adequate laws and regulations are in place, sufficient and appropriate to effectively govern a sector. In the process, discipline is a priority as it ensures the standard application of the laws and regulations across the board of those regulated, and without fear or favour.
- Regulators prioritize focus areas based on impact and likelihood, which are the variable factors of any risk-based approach.
- Independence in mind and appearance applies to the internal auditors as much as it applies to the regulator. A regulator must be seen to be objective and unbiased at all times. The national independence of the regulator is as important as the organizational independence of an internal auditing function.

Oftentimes, stakeholders have the following perceptions or misconceptions about internal auditors:

- Internal auditors are perceived as fault finders;
- Perfectionists who require that things be done by the book;
- Internal auditors are the policemen;
- Internal auditors do not deserve high-ranking positions within organizations as stipulated by their standards;
- Internal auditors think they know everything;

- They are working for the Board of Directors to get us fired;
- They think they are the smartest people on earth.

Given the enforcement role of a regulator, some may mistakenly perceive a regulator as unfair, or out to punish business by requiring adherence to many laws and regulations. Internal auditors conduct awareness campaigns to ensure that stakeholders understand the role of internal audit. A regulator too needs to invest in effective and transparent stakeholder engagement.

The effectiveness of an internal audit function depends on the size of the internal audit team, their competencies and skills, personal attributes such as integrity, objectivity amongst others. Similarly, a regulatory authority requires sufficient technical expertise to regulate effectively. Even more important for the success of an internal audit function is how well it is governed internally. Those audited by the internal auditors often wonder who it is that then audits the auditors. There is a high likelihood of overlooking the internal governance aspect as internal auditors get carried away by the day to day audits. Furthermore, an internal audit function must lead by example - internal auditors cannot expect other departments within the organization to be operationally astute, adhering to policies and procedures if they themselves are not doing the same.

The operational system of a regulatory body is as important as the internal governance of an internal audit function. The Chief Audit Executive is expected to be of high integrity, ethical, a trendsetter, competent as well as impartial in leading the internal audit function. The leader at the helm of any regulatory agency is responsible for setting the regulatory tone. The operational system of the regulator agency has an impact on the regulatory team and how they in turn execute their duties for the regulation of the entire sector. This has a ripple effect on the image; hence, the reputation of the regulatory authority.

I have since concluded that regulation is about the regulatory authority, and the regulatory authority comprises both the processes and the people. The people determine the processes in place and the success of the regulation. So regulation is really about the people. The right people to put in the right processes for the right regulation.

When anything becomes about the people, it gives rise to a call. As the 1st Vice President of the Institute of Internal Auditors in Zimbabwe, responsible for the Chief Audit Executives Committee, my motto is, "With a call to Internal Audit leadership comes the call to walk judiciously." In reflecting on matters of regulation versus internal auditing, it goes without saying that — *"With a call to Regulation comes the call to walk judiciously"* and who should walk judiciously? — The people involved in regulation and, more importantly, those with leadership roles within regulatory bodies, and needless to say, the same applies to internal auditing.

Rumbidzai Musiyiwa

Rumbidzai Musiyiwa has more than 14 years of experience in governance, risk, and compliance auditing. She currently leads the Zimbabwe Energy Regulatory Authority's (ZERA) internal audit function. She also holds the Chartered Accountant (CA (Z)), Certified Internal Auditor (CIA), Certified Information Systems Auditor (CISA), and Certified Risk Management Assurer (CRMA) qualifications.

Musiyiwa is First Vice President of the Institute of Internal Auditors Zimbabwe, as well as the Chairperson of the Chief Audit Executives Committee and is Editor of the *AuditExec Newsletter.*

Moreover, she is head of Internal Audit at the Zimbabwe Energy Regulatory Authority, in charge of the Internal Audit Function. She reports administratively to the Chief Executive Officer and functionally to the Audit and Risk Management Committee of the Board of Directors.

Finally, she is an Audit Committee member for the local pharmacist regulating body, the Pharmacist Council of Zimbabwe.

Women in Energy
The ICER International Network

The Footprint

Regina Ranieri

I remember that I was 22 years old when a manager from the largest generation company in Argentina told me, "You a have huge potential; you are in this world to leave 'a footprint'." And this was how my career in this field began.

I have been working in renewable energy since I was 21 years old. I used to believe that the simple "task" of reducing greenhouse gases was enough to leave this "famous mark" in the world. But it was not. Of all of my friends, only I worked in environment and climate change. However, today I could say that I am fully dedicated to promoting a collective knowledge in energy and women's roles in society.

In my country, people tend to think of a successful woman in terms of her physical appearance rather than her intellectual skills. So, the biggest challenge I faced in my career was to deal with prejudice. I was judged and underestimated for not having the regular "appearance" that an engineer "should have." My first piece of advice to young women in the first stage of their careers is to ignore society's prejudice and standards. You could be the best in anything you really love, from music, dancing, to physics.

While I was studying for my career (industrial engineer), I took all kinds of courses; I attended technical workshops of almost all subjects. I started to study Portuguese language, Mandarin Chinese, and I traveled to London to improve my English. The purpose? To find my way. My second advice is that our life is like a "vector" composed of magnitude, orientation, and sense. Magnitude is the time you take on that. Orientation is about your life´s approach, so you must be very safe in it to reach your life's goal.

When I was 21, I began my professional career in the only Argentinian manufacturing company that produces wind and hydroelectric turbines. It was my "first love"—no schedules, no restrictions—because it also was my hobby. Nevertheless, high-level meetings and political situations forced me to grow up.

Probably the biggest challenge I faced in my career in energy was to make myself respected within a macho society.[1] I must confess that it took me more hours than my family would want for me to be away from home, but another piece of advice for young women is to take advantage of experienced people. To have "great mentors" helped me a lot in my professional life.

After graduating at the age of 24, I felt that my first goal was reached. So I needed to find the next one. I started a master's degree in an Argentine energy regulatory framework and after that, I got a job opportunity in Chile. Here is my third piece of advice: One of the "attributions for success" is to be a real expert in the subject you are working on (at the highest academic level) and to take as much international experience as you can (even when you are from a developing country). My experiences in Chile were my first "trips to the future" in the energy Industry.

No one spoke of renewable energies in my country (renewable energy only was 1.2 percent of the energy matrix). But in 2015, a law was passed. I participated

through the consultancy "Ad Honorem" of some deputies.

When I was 26, UL (the biggest North American certificate company) hired me as a business developer manager from Argentina. It was an exciting experience, but not enough to leave "the footprint" in society.

So there I found my way to leave "the footprint." I started to direct an executive program in the knowledge that only an Argentinian professional would stand out, acknowledging that the international "know how" comes from other countries. My vision is to give companies local valuable people through a five-month program with the most qualified professional in each area.[2]

I say that it was my "first footprint" because in my almost eight years of experience, when a student tells me that he or she found a new energy job because of my program, it makes me feel really proud. I think in all single detail, so recruitment companies call me for candidates, and this really makes me happy.

I realized there is nothing more rewarding than sharing your knowledge with others. So I decided to do something even more massive. That's why I started to direct and present a TV program called "ENEGÍA XXI," where I show the most recognized people's discussions of different topics. This program is for the whole country and every week, we discuss new energy and infrastructure matters.[3]

On other hand, last year I was invited for "cumbre de Economía Verde"[4] to talk about the renewable energy program. When the interviewer presented me, she said "Regina will talk about renewable energy with a woman's approach." In that moment, I realized that there was an opportunity to make a difference. Barack Obama, President number 44 of the United States, was there. It was an amazing Congress; more than 500 people attended. The interviewer was an Argentine journalist and I had discussions with her before (she had participated in a Women's Congress in the USA). That is why she promoted women's vision and told me "it is a unique time to do it."

I started to notice that women's contribution in the Energy Congress was 25 percent to 30 percent of the total audience, but only myself and two or three other women were invited to be interviewed in more than 70 yearly events.

It was the beginning for our Women in Energy Corporation in Argentina association, with 12 other colleagues (and very close friends). We talked many times with different points of views, but my wishes to change organizational cultures to keep women in the workforce and help talented women advance further and faster in their careers are:[5]

Training each other to share knowledge. I suggest options to practice communication skills, where different professional women expose topics in which they are experts.

Insist on creating a space to present charges regarding sexual assault, among peers and superiors, so that the working environment for all of us will be ideal.

And, above all, companies should give their employees the option to achieve both desires: as a professional and as a mother. Then, companies must adapt to family cases so that motherhood does not stop or interfere in the professional life of a woman. In Argentina, there is no regulation on this topic.

I believe that the WIE experience will help a lot in these culture issues.

To know about different cultures, exchanging experiences, learning from other women, and evaluating failures and successes of other colleagues will be a most useful experience for our Argentinian's women's mission.

This year, I was awarded by LIDE as the "woman in energy" because of my contribution to renewable energy matters and my performance in women's issues in Argentina. In July, I also received a mention as Doctor Honoris Causa[6] by the Civic Parliament of Humanity and my first activity as member of a highly qualified group of people was to collaborate in an International Congress of Women in ethics issues to cooperate in world peace.

Both mentions (which came as a surprise to me) showed me that my motivation is recognized by third parties. So I must use such visibility as a source of motivation and inspiration for other women.

We are living in an historical "Age for women,"

where the entire world is working on recognizing women's equality. I strongly agree that we are the only ones responsible for our future, so we must work very hard to achieve our goals.

Argentina, like many other countries in the Southern Cone, is "backwards" regarding educational, regulatory, and technological matters. We millennials must use "globalization" benefits to develop our country. I think this is my main goal at this moment.

It is a very difficult path, but this is just the beginning of something I hope our daughters will be grateful for.

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Regina Ranieri

Dr. Regina Ranieri is an Argentinian, Industrial Engineer, and master in energy at the University of Buenos Aires and Dra. In Honoris Causa in Eco-ethics. She is a member of the renewable and suitability (sustainability) women's association in Argentina, and she was considered as the "Woman in Energy" for LIDE 2018. She has eight years of experience in the renewable energy sector working in LATAM countries. She is also a business development manager in UL RENEWABLES and a director of the renewable energy development and finance executive program in Argentina.

Retail Market Opening in Austria:
No Fair Sailing

Maria Haberfellner

Abstract

The article shines a light on the challenges faced and effort invested by the Austrian energy regulatory authority in opening up a formerly monopolistic market so that Austrian households might benefit from liberalisation. It will point to typical difficulties in such large-scale change processes and shows how they can be overcome. While the present article focuses on the mass market for electricity, large parts of it apply for gas as well. The experience gained will help the regulator and market players weather the deep transformation of the electricity industry we expect to see during the next couple of years.

Enabling consumers

Technological developments toward the end of the 20th century brought splitting competitive activities from natural monopolies within reach. The latter would need to remain regulated, but the former could be opened to the forces of demand and supply. Complex rules would be needed to ensure equal access to the network and a level playing field for all (wholesale and retail) market players. So, rather than removing rules and regulations, liberalisation meant redesigning them to both enable competition and control monopolies. A herculean task for legislator, regulator and players alike.

In Austria, overseeing and regulating natural monopolies (i.e., networks) and supporting the development of competitive markets falls to the energy regulator, EControl. We worked on enabling competition and limiting market power. This went fine for wholesale[1] and large customers, but for households, electricity accounted for a rather small portion of expenditures and there was little incentive for them to get involved in this newly created market. Without the mass market as a market force, liberalisation benefits remained meagre, and whatever benefits there were enjoyed by larger players (traders, producers, large customers). Mass market opening would not gather speed on its own; we would need to push it.

Caught in the ownership net

When the Austrian electricity market was fully opened in 2001, expectations towards consumer benefits were high.

The sector displayed the typical characteristics of electricity markets at the time: a small number (15) of state- or city-owned, vertically integrated undertakings dominated the market and served about 95 percent of households; the only other players were a couple of municipal or private businesses. Overall, the market counted about 140 companies.

Liberalisation was meant to disrupt this system by enabling suppliers to go beyond their incumbent supply area and compete with one another. In practice, complex (cross-) ownership stifled liberalisation. Structures became ever more tightly meshed as five large suppliers formed EAA group right after the market was opened, and one year later, they were joined by Verbund, Austria's largest electricity producer. Authorities approved these transactions, assuming that EU-wide competition would propel competition in Austria. However, this might precisely be why the market, in the end, took a different course: even though Verbund ended up leaving the group, EAA continued as a dominant factor on the retail market. This type of ownership structure kept suppliers from actively acquiring customers outside their incumbent area.

1 At first, we focused on wholesale market functioning (which was generally considered a good indicator for successful liberalisation). Flawed implementation and producer surplus at wholesale level led to downstream price increases, i.e., for the retail market.

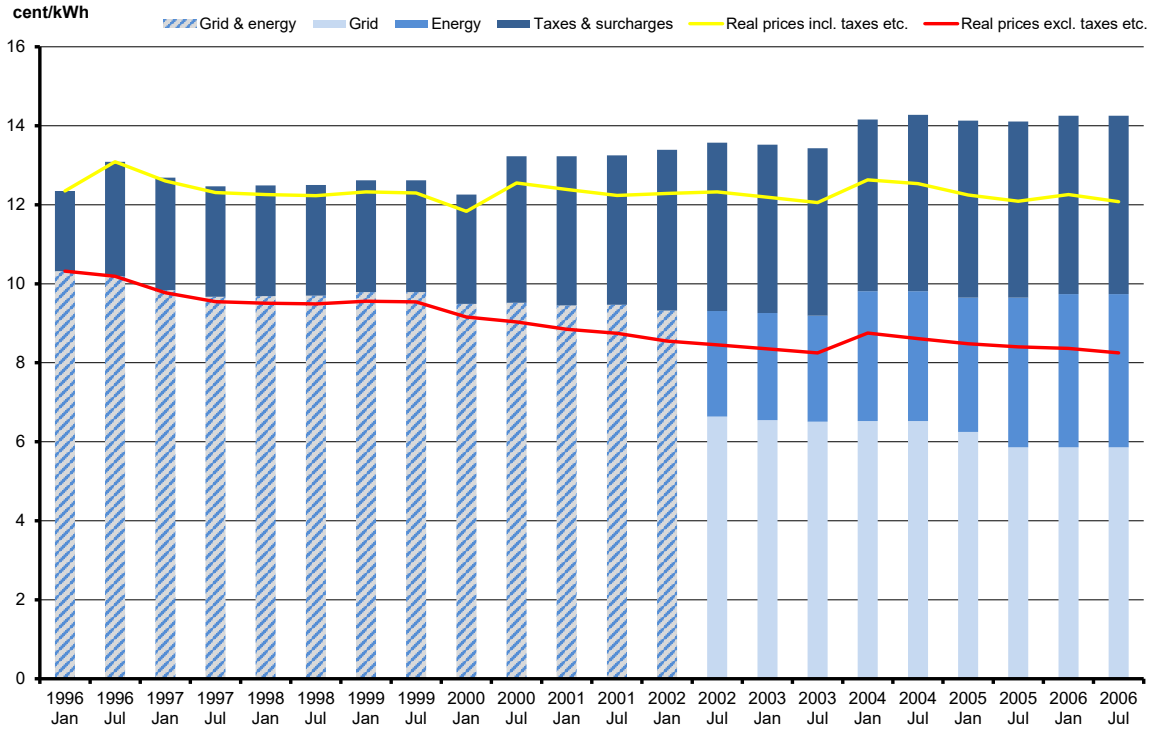
This was a disappointment, because conditions at wholesale level were much more favourable than for gas[2] or in other EU member states: well-developed interconnections with Germany facilitated a common wholesale market with many players. Austrian producers or traders could wield no market power here; they were small compared with their German competitors. An extensive sector inquiry by the European Commission's Directorate General for Competition[3] underlined just how much market power the German players held.

