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Note

Centralizing Energy Consumption Data in a State Data Hub

*Zachariah Sibley**

INTRODUCTION

At least 78.9 million smart meters currently monitor the electricity usage of U.S. residents and businesses.[1] Each of those meters can transmit a reading every fifteen minutes, logging over 35,000 data points on a single customer every year.[2] Over time, these data points tell a story about each customer—a valuable one for those looking to optimize the electric grid and consumption behavior, but also at invasive one detailing customers' private activities. The tension between smart meter data as optimizing information and smart meter data as an intrusive view into a home or business raises an important question: Who should manage all the electricity usage data collected by smart meters?[3]

A satisfactory answer to this question becomes increasingly necessary as the store of energy usage data continues to grow

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1. *See How Many Smart Meters are Installed in the United States, and Who has Them?*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.php?id=108&t=3 (last updated Oct. 6, 2018).

2. Mani Vadari, *Data Analytics Transforms Utilities*, T&D WORLD (Nov. 20, 2018), https://www.tdworld.com/smart-grid/data-analytics-transforms-utilities ("Advanced metering infrastructure (AMI) and smart meters are bringing in more than 35,000 data points per year based on 15-minute reading intervals per customer.").

3. Data "management" in this context boils down to practices and policies that balance the benefits of broad access to energy usage data with the costs of data misappropriation and remedial measures to cure data breaches.

and as the scope of customers being smart-metered expands.[4] In fact, the management of energy data is emerging as a core function of electricity markets.[5] U.S. states predominantly place the data management burden on the electric utilities while regulating their practices and policies from the sidelines. That decentralized model underperforms, however, at getting the stories contained in smart meter data to the policymakers and energy entrepreneurs anxious to realize the social benefits of this data.[6]

This Note argues that centralizing the management of energy consumption data into government data centers provides a more efficient and effective option. Namely, a central data hub, like those emerging in European countries,[7] would better balance data disclosure and completeness with data privacy protection. Previous literature advocates the reduced burden on electric utilities to collect, aggregate, and release the data, the greater ability to police data disclosures and privacy practices, and the advantages of leveraging staff expertise to address

4. *See* Herman K. Trabish, *No Time to Think: How Utilities are Handling the Deluge of Grid Data*, UTIL. DIVE (Aug. 24, 2016), https://www.utilitydive.com/news/no-time-to-think-how-utilities-are-handling-the-deluge-of-grid-data/425021/ ("As much information as utilities are facing today, it likely pales in comparison to the wave of data they will face as more customers add distributed generation, microgrids proliferate and demand-management programs become more sophisticated."); *see also* ADAM COOPER, INST. FOR ELEC. INNOVATION, ELECTRIC COMPANY SMART METER DEPLOYMENTS: FOUNDATION FOR A SMART GRID 1 (2017), http://www.edisonfoundation.net/iei/publications/Documents/IEI_Smart%20Meter%20Report%202017_FINAL.pdf (projecting U.S. smart meter deployment to reach 90 million by 2020).

5. *See* MASS. INST. OF TECH. ENERGY INITIATIVE, UTILITY OF THE FUTURE 199–200 (2016), http://energy.mit.edu/wp-content/uploads/2016/12/Utility-of-the-Future-Full-Report.pdf ("[A] fourth core function [of electricity distribution systems] may become increasingly important: that of data platform or data hub.").

6. *See* Jeff St. John, *US Smart Meter Deployments to Hit 70M in 2016, 90M in 2020*, GREENTECH MEDIA (Oct. 26, 2016), https://www.greentechmedia.com/articles/read/us-smart-meter-deployments-to-hit-70m-in-2016-90m-in-2020#gs.FLna=sQ (describing how California, Florida, Texas, and Illinois still lack customer data-sharing and applications despite expansive advanced metering infrastructure deployment).

7. *See infra* Part I.D.i. (discussing examples of European energy meter data hubs).

technical issues and provide independent research services.[8] Skeptics, on the other hand, argue that well-crafted regulations of utilities can achieve the same without the added bureaucracy of an energy data hub.[9] This Note counters that misaligned incentives and moral hazards between private utilities and government regulators increase the social costs of the decentralized approach and justify any added bureaucratic costs of a centralized energy data hub.

Part I recounts the history of energy metering, introduces how the transition to advanced meter infrastructure (AMI) revolutionized its potential, and describes the obstacles energy consumption data management must overcome to achieve that potential. Part I concludes with a survey of the European experience and the current energy usage data management practices in the United States.

Part II analyzes the effects of centralizing energy consumption data management in a government meter data hub. A centralized, public data center would experience significantly less market power, agency, and coordination problems which detract from the effectiveness of the decentralized, private data management model. The data hub model would optimize energy data collection, disclosure, and protection.

This Note concludes that the centralized smart meter data hub more than compensates for its added bureaucratic costs by correcting for moral hazards, better coordinating data collection and distribution, and implementing privacy protections more aligned with public expectations. The centralized, public agency approach warrants more serious discussion by U.S. states as they investigate the best data management structure for their growing store of energy consumption data.

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8. *See* Alexandra B. Klass & Elizabeth Wilson, *Remaking Energy: The Critical Role of Energy Consumption Data*, 104 CALIF. L. REV. 1095, 1150–57 (2016).

9. *See* The Utility Reform Network, Comments on Assigned Commissioner's Scoping Memo and Ruling Amending Scope of Proceeding to Seek Comments and to Schedule Workshops on Energy Data Center 3–5 (Cal. Pub. Util. Comm'n Dec. 17, 2012), http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M039/K596/39596153.PDF.

I. BACKGROUND

This Part introduces AMI and the various governmental approaches to regulating it. Section A discusses the history of electricity metering and how the emergence of AMI is changing the traditional relationships between electric power industry players. Section B explores energy consumption data's potential benefits for energy consumers, electric utilities, government policymakers, and energy efficiency service providers. Section C discusses the obstacles to achieving these benefits requiring regulatory intervention to overcome. Section D concludes with a survey of U.S. federal, state, and European approaches to energy consumption data management.

A. HISTORY OF ENERGY USAGE DATA AND THE ADVENT OF ADVANCED METERING INFRASTRUCTURE

The electricity meter reader is disappearing.[10] In its place is a network of advanced meters wirelessly recording and transmitting consumers' energy consumption data[11] at a much greater frequency than monthly readings.[12] These "smart" meters operate in an internet-of-things, supported by AMI, which includes "communicating thermostats and other in-home controls, . . . communication networks from the meters to local data concentrators, back-haul communications networks to corporate data centers, meter data management systems (MDMS) and, finally, data integration into existing and new

10. *See* Eric Roper, *Move Over Rotary Phones – Meter Readers Join Ranks of the Relics*, STAR TRIBUNE (Oct. 1, 2016), http://www.startribune.com/once-neighborhood-regulars-water-meter-readers-disappear-as-technology-advances/394862321/.

11. As of 2017, nearly half of U.S. electricity customers had smart meters. *See* Alexander Mey & Sara Hoff, *Nearly Half of All U.S. Electricity Customers Have Smart Meters*, U.S. ENERGY INFO. ADMIN. (Dec. 6, 2017), https://www.eia.gov/todayinenergy/detail.php?id=34012. At least 78.9 million smart meters have been installed. *See How Many Smart Meters are Installed in the United States, and Who has Them?*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.php?id=108&t=3 (last updated Oct. 6, 2018).

12. *See* MAURICE R. GREENBERG, DIGITAL DECARBONIZATION: PROMOTING DIGITAL INNOVATIONS TO ADVANCE CLEAN ENERGY SYSTEMS 74 (Varun Sivaram ed., 2018), https://cfrd8-files.cfr.org/sites/default/files/report_pdf/Essay%20Collection_Sivaram_Digital%20Decarbonization_FINAL_with%20cover_0.pdf ("Smart meters provide 2,920 times more data points than monthly manual meter readings.").

software application platforms."[13] This vast internet-of-things connects "the grid, consumers and their loads, and generation and storage resources."[14]

Meter readers of the past manually collected cumulative account-level data for billing purposes.[15] AMI, on the other hand, automatically communicates significantly more detailed information—like the consumption of a particular appliance within the home—at more frequent time intervals. AMI turns real time activities in the physical world—flipping a light switch, starting a clothes dryer, or charging an electric vehicle—into meaningful data. These data points create a detailed narrative about one's energy usage that can serve purposes far beyond billing for whoever has access to them.

This transition elevated data from transactional "exhaust" into a valuable asset.[16] As more software-equipped appliances integrate themselves into this energy internet-of-things, smart metering can break down their individual contributions to a building's overall consumption on monthly, weekly, or even minute-by-minute intervals.[17] Beyond describing the energy situation within the home or business, account-level data can also be aggregated to form a "building-level" or "community-

13. NAT'L ENERGY TECH. LAB., U.S. DEP'T OF ENERGY, ADVANCED METERING INFRASTRUCTURE 5 (2008), https://www.smartgrid.gov/files/advanced_metering_infrastructure_02-2008.pdf.

14. *Id.* at 2.

15. Account-level data refers to energy usage data from a single meter, which can also be considered one's "energy usage personality." Virginia Hewitt, *So You Think You Can Aggregate Data: The Reality Show of Energy Usage*, ACEEE BLOG (July 7, 2014, 2:00 PM), https://aceee.org/blog/2014/07/so-you-think-you-can-aggregate-data-r; *see also* Klass & Wilson, *supra* note 8, at 1103 (detailing the history of manual energy usage data collection and the utilities' need for smarter technology).

16. *See* BILL SCHMARZO & MOUWAFAC SIDAOUI, APPLYING ECONOMIC CONCEPTS TO BIG DATA TO DETERMINE THE FINANCIAL VALUE OF THE ORGANIZATION'S DATA AND ANALYTICS, AND UNDERSTANDING THE RAMIFICATIONS ON THE ORGANIZATIONS' FINANCIAL STATEMENTS AND IT OPERATIONS AND BUSINESS STRATEGIES 1 (2017), https://infocus.emc.com/wp-content/uploads/2017/04/USF_The_Economics_of_Data_and_Analytics-Final3.pdf.

