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Regarding Illinois's Consideration of the Utility of the Future: "NextGrid" Grid Modernization Study

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Summary

To address Illinois' opportunities and reforms for emerging electricity grids, I offer two lessons from my work as a member of the Illinois Commerce Commission's Blue Ribbon Telecommunications Task Force in 1990-91. We were similarly tasked to provide guidance on transformative regulatory models, technologies and markets.

For telecommunications networks, I recommended expanding cost-based pricing options for customers; off-peak discounts help avoid adding expensive peak-load capacity and incentivize efficient actions by customers. Also, I supported integrating into networks storage capacity for data and information processing from various providers; these capabilities facilitate innovative offerings and efficiencies.

NextGrid should endorse these same two directions. Time-varying electricity pricing would take advantage of Illinois' investment in over 5 million smart meters; build on the savings for customers and networks from early experience with peak-time incentives; and improve human health and the environment. Adding storage to electricity grids would save costs and enhance reliability; facilitate renewable power systems; and protect human health and the environment.

Introduction

The charge from the Illinois Commerce Commission (ICC) to the NextGrid task force[1] reminds me of a similar effort I contributed to 27 years ago. In 1990-91, the ICC sought external expert guidance on developments in the telecommunications market and directions for reforming regulations. The nine-member Blue Ribbon Telecommunications Task Force to the ICC[2] produced a report addressing several transformative issues, including reforming service pricing and integrating storage

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[1] ICC. (April 30, 2017). Resolution: Regarding Illinois' Consideration of the Utility of the Future: "NextGrid" Grid Modernization Study.

[2] Professors George Stigler and Marcus Alexis were co-chairs; my other fellow members were Donald Frey, George Keyworth, Mark Lee, Charles Stanton, Scott Teissler, and Calvin Monson.

for data and information processing with transmission networks. That initiative followed my work at the Federal Communications Commission as Special Assistant to the Chief of the Common Carrier Bureau, and on Illinois' Universal Telephone Service Protection Law of 1985.

Over the past eight years, I was an adjunct professor at the University of Illinois and consultant on many developments in electricity markets. The issues include implementing community solar projects,[3] pricing incentives for distributed generation of renewables,[4] and structuring energy efficiency programs.[5] On reforming legal frameworks, I briefed members of the General Assembly in support of the Future Energy Jobs Act of 2016, and submitted comments to the U.S. Environmental Protection Agency on rules for vehicles and power plants.

For the NextGrid task force, my comments return to the issues of service pricing and integrating storage with transmission networks, now in the context of electricity regulations. As in my advice to the ICC in 1991 as a member of the Blue Ribbon Telecommunications Task Force, I recommend that the NextGrid task force support increasing pricing options to reduce peak-time demand and facilitating more cost-effective storage capacity in grids.

Time-Varying Service Pricing

Lessons from the ICC's Blue Ribbon Telecommunications Task Force. In 1991, time-varying rates applied to most long-distance telephone services. Different rates at different times of day were well-understood and accepted by residential and business consumers. Rates were highest during the peak demand periods of the business day; lowest late at night and on weekends; and in the middle during weekday evenings. These rate structures reduced network congestion by shifting demand, reflected the higher costs of providing services during peak-load periods, and decreased costly investment for peak-time capacity of lines and switches.

Based on my experiences in federal and state markets and regulations, I advised the ICC's Blue Ribbon Telecommunications Task Force to build on the benefits of time-varying pricing by supporting more cost-based rates and service options, such as offerings of volume discounts for off-peak usage.

Now the NextGrid task force should recommend a similar direction for Illinois electricity regulation – more time-varying electricity service pricing. Customers will understand and save from such pricing.

Illinois laws and guidance for electricity pricing. Illinois' General Assembly and Governor have recognized the benefits of time-varying electricity service pricing. Pursuant to Illinois' Energy Infrastructure Modernization Act of 2011, utilities must offer "an opt-in market-based peak time rebate program to all residential retail customers with smart meters".[6] Additionally, pursuant to Illinois' Future

[3] University of Illinois College of Law Library, "Community Solar" https://law-illinois.libguides.com/community_solar.

[4] Lavey, W. (2012). Overcoming Conceptual and Practical Hurdles to Market-Based Discovery of Prices for Utility Procurements from Rooftop Solar Systems. *Tulane Environmental Law Journal, 25*(2), 289-326.