In spite of the adverse situation on the retail market at the beginning of liberalisation, household prices were moderate. This was because utilities had already started bringing prices down before market opening, expecting competitive pressure to kick in soon after.

As regulator, we could lower system charges by correcting how costs were assigned between network and supply in integrated companies and as part of the preparations for our incentive regulatory system. However, once utilities realised that retail competition was not as fierce as they had feared, they started upping household prices again. The downward trend of electricity rates (excl. taxes or surcharges) stopped. Even so, in 2006 they were still below 1996 levels (cf. Figure 1).

This was when government decided to introduce a sector-financed renewables support scheme; the additional costs for households were comfortably hidden in the downward movement of other cost components.

Figure 1: Trends in household prices and components, before and after liberalisation



Source: Eurostat

2 The gas market, liberalised one year later, faced a completely different situation. The industry was dominated by west- and south-bound transits from Baumgarten, at the Austro-Slovak border. Long-term transport and supply contracts with the one dominant supplier from Russia were commonplace and massively hindered wholesale market development. Austrian companies had little room for manoeuvre; instead of optimising their procurement strategies to fit customer needs, they had to optimise use of the rather fixed amounts of gas they procured under this model.

3 See DG Competition Report on Energy Sector Inquiry, SEC(2006) 1724: http://ec.europa.eu/transparency/regdoc/?fuseaction=list&coteId=2&year=2006&number=1724&version=ALL&language=en (last accessed 16/07/2018)

At this time, the only retail market data we had were prices and switching rates – and these were rather sobering: household switching was below 1 percent, other consumer groups were between 1 percent and 2.5 percent. As early as 2003/2004, business consumers complained heavily that prices were rising and that they got fewer and fewer offers. Austria's competition authority, supported by EControl, undertook a sector inquiry to gather more information. It revealed that the relevant market delineation on the mass market (households and small businesses) was still the incumbent supply area, corresponding to integrated operators' network areas. Cross-ownership basically kept suppliers out of each other's way.

Larger consumers fared much better: though there was still room for improvement, they enjoyed more competition and new (even foreign) suppliers had entered the market. Increased prices for this consumer segment reflected wholesale price movements and were therefore judged to be reasonable.

The mass market had failed to attract new players. One foreign supplier briefly tried its luck but left the market again in 2004. Two pioneers offered green electricity. All other players were subsidiaries of incumbents that marketed to eligible consumers as discount brands. What marketing they did was lukewarm.

A sector inquiry revealed that players could hardly expect positive margins. One of the many reasons for this was the regulatory and legal framework: servicing the mass market meant more bureaucracy, e.g., because of consumer protection law; also, if you wanted to service customers all over Austria (which made sense in this segment), you had to work in three control areas, i.e., handle three sets of rules; and integrated, incumbent suppliers had better and easier access to metering data (e.g., about newly established connections and fully automated exchange of consumption data) than new entrants.

A less expected obstacle was consumer inertia. Switching could cut household bills by about 15 percent (i.e., about 30 percent of electricity costs), but not even 1 percent of households actually changed suppliers. This meant that there had to be switching costs[4] that outweighed the potential savings.

The sector inquiry, consumer surveys and interviews with suppliers indicated that incumbents intentionally kept transaction costs for consumers and barriers for potential market entrants high. Without proper unbundling and transparency requirements, utilities obscured in their publicity, presentation, information materials and on bills that network and supply were now separate businesses. Consumers were led to believe that their supplier was responsible e.g., securing their supply, even though this is strictly a system operator task. Consumers also drastically overestimated how difficult switching would be. Alternative suppliers had to invest much time in convincing consumers–which again reduced their margins.

To address these concerns, the competition authority and EControl worked with the electricity industry to stimulate competition.[5] There was no legal obligation for market players to cooperate, so the endeavour was fully voluntary at first. But similar problems emerged in other EU countries, and in 2009 the European institutions passed the "third package," a series of legislative measures to drive market development.

Setting a new course through legislation

The third package was transposed into Austrian law in 2010, bringing improvements for consumers and suppliers. Consumers were to benefit from clearer unbundling, more transparency, quicker switching and more information from suppliers. Also, smart meters were to be rolled out by 2020 unless a cost-benefit analysis were negative. And there were new tasks for EControl: we were to monitor competition, prices, and consumer rights.

The revised legal basis introduced minimum requirements for suppliers' bills and promotional materials etc. For instance, it obliged suppliers to state

4 Switching costs include the effort invested in gathering information and conducting transactions; switching fees, i.e. monetary fees charged for switching in some countries, are a different matter.

5 See the competition authority's competition stimulation package at https://www.bwb.gv.at/de/branchenuntersuchungen/untersuchungen_strom_und_gas/wettbewerbsbelebungspaket_strom/ (German only, last accessed 16/07/2018).

their rate in cent/kWh and to clearly display consumption. Another new obligation meant they had to promptly enter into EControl's online price comparison tool prices and other relevant parameters of their products for the mass market. The tool only increases transparency if it has an up-to-date and complete information basis, and this information basis was greatly improved by the new legislation. Overall, consumers could now compare suppliers.

The good news for entrants was that the three Austrian control areas were merged into one. Also, a quicker switching process, through an automated switching platform, made life easier for them.

At that time, EControl already had a dedicated department that bundled all of our consumer services, as well as monitoring and development of consumer rights. They ran information campaigns to inform consumers and build trust in the market.

For another department at EControl, specialising in monitoring prices and competition at wholesale and retail level, the revamped Austrian legislation enabled more in-depth investigation, and this was very timely indeed. Household price trends did not reflect wholesale market movements at all: following the 2008 recession, wholesale prices had fallen by about 35 percent by 2012; household prices, on the other hand rose by 10 percent during the same period. More than 10 years after we had opened the market, there was still little mass market competition.[6] Though we did not find evidence of unlawfully high margins, there were drastic efficiency discrepancies between suppliers' procurement strategies and services. And given the lack of competitive pressure, they could pass on these (more or less efficient) costs to their customers. This was quite disappointing for us as a regulator.

Gathering speed

In the end, the Austrian retail market's structural inertia was overcome as a result of a series of several small, inconspicuous events. VKW AG, the only provincial utility without cross-ownerships, started acquiring customers outside its incumbent area almost immediately after market opening. Supplier Verbund split away from EAA group, set up its own supply business in 2005, and dissolved other cross-ownerships it had. It was the first supplier to run TV ads and to try and get larger parts of the population to switch. Verbund and VKW AG offered similar, cheap prices, vying for consumers all across Austria. A little later, two more suppliers left EAA to start country-wide operations as ENAMO late in 2011.

This was also when we started receiving more and more queries from potential market entrants. We put together information starter kits to help them find their way around the entry process and we set up a dedicated contact point. Between 2011 and 2017, 21 domestic suppliers entered the mass market. Seven of them were completely new to the electricity business.[7] And even foreign companies (most of them from Germany) started working the Austrian markets. German goldgas was the first to enter the Austrian gas market; a while later, it expanded into electricity. In 2017, 12 foreign suppliers were active in Austria (all of them in electricity and gas). Overall, households had a choice of 45 electricity and 26 gas suppliers.

The uptake in interest by new players could be due to several reasons: one, the 2008 recession brought wholesale demand down and prices fell. Serious decarbonisation efforts in Germany in 2011 meant further pressure on wholesale prices. For suppliers with short-term procurement strategies, this was the ideal time to enter the mass market. In addition, the massive support for wind and solar power all but pushed gas-fired plant off the merit order. Gas demand retracted and suppliers with long-term procurement contracts had to market their commodity elsewhere. They began looking at mass markets.

Two, there was increasing financial support for renewables in Austria, which had by then committed

6 See EControl (2014), Electricity supply probe - probe of electricity suppliers according to section 21 para. 2 EControl Act, at https://www.e-control.at/documents/20903/443907/E-Control+Electricity+Supply+Probe+2014.pdf/cadd81d3-a07f-4934-977c-9d1552d57fb8 (last accessed 16/07/2018).

7 Gas developments were quite similar: 15 country-wide electricity retailers expanded into gas, and some have become well-established.

to the Kyoto protocol. Slowly, households realised that they could produce their own (solar) power, and early smart meter roll-out based on a positive cost-benefit analysis helped them along. It dawned on all players that the conventional business model (i.e., simply supplying electricity) would soon reach the end of its life span. Austrian suppliers began employing more targeted sales strategies, expanding their supply area, combining other services, and strengthening customer relations. Encouraged by growing smart meter coverage, small, often privately owned start-ups tried to establish innovative products on the market.

And three, several experienced German retailers found their own national market saturated and moved into Austrian.

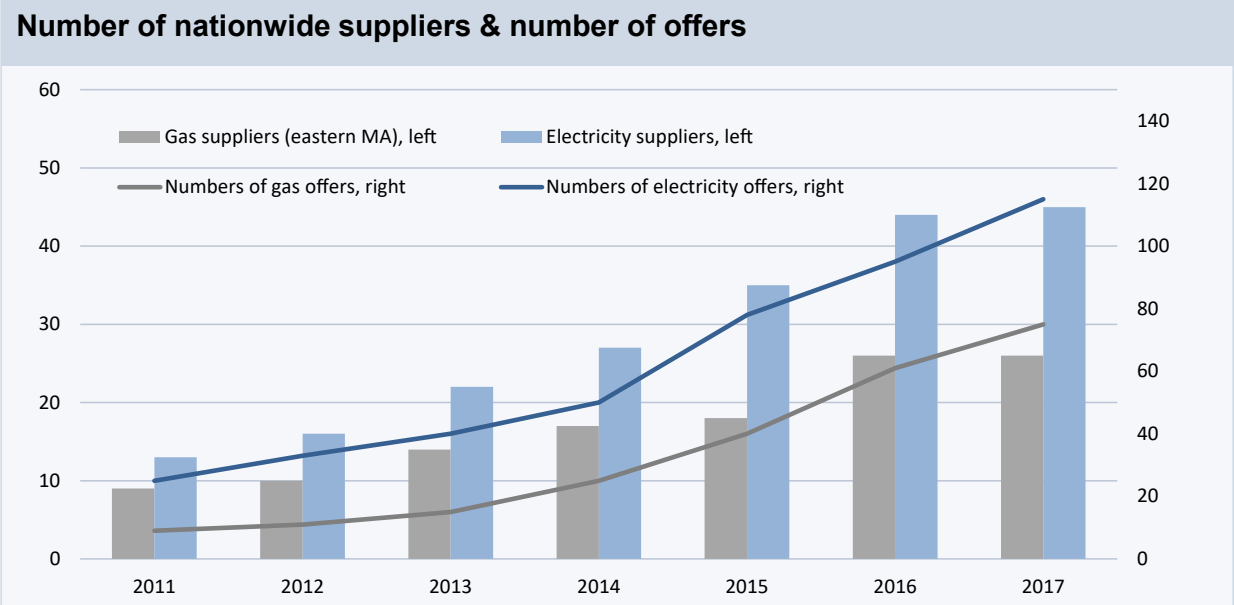
More choice

As new suppliers entered the market and established ones introduced new products, choice for consumers grew significantly. Offers differed in prices, minimum contract durations, primary energy sources, type of billing, service level, etc. In 2011, a Viennese household could choose between 10 electricity products only; in 2017, that same household had a choice of 115 (s. Figure 2). To keep up with these developments, we regularly updated our online price comparison tool; the most recent complete overhaul, in 2017, should make it fit for our purpose for a couple of years to come.

Many new entrants purchased their energy mainly on short-term markets and falling wholesale prices meant they were serious competition for established suppliers with mixed procurement strategies. Customer acquisition often hinged on large one-off discounts, meant to compensate consumers for the switching costs (which they continued to perceive as overwhelming). Savings potentials climbed: including all discounts, households could save around € 100 in 2011, but € 350 in 2017. This meant cutting bills by almost 50 percent (i.e., reducing energy costs by more than 90 percent). Of course, consumers must switch every year to continue to benefit from one-off discounts, and this scares away many.