17. *See* Zhanyu Ma et al., *The Role of Data Analysis in the Development of Intelligent Energy Networks*, 31 IEEE NETWORK 88, 91 (2017) (suggesting between eight and thirty-minute intervals is optimal for "most analytical purposes").

level" picture of energy usage.[18] The next section outlines how sufficiently granular and aggregated energy usage data can be leveraged to benefit the consumer, the electric utility provider, governments, and third-party energy businesses.

B. Benefits of Energy Usage Data

Electricity powers much of U.S. daily life and so reducing the costs to produce, transmit, and consume it will positively impact everyone on an electrical grid. AMI's two-way flow of information enables energy consumers, power utilities, governments, and energy efficiency service providers to visualize, interact with, and optimize the flow of energy in ways not previously possible. This section details how these energy industry stakeholders can gain from continued investment in, and proper management of, energy data.

1. Consumers—Better Informed Energy Consumption Decision-Making

Energy consumers occupy three traditional categories: (1) residential; (2) commercial; and (3) industrial.[19] These customer classes have different historical relationships with electricity usage data availability and application. Greater rollout of AMI will equalize access to energy information and enhance existing market opportunities for all customer classes as well as creates new energy product markets for consumers.[20]

Energy consumers, particularly residential and small business customers, face steep informational asymmetries when making energy-related decisions.[21] A consumer that only sees

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18. AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., BEST PRACTICES FOR WORKING WITH UTILITIES TO IMPROVE ACCESS TO ENERGY USAGE DATA 1 (2014), https://aceee.org/files/pdf/toolkit/utility-data-access.pdf.

19. *See Electricity Customers*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/energy/electricity-customers (last updated Mar. 13, 2018). The transportation sectors' use of electricity as fuel is nascent and is intertwined with residential end-users and commercial fleets, so the distinction is ignored in this Note.

20. *See* NAT'L ASS'N OF REGULATORY UTIL. COMM'RS, VALUE OF CUSTOMER DATA ACCESS: MARKET TRENDS, CHALLENGES, AND OPPORTUNITIES 11 (2015), https://pubs.naruc.org/pub.cfm?id=536E2C7B-2354-D714-51CE-F035BA50FAA1.

21. Electricity price signals are less intuitive or often difficult to discern for energy consumers, especially when compared to other energy resources they purchase, like gasoline. *See* Klass & Wilson, *supra* note 8, at 1105, 1110.

the traditional monthly flat-rate bill receives no price signal that might inform his or her daily or hourly energy consumption habits. Since burning natural gas or coal, turning a wind turbine, or causing controlled nuclear reactions generate electricity at different costs,[22] a kilowatt-hour of electricity produced with a higher-cost generator should cost more to the consumer. And since electric utilities sequence energy production so that the low-cost generators go online before the high-cost generator until it meets the current demand,[23] electricity should be low cost when demand is low—because only the low-cost generators are online—and more expensive during high-demand hours of the day. Smart metering allows electric utilities to match the true cost of a kilowatt-hour of electricity with the price reflected on the bill through a method known as time-variant pricing.[24] These near-real-time price signals inform consumers on the real costs of their daily or hourly energy use and encourage them to either turn off an energy-intensive appliance or shift non-essential energy use off high-demand times to the lower-cost, low-demand times.[25]

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22. *See generally*, *How Much Does It Cost to Generate Electricity with Different Types of Power Plants*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.php?id=19&t=3 (last updated Mar. 8, 2019) (linking to a table with historical data on average annual power plant operating expenses).

23. Dispatch stacking of generation facilities occurs at regional electricity wholesale markets, which are competitive energy clearinghouses with federal oversight. *See* DIV. OF ENERGY MKT. OVERSIGHT, FED. ENERGY REGULATORY COMM'N, ENERGY PRIMER 54–55 (2015), https://www.ferc.gov/market-oversight/guide/energy-primer.pdf.

24. Time-variant pricing includes: (1) time-of-use (TOU) pricing which varies prices at a set amount depending on the time of day consumption occurs; (2) real-time pricing (RTP) which varies prices on a frequent basis, such as hourly, that match the volatility of the actual cost of energy production; (3) critical peak pricing (CPP) which signals the customer that demand is reaching critical peak and prices will be increased above the flat rate; and (4) critical peak rebate (CPR) which pays the utility customer for each kWh removed from their normal load. *See* Beia Spiller, *All Electricity Is Not Priced Equally: Time-Variant Pricing 101*, ENVTL. DEF. FUND'S ENERGY EXCHANGE BLOG (Jan. 27, 2015), http://blogs.edf.org/energyexchange/2015/01/27/all-electricity-is-not-priced-equally-time-variant-pricing-101/; *see also* William W. Hogan, Time-of-Use Rates and Real-Time Prices (Aug. 23, 2014) (unpublished manuscript) (on file with Harvard University's John F. Kennedy School of Government at https://sites.hks.harvard.edu/fs/whogan/Hogan_TOU_RTP_Newark_082314.pdf) (comparing the efficiency gains of TOU and RTP rates).

25. *See* Cheryl Dancey Balough, *Privacy Implications of Smart Meters*, 86 CHI.-KENT L. REV. 161, 162 (2011).

These demand incentives make time-variant pricing an important tool in a larger effort known as demand-side management.[26] Demand-side management encompasses two separate approaches. The first is demand response, in which electric utilities compensate consumers—typically large commercial or industrial customers—for reducing their energy consumption at peak demand intervals.[27] Demand flexibility, on the other hand, seeks to shift consumption off of peak demand and onto low-demand intervals.[28] These efforts help electric utilities avoid costly investments to upgrade generation, transmission, and distribution systems because they ensure that the number of kilowatt-hours consumers need during peak demand does not exceed the currently available capacity to generate and transport those kilowatt-hours.[29] Customers benefit from avoided upgrade costs that would otherwise be passed on to their utility bills.

In addition to being blind to the true cost of every kilowatt-hour they consume, consumers are also out of tune with their energy consumption across individual appliances.[30] Lack of knowledge about which energy-consuming activities are most costly or energy-intensive frustrates attempts at being more

26. *See Electric Utility Demand Side Management*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/electricity/data/eia861/dsm/ (defining DSM as the "planning, implementing, and monitoring activities of electric utilities which are designed to encourage consumers to modify their level and pattern of electricity usage."); *see also* Fed. Energy Regulatory Comm'n v. Elec. Power Supply Ass'n, 136 S.Ct. 760 (2016) (upholding the Federal Energy Regulatory Commission's Order 745 promoting demand response programs in wholesale energy markets).

27. *See* Klass & Wilson, *supra* note 8, at 1106–07.

28. *See id.* at 1107.

29. *See* David Ferris, *Nest Best, Tesla Worst in a Suite of Tools that Could Save Utilities Billions*, ENERGYWIRE (Aug. 27, 2015), http://www.eenews.net/energywire/2015/08/27/stories/1060023999 (citing a Rocky Mountain Institute report that demand flexibility "could reduce U.S. peak demand by about 8 percent and in the process save $9 billion a year in infrastructure upgrades to generation, transmission and distribution systems").

30. There are also high transaction costs—in terms of time spent and risk of human error—for consumers to manually obtain their energy consumption information which could be reduced if smart meter data was meaningfully presented to him or her. *See* Phillip Henderson, *Utilities Should Stop Driving with the Brakes On! Give Building Owners Information on Energy Use*, NAT'L RESOURCES DEF. COUNCIL: EXPERT BLOG (Sept. 28, 2015), https://www.nrdc.org/experts/philip-henderson/utilities-should-stop-driving-brakes-give-building-owners-information.

energy efficient. It is hard to invest high upfront costs in an energy-efficient appliance without a real sense of whether the long-term energy usage reduction will result in actual financial savings.[31] Consumers with access to the sufficiently granular energy usage data, however, can independently analyze their energy usage and work to "increase energy efficiency, produce their own energy, make better financial decisions, and create new energy business models."[32] If the energy usage data is presented effectively,[33] it can significantly lower transaction costs associated with obtaining this consumption information and promote energy-efficient lifestyle changes.[34]

For example, smart meter data could correct an informational blind spot for potential homebuyers.[35]

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31. *See* Klass & Wilson, *supra* note 8, at 1106.

32. *Id.* at 1107–08; *see also* Simon Mouat, *A New Paradigm for Utilities: The Rise of the Prosumer*, SCHNEIDER ELECTRIC BLOG (Nov. 17, 2016), https://blog.schneider-electric.com/energy-management-energy-efficiency/2016/11/17/new-paradigm-utilities-rise-prosumer/ (discussing how smart grid technologies such as AMI now allow for prosumers—retail energy customers also capable of energy generation which they can sell back to the grid—as well as more customer control over consumption).

33. *See* PAOLO BERTOLDI ET AL., EUROPEAN COMM'N JOINT RESEARCH CTR., CONSUMER FEEDBACK SYSTEMS: HOW MUCH ENERGY SAVINGS WILL THEY DELIVER AND FOR HOW LONG? 12-9 (2016), https://aceee.org/files/proceedings/2016/data/papers/12_769.pdf (listing features of feedback that reduce energy consumption); *see also* Brian Bowen, *How Utilities Can Meet Millennials' Needs in a Data-Sharing Economy*, GREENTECH MEDIA (Nov. 9, 2017), https://www.greentechmedia.com/articles/read/how-utilities-can-meet-millennials-needs-in-a-data-sharing-economy#gs.kDdvbt2Z.

34. One way to lower transaction costs is to improve energy-efficiency providers' ability to access energy usage data and target customers with specific products and services tailored to their energy needs, bringing energy efficiency to consumers instead of consumers having to expend resources finding them on their own. *See* Denis Du Bois, *How Efficiency Is Learning About Market Segmentation from Internet Giants and Political Campaigns*, GREENTECH MEDIA (Oct. 30, 2014), https://www.greentechmedia.com/articles/read/how-energy-efficiency-marketers-are-learning-about-market-segmentation-from#gs.gRyMNIU.