[5] Lavey, W. (2017). Underutilized community health needs assessments: four environmental actions for hospitals that improve community health. *Health Matrix*, *27*, 229; Lavey, W. (2012). Energy Efficiency as Fundamental to the Missions of US Religious Congregations, Health Care Providers and Schools. *Washington and Lee Journal of Energy, Climate, and the Environment*, *3*(1), 1.

[6] Illinois Public Utility Act Section 16- 108.6(g).

Energy Jobs Act of 2016, utilities must "implement cost-effective demand-response measures to reduce peak demand by 0.1% over the prior year for eligible retail customers".[7]

Moreover, in 2012 the Illinois Smart Grid Advisory Council concluded: "As [Smart Grid Advanced Metering Infrastructure (AMI)] is deployed across Illinois, benefits should be maximized for utility customers, who are financing the AMI investment. Dynamic pricing options that facilitate household energy management and promote improved efficiency and potential cost-savings are essential to generating customer benefits from AMI deployment."[8]

AMI meter deployment and favorable experiences with time-varying rates. ComEd and Ameren are close to completing about seven years of extensive investments in deploying AMI or "smart" meters. Millions of residential and business customers are now ready for more efficient, lower-cost electricity supply and time-varying pricing, which will yield huge cost savings for electricity providers and transmission networks. The transformation in capability to offer time-varying pricing options is impressive. Deployment will exceed 5 million households. April 2018 reports showed:

- ComEd
  - **Total system meter population will be 4.2 million**: deployed 3.8 million AMI meters as of the end of 2017; plans to deploy 330,850 in 2018 and 17,000 in 2019; and projects new business installs of 85,810[9]
  - **AMI deployment will cost total about $1.39 billion:** $920 million in capital, and $470 million in operations and maintenance[10]
- Ameren
  - **Total meter deployment will be 1.2 million**, covering 100% of its customers: deployed 705,465 AMI meters as of the end of 2017; plans to deploy 305,800 in 2018 and 236,019 in 2019[11]
  - **AMI deployment will cost total about $302 million[12]**

During the ramp-up in AMI meter deployment, ComEd and Ameren have been offering a limited range of time-varying rates. Illinois energy customers are benefiting from these current offerings, and would gain further from expanding such offerings and adoption. Personally, my household subscribes to Ameren's Peak Time Rewards. Here are some highlights from April 2018 reports and related analysis:

- ComEd
  - **Peak Time Savings** (PTS) is an opt-in, demand response program offered to residential customers with smart meters: 228,700 enrollments, resulting in $2.5 million in customer savings; marketing campaign grew the program by more than 50% in 2017; about 2.9 million customers were eligible in 2018.[13]

[7] Illinois Public Utility Act Section 8-103B(f)(4.5). Section 1-10 of the Illinois Power Agency Act defines demand response as "measures that decrease peak demand or shift demand from peak to off-peak periods."
[8] Illinois Smart Grid Advisory Council. (Mar. 14, 2012). Guidance Regarding Implementation of Time of Use Rates, 6.
[9] Commonwealth Edison. (April 2018). Smart Grid Advanced Metering Annual Implementation Progress Report, 11 (ComEd 2018 Report).
[10] Id. at 30.
[11] Ameren Illinois. (April 2018). Ameren Illinois Advanced Metering Infrastructure (AMI) Annual Update, 5, 22 (Ameren 2018 Report).
[12] Id. at 26.
[13] ComEd 2018 Report at 26, 35, 38, 64.

- A 2017 review of ComEd's PTS program found benefits of $55.6 million compared to costs of $27.5 million (a benefit/cost ratio of over 2). Single family customers had an average load reduction of 7.8%, or 0.19 kW.[14]
- **Hourly Pricing** program is a dynamic pricing option: 21,500 participants in 2017; saved customers more than $16.5 million in electricity supply charges, average savings of 15% compared to ComEd's fixed-price rate; participants grew by about 50% in 2017[15]
- ComEd uses Hourly Pricing and PTS as demand response measures. ComEd reported to the ICC that the PTS program brings 76 MW of capacity for 2018, and Hourly Pricing has about 8.2 MW of price response potential.[16]

- Ameren
  - **Peak Time Rewards** program had 40,131 customers in 2017, up from 10,455 in 2016 and expected to grow to 72,425 in 2018[17]
  - **Power Smart Pricing** (an optional basic real-time pricing program for residential customers) had 12,138 customers in 2017[18]
  - **Real Time Pricing** program had 1,478 customers in 2017: 274 residential and 1,044 small commercial[19]