As households started to overcome their inertia, the switching rate progressed from 1.7 percent in

Figure 2: Players and products on the market, 2011-2017



Source: E-Control price comparison tool, typical household (Vienna), 3,500 kWh electricity, 15,000 kWh gas

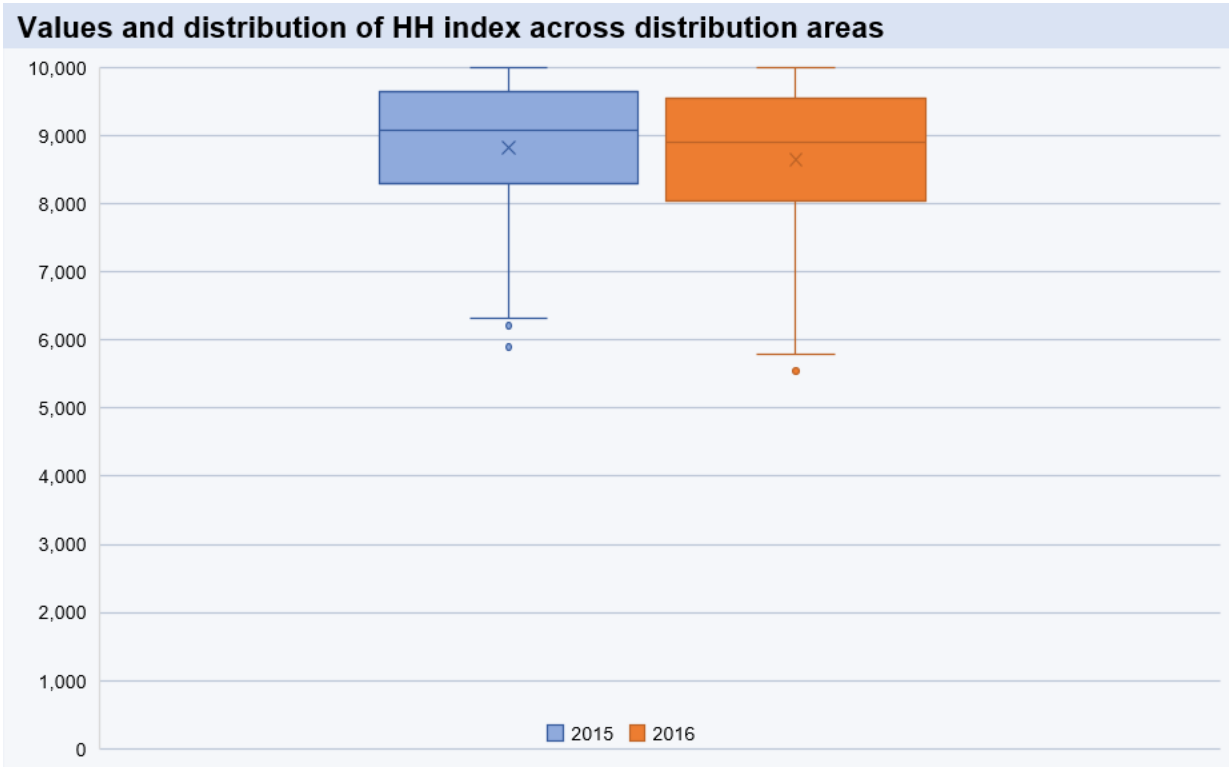
2011 to 4.3 percent[8] in 2017. There were drastic regional differences: some incumbents could retain almost all of their customers, keeping switching rates in their area to around 1 percent, whereas others had to watch around 7 percent of their household customers leave for other offers. From a market power perspective, this meant companies with close to 100 percent market share in some areas, while elsewhere the dominant supplier serviced only about 75 percent of households. The HHI puts this observation into numbers: market concentration fell between 2015 and 2016, with stark differences between the over 120 network areas (s. Figure 3). In some places, we continued to have an HHI of 10,000, whereas the lowest value observed in 2016 was just below 6,000. Even this lower figure was still way beyond what is considered little market concentration.

Consumer activity may result in supplier switches, but it can also lead to consumers staying with their supplier and switching to a different product. This becomes more and more relevant as suppliers expand their offer. Our data on such activity are not yet as solid as we would wish, but we estimate that in 2017 between 1 percent and 3 percent of customers switched to a different product offered by their supplier. These numbers place Austria in the lower third of consumer activity measures in Europe.

Getting consumers involved

Though activity has picked up somewhat, most consumers in Austria remain passive. A 2017 survey found that close to 80 percent of households had never switched. A growing percentage of then 63 percent said that they were happy with their (incumbent) supplier. Many also felt they did not know enough about prices and switching. And consumers

Figure 3: HHI at distribution level, 2015-2016



8 Please note that small adjustments to data collection between 2011 and 2017 impact comparability of these numbers.

admitted that they were simply too lazy. The survey outcome is easier to understand against the background of the market conditions described below. Together, they explain the weak consumer activity.

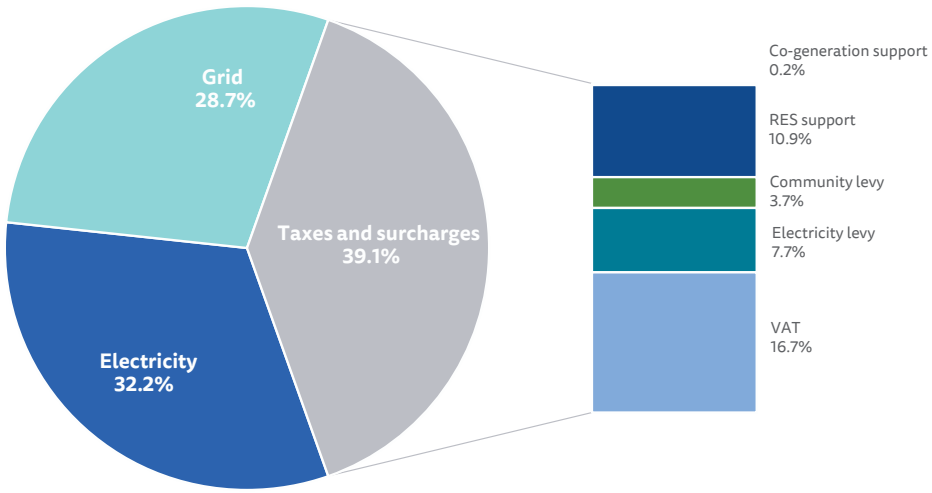
Even 16 years after market opening, the average consumer still has difficulties distinguishing between system operator and supplier. Logic dictates that this should be remedied by more information, so that consumers can build trust in the market. However, the questions and complaints we receive at EControl show that more information does not necessarily mean better-informed consumers: for instance, many find the abundance of information on bills (which is prescribed by law) overwhelming. Recent developments such as step-fixed discounts, solar power injection, smart metering etc., mean ever more complex bills—and ever more errors. Also, data exchange between market players does not always run smoothly. And often, consumers do not know to whom to address their questions. But electricity is an essential good, and so even if it is a friend of a friend who has had one bad experience—e.g., a possibly defective bill or a less-than-ideal market process with no real person to talk to—this might stop consumers from getting involved.

Against this background, it is also logical that more and more intermediaries should be popping up on the market. They broker contracts for consumers or suppliers, make them "easier to understand," and they work on commission. Some are quite successful in this business: one example is an annual collective switching campaign by the Austrian consumers association that is perceived as very trustworthy. Also, a commercial online price comparison tool has appeared, and known grocery stores and the Austrian postal service have become active. They cater to consumers who would not act on their own. We generally welcome this, but even a single shady sales practice can seriously damage transparency and consumer trust. Rules and regulations for consumer information are paramount; a balance must be struck between simple and straightforward information on the one hand and misleading information reduction on the other.

Besides trust, price is most relevant for consumers. But the share of a household's overall electricity bill that is subject to competition is shrinking: although energy accounted for 43 percent of a bill in 2011, it is only 32 percent in 2018 (cf. Figure 4). This is close to the share we had at the beginning of liberalisation, before we corrected how utilities allocated costs between network and supply.

Whereas liberalisation hinges on market mechanisms, decarbonisation is financed through a non-market support scheme in Austria. This impacts the energy component on bills in two ways: one, more expensive plant are pushed out of the market

Figure 4: Composition of an average Viennese household's electricity bill



Source: E-Control price comparison tool, typical household, 3,500 kWh electricity, as of 1 Jan. 2018

and wholesale prices drop. If retailers pass this on to consumers, the energy share in the overall bill shrinks. Two, money for the support scheme comes from surcharges on the bill, which increases this component and again decreases the energy share. Overall prices are the most important signal for consumers, but the way they are constructed destroys cost-reflectivity and reduces consumer activity.[9]

Another reason for the shrinking energy component on bills is the increase in system charges. Distributed generation and storage require that the distribution networks be revamped, and these costs must be recovered through the system charges. How much additional investment is necessary will strongly depend on optimising flexible use of distributed assets. And households will play a role as well. The regulatory challenge now consists in developing a framework that enables technological change in the best interest of consumers.

Riding the wave

After market opening, Austria's retail market was not as dynamic as expected, or as lively as in other European countries. But since then, choice and savings potentials for consumers have grown. And we must not forget the additional benefits of liberalisation: the new market environment has forced suppliers to pivot and capitalise on their strengths. They have learned to handle disruptive developments. This way, liberalisation has prepared them for an uncertain future that might well turn the energy business on its head.

Already, we see indications on the horizon: 80 percent of consumers must have smart meters by 2020 (and 95 percent by 2022).[10] Having a solar panel on your roof and becoming a prosumer is á la mode. Consumers are empowered to act in the market and consume products that correspond to their willingness to pay. This is how they benefit from liberalisation.

Over the last couple of years, supplier interest in classic business models has dropped. Involvement in smart home solutions, pooling models and energy optimisation is on the rise. Often, we are contacted with questions about how such new products fit into the existing regulatory regime.

Negotiations around the Clean Energy for All Europeans legislative package are ongoing, but we already know that it will have a thing or two to say about retail. The package strengthens consumer rights, pushes active consumer involvement and establishes a right to generate and store electricity. The aggregator as a new type of market player appears on the scene. Digitalisation, enabled by smart meter data, means aggregators can service a broader public; this is already working elsewhere. Retail is becoming ever more complex.

For many Austrian consumers, the share of the energy component in their electricity bill will remain the main reason to become active. This will depend on wholesale prices, which in turn are connected to our neighbouring countries' national energy policies and the development of the carbon price. Also, the future Austrian renewables support scheme and its financing mechanism will play a role. And of course, it will depend on the system charges, which themselves hinge on efficiently transforming the distribution system.

Though we cannot know the future, lessons learnt in the past will be valuable. The better use we make of them, the more we can work toward a well-functioning future retail market. We have learnt that:

Consumers, to become active on the market, need a market they can trust, through:

- cost-reflective energy prices (and grid charges)
- transparency about prices and important product features
- easy-to-understand and quick information about their consumption

9 The current renewables scheme also counteracts climate goals. If we are to reach them, consumers must actively participate in the market. The smaller the energy share in a bill, the less likely a consumer is to change behaviour. Thanks to smart meters, it is now possible to develop innovative products that reward consumers for reacting to price signals. But if these signals remain weak, such products might not become very popular.

10 The legislator, in a step lamented by start-ups, has decided to push back rollout by a couple of years.

- objective comparison tools
- easy-to-read bills that compare the result with the original offer
- trustworthy suppliers, service providers, intermediaries etc.
- well-functioning market processes with contact persons
- guaranteed assistance for when people face difficulties

Suppliers that work the mass market need low-entry barriers, such as:

- a level playing field for all
- sufficient market size
- little switching costs for consumers
- flexibility in designing products and services
- fully automated market processes
- quick remedies for problems that keep surfacing

Competition needs dynamic market oversight:

- independent monitoring to identify unwanted developments

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[2] Commission staff working Document - Accompanying the COMMUNICATION from the Commission Inquiry pursuant to Article 17 of Regulation (EC) No 1/2003 into the European gas and electricity sectors (Final Report) {COM (2006) 851 final}; http://ec.europa.eu/transparency/regdoc/?fuseaction=list&coteId=2&year=2006&number=1724&version=ALL&language=en (last accessed 16/07/2018).

[3] Bundeswettbeberbsbehörde (BWB, 2006), The competition authority's competition stimulation package at https://www.bwb.gv.at/de/branchenuntersuchungen/untersuchungen_strom_und_gas/wettbewerbsbelebungspaket_strom/ (German only, last accessed 16/07/2018).

[4] E Control (2014), Electricity supply probe - probe of electricity suppliers according to section 21 para. 2 E Control Act, at https://www.e-control.at/documents/20903/443907/E-Control+Electricity+Supply+Probe+2014.pdf/cadd81d3-a07f-4934-977c-9d1552d57fb8 (last accessed 16/07/2018).

[5] E-Control (2003), Liberalisierungsbericht 2003, https://www.e-control.at/documents/20903/-/-/e178fode-2100-4fac-aa5f-9aead755e150 (German only, last accessed 16/07/2018).

Maria Haberfellner

Ms. Maria Haberfellner is Senior Market Analyst at E-Control. She joined E-Control in its first year of existence, more than sixteen years ago, and accompanied the market opening process. Market analysis, monitoring and reporting, both in electricity and gas, are her passion. She shares her knowledge about liberalisation and regulation with European NRAs in the frame of CEER Working Groups or Task Forces, as co-author of the CEER-ACER Market Monitoring Report, at E-Control workshops and in working papers or as expert in EU twinning projects, most recently with the Georgian NRA. She also established guidelines for new market entrants which provide advice to enterprises considering entering the Austrian market.

Can Blockchain Enable Faster, Cheaper, and More Secure Energy Services?

Alex Kizer,[1] Joe Hezir, Melanie Kenderdine, and Sam Savitz

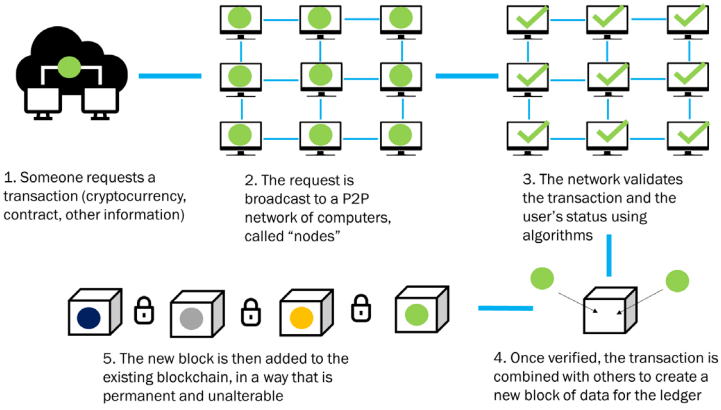
Advances in digital technologies are unlocking new opportunities for businesses in every industry. Blockchain—a high-value data management/transaction platform that is made possible by this increasingly digital economy—is part of this revolution.

At the same time, energy sector stakeholders are managing a range of rapid changes: the need for deep decarbonization, flat or declining demand, integrating variable generation technologies, evolving measures of reliability, increasing customer choice, and growing national security implications of electricity reliance. These changes are difficult for commodity-based, highly regulated energy systems with complex, extensive supply chains, and long-lived, expensive infrastructures. New blockchain applications for energy may assist energy players in managing these and other changes.

In analyzing blockchain's potential to be integrated into changing energy systems, the Energy Futures Initiative (EFI) asked two questions. First, does the application adequately align the core benefits of blockchain with the emerging issues in the energy sector? And second, is the blockchain used to support an ecosystem of business functions rather than a single-use?

These questions produced four key areas of focus: distributed energy resources, electric vehicles, energy trading platforms, and carbon emissions tracking. For all these applications, blockchain presents significant opportunities for reducing time, cost, and risk of many business transactions, resulting in process improvements, added value, enhanced transparency, and improved trust among actors in the energy system. At the same time blockchain is a relatively new technology and challenges remain to widespread uptake due to current business models, regulatory environments, and market structures. That is why it is important that existing, and emerging, players in the energy sector, as well as policy-

Figure 1. How Does Blockchain Work?