35. Energy efficiency affects a home's valuation and so transparency about the home's actual energy profile will better match the ultimate price with the indirect and future financial impacts the home's energy efficiency. *See* ERDAL AYDIN, DIRK BROUNEN & NILS KOK, INFORMATION ASYMMETRY AND ENERGY EFFICIENCY: EVIDENCE FROM THE HOUSING MARKET 22–23 (2018), https://sustainable-finance.nl/upload/researches/Aydin-Et-Al-Information-Asymmetry.pdf; Danielle Winner, Data Access Rules: Energy Bill Disclosure in the Rental and Housing Markets 5 (Apr. 26, 2015) (unpublished Masters of

Homebuying is a major financial decision, and the law respects that fact by obligating disclosures about a home that may affect its value.[36] Those disclosure rules, however, generally do not include the home's energy usage profile. The seller's cost to manually create the energy profile made such a disclosure impractical, but now the digital record produced by smart metering significantly reduces that cost. Given the importance of a home's monthly electric utility costs in assessing mortgage affordability[37] and this reduced cost, a minority of states and cities have embraced the concept of a "home MPG" that "reflects a home's expected energy use and carbon emissions, and allows comparison between area homes."[38] The real estate example illustrates how smart metering can correct information deficiencies in markets where complete information is critical to optimal financial decisionmaking.[39] These smart meter enabled opportunities "represent necessary, if not sufficient, conditions for customer involvement in power management."[40]

2. Electric Utilities—Programs to Increase Demand, Avoid Infrastructure Costs, and Trim Operational Costs

Enabling demand-side management with smart meter data not only benefits consumers, but also assists electric utilities in avoiding costly investments to upgrade generation, transmission, and distribution systems.[41] Utilities traditionally structured rates and future investments by assuming a steadily-

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Public Policy Professional Paper, Humphrey School of Public Affairs, University of Minnesota), https://conservancy.umn.edu/handle/11299/172486.

36. *See, e.g.*, CAL. CIV. CODE §§ 1102–1102.14, 2079–2079.10 (2018).

37. *See* Scott Cooney, *Tell Freddie & Fannie to Include Home Efficiency in Buyer Disclosures*, CLEANTECHNICA (Mar. 10, 2016), http://cleantechnica.com/2016/03/10/freddie-fannie-fhfa-home-efficiency-buyer-disclosures.

38. *Home MPG: Energy Performance Scores*, MASS.GOV, https://www.mass.gov/service-details/home-mpg-energy-performance-scores (last visited Mar. 23, 2019); *see also* Minneapolis, Minn., Code of Ordinances §§ 47.190(e), 248.75 (2019); JACOB CORVIDAE & RACHEL GOLD, ROCKY MOUNTAIN INST., AN MPG FOR HOMES (2017), https://www.rmi.org/wp-content/uploads/2017/09/RMI_An-MPG-for-Homes_Report_2017-1.pdf.

39. *See* AYDIN, BROUNEN & KOK, *supra* note 35 (citing K. Gillingham et al., *Energy Efficiency Economics and Policy*, 1 ANNUAL REV. OF RES. ECONS. 597 (2009)) ("[I]nformation asymmetry between seller and buyer is generally accepted as one of the main reasons leading to underinvestment in energy efficiency in the housing market.").

40. GREENBERG, *supra* note 12, at 46.

41. *See* Ferris, *supra* note 29 and accompanying text.

increasing demand for electricity, but more energy-efficient lifestyles and appliances along with new behind-the-meter generation alternatives like wind, solar, and storage disrupted that assumption to the detriment of utilities and their customers.[42] The less frequent need for infrastructure upgrades means that energy utilities will not be spending capital on which they earn a set, competitive rate of return. The deployment of AMI, however, requires utility capital investment in the range of about $17 to $24 billion annually through 2030.[43] These investments would revitalize, to an extent, that traditional rate of return on larger grid infrastructure investments.[44]

Two-way communication through AMI also allows utilities to affect peak-hour demand to avoid stressing current grid capacity and incurring the social costs of power outages.[45]

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42. Stagnant demand is particularly harmful for electric utilities who must raise rates to cover static fixed costs even when these disruptive forces reduce the total number of kWhs they must deliver. *See* Leonard S. Hyman & William Tilles, *The Sun Will Set on Electric Utilities*, BARRON'S (July 9, 2016), https://www.barrons.com/articles/the-sun-will-set-on-electric-utilities-1468041067 (describing a "utility death spiral"—"[u]tilities raise prices, making an easier entry for competitive products, then utilities lose sales and must raise prices more to pay for all of the overhead they installed unnecessarily, and competitors take still more of the market"—if utilities fail to craft more flexible rate designs). *But see* JÜRGEN WEISS ET AL., THE BRATTLE GRP., ELECTRIFICATION: EMERGING OPPORTUNITIES FOR UTILITY GROWTH (2017), http://files.brattle.com/system/publications/pdfs/000/005/396/original/electrification_-_emerging_opportunities_for_utility_growth.pdf?1485268804 (explaining that the utility death spiral is likely an overstatement considering upcoming investment opportunities to increase electricity demand).

43. *See* STEVE BOSSART & RYAN EGIDI, NAT'L ENERGY TECH. LAB., MATERIALS RESEARCH FOR SMART GRID APPLICATIONS 5 (2012), http://ceramics.org/wp-content/uploads/2012/02/mcare12-smart-grid-apps.pdf.

44. *See* Mike O'Boyle, *Three Ways Electric Utilities Can Avoid a Death Spiral*, FORBES (Sept. 25, 2017), https://www.forbes.com/sites/energyinnovation/2017/09/25/three-ways-electric-utilities-can-avoid-a-death-spiral/2/#7bb779b4713e.

45. *See* Mary Miller & Ruth Littmann-Ashkenazi, *Beyond Smart Meters: Pushing the Envelope of Demand Response*, ELECTRIC ENERGY ONLINE (March 2010), https://electricenergyonline.com/show_article.php?mag=62&article=480 (suggesting that an annual $150 billion cost could be reduced by the demand management potential of smart meters); *see also* Kayoung Kim et al., *Estimation of the Inconvenience Cost of a Rolling Blackout in the Residential Sector: The Case Of South Korea*, 76 ENERGY POL'Y 76 (2015) (measuring the social cost attributable to rolling blackouts, defined as "the intentional outage of electricity during peak demand periods . . . to maintain the balance between supply and demand"); *The Large Costs of Even the Smallest Power Outages . . . and Tools to Prevent Them*, NRG INSIGHTS (Nov. 10, 2017), https://www.nrg.com/insights/energy-education/the-large-costs-of-even-the-

Utilities can create tariffs and programs that compensate consumers for the right to turn off certain energy-intensive items to reduce overall demand.[46] AMI-connected electric water heaters or air conditioners could be remotely cycled off by the utility.[47] Tariffs could establish time-of-day and duration parameters for these remote interruptions.[48] With enough customer participation, short shutoffs of select customer appliances could achieve significant demand reduction,[49] avoiding the inconvenience of a full rolling blackout. Direct demand control would also help utilities prolong the life of existing transmission and distribution infrastructure.

Demand-side management also presents an opportunity for utilities to coordinate the introduction of new loads—and maximize profits from the higher electricity demand—while avoiding costly infrastructure updates. For example, increased transportation electrification presents a new, energy-intensive load.[50] Electric cars and buses would significantly increase

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smallest-power-outages-and-tools-to-prevent-them.html (stating one tool to reduce the $27 billion annual cost of power outages in key sectors is utility demand response).

46. *See* ELEC. POWER RESEARCH INST., DEMAND RESPONSE—UTILITY COMMANDED LOAD CONTROL, IECSA Vol. 2 at D12-2, http://smartgrid.epri.com/UseCases/DemandResponse-UtilityCommandedLoadControl.pdf.

47. For example, the Wisconsin Public Service Commission offers a "Cool Credits" program that lets customers "earn credits on [their] electric bills for allowing [their] air conditioning and/or electric water heater to be occasionally shut down for short periods." *Cool Credits Direct Load Control Program*, WIS. PUB. SERV., https://accel.wisconsinpublicservice.com/home/cool_credits.aspx (last visited Mar. 20, 2019); *see also* Nicole Casal Moore, *How Air Conditioners Could Advance a Renewable Power Grid*, THE U. REC. (Feb. 8, 2019), https://record.umich.edu/articles/how-air-conditioners-could-advance-renewable-power-grid ("More strategic control of air conditioners could improve the overall efficiency and reliability of the power grid and make it easier to transition to renewable energy.").

48. *See id.* (explaining the time-of-day and duration parameters of the Cool Credits program).

49. *See* Robert Walton, *Duke, Austin Energy, PG&E Among Demand Response Award Recipients from PLMA*, UTIL. DIVE (Apr. 21, 2016), https://www.utilitydive.com/news/duke-austin-energy-pge-among-demand-response-award-recipients-from-plma/417841/ (describing Duke Energy Florida's EnergyWise Home Program that has more than 400,000 participants and allows it to directly manage 653 MW).

50. *See* Gavin Bade, *CEC: California EV Chargers Will Add 1 GW of Peak Demand by 2025*, UTIL. DIVE (Mar. 20, 2018), https://www.utilitydive.com/news/cec-california-ev-chargers-will-add-1-gw-of-peak-demand-by-2025/519517/ (reporting on a California Energy Commission

demand and subsequent profits from electricity sales. Those profits are maximized if, through demand flexibility incentives, consumers shift electric vehicle charging to off-peak times so that this demand is captured when the grid is underutilized. This approach increases electricity sales and simultaneously avoids expenditures on infrastructure upgrades. Energy usage data is critical to electric vehicle loads particularly because of their unique load profile which researchers label the "Dragon Curve."[51] Without sufficient usage data and analysis on increasing electric vehicle loads, researchers fear electric utilities "may be caught unprepared" and instead of maximizing profits of a new load, these unprepared electric utilities will be expending costs on new grid infrastructure and recovering those costs through increased rates.[52]

Utilities could follow the example of Southern Company, National Grid, and Xcel Energy which invested in utility-focused energy data analytics companies like AutoGrid.[53] The electric utilities will be able to compete in these energy services markets, with $20 billion already anticipated to be spent on consumer data analytics throughout the United States by 2021.[54] These investments signal that major electric utilities are interested in optimizing the power industry and possibly providing their customers targeted energy-efficiency services. This new utility-customer relationship would open an additional revenue source in the face of stagnant or declining demand for electricity.