Building on the investment in AMI meters and favorable early experiences with time-varying rates, the NextGrid task force should encourage more offerings and consumer outreach efforts to expand adoption. A recent study of actual Illinois usage data by the Citizens Utility Board and Environmental Defense Fund found: "[R]oughly 97 percent of ComEd customers would have saved money through real-time pricing in 2016 without changing behavior, with a net average savings of $86.63 annually. In percentage terms, ComEd customers would have saved an average of 13.2 percent through the real-time pricing program."[20]

Importantly, these rates also provide the equivalent of electricity production and transmission capacity without harms to human health or the environment.[21] Peak-load generators often use dirty fossil fuels and have highly polluting, inefficient ramp-up operations, resulting in high levels of particulate matter, nitrogen oxides, carbon dioxide, and other toxic emissions. These emissions elevate morbidity and mortality, and especially burden low-income and minority communities.[22]

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[14] Nexant. (Aug. 2017). Commonwealth Edison Company's Peak Time Savings Program Annual Report For the Year Ending May 31, 2017, 4.
[15] ComEd 2018 Report at 27, 35.
[16] Commonwealth Edison. (July 14, 2017). Load Forecast for Five-Year Planning Period June 2018-May 2023, 24.
[17] Ameren 2018 Report at 14, 28.
[18] Id. at 28.
[19] Id.
[20] Citizens Utility Board and Environmental Defense Fund. (2017). The Costs and Benefits of Real-Time Pricing at 3.
[21] PJM. (2017). Illinois State Report; McAnany, J. (2018). PJM 2017 Demand Response Operations Markets Activity Report: April 2018.
[22] Gilbraith, N., & Powers, S. (2013). Residential demand response reduces air pollutant emissions on peak electricity demand days in New York City. *Energy Policy*, *59*, 459-469; Krieger, E., Casey, J., & Shonkoff, S. (2016). A framework for siting and dispatch of emerging energy resources to realize environmental and health benefits: Case study on peaker power plant displacement. *Energy Policy*, *96*, 302-313.

Other regulatory guidance. Experiences in other states confirm the benefits of time-varying electricity rates. A few examples follow.

- In 2015, the California Public Utilities Commission adopted a transition to opt-in and default time-of-use rates, which it expected would reduce electricity costs for and empower all customers in the long-term.[23] This decision built on the 2012-13 time-varying pricing pilot programs launched by Sacramento Municipal Utility District which used both opt-in and default enrollments; a majority of customers reported responses to the pricing, such as shifting laundry and dishwashing hours, turning off lights and other appliances, or changing thermostat settings.[24]
- Oklahoma Gas and Electric Company's dynamic pricing SmartHours program had 107,408 participating customers in 2015, resulting in reduced system demand of 116 MW.[25]
- Arizona's Salt River Project utility found that time-varying rates were effective at shifting demand for electric-vehicle charging to off peak times, which helps avoid building additional power plants.[26]

Integrating More Storage with Generators and Transmission Networks

Lessons from the ICC's Blue Ribbon Telecommunications Task Force. In 1991, there was increasing demand to connect telecommunications networks with computer storage of data and information processing capabilities. While long before the current era of Internet services, remote access to various providers' information and computing services was growing. Until these developments, computers were used with telecommunications networks mostly for switching and billing, and carriers viewed other storage functions as outside of network operations.

Regulators faced difficult issues on interconnecting telecommunications common carrier networks with information storage facilities and service providers: what services should be offered, which entities should be regulated, what prices and conditions should apply, and others. The on-going battle called "net neutrality" illustrates that these regulatory issues have not been resolved.

As a member of the ICC's Blue Ribbon Telecommunications Task Force, I recommended open interconnection of telecommunications networks and storage providers to promote innovative services and efficiencies for customers. Storage capabilities for information and computing should supplement traditional network transmission and switching facilities. Since then, the Internet's integrated transmission and storage functions and facilities revolutionized telecommunications services.

Now the NextGrid task force should recommend a similar direction for Illinois electricity grids – expanding and integrating the efficiencies of energy storage into the energy portfolio.