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Adding new transactions to the blockchain is a relatively straightforward interaction between independent computers that verify each transaction and then add them to the immutable chain

Other sources: Blockgeeks, Nounproject

1 Lead author.

makers and regulators, understand what blockchain is and what it offers to the rapidly changing energy sector.[2]

Blockchain and Energy

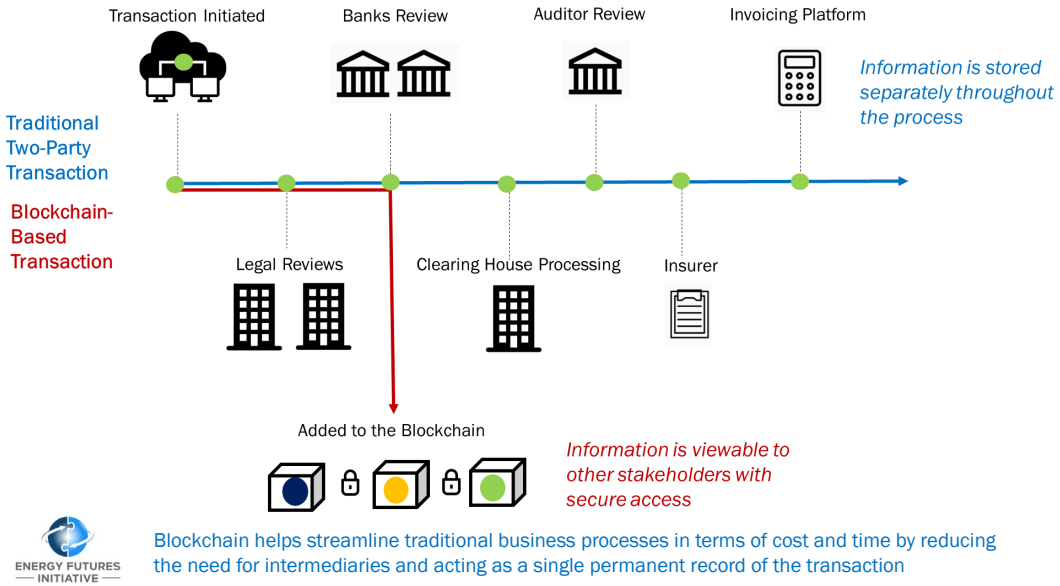
What is Blockchain?

Blockchain is an electronic ledger system managed without a central authority by a distributed network of independent computers, called "nodes" (Figure 1). Blockchains enable users to record digital transactions without risk of third-party interference or alteration.[3] New transactions are submitted to a node, which then alerts the network of computers of the pending transaction. A node is randomly selected to review the details of the pending transaction and determine its legitimacy using specific rules established by the blockchain's design. To maximize efficiency, many transactions are bundled together by nodes into a block and are then added to the chain. All nodes receive an updated copy of the blockchain and there exists no "master" version.

Any attempt to corrupt one version of the blockchain or add transactions without following the rules will be rejected by the network. This creates an intrinsic form of cybersecurity. Although blockchain guarantees the security and validity of a dataset, it does not review or verify the accuracy of the underlying transaction information. In some cases, blockchain may exacerbate the "garbage in, garbage out" problem because it is difficult to change information once it is added to the chain.

Blockchain is an approach for managing large volumes of transactions, settled quickly, securely, and at relatively low cost. Although many uses have been suggested,[4] the breakthrough potential of blockchain emerges from the myriad ways it can help firms capture more value from the digital economy by improving existing processes (Figure 2)

Figure 2. How Does Blockchain Compare to Conventional Business Transactions?[5]



2 For an expanded version of this article, see the Energy Futures Initiative report titled "Promising Blockchain Applications for Energy: Separating the Signal from the Noise." July 2018. https://energyfuturesinitiative.org/s/EFI_Blockchain_July2018_FINAL.pdf

3 https://csrc.nist.gov/CSRC/media/Publications/nistir/8202/draft/documents/nistir8202-draft.pdf

4 https://www.wired.com/story/187-things-the-blockchain-is-supposed-to-fix/

5 http://resourcecenter.smartgrid.ieee.org/sg/product/education/SGWEB0063; https://thenounproject.com/

Table 1. Advantages of Blockchain Over Current Data Management Approaches

Attribute	Current Approaches	Blockchain Benefits
Database Architecture	Centralized Systems, Often Administered by Third-Party; Largely Fixed Architecture; Independent Data Taxonomies	Decentralized Systems can be Self-Administered; Scalable Design with High-Level of Flexibility; Single Data Structure
Data Permissions	Access Controlled by IT Administrator or Managed Service Provider; Policy and Architectures Limit Access of Outside Businesses Partners, Collaborators	Architecture Sets Permissions, Regulated by Rules-based System; Businesses Partners (e.g., supply chain vendors) can Access Records
Cybersecurity	Cybersecurity Protections (e.g., monitoring, digital signatures) are Add-ons to Basic Architecture; High Reliance on Human Element for Data Protection; Few Protections from Attack Vectors Using Legitimate Credentials	Cybersecurity Protections are Inherent to Blockchain Design and Layered; Advanced Cryptography Underpins Framework; Data Stored on Verifiable, Decentralized Network; Engineered to be Immutable
Contracts and Financial Transactions	Contracts and Transactions Handled Internally (or Contracted); Rules and Terms May Adapt Based on Contract Type; Highly Reliant on Trusted Third-Parties; Low Process Transparency, Enforceability, Limiting Access to Emerging Markets; Highly Centralized Infrastructure for Transactions	Enables "Smart" Contracts for Streamlining and Automating Contract Terms (i.e., Deposits, Payments, Proof of Performance Actions); Removes Need for Trusted Third Parties; Regulators and Governments Can Observe or Record Details; High Process Transparency and Enforceability, Opening Access to Emerging Markets
Financing	Separately Managed Electronic Funds Transfers; Third-Parties Handle and Process Transactions	Supports Digital Payments; Enables Cryptocurrencies, Removing Need for Trusted Third Parties; Cryptocurrencies Create Additional Opportunities to Capture Value (ICOs and Coin Valuation)

Source: Energy Futures Initiative

A critical element to the value of blockchain is its ability to reduce multi-party transaction times to near-zero. It also dramatically reduces overhead costs of using intermediaries, such as clearing houses, enabling leaner, more profitable enterprise.

Finally, blockchain can improve confidence in transactions between firms and people in the digital world, reducing redundancies and associated bureaucracies.[6] Blockchain-enabled systems provide businesses with a tool to manage transactions; maintain their economic advantages, privacy, and security; and reduce the costs of each.

Blockchain and the Energy Sector

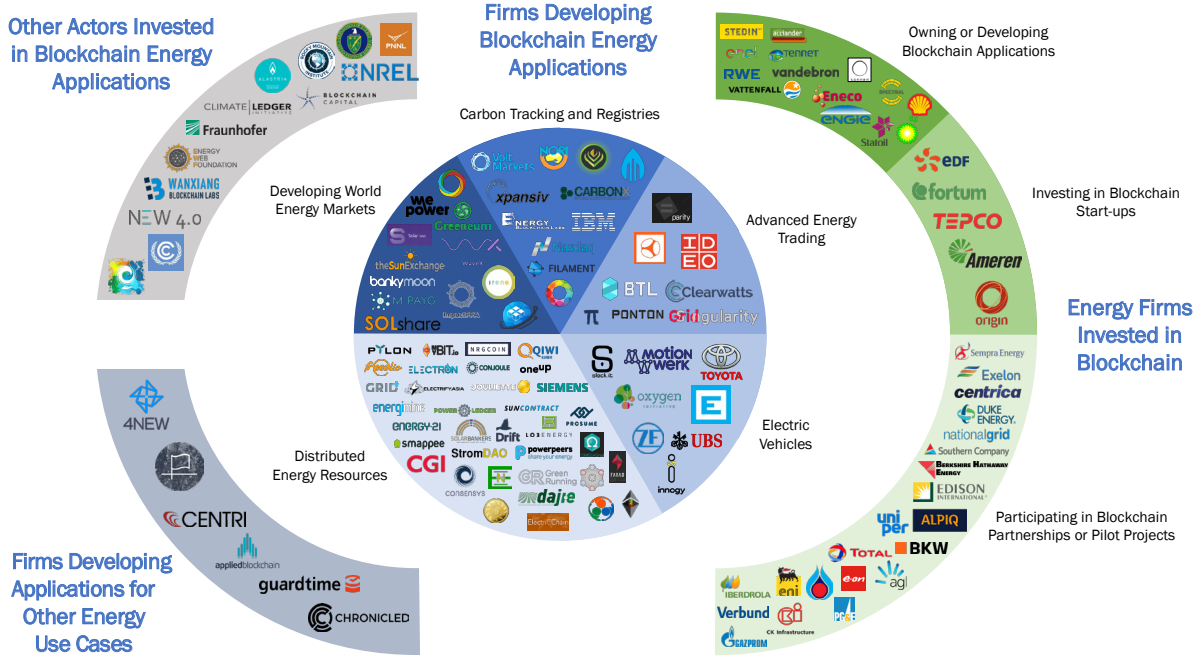
Many of the same digitalization trends that are unlocking blockchain's potential are driving profound changes in the energy sector. The rapidly growing capabilities and falling costs of digital technologies are creating energy systems that are more digitally enabled, have growing options for decentralization, give consumers greater input and control, and are less resource- and more technology-dependent. In the power sector, for example, global investment in digital infrastructure has grown by over 20 percent annually since 2014, reaching $47 billion in 2016.[7]

Blockchain offers firms a potential pathway to better manage these changes by optimizing the use of energy data and creating new transaction methods. Estimates suggest that to date, there has been $100-$300 million dollars invested in more than 100

6 https://www.youtube.com/watch?v=JNeNQ2W15b0

7 http://www.iea.org/digital/

Figure 3. Blockchain for the Energy Sector: An Estimated $100-300 Million Investment



energy-sector blockchain applications (Figure 3).[8,9]

Technology firms are leading the development of blockchain applications for energy. Some, such as Siemens, have invested in companies that are already developing blockchains. Others are developing their own blockchain products: IBM, for example, has a dedicated "Blockchain Lab." Development is not, however, limited to existing firms—at least 60 energy-blockchain startups have recently emerged.[10] Opportunities in the energy sector are exciting for new firms and conventional energy players alike. The Energy Web Foundation (EWF), for example, is a consortium bringing together established firms like Shell and Equinor with energy-blockchain startups.

Promising Blockchain Applications For Energy

Distributed Energy Resources

Distributed energy resources (DER) are physical and virtual assets characterized by their small capacity and connection to low and medium voltage grids.[11] DER are often behind-the-meter or connected directly to the distribution system. Examples include rooftop and community solar, electric vehicles (EVs), and energy storage.

DER are changing how the distribution system interacts with the bulk power system.[12] These changes can alter the flow of power and the grid operator's

8 Author estimates based on reviews of public documents and private discussions with energy, technology, and blockchain firms

9 https://www.greentechmedia.com/articles/read/leading-energy-blockchain-firms#gs.OHso4Ms

10 https://www.indigoadvisorygroup.com/blog/2017/3/6/global-energy-utilities-blockchain-pilots-and-use-cases

11 https://energy.mit.edu/wp-content/uploads/2016/01/CEEPR_WP_2016-001.pdf

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Table 2. Alignment of Emerging Energy Issues and Core Blockchain Capabilities Result in Promising Energy Sector Applications of Blockchain

Emerging Energy Sector Issues	Core Blockchain Capabilities	Promising Energy Sector Applications
Falling Technology Costs; Decentralization; Changing U.S. Energy Supply System; Evolving Grid Control Capabilities	Decentralized Systems can be Self-Administered; Architecture Sets Permissions, Regulated by Rules-based System	Distributed Energy Resources
Vehicle Electrification; Falling Battery Costs; Decentralization; Decarbonization	Enables "Smart" Contracts for Streamlining and Automating Contract Terms (i.e., Deposits, Payments, Proof of Performance Actions); Removes Need for Trusted Third Parties; Regulators and Governments Can Observe or Record Details;	Electric Vehicle Deployment
Decentralization; Digitalization; Changing U.S. Supply System; Emerging Global Natural Gas Markets	Businesses Partners can Access Records; Removes Need for Trusted Third Parties; Regulators and Governments Can Observe or Record Details;	Energy Trading
Decarbonization; Digitalization; Changing U.S. Supply System; Evolving Carbon Markets	Removes Need for Trusted Third Parties; Regulators and Governments Can Observe or Record Details; High Process Transparency and Enforceability, Opening Access to Emerging Markets	Carbon Tracking and Registries

Source: Energy Futures Initiative

response to various conditions. Whereas some grid operators can optimize DER integration through advanced forecasting and larger balancing authorities,[13] many operators do not have the infrastructure, operational practices, generation fleet, or regulatory structures to make these adjustments.[14]

Blockchain can help create a framework for improving visibility and control of DER to meet increasingly complex grid operations' needs. Operators and utilities can use blockchain to create a trusted, secure system for managing the record, status, and transaction of the distributed resources. This benefits the grid by providing operators with critical information related to load forecasting and interconnection requirements to reduce unnecessary ramping.[15]

Blockchain also can enable the use of "smart contracts" among market participants to further increase resource efficiency. Here the blockchain is programmed with a set of conditions, so transactions are automatically triggered when conditions are met. These advanced applications and grid designs can improve balancing of supply and demand. TenneT, a Transmission System Operator (TSO) in Europe, has partnered with IBM to use smart contracts for improving the performance of DER by making EV batteries available to support grid balancing.[16]

The power sector is already developing ways to make DER more efficient and effective for the grid. A leading

13 https://www.nrel.gov/docs/fy13osti/60451.pdf

14 https://www.nrel.gov/docs/fy13osti/60451.pdf

15 https://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/Distributed_Energy_Resources_Report.pdf

16 https://www.tennet.eu/news/detail/tennet-unlocks-distributed-flexibility-via-blockchain/

approach is the use of aggregators that group DER agents to act as a single entity when engaging in power markets or selling services to the operators.[17] DER Management Systems can analyze load behaviors and create pathways for optimizing the benefits of these aggregated resources. Blockchain and smart contracts take this further by creating a mechanism through which individual DER agents share data, signal their intention, and be compensated for specific actions (Figure 4).[18]

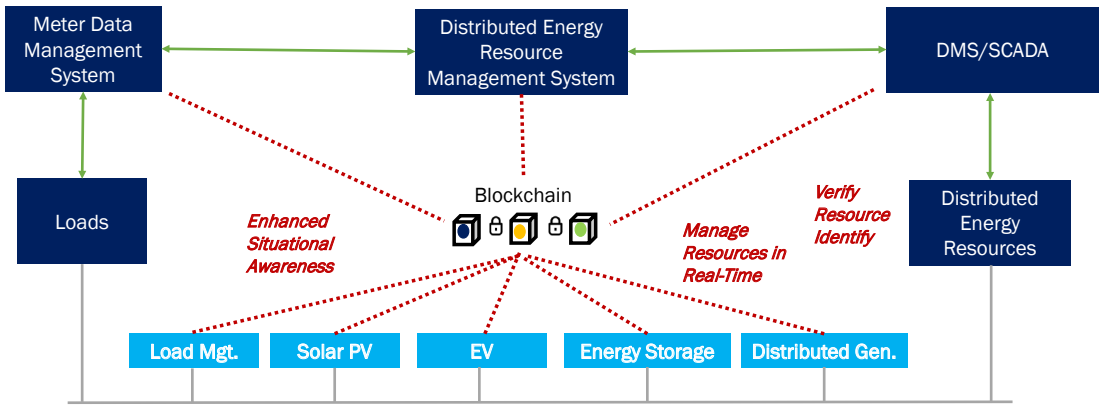
In more technologically advanced cases, microgrids running on blockchain can enable peer-to-peer energy markets. All members of the network can enter directly into energy exchanges without oversight from a centralized authority. An example is the Brooklyn Microgrid, a $6 million project with over 500 participants that automates transactions between DER owners and consumers. The microgrid is designed to work with the Con Edison network.