Finally, smart meters allow utilities to trim operational costs.[55] Analog tasks like meter reading and on-demand meter connections become automated. Quicker, remote, and customer-

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report that states there will be 1 GW of residential and nonresidential electric vehicle charging added to peak electricity demand throughout the California electricity grid by 2025).

51. *See id.*

52. *See* Robert Walton, *Utilities Ill-Prepared for EV Demand, SEPA Finds*, UTIL. DIVE (Mar. 21, 2018), https://www.utilitydive.com/news/time-not-on-their-side-utilities-ill-prepared-for-ev-demand-sepa-finds/519530/.

53. *See* Katie Fehrenbacher, *There's Big Money in Energy Big Data*, FORTUNE (May 24, 2016), http://fortune.com/2016/05/24/big-money-in-energy-big-data/.

54. *See* Olivia Chen, *US Utilities to Spend $20 Billion on Customer Analytics Through 2021*, GREENTECH MEDIA (Nov. 8, 2017), https://www.greentechmedia.com/articles/read/us-utilities-to-spend-20-billion-on-customer-analytics#gs.0dENHKs.

55. *See* NAT'L ASS'N OF REGULATORY UTIL. COMM'RS, *supra* note 20, at 12–13.

specific service reduces the costs of correcting billing errors, using paper mail to send and collect bills, or communicating issues and repair times which can increase customer satisfaction.[56] The remote monitoring of the meters and their data also allows for utilities to better respond to meter tampering and to more accurately evaluate their demand-side management programs.[57] Overall, utilities stand to gain from reduced operational and infrastructure costs by more dynamically working with customer loads and needs—a possibility only with AMI's real-time information about customer energy consumption and two-way communication capabilities.

3. Governments—Benchmarking and Improved Policy Crafting

The benefits of AMI and energy usage data are not exclusive to the utility-consumer relationship. Third parties can also capitalize on the information-rich energy usage data supplied by smart meters. One major third party in the power industry is government. State and local policymakers need energy usage data to support and enforce ordinances and mandates focused on consumption reduction or improved energy efficiency.[58] Energy usage data also allows state agencies "to verify compliance with conservation, energy efficiency, and emission reduction efforts" as well as benchmark progress toward legislative goals.[59] Governments can additionally take proactive steps by targeting energy-efficiency interventions at particularly high-demand energy consumers, saving taxpayer dollars on implementation costs.[60]

Energy usage data also empowers environmental interest groups to be better informed civilian monitors of public officials

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56. *See id.*

57. *See id.*

58. *See* Klass & Wilson, *supra* note 8, at 1108; Joe Hall, Bob Cattanach & Brad Hammer, *So, Who Owns Your Energy-Use Data?*, WINDPOWER ENG'G & DEV. (Oct. 23, 2015), https://www.windpowerengineering.com/environmental/so-who-owns-your-energy-use-data/.

59. Hall, Cattanach & Hammer, *supra* note 58; *see also* Klass & Wilson, *supra* note 8, at 1108.

60. *See* Matteo Jarre et al., *Energy Consumption Data as a Decision-Making Tool for Energy Efficient Interventions in PA: The Case-study of Turin*, 111 ENERGY PROCEDIA 1050 (2017).

and agencies. Whether government resources are scarce or its priorities have shifted away from energy consumption programs, energy data allows independent analysis by public interest organizations to evaluate government efforts and effectiveness in achieving the conservation, efficiency, or emission reduction goals of legislation.[61] For government actors and those concerned citizens monitoring their governance, energy usage data allows for "better program implementation, accountability, and evaluation."[62]

4. Third-Party Businesses—Energy Efficiency Service Providers and Data Analytics

A major hurdle that prevents wider adoption of energy-efficient technology and practices is the high price to acquire the information necessary to make an individual business case for such an investment.[63] In the same way energy data better informs individual consumers, entrepreneurs can leverage economies of scale to interpret and make the business case for entire categories of consumers. A 2016 estimate suggests that the market for companies researching and designing new energy-related products and services will be worth $1.3 billion, in addition to a $3.3 billion market for targeted marketing by the product and service providers.[64] While utilities will likely begin to see the market opportunity to provide these energy-efficiency services themselves, non-utility providers should also have an opportunity to compete.

Energy-efficiency services use energy data to identify energy consumers who will profit most from a new energy technology or an investment in more efficient electric appliances. Companies like Opower and FirstFuel, for example, collect energy usage data from utility companies, combine it with other third-party data about consumers and evaluate the energy use

61. *See* Hall, Cattanach & Hammer, *supra* note 58.

62. Klass & Wilson, *supra* note 8, at 1108.

63. *See* Alan H. Sanstad & Richard B. Howarth, *'Normal' Markets, Market Imperfections and Energy Efficiency*, 22 ENERGY POL'Y 811, 814–16 (1994) (citing imperfect information, informational asymmetry, high transaction costs in correcting those information market failures, imperfections in capital markets, and the bounded rationality tied to energy decisions as the top major obstacles to optimal adoption of energy efficiency).

64. Jim Mazurek, *The Data Treasure Chest: Is There a Market to Sell Utility Data?*, ACCENTURE BLOG (Dec. 7, 2016), https://www.accenture.com/us-en/blogs/blogs-utility-data-treasure-chest-there-market-sell-utility-data.

and improved efficiency opportunities of different segments of a given population.[65] Utilities like the Tennessee Valley Authority work with large industrial customers to comply with greenhouse gas accounting standards and provide them with more accurate information for emission reporting requirements.[66] Other, more unique third parties like meteorological organizations might also offer energy-efficiency services by adjusting a homeowner's thermostat to match the day's weather conditions.[67] Price and marketing competition in new energy-efficiency markets will continue to improve these services as more energy data becomes accessible to utility and non-utility providers alike.[68]

C. Barriers to Optimal Smart Meter Data Usage

Energy usage data can only achieve its upside if it is accessible, complete, and confidential. Access is hindered when private data holders, like the electric utility, face higher transaction costs to make the data available than they could recover in infrastructure savings or profit-making opportunities. Left to economic incentives alone, private sector data holders will undersupply access and fail to realize the potential of an "open data" approach.[69] Completeness of data diminishes when there is a lack of participation in smart metering, a lack of coordination between the separate utilities, or a lack of AMI-connected items. Finally, overreactions to privacy risks may distort views on where the appropriate level of protection lies—leading to overinvestment in privacy protections which drives up

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65. *See* Justin Worland, *Your Utility Company Wants to Sell You More than Just Electricity*, TIME (June 3, 2016), http://time.com/4312285/utility-company-electricity-solar-power/; *see also* Du Bois, *supra* note 34 (discussing the underuse of market segmentation and target marketing in the energy-efficiency markets).

66. *See* Klass & Wilson, *supra* note 8, at 1102.

67. *See* MICHAEL MURRAY & JIM HAWLEY, GOT DATA? THE VALUE OF ENERGY DATA ACCESS TO CONSUMERS 10 (2016).

68. *See* Katherine Tweed, *Texas Has Millions of Smart Meters. So Why Haven't Third-Party Energy Services Blossomed?*, GREENTECH MEDIA (Oct. 14, 2016), https://www.greentechmedia.com/articles/read/texas-highlights-the-challenge-of-one-click-energy-services (detailing the technological bottlenecks that prevent non-utility service providers from accessing enough energy customer data to successfully provide their services).

69. ABRAMS ENVTL. LAW CLINIC, UNIV. OF CHI. LAW SCH., FREEING ENERGY DATA (2016), https://www.law.uchicago.edu/files/file/freeing_energy_data_report_abrams_environmental_clinic_june_2016.pdf.

transaction costs, entry barriers to energy markets, and missed opportunity costs.

1. Accessibility

"The inability of customers and third parties to access this data—be it daily, hourly, or near-real time—significantly limits the benefits that smart meters can provide."[70] Access is first measured by who can access energy usage data and presentation quality. There is general agreement that customers should have access to their data.[71] The utility responsible for billing customers also requires access to calculate account-level usage. But when it comes to third parties—researchers, government agencies, and energy service providers—access can be difficult to come by.[72] The questions are which third parties should enjoy access to account-level and aggregated data and how should access be limited. Third-party access varies among the states,[73] but current "legal ambiguities" in regulations and a patchwork of policies hinder optimal access for many.[74] Non-disclosure requirements also keep smart meter data access concentrated in a select few

Accessible also means convenient and intuitive displays. This feature weighs heavily as an obstacle for residential and small business customers.[75] Without the sophisticated data analytic capabilities of utilities or larger businesses, raw data is

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70. Coley Girouard, *Electricity in the Information Age: Big Data Could Mean Big Benefits for All*, ADVANCED ENERGY PERSP. (Dec. 1, 2016, 4:39 PM), https://blog.aee.net/electricity-in-the-information-age-big-data-could-mean-big-benefits-for-all.

71. *See* Klass & Wilson, *supra* note 8, at 1118 ("When states have considered customers' access to their own data, nearly all have decided that customers should have access."); *see also* TEX. UTIL. CODE § 39.107(b) (2018).

72. *See* GREENBERG, *supra* note 12, at 11 ("[E]lectric power utilities often require researchers to sign nondisclosure agreements to access and analyze electricity consumption data from smart meters.").