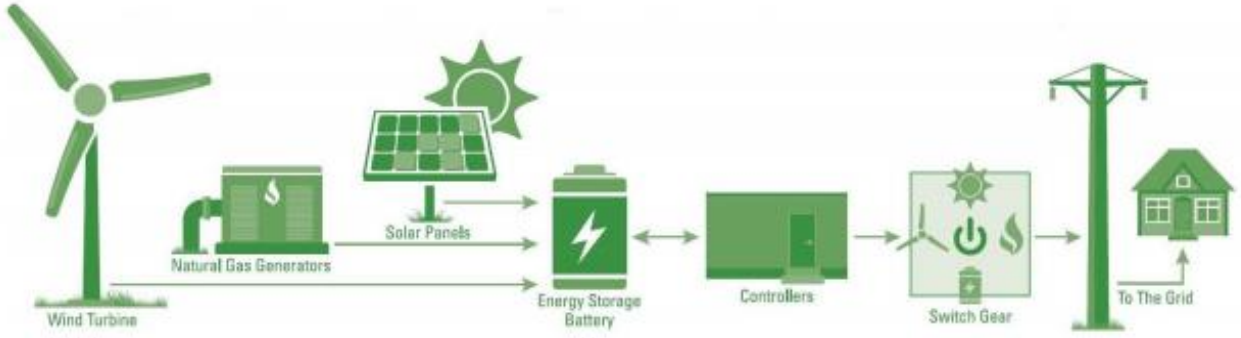
Illinois storage projects yield benefits. Energy storage adds to network efficiency, reliability and flexibility.[27] In particular, storage facilitates the shift to clean renewable power systems from dirty fossil

[23] California Public Utilities Commission. (2015). Order Instituting Rulemaking on the Commission's Own Motion to Conduct a Comprehensive Examination of Investor Owned Electric Utilities' Residential Rate Structures, the Transition to Time Varying and Dynamic Rates, and Other Statutory Obligations. Decision 15-07-001.
[24] Union of Concerned Scientists. (2017). Flipping the Switch for a Cleaner Grid, 6.
[25] Oklahoma Gas and Electric Company. (2016). 2015 Oklahoma Demand Programs Annual Report, 6.
[26] Salt River Project. Electric Vehicle Price Plan; Walton, R. (2018). Time-of-use rates can manage EV charging, new report says. *UtilityDIVE*.
[27] Union of Concerned Scientists. (2015). How Energy Storage Works.

fuel plants, and avoids expensive peak-time generators and transmission lines. With recent sharp drops in battery storage costs, customers would benefit from increased integration of storage into electricity grids.

Recent utility-scale energy storage projects in Illinois by Ameren, ComEd and Invenergy are proving the feasibility and benefits of integrating storage facilities with generators and distribution networks.

- Ameren Illinois built a leading utility-scale microgrid integrating an energy storage battery with renewable energy sources and advanced automation. The microgrid began operations in 2017 in Champaign.[28] The lithium battery can supply 250 kilowatts of energy for two hours, and up to 1475 kW of energy is produced by a wind turbine, solar panels, and natural gas generators. Ameren's graphic shows the storage-enhanced design.



- ComEd announced in May 2018 that it is deploying a community microgrid demonstration project in Chicago with a 2 MWh energy storage system using a lithium-ion battery.[29] In March 2017, ComEd announced a smaller community energy storage pilot project in Beecher, using a 25 kWh lithium-ion battery system.[30]
- In 2015, Invenergy's Grand Ridge Battery Storage Facility had one 31.5 MW storage unit, a second 1.5 MW energy storage project, and a third 3 MW storage project which was being commissioned. The facility includes a 210 MW wind farm and a 20 MW solar farm. The project uses a lithium-ion Iron-phosphate battery.[31]

The prospects for future energy storage systems are even brighter because of economies coming from technology improvements and large-scale deployments. Here are some of the developments:

- The cost of battery storage fell from $1,000 a kilowatt-hour in 2010 to $273 a kilowatt-hour in 2016 (73% decline). Projections are for further sharp cost decreases.[32]

[28] Ameren Illinois. (2017). Fact Sheet: Ameren's Champaign Microgrid; Kacich, T. (May 18, 2017). Ameren showcases continent's most advanced "microgrid" on UI campus. *The News-Gazette*; Pate, R. and Rousan, T. (Aug. 8, 2017). Ameren Illinois Builds Microgrid of the Future. *T&D World*.
[29] Colthorpe, A. (May 21, 2018). Lockheed supplying Li-Ion system to Chicago community microgrid demonstrator. *Energy Storage news*.
[30] Wood, E. (Mar. 17, 2017). Commonwealth Edison Makes Move into Community Energy Storage. *Microgrid Knowledge*.
[31] Invenergy. (Dec. 7, 2015). Invenergy's Grand Ridge Battery Storage Facility Wins 2015 Best Renewable Project Award; Invenergy opens 31.5 MW energy storage project in Illinois. *Reve* (May 15, 2015).
[32] Peters, A. (June 5, 2018). Tesla has installed a truly huge amount of energy storage. *Fast Company.*