A principal challenge for blockchain-based DER is that many benefits may only be realized in market structures with specific characteristics, including dynamic pricing, peer-to-peer offerings, and multiple organizations with shared data processes. Although blockchain can help enable some of these, many power markets do not have the needed technologies, regulations, or business models. Also, it may be premature to apply blockchain applications to DER, as DER markets are in their early stage of development, and the inherent design of blockchain makes it difficult to modify retroactively.

Electric Vehicle Markets

The electrification of transport will play a major role in the modernization and decarbonization of energy and associated systems. The global EV stock surpassed two million in 2016—after passing one million vehicles in 2015.[19] Blockchain can leverage the charging infrastructure needed to support this rapidly growing market.

Figure 4. Blockchain-Supported DER Management[20]



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Blockchain can be integrated into DERMs to create new mechanisms for managing DER resources in real-time with smart contracts, verifying resource identify, and enhancing situational awareness of DER entity intentions

Source: Adapted from Kley, Holger, "What is a Distributed Energy Resource Management System?"

17 https://energy.mit.edu/wp-content/uploads/2016/01/CEEPR_WP_2016-001.pdf

18 https://ecal.berkeley.edu/pubs/CCTA17_Blockchain.pdf

19 https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

20 https://www.gtai.de/GTAI/Content/EN/Meta/Events/Invest/2016/Reviews/Hannover-messe/smart-grids-forum-2016-presentation-holger-kley.pdf?v=2

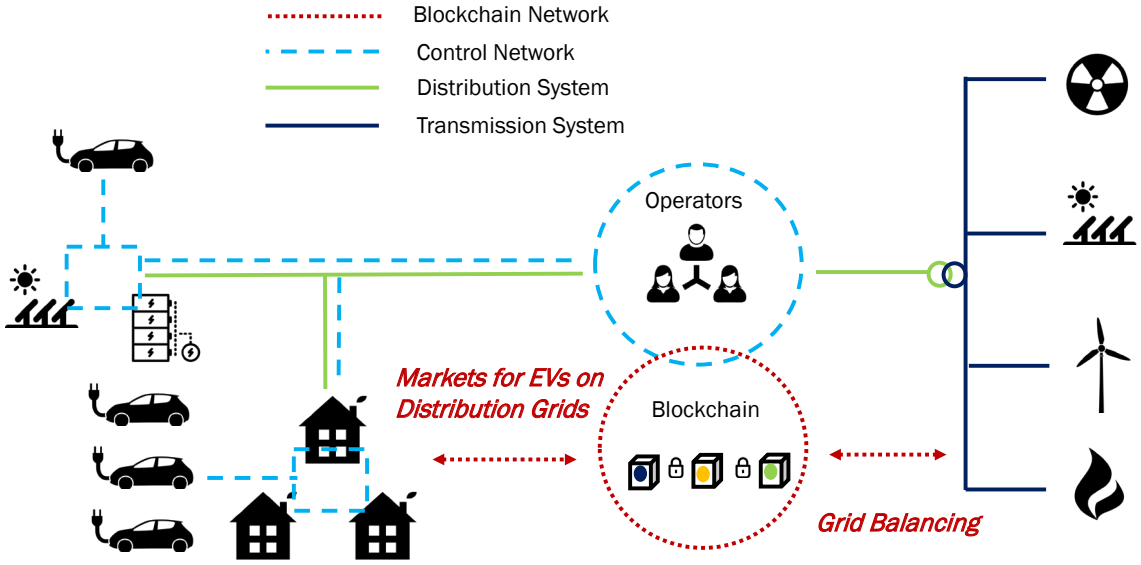
The availability of EV chargers remains a key barrier to market penetration.[21] There are roughly 322,000 public chargers and 1.68 million private chargers worldwide. More chargers will increase certainty for drivers and add flexibility to the EV market. The predominant approach to addressing this issue is public subsidies for further deployment.

Blockchain enables and provides economic incentives for owners of private chargers to bring them online for public use, avoiding the build-out of a massive new wires network. The vast majority of existing chargers remain idle for most of the day. Blockchains are being developed to create simple, peer-to-peer transactions on private chargers so owners can set their own prices (flat, time-based, or electricity-based) and use the blockchain to handle billing, payment, and authentication. In most cases, a cell phone app is used to find the most convenient private charging station based on location, cost, etc. One example is Innogy, a subsidiary of German utility RWE, which has already launched over 1,200 charging stations supported by blockchain.[22]

Blockchain-based tools for supporting EV deployment offer unique benefits to grid operations as well (Figure 5). Current non-blockchain-based approaches use smart meters, intelligent endpoints, and behind-the-meter learning to create disaggregated load profiles.[23] These tools rely on statistical methods, whereas blockchain-enabled EVs offer actual load measures, providing greater certainty to operators to drive down operational costs, reduce energy use, and more precisely identify technical issues.

Although there are several opportunities for blockchain technology to transform EV markets, there are still many challenges at the consumer, household, and local levels for the widespread deployment of

Figure 5. Multiple Opportunities Exist for Blockchain to Support EV Charging Networks



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Blockchain can support the growth of EV markets by incentivizing owners of private chargers to bring them online for public use and by assisting grid operators to better manage EV demand on the grid

21 https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

22 https://shareandcharge.com/en/

23 https://www.antennagroup.com/blog/cleantech-trends-2018

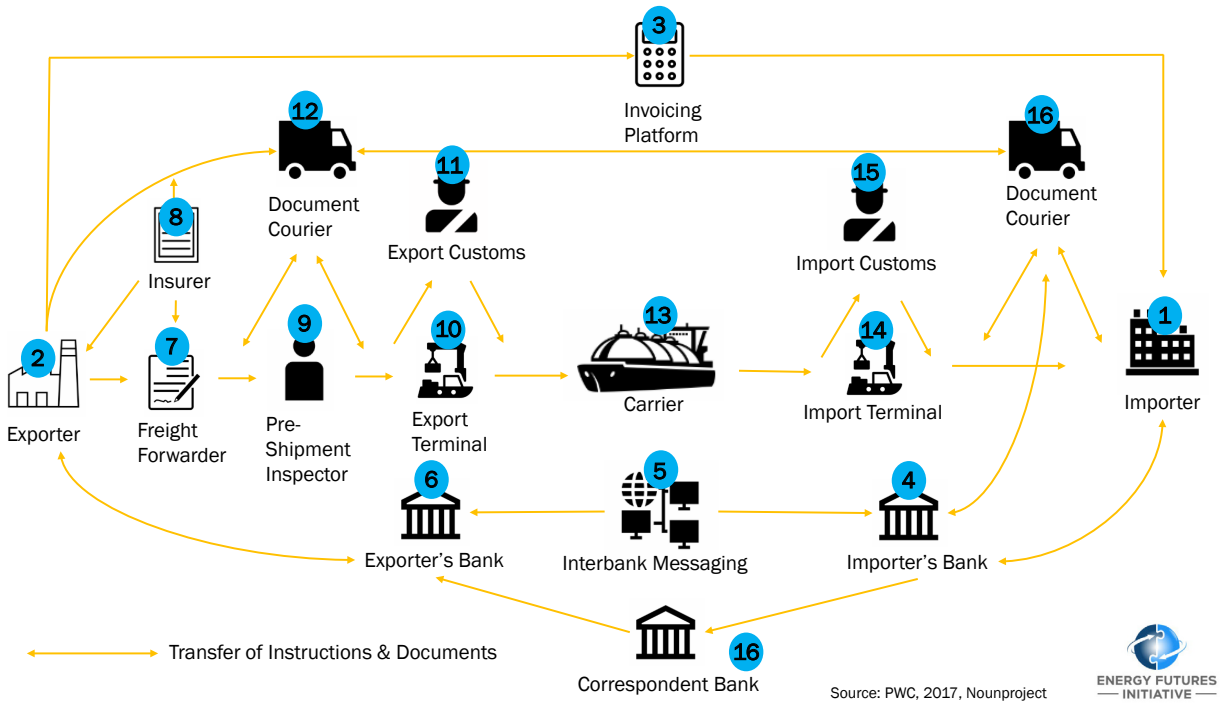
blockchain-based EVs. At the consumer level, only active consumers or "prosumers" may see the full benefits of using blockchain. The additional cost of blockchain could outweigh the benefits if consumers do not carefully monitor the market and take advantage of price arbitrage opportunities to ensure a return on investment. At the household level, hosting EVs on private property may create privacy and zoning issues. At the local level, private charger-associated vehicle congestion at homes, offices, parking lots, or on local streets may present logistical challenges to blockchain deployment. Addressing these issues may be difficult due to their cross-jurisdictional nature.

Advanced Energy Trading Platforms

Even as energy and commodity trading firms invest millions to optimize their business systems,[24] the trading process still heavily relies on the manual exchange of goods, multiple interactions between firms, and third-party intermediaries to close deals (Figure 6).

These agents may use different data tracking systems, leading to the potential for gaps or errors in information that could impede the transaction process. Multiple parties in the supply chain purchase goods, add value, and sell goods to the next actor in the chain. The associated transfers of ownership are often still recorded on paper.[25] A blockchain-based platform can help integrate current market participants and incentivize new ones.

Figure 6. Typical Energy Logistics Chain Requires Multiple Transfers of Documentation[26]



24 http://www.ey.com/Publication/vwLUAssets/ey-overview-of-blockchain-for-energy-and-commodity-trading/$FILE/ey-overview-of-blockchain-for-energy-and-commodity-trading.pdf

25 https://www.pwc.com/gx/en/industries/assets/blockchain-technology-in-energy.pdf

26 https://www.pwc.com/gx/en/industries/assets/blockchain-technology-in-energy.pdf

The core benefits of blockchain are well aligned with energy trading applications and the many changes related to digitalization in the energy space. Blockchain may be used to optimize the entire trading lifecycle for oil and refined products, natural gas and LNG, and electricity, from price discovery and trading to managing the back-office settlements and payments.[27] Using blockchain, transactions may be logged without the need for a single, centralized controller. This reduces or eliminates the need for multiple interactions between firms, thereby reducing labor costs, lowering capital costs through faster settlements, and cutting technology costs by shifting away from multiple processes to a single process.[28]

Blockchain also creates a platform for sharing transaction costs between firms. Firms can split the costs of blockchain and each use it for transactions, and for recordkeeping and validation, while maintaining their data security and privacy. Energy trading is an ideal participatory network for using blockchain to help firms maintain their competitive advantage while all benefiting from increased business efficiency.

In early 2017, ING, Societe Generale, and Mercuria tested blockchain for trading an oil cargo from Africa to China, which involved three different sales. The traders, banks, and inspectors all performed their role in the transaction directly on the blockchain. This reduced paperwork costs, risks associated with fraud and data verification, and processing times that, for banks, fell from an average of three hours to 25 minutes. Systems for electricity and natural gas trading are being piloted as well.

A major obstacle to the adoption of blockchain for improving energy trading is that firms already have significant investments in the current system. Shifting to a blockchain-based trading platform could create significant stranded assets. Also, there is uncertainty surrounding legal issues such as liability and dispute settlement, which have established practices under the current system.

Emissions Tracking

A concerted global effort is underway to decrease greenhouse gas (GHG) emissions. Each technology and policy pathway to decarbonization will rely on methods for accurately measuring and recording carbon emissions with limited transparency, disconnected standards, uneven regulatory regimes, and issues of trust.

A prominent mechanism for managing carbon emissions reductions is an emissions trading system (ETS), which establishes a mandatory cap on emissions and allocates tradeable permits to participating entities. An ETS is designed to internalize the invisible costs of emissions and allow a sustainable marketplace to emerge.[29] A successful ETS requires substantial resources, meticulous design, and a commitment to best practices in monitoring, reporting, and verification (MRV). Globally, the total cost to administer current ETS systems has been estimated at $980 million.[30]

Blockchain's core capabilities directly align with the many challenges around developing, deploying, and managing emissions tracking and trading systems. As a trusted repository of transaction data, blockchain streamlines trades, strengthens the verification process, and eliminates the need for costly centralized management (Figure 7). Blockchain could help harmonize design criteria across numerous ETS through a uniform set of rules, maintaining a consistent framework for interoperability between linked systems. MRV design criteria created by market participants can be embedded in the blockchain to establish consistent markets, while assuring best practices are maintained.