73. *See infra* Section D for a discussion of state approaches to energy data management.

74. ABRAMS ENVTL. LAW CLINIC, *supra* note 69, at 1 ("[L]egal ambiguities—along with concerns of consumer privacy advocates and utilities—appear to have discouraged utilities from releasing the data to [energy efficiency service providers].").

75. *See generally* Press Release, J.D. Power, Utilities Lag Other Industries in Digital Experience, but Standouts are Emerging, J.D. Power Finds (Mar. 21, 2018), http://www.jdpower.com/press-releases/jd-power-2018-utility-digital-experience-study (acknowledging that consumers are accustomed to user-friendly digital interfaces in many aspects of life).

useless or misleading to them.[76] Rather, online web portals capable of presenting basic analytical breakdowns of a customer's energy usage should be adopted. Unfortunately, J.D. Power recently found that "[u]tilities are among the lowest-performing industry groups when it comes to delivering distinct digital customer experiences."[77] The solution is the intuitive display of "usage, account information and payment information, in a streamlined format" delivered via desktop or mobile devices.[78]

Convenient, user-friendly energy data applications also increase customer willingness to authorize third party access where necessary. Multi-step online authorization processes and even single-page paper authorization forms can present a cumbersome obstacle to a third party receiving customer-controlled authorization.[79] One- or two-step processes, click-through functionality, and digital signatures provide the necessary convenience and intuitiveness to encourage increased third party access agreements.[80]

2. Completeness

The first aspect of completeness is representativeness, both in terms of which players participate and in terms of which

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76. *See* Yogi Schulz, *Big Data Is Useless without Visual Analytics*, IT WORLD CAN. (Oct. 5, 2016), https://www.itworldcanada.com/blog/big-data-is-useless-without-visual-analytics/386943; Brian Solis, *Without Analytics, Big Data Is Just Noise*, BRIAN SOLIS (Apr. 24, 2013), https://www.briansolis.com/2013/04/without-analytics-big-data-is-just-noise/ (describing the misleading and uninformative nature of digital data without sufficient analytical processes to interpret it).

77. Press Release, J.D. Power, *supra* note 75 ("When benchmarked against other consumer-facing industries, utilities deliver the worst digital experiences . . . . [T]he utility industry scores 571 on a 1,000-point scale. The retail sector, by contrast, scores 771.").

78. *Id.* (finding these features bumped digital customer satisfaction up by 43 points).

79. *See* ROBERT KING & ROB BEVILL, S.-CENT. P'SHIP FOR ENERGY EFFICIENCY AS A RES., IMPROVING ACCESS TO SMART METER DATA IN TEXAS 8–13 (Oct. 2016), https://eepartnership.org/wp-content/uploads/2016/10/Meter-Data-Access-Report-FINAL.pdf (comparing in part the effects of cumbersome authorization and consumer-side information requirements on smart meter data access in Texas).

80. *See* ADVANCED ENERGY ECON., ACCESS TO DATA: BRINGING THE ELECTRICITY GRID INTO THE INFORMATION AGE 9 (Sept. 2017), https://info.aee.net/hubfs/PDF/Access-to-data.pdf (proposing consumer-conscious measures to increase access to energy data).

appliances are connected. An internet-of-things often fails in practice because the relevant stakeholders fail to develop a "partner ecosystem."[81] In the power industry, that means regulators and utilities of all types—investor-owned, municipal, and cooperatives—need to coordinate intrastate data management efforts.[82] Coordination and cooperation, however, are not favored business strategies for utility monopolies protective of service territories,[83] nor for energy municipalities or power cooperatives looking to avoid state regulator interference in their affairs.

One manifestation of coordination would be standardization. Standardization is "critical" to achieving the energy policy benefits promised by energy usage data.[84] Sharing energy usage data between a state's utilities, and then between states, requires the same application programming interface or interoperability between separate systems.[85] For third parties, the additional cost of translating data from multiple utilities with inconsistent formats into a compatible format on top of access costs may dissuade many from dealing with certain utilities and leave portions of a state underserved.

The second aspect of completeness is maximizing the number of devices connected through an internet-of-things. Only with the insights provided by appliance-level data can the above-

81. Maciej Kranz, *Success with the Internet of Things Requires More Than Chasing the Cool Factor*, HARV. BUS. REV. (Aug. 7, 2017), https://hbr.org/2017/08/success-with-the-internet-of-things-requires-more-than-chasing-the-cool-factor.

82. Ideally completeness requires interstate collaboration, but in the absence of federal action that is not an imminent reality.

83. For example, the Federal Energy Regulatory Commission had to order public utilities to stop discriminatory transmission practices in energy wholesale markets. Non-Discriminatory Open Access Transmission Tariff, 18 C.F.R. § 35.28 (2018); *cf.* Marius Buchmann, *The Coordination Problem: A Key Challenge for Smart Grids*, THE ENERGY COLLECTIVE GROUP (June 26, 2017), http://www.theenergycollective.com/enerquire/2407459/coordination-problem-key-challenge-smart-grids.

84. Klass & Wilson, *supra* note 8, at 1152.

85. *See* MCKINSEY GLOB. INST., THE INTERNET OF THINGS: MAPPING THE VALUE BEYOND THE HYPE 23–25 (2015), https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/The%20Internet%20of%20Things%20The%20value%20of%20digitizing%20the%20physical%20world/The-Internet-of-things-Mapping-the-value-beyond-the-hype.ashx.

described benefits be achieved.[86] Completeness requires major appliances, electric transportation, solar panels, and residential battery units to be communicating with one another. This transition needs targeted investments for customers to replace standard electric appliances with two-way connected ones.[87] Completeness requires more energy consuming items to become smart.[88]

3. Privacy Security

There are four major factors that drive privacy concerns in big data: (1) the incremental effect; (2) automated decision-making; (3) predictive analysis; and (4) lack of access and exclusion.[89] Privacy fears enlarge because existing legal frameworks often get outpaced by big data collection, aggregation, and analysis, leaving these adverse effects unchecked.[90] As energy data becomes more granular, it reveals more about the data subject's energy usage, even to the point of personally identifying a specific person or business—a benefit

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86. *See, e.g.*, Coley Girouard, *Advanced Metering: Making the Most of Connectivity for a Modern Grid*, ADVANCED ENERGY PERSP. (Sept. 28, 2017), https://blog.aee.net/advanced-metering-making-the-most-of-connectivity-for-a-modern-grid ("[Highly granular] data are essential building blocks for customized load management programs and other services that can empower customers to effectively and simply control their energy usage and costs . . . [as wel as] improve system-wide efficiency by enabling utilities to develop more precise real-time load monitoring and forecasting capabilities.").

87. *See, e.g.*, Adam B. Jaffe, Richard G. Newell & Robert N. Stavins, *Economics of Energy Efficiency*, *in* 2 ENCYCLOPEDIA OF ENERGY 83–84 (Cutler Cleveland ed., 2004) (explaining that adoption of new energy-efficiency products is hindered by incomplete information, principal-agent problems, lack of incentive to internalize environmental externalities, and inabilities to privately incentivize the development of energy-efficient technologies with high positive externalities for the environment but low profits for sellers).

88. *See* Amena Ali, *Four Ways to Unlock the Full Potential of the IoT Connected Home*, IOT AGENDA (Jan. 24, 2017), http://internetofthingsagenda.techtarget.com/blog/IoT-Agenda/Four-ways-to-unlock-the-full-potential-of-the-IoT-connected-home ("The path to this future requires data—big data—on each appliance and home to observe and analyze appliance and home energy consumption patterns, trends and anomalies.").

89. Omer Tene & Jules Polonetsky, *Big Data for All: Privacy and User Control in the Age of Analytics*, 11 NW. J. TECH. & INTELL. PROP. 239, 251–56 (2013).

90. *Cf., e.g.*, M. James Daley, *Information Age Catch 22: The Challenge of Technology to Cross-Border Disclosure & Data Privacy*, 12 SEDONA CONF. J. 121, 122 (2011) ("Law and public policy, which exist to help bring order out of chaos, simply cannot keep pace.").

for targeted marketing but potentially invasive if it falls into nefarious hands.[91]

Consumers fear personally identifying energy consumption data may alert potential thieves to when their home is unoccupied.[92] Another major concern is that smart meter data will lead to violations of Fourth Amendment rights—namely police using energy usage data to detect potentially criminal operations or zoning violations.[93] Finally, neighbors, friends, or political opponents could monitor sensitive personal information traditionally protected by a building's four walls.[94]

The consumer privacy concerns create hesitation and delay on the part of energy utilities and public utility regulators. For utilities, the lack of industry practice for data disclosures, the looming costs of regulatory hurdles, and the regular security maintenance costs for protecting customer usage data all delay utility executives from diligently exploring this new opportunity.[95] Moreover, regulators fear being "caught with their pants down" by authorizing a data practice that leads to a privacy breach.[96] The fear of public backlash and criticism may

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91. *See* 2 NAT'L INST. OF STANDARDS & TECH., U.S. DEP'T OF COMMERCE, GUIDELINES FOR SMART GRID CYBERSECURITY 9–12 (2014), https://nvlpubs.nist.gov/nistpubs/ir/2014/NIST.IR.7628r1.pdf.

92. *See* ISHTIAQ ROUF ET AL., ACM CONFERENCE ON COMPUTER AND COMMUNICATIONS SECURITY, NEIGHBORHOOD WATCH: SECURITY AND PRIVACY ANALYSIS OF AUTOMATIC METER READING SYSTEMS 462, 468 (2012) ("[I]t is feasible to identify sensitive information of the residents, such as whether the residents are at home.").

93. *See, e.g.*, Natasha H. Duarte, *The Home Out of Context: The Post-Riley Fourth Amendment and Law Enforcement Collection of Smart Meter Data*, 93 N.C. L. REV. 1140, 1156–60 (2015) (discussing jurisprudence on the Third Party Doctrine failing to protect smart meter data and the personal information it reveals about one's home); Sonia K. McNeil, *Privacy and the Modern Grid*, 25 HARV. J.L. & TECH. 199, 205 (2011) ("The information can be used to identify marijuana 'grow houses,' sweat shops, or brothels, or to detect violations of housing ordinances or zoning regulations.").