- From 2015 through May 2018, Tesla installed a gigawatt-hour of energy storage worldwide. Among other projects, Tesla batteries installed with wind and solar farms are saving consumers money, making the grid more reliable, and handling peak energy demand without requiring extra fossil-fuel-powered plants to come online.[33]
- An Arizona utility is building a 10 MW/40-MW-hour system for peak power. Three Arizona utilities are pairing solar plants with energy storage to shift clean energy production into the evening when the system peak arrives.[34]

Along with the economic and system reliability benefits of energy storage, these facilities avoid the harms to human health and the environment from using fossil-fuel generators, especially in low-income and minority communities.[35]

Other regulatory guidance. As further encouragement for NextGrid to recommend more cost-effective energy storage in Illinois, federal as well as many state regulators have recently pointed to the benefits of energy storage. Storage deployments would build on Illinois' policy commitments to and investments in AMI meters and renewable energy sources. Some of the leading developments include:

- Federal Energy Regulatory Commission (FERC) adopted Order No. 841 on February 15, 2018 to remove barriers to the participation of electric storage resources in Regional Transmission Organization and Independent System Operator markets.[36] FERC noted that energy storage could reduce costs to consumers, improve system reliability, as well as increase competition and efficiency. Energy storage could avoid the dispatch of more expensive resources to meet system needs.
- In 2013, the California Public Utility Commission adopted a 1,325 MW by 2024 energy storage mandate applicable to the state's three investor-owned utilities. Legislation in 2016 added 500 MW of distribution-connected or behind-the-meter energy storage resources to the target.[37]
- Nevada in 2017 adopted legislation requiring the public utilities commission to study whether to mandate that the utilities procure energy storage systems. Each kilowatt-hour of energy delivered by a qualified energy storage device will count double for purposes of meeting the renewable portfolio standard requirement.[38] Qualified storage systems charge from renewable generation and discharge during a peak load period, or perform ancillary grid services helping to integrate renewable generation. The new treatment of storage systems accompanied an increase in the renewable portfolio standard from 25 percent by 2025 to 40 percent by 2030.

[33] Id.
[34] Spector, J. (May 30, 2018). Arizona is Getting its First Standalone Battery Peaker. *Greentech Media.*
[35] Krieger, et al., supra; Mullendore, S. (Aug. 22, 2016). Energy Storage for Public Health: A Smarter Way to Deploy Resources. *Renewable Energy World*; Environment America. (2017). Making Sense of Energy Storage: How Storage Technologies Can Support a Renewable Future.
[36] FERC. (Feb. 15, 2018). Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators. Order No. 841.
[37] The Climate Group. (2017). How California is Driving the Energy Storage Market Through State Legislation.
[38] Spector, J. (June 7, 2017). Nevada Just Became the Most Exciting State for Energy Storage Policy. *Greentech Media*.

- Massachusetts adopted An Act to Promote Energy Diversity, Chapter 188 of the Acts of 2016, providing for energy storage system procurement targets.[39] In June 2017, the state's Department of Energy Resources released a target of 200 MWh by January 1, 2020.[40]
- New York's governor announced energy storage goals of 1.5 GW by 2025, following legislation adopted in November 2017.[41]
- Washington Utilities and Transportation Commission, in October 2017, adopted a report and policy statement on the treatment of energy storage technologies in integrated resource planning and resource acquisition. The Commission concluded that "energy storage is a key enabling technology for utilities to accomplish the goals of the state's energy policies, and that Washington's investor-owned utilities should be working diligently to identify and pursue cost-effective opportunities to incorporate energy storage into their systems."[42]

Conclusion

Illinois has great opportunities in the electricity grid and marketplace of the future, especially in time-varying pricing options and energy storage. These directions would save money for customers and providers, enhance grid reliability and flexibility, and protect human health and the environment. More time-varying pricing options and cost-effective energy storage would build on Illinois' investments in and policies supporting renewable energy systems and AMI meters. These reforms would also strengthen the state's infrastructure for electric vehicles and other developments.

Many years ago, I was pleased to offer recommendations as part of the ICC's Blue Ribbon Telecommunications Task Force. Now, I am grateful for the current work of the NextGrid task force and this opportunity to support more time-varying electricity pricing and storage for electricity grids.

[39] Massachusetts Bill H.4568 (2016).
[40] Patel, S. (Mar. 1, 2018). The Big Picture: Energy Storage Mandates. *POWER*.
[41] Id.
[42] Washington Utilities and Transportation Commission. (Oct. 11, 2017). Investigation into Energy Storage Technologies, Report and Policy Statement, 9-10.