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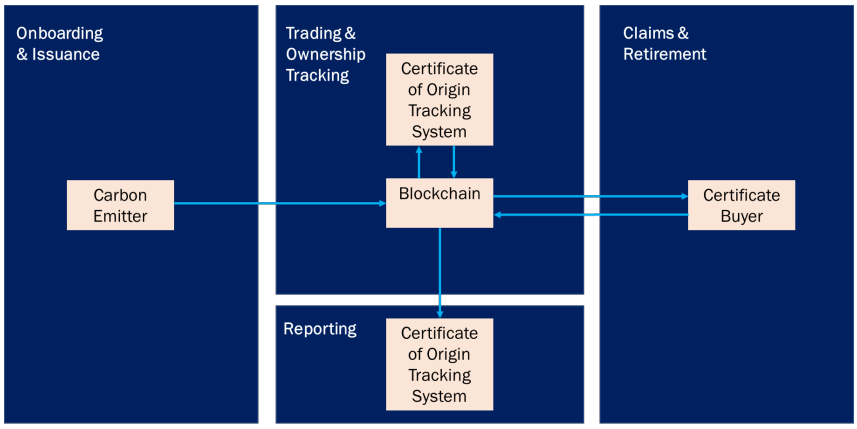
27 http://www.ey.com/Publication/vwLUAssets/ey-overview-of-blockchain-for-energy-and-commodity-trading/$FILE/ey-overview-of-blockchain-for-energy-and-commodity-trading.pdf

28 http://www.ey.com/Publication/vwLUAssets/ey-overview-of-blockchain-for-energy-and-commodity-trading/$FILE/ey-overview-of-blockchain-for-energy-and-commodity-trading.pdf

29 https://poseidon.eco/assets/documents/Poseidon-White-Paper.pdf

30 https://www.weforum.org/agenda/2017/09/carbon-currency-blockchain-poseidon-ecosphere/

Figure 7. Example of Blockchain's Streamlined Process[31]



Source: Adapted from Energy Web Foundation

ENERGY FUTURES INITIATIVE

Blockchain can help address many of the current challenges facing carbon markets, including validating MRV, harmonizing market rules, and ensuring transparency of processes across members.

Another major benefit of blockchain for carbon tracking and registries is the opportunity to create an immutable and transparent record of the market data. This could provide an accountability mechanism for tracking implementation of national commitments under the Paris Agreement. Blockchain could provide clarity, credibility, and interoperability for carbon inventories and registries around the world.

Blockchain registries could improve the tracking of carbon capture, utilization, and storage (CCUS) activities. Nori, a newly formed blockchain technology company in the United States, is seeking to facilitate a carbon removal marketplace where suppliers who remove CO_2 from the atmosphere can connect with buyers who want to purchase verified carbon removal certificates.[32] Blockchain could also be similarly used for managing renewable energy credits (RECs), which currently have huge problems with verification and double-counting.

The main challenges for blockchain in emissions tracking include competition with previous investments in existing platforms, lack of testing in emissions markets, unknown cost of deploying blockchain, uncertainty around the successful adoption of blockchain across the market and lack of consensus among market stakeholders about international carbon tracking and registries. The blockchain's design, its use case, and cost-sharing mechanisms for the tool itself and other support infrastructure would need to be agreed to by market participants before deployment; it would likely need to be deployed by a competent, neutral party. Changing a blockchain after deployment significantly reduces the process efficiency and thus the overall benefits of using blockchain.

Policy and Regulation for Blockchain

Energy law, regulation, and policy are additional areas that need to keep pace with the opportunities offered by blockchain. As a data management system that emphasizes trustworthiness and immutability, blockchain is well designed for streamlining the process and improving the transparency of transactions that require legal or regulatory reviews. Blockchain offers a secure, private (if need be), online repository of trading data, reducing the inefficiency of documentation passing from the transacting parties to the regulator and back again. During energy trading, for ex-

31 https://www.oecd.org/going-digital/digital-security-in-critical-infrastructure/digital-security-workshop-february-2018-Trbovich.pdf

32 https://nori.com

ample, blockchain would allow a regulatory authority to participate, overseeing transactions as they occur.

It is important for regulators and policymakers to review compliance measures for existing rules to ensure they have sufficient flexibility to allow for the use of blockchain. Even though at its core, blockchain is similar to other reporting systems currently in use—it is a computerized, web-based tool for managing interactions between participants—blockchain's adoption will still rely on acceptance from current standards and regulations. In states with Renewable Portfolio Standards (RPS), for example, regulators and policymakers should evaluate the use of blockchain-based reporting as an alternative to existing approaches. Likewise, for emissions trading systems, DER deployment, energy trading, and many other areas with existing policy and regulations, blockchain-based systems for data measuring, reporting, and verification should be considered.

Another important aspect for regulators and policymakers will be their treatment of new services enabled by blockchain. As the energy system becomes more digitally enabled and customer-centric, regulation in these areas could shape the sector going forward. For example, as private owners of electric vehicle chargers sell electricity to EV owners using blockchain, who owns the data of this transaction? What are the market rules? Is the private owner of EV chargers now classified as an electricity provider? Should the design of the blockchain system be subject to regulatory approvals? Additionally, because many blockchain transactions involve multiple parties, how are the jurisdictional issues handled? Although many of these issues seem extraordinary, these legal and regulatory issues are confronting other new digitally based technologies, including certain DER, two-way control devices, behind-the-meter data, and many others.

Energy regulation is often constructed around clearly delineated roles, such as supplier, consumer, and transmission owner;[33] blockchain and other emerging technologies are blurring the lines between these roles. Widespread adoption of certain blockchain technologies may depend on deregulation of retail energy markets; some blockchain companies, such as the utility-scale start-up Drift, are currently confined by their business model to deregulated markets only.

In addition, the ways energy infrastructure is financed may also raise issues, especially with widespread adoption of blockchain in areas like EVs and DER. Financing for transmission and distribution networks is currently regulated so that costs are covered over the lifetime of the investment. Under a system where there are alternative methods for energy supply, costs are transferred onto customers who stay "on-grid."[34] In the case of widespread adoption of blockchain for certain energy applications, regulations may have to change to avoid this cost shifting.

Alex Kizer

Lead Author: Alex Kizer, Director of Strategic Research, shapes EFI's research agenda, focusing on issues related to advanced information technology such as digitalization, blockchain, and cybersecurity.

Joe Hezir

Joe Hezir, Principal, directs and manages many of the daily activities at EFI, focusing on energy finance and technology issues.

Melanie Kenderdine

Melanie Kenderdine, Principal, directs and manages many of the daily activities at EFI, focusing on global energy policies and systems analysis.

Sam Savitz

Sam Savitz, Analyst, is a major contributor to all EFI research initiatives, providing in-depth policy assessments to EFI leadership.

33 http://www.nortonrosefulbright.com/knowledge/publications/165332/blockchain-and-the-energy-sector

34 http://www.nortonrosefulbright.com/knowledge/publications/165332/blockchain-and-the-energy-sector

Energy Policy and the Digital Divide:
Broadband Deployment and Adoption are Insufficient to Meet the Needs of Demand Response and the Smart Grid

Lloyd Levine

Introduction

The Internet of Things is, by definition, dependent on the Internet. But, what if you don't have the Internet? What if millions of Americans don't have Internet access at home? This isn't a hypothetical question, it is a real problem.

In 2018 the Internet and device technology have achieved such a level of ubiquity, functionality, and speed that they have become broadly incorporated into modern life, including energy policy and operations. That ubiquity is only expected to increase and policy makers, regulators, energy companies, environmental groups, and researchers all operate with the implicit assumption the electricity grid of the future will be tied to a real-time communications loop facilitated by the Internet. But that implicit (and in some cases explicit) incorporation into policy assumes everyone has access to the same technologies at the same rate. That is a demonstrably false assumption with real-world implications for households, policy makers, and community at large.

This paper examines the current and potential future impacts of the digital divide on energy policy and energy savings. The paper starts by using recent data to establish the magnitude and composition of the digital divide. From there we look at energy usage and energy efficiency policies in California, the state with the lowest per capita energy use, and then examine the role broadband enabled technologies and networks will play in achieving the next level of reductions in energy usage, including an examination of energy policies, and energy related products and services that both explicitly and implicitly acknowledge and/or incorporate broadband technology into the energy realm. Finally, we will look at two recent projects conducted with two different California electricity providers that incorporated broadband adoption programs into the outreach efforts of the electricity providers.

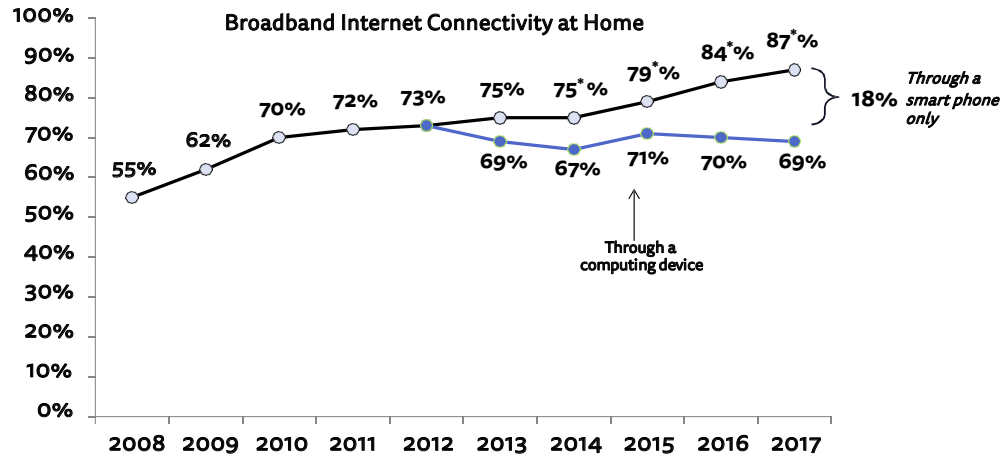
Digital Divide – Size and Scope

There is no official government definition of the Digital Divide, although it is generally understood as a divide between technology "haves" and "have-nots." However, for policy makers and regulators, it is useful to have a clearly articulated definition. The best definition we find comes from the California Emerging Technology Fund (CETF), who defines the Digital Divide "…as the condition when significant segments of the population do not have access or are not using technology at the same rate and manner as the average…" (CETF, 2008). More specifically, CETF applies a "general rule in statistical variation in populations, and a 'divide' exists if any segment of the population is 10 percentage points or more away from the population as a total (or average)" (CETF, 2008).

Figure 1 draws on data from the Annual Broadband Adoption Survey commissioned by CETF and conducted by IGS Berkeley and shows that since 2010 broadband adoption in California has held steady at approximately 70 percent. That translates to 3.8 million households who lack meaningful Internet access at home, with the vast majority—3.2 million—being in urban areas where lack of network access is not the problem (Levine & Taylor, 2018). An additional 4.78 percent of Californians living in rural households lack network access due to the absence of broadband infrastructure (Levine & Taylor, 2018).

The Pew Research Center on the Internet and Technology and the California data find income to be the

Figure 1. Trend of California Households with Broadband Internet Connectivity (2008–2017)



** For all years prior to 2013, broadband Internet connectivity included those accessing the Internet through DSL, cable, satellite or fiber optic connections to a home desktop, laptop or tablet computer. For 2013 and thereafter, this also includes those connecting to the Internet at home solely through a smart phone.*

Source: 2017 results from Berkeley IGS Poll. Prior year results as reported by CETF from surveys conducted by The Field Poll (2014-2016) and the Public Policy Institute of California (2008-2013).

California Emerging Technology Fund ***Berkeley IGS Poll***

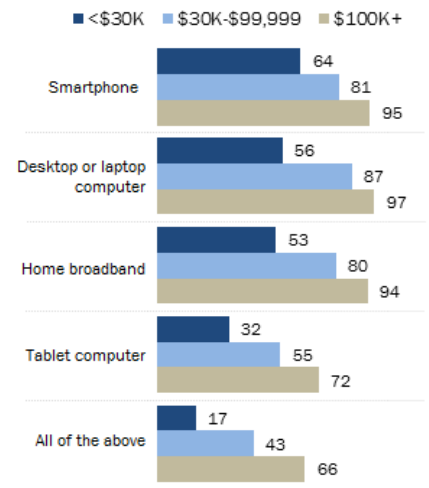
(Berkeley IGS Broadband Adoption Survey - 2017)

strongest predictor of broadband status (IGS Berkeley, 2017). The Pew data in Figure 2 shows 47 percent of households with an annual income of less than $30,000 lack broadband at home. And Figure 3 from the annual Broadband Adoption Survey shows the broadband adoption rate falling as household income falls. This means those 3.2 million households lack Internet access because they can't afford the monthly service, a device, or both.

Figure 3 also shows that reliance on smart phones for Internet access increases as income decreases, with 23 percent of households with an income between $20,000 and $39,000 relying only on a smartphone for Internet access (11 percent have no access at all). The Pew data also show 44 percent of households don't have a laptop or a desktop computer (Pew, 2016).

Relying on a "smartphone" alone is insufficient as those who depend on a smartphone for Internet access face numerous challenges. Those problems are most pronounced for "instrumental activities" (Marler, 2018) such as conducting web searches, uploading resumes and other functions relating to em-

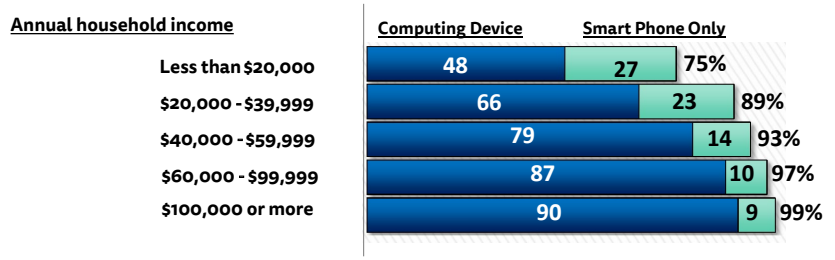
Figure 2. Lower-income Americans continue to lag behind in technology adoption



(Anderson, 2017)

ployment and economic advancement (Napoli and Obar, 2014). The underlying reasons for those challenges are in large part due to the technological limitations of the devices, including small keyboards, inferior devices, storage capacity, data caps, and connection speeds. Intermittent access due to unpaid bills is also a significant impediment (Gonzalez, 2014; Napoli and Obar, 2014; and Finamore et al., 2011).