94. *See* McNeil, *supra* note 93, at 205 ("Anyone with access to smart meter data can deduce the 'avocations, finances, occupation, general reputation, credit, health, or any other personal characteristics of the customer or the customer's household.'").

95. *See* ABRAMS ENVTL. LAW CLINIC, *supra* note 69, at 15–22.

96. Jeff St. John, *New Report Highlights the Costs of Ongoing Utility-Customer Data Divide*, GREENTECH MEDIA (Feb. 4, 2016), https://www.greentechmedia.com/articles/read/new-report-highlights-the-costs-of-ongoing-utility-customer-data-divide#gs.HbR80=I.

be why privacy standards currently being adopted tend to be overly restrictive.[97]

While important, privacy concerns can be overstated in the energy usage data context.[98] Costly privacy protections and methods should be matched with different categories of energy usage data, each with their own benefits and sensitivity. Professors Klass and Wilson categorized energy usage data by its level of granularity and its associated time lag.[99] The different characteristics warrant separate privacy treatments; at one end is mandatory customer consent, extensive aggregation techniques, and strong anti-breach infrastructure, and at the other is no consent requirement, minimal aggregation, and lax requirements on the data-receiver's facilities.[100] The merits of different aggregation methods are beyond the scope of this Note, except to note that policymakers should tier privacy requirements to match the actual privacy risks associated with different categories of energy usage data.

D. APPROACHES TO ENERGY METER DATA MANAGEMENT

The central question of this Note is who should be responsible for meter data management—the distribution system operators (DSOs), the retail electric providers (REPs), a private third party, or a government agency.[101] Data

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97. *See* Klass & Wilson, *supra* note 8, at 1153 ("Most, if not all, data-seeking parties agree that the current 15/15 standard is overly restrictive, but no clear successor has yet emerged."). For a discussion on the 15/15 rule, see *infra* note 145 and accompanying text.

98. *See* Klass & Wilson, *supra* note 8, at 1158.

99. *Id.* at 1156–57 (categorizing energy usage data into three separate categories: (1) real-time, subhourly data (high sensitivity); (2) semigranular hourly or monthly historic data (moderate sensitivity); and (3) nongranular annual historic energy use data (low sensitivity)).

100. *See id.*

101. A utility company might be a DSO or a REP or both depending on whether it is located in a traditionally regulated or deregulated state. In traditionally-regulated state electricity markets, a single utility company operates a closely-regulated monopoly over the generation, distribution, and retail sales of electricity making it both the DSO and REP. *See Regulated vs. Deregulated Electricity Markets*, ENERGYWATCH (Jan. 9, 2018), https://energywatch-inc.com/regulated-vs-deregulated-electricity-markets/ ("From the generation to the meter, the utility has complete control."). Deregulated, or restructured, electricity markets unbundle at least retail sales which requires DSOs (the incumbent utilities with ownership over the electricity distribution lines and wires) to compete with individual REPs for customers. *See id.* For a more thorough explanation see Seth Blumsack,

management responsibilities can also be spread across these parties. A 2016 survey from the Council of European Energy Regulators observed three general meter data management approaches:

> A fully centralised model . . . would be a data hub, where all data is retrieved, validated, stored, protected, processed, distributed and accessed. This model is essentially a 'one stop shop' for data, where DSOs, market actors and all consumers only have one actor, the data hub, which they relate to.
>
> A partially centralised model involves centralisation of one of the key aspects of data management, typically distribution and access to data . . . [like] a communications hub that provides a common access point for data that could be stored in several databases, at DSOs or at metering points i.e. the model could enable centralized access to data stored at decentralised locations . . . .
>
> A decentralised model would typically mean that all the key aspects of data management are . . . the responsibility of the DSO. A typical decentralized model would be a standardised message exchange system or another more crude way of connecting market actors with DSOs, such as the use of PDF-files for updated network tariffs. This does not typically include a common access point, but rather a standardised or non-standardised format through which market actors can communicate with DSOs and request the data they require. The customer does not typically have access to data in a decentralised model, but will have to contact the DSO for access to data.[102]

Numerous European and U.S. examples illustrate these three approaches and how they function in practice.

1. The European Experience

The data management structures in the Netherlands, Norway, Italy, Denmark, Belgium, and Great Britain offer a brief but informative introduction to the array of potential centralization options:

Electricity Industry Structure and Regulation, E-EDUC. INST., https://www.e-education.psu.edu/eme801/node/529 (last visited Jan. 17, 2019).

102. COUNCIL OF EUROPEAN ENERGY REGULATORS, REVIEW OF CURRENT AND FUTURE DATA MANAGEMENT MODELS 13 (2016), https://www.ceer.eu/documents/104400/-/-/1fbc8e21-2502-c6c8-7017-a6df5652d20b; *see also Atrias and MIG6.0: Towards a New Energy Market Model in Belgium*, SIA PARTNERS (Jan. 7, 2016), http://energy.sia-partners.com/20160701/atrias-and-mig60-towards-new-energy-market-model-belgium (distinguishing between the decentralized, point-to-point approach, the "centralized approach through externalization of services," and the DSO-centric data gathering approach with a centralized common service).

Netherlands. In 2007, the Energie Data Services Nederland (EDSN) centralized Dutch energy meter data.[103] EDSN standardized data formatting for grid operators, which led to innovations in Dutch laws and regulations to better allow the application of smart meter data to benefit consumers, and, through its Project Meetcampagne, create energy consumption profiles to optimize underlying systems.[104]

Norway. Prior to AMI rollout in Norway, it used a decentralized, DSO-centered approach with a standardized communication portal to exchange meter data.[105] Even with a uniform communication format, the decentralized approach still resulted in "complex business processes, as market participants have to speak with each individual DSO to gain access to data."[106] To minimize these transaction costs, Norway transitioned to Elhub—a centralized meter data storage, protection, and distribution hub.[107]

Italy. Italy uses a decentralized, DSO-centric approach but lacks communication uniformity.[108] With Italian DSOs using over 350 different standards in their own management systems, the Italian energy industry faced a "major communications issue . . . between distributors and suppliers, and . . . a total lack of

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103. *See* ENERGIE DATA SERVICES NEDERLAND (EDSN), https://www.edsn.nl/english/ (last visited Jan. 18, 2019).

104. *See Onze Projecten*, ENERGIE DATA SERVICES NEDERLAND (EDSN), https://www.edsn.nl/onze-projecten/ (last visited Jan. 18, 2019); *see also* FILIP CHRISTIANSEN & MATILDA TRANELL, DATA MANAGEMENT AND BUSINESS OPPORTUNITIES IN EMERGING SMART METERING MARKETS 29–30 (2016), http://www.diva-portal.org/smash/get/diva2:1094807/FULLTEXT01.pdf ("As of 2016, EDSN is mainly working as a portal where all external parties, such as suppliers and third parties, can request and retrieve data. The standardization of the hub has reached a high level, allowing efficient distribution of data irrelevant of which DSO that is collecting and submitting the meter data to the hub.").

105. COUNCIL OF EUROPEAN ENERGY REGULATORS, *supra* note 102, at 21.

106. *Id.*

107. ELHUB, https://elhub.no/ (last visited Jan. 17, 2019) (stating that Elhub went operational February 18, 2019). S*ee generally* El Hub, *The Norwegian Datahub for the Electricity Market—ELHUB (English main)*, YOUTUBE (Mar. 11, 2016), https://www.youtube.com/watch?v=uYVo1MHBFvc.

108. COUNCIL OF EUROPEAN ENERGY REGULATORS, *supra* note 102, at 21 ("The DSO is responsible for meter readings and technical activities, collecting and storing metering data, meter data validation and making them available for market participants on a non-discriminatory basis . . . . DSOs and suppliers have to keep to the Privacy Code and other rules on privacy.").

completeness in [its] consumer identification data."[109] To correct these issues, Italy mandated the creation of the Sistema Informativo Integrato (SII) that centralized the sharing, integration, and exchange of energy meter data.[110] The Italian government already uses the SII to prevent rampant evasion of a TV tax and recognizes significant public policy and commercial uses of SII's centralized format.[111]

Denmark. This electricity market is uniquely REP-centric and uses its DataHub as a central market platform that functions as the country's centralized data storage and exchange medium as well as the central market processer.[112] The DSOs report all metering values to the DataHub which then distributes it to "authorised market actors, end customers and relevant third parties."[113] The REPs control "how to visualise consumption data to their consumers" within certain minimum requirements.[114] Retail customers "fully control how and when energy advisors, service providers and other third parties can get access to their consumption data."[115] DataHub facilitated significant improvements in the Danish electricity markets.[116]

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109. Alessio Borriello, *The Italian Energy Data Platform*, *in* 6TH EUROPEAN ENERGY FORUM 13 (2017), http://www.wec-france.org/DocumentsPDF/rapports/Actes-2017.pdf.

110. *See* Legge 13 agosto 2010, n. 129, in G.U. Aug. 18, 2010, n.192 (It.); *see also* COUNCIL OF EUROPEAN ENERGY REGULATORS, *supra* note 102, at 23 ("[SII] will become a central hub for customer consumption data, although some processes such as activation, deactivation and meter reading will still be carried out by DSOs.").

111. Borriello, *supra* note 109, at 13–14.

112. *See* COUNCIL OF EUROPEAN ENERGY REGULATORS, *supra* note 102, at 21–22; *see also What Is the Purpose of DataHub?*, ENERGINET, https://en.energinet.dk/Electricity/DataHub#Documents (last visited Jan. 17, 2019) ("Every piece of information about the electricity consumption of Danish consumers is stored in DataHub, which also handles business processes, such as change of address, change of supplier etc.").