Figure 3. Broadband Internet Connectivity at Home (by household income)



(Berkeley IGS Broadband Adoption Survey – 2017)

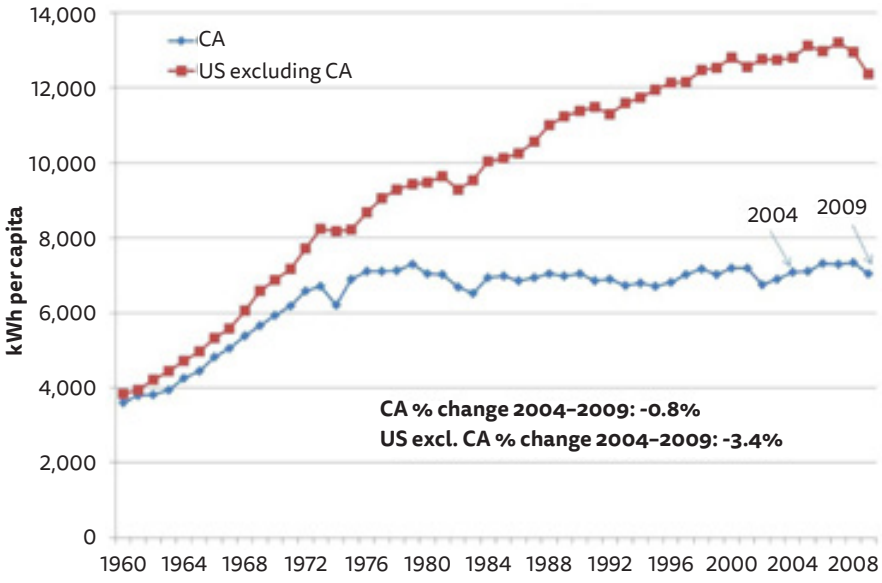
Internet-Dependent Energy Policy and Technology

California's per capita energy consumption is the lowest in the nation (CEC, 2018a) and as Figure 4 illustrates, has remained virtually unchanged since 1974.

The genesis of this was the Warren-Alquist State Energy Resources Conservation and Development Act, which created the California Energy Commission (CEC, 2018c). The Commission was charged with, among other things, developing energy efficiency standards for the state of California. The Commission, along with the legislature, must continually update energy efficiency standards for housing, commercial buildings, and a wide variety of electronic appliances and devices. But with California's already low per capita consumption, the state's policy making and regulatory bodies are looking to demand response, real-time pricing, smart meters, and other similar measures to save energy, spread out demand, and reduce greenhouse gas emissions.

Under the authority of the California Public Utilities Commission (CPUC), California's investor-owned utilities (IOUs) are in the process of replacing old electricity meters with smart meters. The CPUC, citing data from the Edison Foundation indicates that more

Figure 4. Per capita total electricity consumption 1960–2009: California and US excluding CA



(CEC 2018b)

than 8 million Smart Meters have already been install throughout the U.S. and by 2020 they forecast that at least 60 million will be installed. In California, the CPUC authorized the IOUs to install nearly 11 million smart meters. The CPUC website lists numerous benefits to be derived from smart meters, including providing consumers with more information about electricity consumption and pricing, thereby allowing customers to exert more control over their power consumption (CPUC, 2018). The Commission also believes the use of smart meters will help the environment "by reducing the need to build power plants, or avoiding the use of older, less efficient power plants as customers lower their electric demand" (CPUC, 2018).

Reliance on Internet technology is explicitly stated:

> *Customers with Smart Meters today can access their prior day's electricity usage through their utility's website. In the near future, by installing an in-home display device that communicates wirelessly with a Smart Meter, a customer could monitor their electricity usage and costs in real-time…allowing them to adjust their usage instantaneously in response to changes in prices or system reliability events… (CPUC, 2018)*

It culminates by declaring:

> *Smart Meters are the first step toward creating a Smart Grid in California. With a Smart Grid, digital technologies are applied to every aspect of the industry, from generation, to transmission, to distribution, to the customer interface. This will help the grid sense what is happening to the energy flow, keep it in balance, and improve reliability and make the grid more resilient in the face of outages and other problems. (CPUC, 2018)*

In addition to utility-installed smart meters, the earliest devices of the Internet of Things, are just coming to market. One of the more popular is the Nest thermostat. According to Nest, citing independent studies, their thermostats have the ability to save consumers "an average of 10 percent to 12 percent on heating and 15 percent on cooling" (NEST.com, 2018). The company's website has a 'ticker' claiming that since 2011, the Nest thermostats have saved more than 23 billion kWh of electricity. Obtaining these benefits comes from a consumer's ability to receive mobile notifications and control the device remotely. However, a disclaimer on their website states, "Mobile notifications and remote control require working internet and Wi-Fi." NEST's energy saving benefits are unavailable to households without Wi-Fi Internet access.

Beyond Nest, the commercial sector for "smart" home appliances is just starting to emerge. A quick search of the Internet shows a variety of Wi-Fi enabled refrigerators, air-conditioners, ovens, washers and dryers, water heaters, and many more. Washers and dryers, for example, are touted as allowing you to load them and then let the machine itself communicate, in real-time, with your electricity provider to determine the best time to start, thereby allowing for better grid management and a savings to the consumer. The biggest impact from the commercial sector will be in electric vehicle charging. With batteries that currently range from single digits of power consumption to 100 kWh, EVs will quickly become the single biggest consumer of electricity. Managing that demand is already assumed to rely on broadband technology to manage the grid. Whether it is the charging stations, the cars themselves, or both, they will need to communicate with the network to ensure maximum efficiency, while also assuring drivers are not stranded without a charge.

Researchers too are writing papers that discuss and analyze specific energy related technology issues and policies. However, the underlying assumption of the papers is that all aspects of the system, the IOUs, the generators, the distributors, the regulators, and consumers, have access to information in real time. In 2005 broadband deployment really began to accelerate but had not reached the state of near ubiquity of access that it holds today. Yet, even then researchers in the energy field were studying energy policy through the lens of broadband enabled technologies. Wood and Newborough (2007) looked at the role of energy information in smart homes with a

focus on enabling conservation. Their paper also cited other works looking at different aspects of the same issue, how to employ smart device technologies and information displays to reduce energy usage. These technologies are highly dependent on near-instantaneous, high-speed communication loops, and implicit in the work is the assumption that all households have access to those broadband loops. It is understandable that research work in the earlier days of broadband might ignore the question of ubiquitous deployment. At that time broadband penetration was increasing rapidly. It wasn't until about 2010 that home broadband in California plateaued at 70 percent (IGS Berkeley, 2017).

However, a more recent paper (Siano, 2014) conducts an extensive and well researched literature survey on the subject of Demand Response and Smart Meters. Again, the assumption of the paper is clear, fixed broadband is ubiquitously deployed and adopted. From the discussions of monitoring and control technologies, to real-time pricing, the different demand response programs are again discussed both explicitly and with the implicit assumption that broadband is necessary and ubiquitous.

Electric Utilities and Broadband

The same review of the literature that illustrates the dependence of the electricity grid on the communications networks also provides myriad benefits that can accrue to the generators, operators, consumers, and society at large. Primary among the benefits explored is demand management and demand response to maintain a stable grid structure (Siano, 2014; CPUC, 2018). That demand management/response will be dependent on a real-time communications/information exchange that can only be accomplished with broadband. The benefits of those programs are an increase in efficiency from all parts of the system resulting in less energy generated with fewer resources consumed and reduced greenhouse gas emissions generated (CPUC, 2018). Working in conjunction with demand response is Time of Use Metering which allows consumers and appliances to respond to price signals, and in turn saves money for both the utility and the customer.

Broadband also enables other potential, non-demand response energy and cost savings technologies that facilitate better grid management resulting in more efficient overall operations. Specifically, sensors can enable remote monitoring and control of non-residential facilities from water management, to agriculture, to rural electricity consumption among other uses, including those that are currently in development or have yet to be conceived. Those sensors will give system operators more information, flexibility and control. However, according to the 2017 CASF Annual Report from the CPUC, 618,719 rural California households do not have broadband due to lack of network access (CPUC, 2017). That means the Internet backbone and/or middle mile hasn't been connected to those communities. Without the broadband infrastructure to support the communications, none of those benefits can be realized.

Lack of broadband also creates inefficiencies and extra costs in non-energy transactions. While many utility customers use email and the Internet to receive and pay bills, that option is not available to the millions of households without meaningful Internet access. The data in Figure 5, provided to CETF from California's IOUs, show the significant disparity between the number of customers enrolled in California's low-income bill assistance program, California

Figure 5. Digital Communication Efforts by California Investor Owned Utilities

Current Enrolled CARE Customers in IOU Service Territory

PG&E	SCE	SDG&E	SoCalGas
1,406,799	1,227,268	282,388	1,557,184

CARE Enrolled Households with Email Addresses on File

PG&E	SCE	SDG&E	SoCalGas
488,752	445,807	197,672	761,709
35% of total CARE	36% of total CARE	70% of total CARE	49% of total CARE

Alternate Rates for Energy (CARE), and those with email addresses on file with the utilities. It is reasonable to assume that a number of these households have email addresses, but have chosen not to provide them. However, given the income correlation from in Figure 3, it is also highly likely that a number of these households are digitally disconnected.

Email correspondence and Internet access by customers creates a time and money savings by eliminating costs associated with printing and postage. It also facilitates near instantaneous communications, which is beneficial in utilities providing their customers with emergency alert notifications.

Between enabling smart meter technology, robust demand response programs, real-time price and usage information, grid stability, cost savings, lower energy demand, and reduced greenhouse gas emissions, it should be clear that the public policy goals of legislatures and utility commissions, and the operations of electric utilities are already dependent on access to a highspeed communications network, and that dependence will only increase over time. Although electric utilities are not going to become broadband providers, they can play a role in facilitating a greater degree of broadband adoption. And, regulatory commissions who are setting broadband dependent goals for those electricity providers could assist and encourage the utilities (and the broadband companies) in reaching 100 percent deployment and adoption rates approaching 100 percent.

Broadband Adoption and Utility Assistance

In 2018, a siloed approach is no longer appropriate. Everything is technology dependent, and as we have seen, the electricity (and natural gas) sector is no different. Given the evidence that the present and future of the energy grid will be dependent on communications technologies, those entities that will depend on a ubiquitously deployed and adopted network—utility companies and government— should play a role in increasing both deployment and adoption. Levine and Taylor (2018) assert that the 2017 IGS Berkeley poll is evidence that broadband providers and the free market have driven adoption to 70 percent. The adoption rate was at 70 percent in 2010 and has stayed there for the past seven years, despite the further deployment of broadband, the continued integration of broadband enabled technologies and services into daily life, and the creation and expansion of affordable broadband offers by the providers. As such, it seems clear that without further interventions broadband penetration has peaked. What follows are three specific "interventions" that can be undertaken by legislative and regulatory entities and utility companies.

Advanced Services Fund

In 2008, the California Legislature and the CPUC created the California Advanced Services Fund (CASF). CASF was created specifically to offset the higher costs of broadband infrastructure deployment in unserved rural areas. Funding for CASF comes from a monthly surcharge on telecommunications bills. The fee is paid by customers, collected by telecommunications companies, and remitted to the CPUC (CPUC, 2017). CASF funding is available to all companies deploying broadband infrastructure in rural unserved areas in the state and is technology-neutral, meaning it can be used for wireless, wireline, cable, or fiber-based communications connection technologies (CPUC, 2008). In the 2017/18 session, the California Legislature passed, and the Governor signed AB 1665, which reauthorized the fund for an additional five years. Significantly, for the first time, the CASF is authorized to spend a significant amount on adoption related efforts as well as rural infrastructure. Given the relative percentages of the households that make up the digital divide, closing it without spending money on low-income adoption programs will be unlikely in the timeframe needed for the full implementation of broadband dependent energy-saving measures.

Low-Income Broadband Adoption Programs

As we have seen from the tables in this paper, the lower the household income, the less likely the household has meaningful Internet access. Most, if not all major Internet Service Providers (ISPs) already have a stand-alone, low-income broadband offering

for qualified families. Unpublished data from CETF focus groups in the lowest income census tracts in Fresno County California found that of the 309 participants, 77 percent had Internet in the home (via either smartphone or fixed connection). However, despite 309 households being qualified for a low-income offer, only 33 percent of those with Internet were subscribed to one of those plans. Yet, of those 229 families who are not subscribed to an ISP's low-income offering, 76 percent want information about the offerings. The data clearly show there is a large gap between those who are eligible for standalone, low-income broadband, and those who are actually enrolled. And, the data further show those who aren't enrolled want information about the programs. Given those percentages, it seems there can be big gains in adoption by informing households of available offers and assisting them with enrollment.

Utility companies can help bridge the information gap. With the income eligibility criteria for CARE enrollment, and the broadband/income correlation, it can easily be inferred from the data that CARE-enrolled customers lack meaningful Internet access at a far greater rate than the population in general. With the utility companies and the regulators having a vested interest in maximizing broadband deployment and enrollment, the utility companies should work to promote existing low-income broadband offers to their low-income customers.

A recent example of this was the project conducted by CETF along with the Sacramento Municipal Utilities District (SMUD), the electricity provider in Sacramento County. SMUD sent letters to their Energy Assistance Program Rate (EAPR) customers notifying them that as low-income customers, they may be eligible for low-cost broadband. The letter provided information designed to raise awareness of existing low-income broadband offerings and a phone number to call for assistance. This two-year effort was completed in June of 2016 with SMUD having sent out approximately 90,000 letters to its EAPR customers. A pilot project with different outreach methodologies was recently completed by CETF, San Diego Gas & Electric, and 211 San Diego. These projects also provided callers with information on community-based organizations that provided free or low-cost computing devices, as well as free digital literacy training.

Shared Planning and Infrastructure

For rural areas, the challenge is in deploying network infrastructure. The cost of trenching hundreds of miles is prohibitive, and the numbers of households and business reached is often small. The economies of scale related to the infrastructure investment necessary just don't make financial sense in a competitive market with publicly traded companies. CASF was implemented to offset the costs of deployment, but there are additional steps to be taken. Electric and gas utilities have infrastructure that reaches many rural communities. When trenching or doing other infrastructure upgrades, the electricity and gas utilities should coordinate with the regulatory commission and the Internet service providers to asses the cost and feasibility of deploying broadband upgrades, or even empty conduit at the same time. This is a more efficient method of construction than having each company trench and/or deploy individually and will very likely result in the rural digital divide being closed more quickly and for less cost than it otherwise would.

Conclusions

The future of energy policy, like so many other aspects of life in the 21st century, is dependent on broadband. Demand response policies, smart grid technologies, and many more depend on real-time data transfer between all aspects of the grid, from customers, to regulators, to power producers, to power providers, to grid operators, etc. But broadband deployment and adoption lag far behind what the energy system will require.

Currently, it appears there has been a siloed approach to energy planning resulting in market structures, energy policies and technologies that seem to be based on the (incorrect) assumption that broadband is ubiquitously deployed and adopted. With the government and industry becoming increasingly dependent on broadband technology, and meaningful Internet access holding constant at 70 percent for the past 8 years, new approaches will be necessary to

meet the goals of policy makers and achieve the technology-dependent, next generation energy and economic efficiencies.

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Lloyd Levine

Former State California State Assembly member Lloyd Levine is President of Filament Strategies, a public policy and public affairs consulting firm, and a Senior Policy Fellow at the University of California, Riverside's School of Public Policy. Mr. Levine is the former Chair of the Assembly Committee on Utilities and Commerce, where he crafted policy in the areas of telecommunications, broadband, energy efficiency, and renewable energy. Mr. Levine was a founding board member of the California Emerging Technology Fund, a member of Governor Schwarzenegger's Broadband Task Force, and an Ex-Officio Member of the California Energy Oversight Board. He currently serves on the Founding Advisory Board of the University of California, Riverside School of Public Policy, and is the co-founder of the school's Center for Technology, Society and Policy.

Consumer Empowerment in the Context of a Developing Energy Market:
Lessons from Peru

Daniel Schmerler

In the advanced economies of North America and Europe, consumer empowerment is typically associated with giving consumers the choice of their energy supplier or turning consumers into prosumers. In contrast, in the context of Peru's quest against energy poverty, the concept of consumer empowerment has taken on a different focus. Peru's experience demonstrates that even in developing countries that do not yet have the technological or regulatory sophistication to introduce consumer choice of the kind enjoyed by American or European consumers, energy regulators have several tools at their disposal to engage with and empower consumers.

In 1992, Peru initiated reforms to unbundle generation, transmission, and distribution and introduced private participation in the electric sector. In 1993, its electric coverage was just 57percent nationally and 8 percent in rural areas. Today, the country is well on its way to meeting the goal of universal electricity access, with 95 percent national and 81 percent rural coverage. These results have had a strong impact on both public and private investment. The installed capacity increased from 4,288.2 MW to 12,508.1 MW, the transmission lines went from 6,202 to 28,441.8 kilometers, whereas the number of consumers increased by 243 percent (from 2,104,868 to 7,224,041 customers).

The start of natural gas production in the Camisea field in 2004 is another important milestone in the development of Peru's energy sector. This expansion in natural gas production rapidly changed Peru's electricity generation matrix. It increased natural gas to 37.2 percent in 2017 (from 9.9 percent in 2004), as well as permitted the use of gas for cooking and transport. The number of connections of residential users of natural gas at the national level in Peru went from 0 clients (before 2004)[1] to 630,956 in January 2018 and it is projected to increase to 1,137,721[2] in the next 4 years. In terms of liquefied petroleum gas (LPG) consumption, the other energy product relied on heavily in Peru for cooking food, went from 6,691 to 20,018 thousand barrels from 2004 to 2016 (one product linked to natural gas is natural gas liquids (NGL), which is transformed into LPG and into other products by a firm in the south of Lima).

In this environment of accelerated growth in the energy sector, Peru's Regulatory Agency for Investment in Energy and Mining (hereinafter Osinergmin), has developed tools and strategies to empower consumers by giving them greater access to information and a greater voice with respect to the quality and affordability of their energy supply. This paper will summarize these tools and strategies and discuss their effect in Peru, as well as the relevant lessons learned that could be applicable in similar contexts.

Consumer engagement across Peru

In spite of its relatively small size, Peru is a country of impressive geographic and cultural diversity. This means that the needs of energy consumers vary

1 Before 2004, there was a very small distribution concession of natural gas in the north of Peru, which is currently inoperative. In Pucallpa, at the Peruvian jungle, there is a fractioning plant that transforms NGL into commercial products that is still in operation.

2 Projected clients are considered by 2022 for these companies: Cálidda (Lima and Callao), Gases del Pacífico – Quavii (7 cities at the north) and Fenosa (4 cities at the south west).

widely across regions and communities. For example, significant parts of the population speak indigenous languages rather than Spanish, especially in the Andean mountain zone and in the more remote areas of the country, state presence and access to technology remains limited.

To address these challenges, Osinergmin has established a decentralized presence throughout Peru, with a total of 48 offices across all regions of the country.[3] These decentralized offices disseminate information to local energy consumers, carry out educational activities, and provide a variety of customer services.

This decentralized presence allows Osinergmin to be much more aware of the consumers' needs in each region and to better tailor its services; for example, by carrying out information campaigns and trainings in local languages, scheduling radio announcements at times when the agricultural workers are more likely to be paying attention, visiting local schools and servicing more customers in person. Familiarizing all Peruvians with Osinergmin's work, as well as educating them about their rights as energy customers has been the first step in making sure that consumers communicate their needs, collaborate with the regulator in monitoring the quality of the services they receive, and assist in more rapid identification and resolution of any issues. In 2017, Osinergmin has carried out 2,775 information activities for citizens.

One successful initiative that has been made possible by having a country-wide presence has been the information campaign on labeling of LPG cylinders.

LPG is widely used across Peru for cooking, and according to Helberg (2003), the proliferation and use of this clean fuel has permitted a reduction in the use of biomass or carbon, which generates indoor air pollution and is associated with respiratory diseases. Nevertheless, the growth of LPG use has experienced some problems as the sector is struggling with informality, contraband, and poor quality of cylinders, which present a safety risk for households.

To engage LPG consumers in tackling these issues, Osinergmin carried out an educational campaign in public spaces across the country that included information on the safe use of LPG cylinders and proper labeling. Equipped with this information, the customer should be able to distinguish cylinders that comply with regulations from those that may be unsafe or those distributed by an informal provider. They can then demand a compliant cylinder from the merchant and report the issue to Osinergmin, allowing the regulator to take action against the firm.

Consumer voice in quality of service

Taking a step beyond informational campaigns, the second important aspect of consumer empowerment in Peru's energy sector has been the development of technological tools that give a voice to the consumer.

Regarding this, the European Commission (2012) supports the idea that technological tools play a crucial role in involving consumers more proactively in the energy market. Notwithstanding, in order to make the most of opportunities offered by the energy market, it is certainly necessary for consumers to know and exercise their rights.

Under these circumstances, Osinergmin has offered a wide range of technological tools. The most basic of these is Tukuy Rikuy (these *quechua* words, the language of the inkas, means the one who listens to everything, the one who sees everything), a text messaging system that allows consumers to report issues in the public electricity service. Its simplicity—particularly the fact that the communication takes place via text messages and not an app—is intentional. It is designed to reach consumers in remote and poor areas, who may not have smartphones and would thus not be able to use an app. Tukuy Rikuy facilitates communication between the consumer and Osinergmin, eliminating the need for the consumer to travel to a local Osinergmin office or call the regulator and leads to better quality electric service because it enables Osinergmin to receive information about malfunctions and accidents in remote areas that otherwise may take a long time to detect and resolve.

3 Additionally, there are 104 contact points in the municipalities of the districts.

Furthermore, Osinergmin has developed more sophisticated app-based channels through which users can file complaints and request services for electricity, natural gas, and LPG.

The first app was *Facilito,* in Spanish means "the easiest." It was designed for drivers to compare fuel and LPG prices for cars at gas stations along their route. This application has been downloaded, on average, 213 times per day since its launch on May 19, 2016). This app encourages transparency and thereby price competition among retailers, as well as their formalization and compliance with sector regulation.

Facilito Electricidad is another app that allows the customer to report issues, such as electrical service interruptions, device malfunction, mass billing issues, problems with street lighting, and electrical risks. The complaints are received in real time by the electric company so that it can resolve the issue and by Osinergmin so that it can monitor progress. The app has been downloaded by 23,107 users since its launch on November 16, 2017, and has been used to inform approximately 80 nonconformities per day.

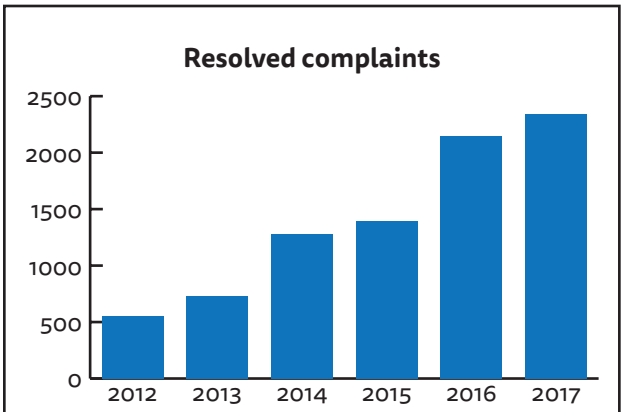
A similar app, *Facilito Gas Natural* is available for natural gas and it was launched in Ica on September 14, 2016. Here, users can check whether their home can be connected to the natural gas network. If a connection is possible, users can then select an installer from a register of certified private companies in their area and submit the application for a connection through the app. Also, the app allows users to report gas leaks, problems with residential natural gas installations and pipelines passing through public spaces. It has been downloaded by 4,148 users in the Ica, Lima, and Callao areas, where pipeline natural gas is currently available. It will extend throughout Peru in the short future as government projects expand the penetration of natural gas throughout the country. Osinergmin is planning a national launch of this application this year.

Finally, *Denuncias GLP* (complains LPG) is an app that allows customers to report issues with LPG cylinders. These include irregularities in the weight of the LPG cylinder or deteriorated cylinders that pose a safety hazard. The app connects the customer with a local LPG seller for service and follow-up. This has been downloaded 155 times since its launch, which was made in the framework of Resolution No. 252-2016-OS / CD, which establishes provisions for consumer information on LPG cylinders. To complement this initiative, the *Facilito Balón de Gas* (Easiest gas tank) application will be launched, which shows the locations and prices of LPG retailers and allows users to request a cylinder and subsequently rate their shopping experience (approximate launch in July 2018 in the cities of Cajamarca and Chiclayo).

The impact of these tools, combined with consumer engagement through a variety of other channels, has been greater awareness among the general population of the role of Osinergmin and an increased volume of complaints filed by customers to Osinergmin. It is important to highlight that this growth does not reflect deteriorating service; rather, it is a reflection of the greater voice of the customers and the ease with which they can reach out to Osinergmin virtually, in a way that is more efficient and convenient for them and for the regulator.

The following bar graph depicts the evolution of complaints received by Osinergmin. A glance at the graph reveals that in the last five years, the number of complaints has risen from 552 to almost 2,500. Hence, the figures have increased nearly fivefold over the period shown in the chart.

Looking into the future, this close communication plays a key role in promoting a culture of accountability among energy sector companies. Consumer



Source and Elaboration: Osinergmin

empowerment, on the one hand, and accountability on the part of the regulator and the sector, on the other, will be all the more important as the Peruvian energy sector develops, modernizes technologically, and gears up to face the next set of challenges that await it as consumers grow more sophisticated and begin to demand the same choices as consumers in more advanced economies. One can also expect that by setting a higher standard for consumer engagement and empowerment in the energy sector, Osinergmin can serve as an example for other public institutions in Peru and other emergent markets.

Affordability

The Peruvian government maintains policies that foments access to energy and has temporarily entrusted Osinergmin with certain programs that aim to reduce energy poverty. Osinergmin considers affordability to be a crucial barrier to reducing energy poverty and achieving the goal of universal energy access. The income disparity in Peru is high, with a Gini Coefficient of 0.43 in 2017, compared to 0.39 in North America and 0.31 and Europe (2016). Thus, one of the most basic tasks in serving all Peruvians is making sure that as many citizens as possible have access to energy products at prices that are affordable to them and that simultaneously support a healthy growth of the sector.

To make electricity, natural gas and LPG more affordable for the poorer sectors of the population, the government has employed a targeted cross-subsidy mechanism, implemented through the *Fondo de Compensación Social Eléctrica* (FOSE) and the *Fondo de Inclusión Social Energético* (FISE). These funds reduce the energy charges for small residential users and provide all or part of the financing for residential natural gas installations.

Until December 2017, the beneficiaries of the FOSE were 4,339,484, which represents 61 percent of the total number of users who have electric services. There has also been an increasing evolution in the FOSE subsidy: since 2015, it has exceeded 60 million dollars a year.

FISE has different programs. In 2017, the BonoGas program (which finances the installation of natural gas inside homes) benefited almost 150,000 households in Lima, Callao, and Ica. The program of Promotion and Access to LPG (which provides a coupon of 16 PEN to specific families to purchase a LPG tank) has benefited 1,559,061 families throughout the country. The Energy Boundary Expansion program has allowed the installation of 26,554 photovoltaic panels benefiting families in rural areas. Regarding the Mechanism of Compensation of the Electric Residential Rate (cross-subsidies mechanisms between energy consumers), FISE has transferred the sum of 167,463,186.30 PEN during 2017.

Another initiative that both empowers FISE beneficiaries and tackles the issue of informality in the LPG sector is Vale Digital FISE. This was implemented in 2013 as an improved version of the LGP discount coupon. Essentially a mobile banking platform, it allows users to pay an LPG seller using the FISE Discount Voucher through their mobile phone. The use of this platform has made the inclusion of microentrepreneurs from the rural areas of the country in the financial system and the elimination of manual processes and procedures possible, which has reduced costs by up to 70 percent.

Conclusion

The form that consumer empowerment takes is distinct in every country, due to its unique energy, economic, and regulatory profile. However, regardless of the stage of development and technological sophistication of the sector, consumer empowerment is an important goal for regulations to pursue. In Peru's experience, engaging with energy consumers, giving them a voice and providing them with choices regarding their energy services and products, benefits not only the consumers themselves, but in the end facilitates the relationship between the consumers and the regulators and contributes to the development of the sector.

Thanks to Osinergmin's decentralization and use of technology to connect to its citizens in all regions of the country, consumers increasingly collaborate with the regulator to hold companies accountable for the quality, safety, and pricing of their products and services, as well as promote formalization in

certain parts of the energy sector. These more discerning consumers will also help ensure that, as the energy sector develops, it does so in a way that reflects consumers' needs and preferences.

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Daniel Schmerler Vainstein

Mr. Schmerler is a specialist in Economic and Network Industry Regulation, Competition and Administrative Law, with a focus in Energy and Telecommunication Infrastructure. His career as a public servant includes significant roles in conflict resolution in highly technical regulatory entities. He has held executive positions in governmental regulatory and competition agencies such as the National Institute for the Defense of Competition and Intellectual Property, INDECOPI.

He is currently the Chairman of Peru's Regulatory Agency for Investment in Energy and Mining (OSINERGMIN), the chair of the International Confederation of Energy Regulators for the 2018-2021 term and the former Chairman of the Ibero-American Association of Energy Regulators.

Mr. Schmerler is a published legal scholar and has been a lecturer in the most prestigious universities of Peru, as well as a guest speaker at national and international events.

Mr. Schmerler is a lawyer and is a graduate of the Pontificia Universidad Católica del Perú. He is a Master's Degree candidate in Law at the same university.

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