113. COUNCIL OF EUROPEAN ENERGY REGULATORS, *supra* note 102, at 22.

114. *Id.*

115. *Id.*

116. *See id.* ("Settlement of small consumers based on hourly values will be implemented gradually from 2017 to 2020, which will increase the incentives for end-users to actively take part in the market. The current DataHub ensures a level playing field for all suppliers through standardised processes for registration and distribution of market data, low entry barriers for new market participants, one point of entry for change of supplier and a clear definition of DSO and suppliers and separation of roles.").

Belgium. The DSOs in Belgium collectively founded Atrias to function as both a central clearing house for the Belgian energy market as well as a central meter data manager.[117] Like the Danish, the approach would still observe a decentralized meter data collection and storage but would centralize distribution and access in the Atrias data hub.[118] High costs have led to delays which worry Belgian energy officials about the future of the project.[119]

Great Britain. Finally, Britain activated its centralized smart network, the Data and Communications Company (DCC), in 2016.[120] DCC is a private entity licensed and regulated by the U.K. government.[121] In addition to facilitating energy market processes, DCC will fully centralize smart meter data retrieval, storage, and accessibility as Great Britain develops its AMI network.[122]

2. U.S. Federal Energy Consumption Data Management

The federal government regulates a limited number of energy usage data creation and dissemination issues. Two programs—the Environmental Protection Agency's ENERGY STAR Portfolio Manager and the electric industry's Green

117. *See id.* ("The CMS is financed by all Belgian DSOs to take up the market data facilitation role and will be operated by a company called Atrias.").

118. *See Atrias and MIG6.0: Towards a New Energy Market Model in Belgium*, *supra* note 102. ("The individual DGOs will still hold the detailed metering data and communicate the necessary data to the data hub (Atrias) who will be responsible for the access register. This approach lowers the barrier for new third party market players to request information from the DGO to be able to provide their services.").

119. *See* Pieterjan Van Leemputten, *IT-Databank Belgische Energiesector Opnieuw Uitgesteld: Tommelein Pleit Voor Vlaamse Databank*, DATANEWS (Dec. 13, 2018), https://datanews.knack.be/ict/nieuws/it-databank-belgische-energiesector-opnieuw-uitgesteld-tommelein-pleit-voor-vlaamse-databank/article-normal-1406145.html?cookie_check=1547770208.

120. *See Building Britain's Smart Economy*, DATA COMM. COMPANY (Aug. 28, 2018), https://www.smartdcc.co.uk/news-and-insights/industry-insights/building-britain-s-smart-economy/.

121. *See Transition to Smart Meters*, OFGEM, https://www.ofgem.gov.uk/gas/retail-market/metering/transition-smart-meters (last visited Jan. 17, 2019).

122. *See* DATA COMMC'NS CO., BUILDING BRITAIN'S SMART FUTURE (2018), https://www.smartdcc.co.uk/media/1954/smart_dcc_business_plan_2018-19__1_.pdf.

Button initiative—encompass the entirety of federal influence on the structure of energy data management.[123]

Portfolio Manager scores and certifies commercial buildings' energy efficiency by "analyzing a building's . . . type, available space, and energy consumption by fuel type."[124] Top scoring buildings receive ENERGY STAR certification.[125] Participating building owners can compare their performance with similar buildings and national medians.[126] Portfolio Manager succeeded in "increasing building owners' awareness of energy efficiency opportunities, incentivizing energy efficiency projects by enabling comparisons to similar types of buildings or national medians, and providing a consistent framework for publishing energy efficiency data."[127] The fact that it relies on voluntary disclosures, however, creates a self-selecting dataset—"high-performing buildings are likely more willing to share their data."[128]

A presidential challenge to increase the uniformity of and access to energy consumption data for customers prompted the electric industry's "Green Button" platform development.[129] Green Button records data in an XML format and features data exchange protocols that allow automatic energy data transfers between utilities and third parties.[130] Green Button permits utilities to provide data in intervals ranging from fifteen minutes to month-by-month consumption.[131] The *Download My Data* feature permits customers to directly download their data to personal devices, where the file can then be uploaded to third-party applications.[132] The *Connect My Data* feature allows

123. *See* Klass & Wilson, *supra* note 8, 1112–13 (identifying the ENERGY STAR Portfolio Manager and Green Button programs as the primary vehicles for federal influence on the structure of energy data management).

124. *Id.*

125. *See id.*

126. *See id.*

127. *Id.* at 1113.

128. *Id.* at 1113–14.

129. *See What Is Green Button?*, ENERGY.GOV, https://www.energy.gov/data/green-button (last visited Feb. 6, 2019); *see also* Klass & Wilson, *supra* note 8, at 1114–15.

130. *See What Is Green Button?*, *supra* note 129. Green Button follows the Energy Services Provider Interface standard published by the North American Energy Standards Board. *Id.*

131. *Id.*

132. *Id.*

customers to authorize the secure transfer of their energy usage data directly to third parties.[133]

Both Portfolio Manager and Green Button suffer, however, because of their voluntary nature. In addition to these voluntary programs, two federal agencies also published non-binding discussions on best energy data privacy practices: (1) the Voluntary Code of Conduct (VCC) published by the U.S. Department of Energy;[134] and (2) the Guidelines for Smart Grid Cybersecurity ("Grid Guidelines") published by the National Institute of Standards and Technology.[135] Both the VCC and Grid Guidelines only recommend practices and standards.[136] This leaves the door open for state and local policymakers to supply the regulatory oversight and incentives to optimize energy meter data management.

U.S. federal management of energy meter data is minimal, leaving states to fill this regulatory void in a "laboratories of democracy" fashion.[137] As relative leaders in smart meter roll out and regulation, California, Illinois, and Texas provide examples of the contemporary state approaches to energy consumption data management.[138] While starting with the

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133. *Id.*

134. U.S. DEP'T OF ENERGY, VOLUNTARY CODE OF CONDUCT: FINAL CONCEPTS AND PRINCIPLES (2015), https://www.energy.gov/sites/prod/files/2015/01/f19/VCC%20Concepts%20and%20Principles%202015_01_08%20FINAL.pdf.

135. NAT'L INST. OF STANDARDS & TECH., *supra* note 91. The VCC and Grid Guidelines provide important discussions on privacy measures and expert analysis on aggregation techniques to protect energy consumers but are beyond the scope of this Note's focus on the organizational choices for energy usage data management.

136. *See* U.S. DEP'T OF ENERGY, *supra* note 134, at 1 ("The VCC's recommendations are intended to apply as high level principles of conduct for both utilities and third parties."); NAT'L INST. OF STANDARDS & TECH., *supra* note 91 (describing its report as "an analytical framework that organizations *can use* to develop effective cybersecurity strategies . . . .") (emphasis added).

137. *See, e.g.*, New State Ice Co. v. Liebmann, 285 U.S. 262, 311 (1932) (Brandeis, J., dissenting) ("It is one of the happy incidents of the federal system that a single courageous state may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country."); *cf.* Sharon B. Jacobs, *The Energy Prosumer*, 43 ECOLOGY L.Q. 519, 572 (2017) (encouraging regulatory experimentalism in energy policy, particularly in regards to "complex and rapidly developing technology").

138. *See* Coley Girouard, *The State of Advanced Metering Infrastructure and Time-Varying Rates, in Three Maps and One Graph*, ADVANCED ENERGY PERSPECTIVES (Nov. 22, 2017), https://blog.aee.net/the-state-of-advanced-metering-infrastructure-and-time-varying-rates-in-three-maps-and-one-

decentralized management structures, these states have begun initial steps toward centralizing particular meter data management responsibilities.

3. California

California moved from a fully competitive retail market to a partially restructured energy regulatory scheme following the California Energy Crisis between 2000 and 2001.[139] There remains some semblance of retail electric choice, with thirty to forty percent of customers in the state's investor-owned utilities' service area receiving service from an alternative source or provider.[140] The majority of retail energy consumers, however, are served by California's six investor-owned utilities.[141] California currently ranks first on the Grid Modernization Index,[142] with over 12.5 million AMI units deployed.[143]

Consumer privacy received early attention. For consumption data, the California Public Utilities Commission (CPUC) readopted a data aggregation privacy practice known as

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graph.-the-leaders-and-laggards-may-surprise-you (comparing the percentage of AMI meters installed out of total residential meters by state, and the active AMI dockets).

139. *See* CARL BLUMSTEIN, LEE S. FRIEDMAN & RICHARD GREEN, THE HISTORY OF ELECTRICITY RESTRUCTURING IN CALIFORNIA 21–28 (Aug. 2002), https://cloudfront.escholarship.org/dist/prd/content/qt85k8w3k7/qt85k8w3k7.pdf.

140. *See The Future of Retail Electric Choice in California*, DIRECT ENERGY BUS. BLOG (May 18, 2017), https://business.directenergy.com/blog/2017/May/future-retail-electric-choice-california ("By the end of 2017, 30–40 percent of California's investor-owned electric utility customers will be receiving some type of electricity service from an alternative source and/or provider, such as community choice aggregators, rooftop solar or direct access providers.").

141. CAL. PUB. UTIL. COMM'N, CONSUMER AND RETAIL CHOICE, THE ROLE OF THE UTILITY, AND AN EVOLVING REGULATORY FRAMEWORK 3 (May 2017), http://www.cpuc.ca.gov/uploadedfiles/cpuc_public_website/content/news_room/news_and_updates/retail%20choice%20white%20paper%205%208%2017.pdf (estimating seventy-five percent of the retail load by the end of 2017 will be handled by investor-owned utilities, but that by the mid-2020s eighty percent of the retail load will instead come from "rooftop solar, Community Choice Aggregators (CCAs) and Direct Access providers (ESPs)").

142. *See* GRIDWISE ALL., FOURTH GRID MODERNIZATION INDEX 10 (Nov. 2017).

143. *See* U.S. ENERGY INFO. ADMIN., ELECTRIC POWER SALES, REVENUE, AND ENERGY EFFICIENCY FORM EIA-861 DATA FILES (2016), https://www.eia.gov/electricity/data/eia861/ (open 2017 ZIP file on web page and select the "Advanced_Meters_2017" Microsoft Excel spreadsheet for data).

the "15/15 Rule" in 1997.[144] The rule requires that database disclosures should be aggregated using at least fifteen customers, none of whom can make up more than fifteen percent of the total aggregated load.[145] Commercial, agricultural, and industrial customer energy usage data must conform to the 15/15 Rule.[146] For residential customers, 100 or more account-level data points must be aggregated.[147]

In September 2012, the CPUC published a brief on its vision of a smart meter data hub.[148] Recognizing the value of aggregated, granular smart meter data, the brief focused on correcting three access issues: (1) utility companies not readily available, unresponsive, or release out-of-scope, overly-aggregated, and outdated usage data; (2) utility companies purposely exploiting these limitations for personal gain; and (3) utility companies interpreting state law and CPUC rules differently.[149] The briefing paper ultimately sought ways to eliminate "the utility as the gate-keeper" to provide for greater government and researcher access to energy usage data.[150] It recommended a public smart meter data hub which the authors believed might "provide greater availability, geographically and temporally, of aggregated and anonymized customer energy usage data in the long run, thereby lowering potential utility barriers to this data."[151]

144. *See* Proposed Policies Governing Restructuring Cal.'s Elec. Servs. Indus. & Reforming Regulation, 76 CPUC 2d 29 (Cal. Pub. Util. Comm'n Oct. 9, 1997).

145. *Id.* ("The 15/15 rule is that the . . . information should be made up of at least 15 customers, and a customer's load must be less than 15% of an aggregation category.").

146. *See* Order Instituting Rulemaking to Consider Smart Grid Techs. Pursuant to Fed. Legislation & on the Comm'n's Own Motion to Actively Guide Policy in Cal.'s Dev. of a Smart Grid Sys., 313 PUB. UTIL. REP. 4th 167 (May 1, 2014).

147. *Id.*

148. *See generally* AUDREY LEE & MARZIA ZAFAR, CAL. PUB. UTIL. COMM'N, ENERGY DATA CENTER BRIEFING PAPER (2012), http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Divisions/Policy_and_Planning/PPD_Work/Pre_2013_PPD_Work/EnergyDataCenterFinal.pdf.

149. *Id.* at 1–2.

150. *Id.* at 2.

151. *Id.*

The authors viewed three possible roles for the smart meter data hub.[152] First, it would be a data aggregator and anonymizer, making the usage data available and accessible without running afoul of privacy protection.[153] Second, the smart meter data hub could provide independent research and analysis for state, CPUC, and utility programs using account-level data, but would then publish results in an "aggregated and anonymized form."[154] Third, the smart meter data hub would facilitate the safe transfer of account-level data to governmental organizations.[155] These functions, in the CPUC's view, would overcome the identified problems with the utility as data manager approach and streamline timely access to both account-level and aggregated and anonymized usage data.[156]

Ultimately, the CPUC chose to continue with the utility-centric model, creating rules on different "use cases."[157] These use cases provide access privileges for local governments, researchers, and the public depending on the sensitivity of the data and the intentions of the requestor.[158] The investor-owned utilities continue to manage energy usage data, aggregating the data and fulfilling access requests.[159] The CPUC, however, suggested that it remains open to revisiting the idea in future proceedings.[160]

4. Illinois

Illinois restructured to a competitive retail market with the Electric Service Customer Choice and Rate Relief Law of 1997.[161] The Illinois Commerce Commission (ICC) has regulatory

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152. *Id.* at 2–3.
153. *Id.*
154. *Id.* at 3.
155. *Id.*
156. *Id.* at 4.
157. *Re* Smart Grid Technologies, 313 Pub. Util. Rep. 4th 167 (Cal. Pub. Util. Comm'n May 16, 2014).
158. *Id.*
159. *See id.* at *91–93 (ordering California's investor-owned utilities regarding data management practices and activities).
160. *Re* Smart Grid Technologies, *supra* note 157, at *16. ("[T]he Commission continues to see the importance of exploring the value of a dedicated energy data center in the future to increase access to data while developing reasonable protections on customer privacy.").
161. *See generally* Electric Service Customer Choice and Rate Relief Law, 5 ILL. COMP. STAT., art. XVI (1997).

oversight and is charged with promoting a competitive retail electricity market.[162] Commonwealth Edison ("ComEd") and Ameren Illinois ("Ameren") operate service territories covering about ninety-eight percent of Illinois' retail customers and all of the competitive retail electric suppliers.[163] The Illinois legislature and the ICC required Ameren and ComEd to invest in AMI deployment,[164] however both utilities offer customer opt-out options for a fee.[165] Illinois is currently second on the Grid Modernization Index,[166] and is expected to have five million smart meters fully installed by 2019.[167]

In 2014, Illinois' Citizens Utility Board—the state's ratepayer advocacy organization—and the Environmental Defense Fund petitioned the ICC to review, refine, and adopt their proposed Illinois Open Data Access Framework.[168] The framework would govern access standards that detail rules for customers, utilities, and third parties to access customer usage data. As part of the discussions instigated by this ICC proceeding, Ameren and ComEd prepared "Data Roadmaps" that include plans for implementing data access standards.[169]

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162. *See* 5 ILL. COMP. STAT., art. XVI, § 16-101A(d) (2018).

163. *See* ILL. COMPETITIVE ENERGY ASS'N, ELECTRIC INDUSTRY RESTRUCTURING IN ILLINOIS AT THE 10-YEAR MARK 3–4 (2017).

164. *See* 5 ILL. COMP. STAT., art XVI, § 16-108.6(c) (2018).

165. ComEd filed a monthly $21.53 AMI refusal fee with the ICC. *Re* Commonwealth Edison Company: Submission of Rider NAM, Non AMI Metering, Docket No. 13-0552 at 13 (Ill. Commerce Comm'n Feb. 5, 2014), https://www.icc.illinois.gov/docket/files.aspx?no=13-0552&docId=209011 ("Staff's proposed $21.53 is reasonable, cost-based, and likely to deter meter refusals."); *see also* Wade v. Ill. Commerce Comm'n, 91 N.E.3d 383, 385 ¶ 20 (Ill. App. Ct. 1st Dist. 2017) (concluding ComEd's $21.53 refusal charge is reasonable, within the legislative prerogative, and is Illinois law under the filed rate doctrine). Ameren filed a $20 monthly tariff for AMI refusals. *See* Tony Reid, *'Smart Meter' Refusal Comes at a Cost*, HERALD & REV. (Sept. 22, 2014), https://herald-review.com/news/local/smart-meter-refusal-comes-at-a-cost/article_dbf05964-ecbf-5b8a-8347-4aaa4f4c9dc9.html (discussing Ameren's $20 monthly fee).

166. *See* GRIDWISE ALL., *supra* note 142, at 10.

167. *See* MURRAY & HAWLEY, *supra* note 67, at 19.

168. *See* Citizens Utility Board and Environmental Defense Fund, Petition to Initiate a Proceeding to Adopt the Illinois Open Data Access Framework, Docket No. 14-0507 (Ill. Commerce Comm'n Aug. 15, 2014), https://www.icc.illinois.gov/docket/files.aspx?no=14-0507&docId=217753.

169. *See* Ameren Ill. Co., Direct Testimony Exhibit 1.1: Ameren Illinois Advanced Metering Infrastructure (AMI) Data Road Map, Docket No. 14-0507 (Ill. Commerce Comm'n June 5, 2017), https://www.icc.illinois.gov/docket/files.aspx?no=14-0507&docId=253801; *see*

The Open Data Access Framework covers recommendations on ownership, customer and third-party access, format, method of delivery, timeliness, security, and charges for provision of energy usage data.[170] The Framework would make energy customers the principal owners of their energy usage data, meaning they have free access to data in fifteen-minute to one-hour intervals.[171] Third-party access to all energy data—account-level and aggregated—is subject to affirmative customer authorization which is revocable at the customer's discretion and subject to re-authorization requirements after a set number of months.[172] It is on the customer to limit the scope of access to third parties, but in no event can be more strict than the 15/15 Rule.[173]

The transmission utilities, under this framework, act as "guardian" by internally protecting and then disseminating the usage data to authorized parties.[174] The utilities may create their own third-party approval processes for data security and transmission purposes.[175] The utility would use "industry-standard secure communications and encryption protocols" and similar industry-standard cyber security protections for internal data storage.[176] Delivery of data should be timely—as near to real time as practicable—and done via the smart meter, over the internet through a "Web Portal" and a mobile application, and through bulk transfers where practicable.[177]

Ameren's Roadmap reveals that it completed several milestones in its deployment of AMI. Besides the physical installation and connection, it has integrated its smart metering with its billing systems and the Green Button Web Portal, made the system capable of remote connections, and began supplying

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also Commonwealth Edison Co., Direct Testimony Exhibit 1.1: ComEd AMI External Data Exchanges, Docket No. 14-0507 (Ill. Commerce Comm'n June 5, 2017), https://www.icc.illinois.gov/docket/files.aspx?no=14-0507&docId=253787.

170. *See generally* CITIZENS UTIL. BD. & ENVTL. DEF. FUND, OPEN DATA ACCESS FRAMEWORK (2014), https://www.smartgridlegalnews.com/wp-content/uploads/sites/517/Illinois_Open_Data_Access_Framework_0814.pdf.

171. *Id.* at 1.

172. *Id.* at 1–2.

173. *Id.* at 2.

174. *Id.* at 1.

175. *Id.* at 2.

176. *Id.* at 7.

177. *Id.* at 6.

retail electric suppliers with "non-billing interval data."[178] Residential customers with smart meters can receive daily or even hourly energy usage data on the web along with their monthly billing data.[179] For commercial and industrial customers, usage data is collected in fifteen-minute intervals.[180] As of 2016, customers with home area networks "could receive 'near real time' data."[181] Energy data is delivered to customers on the meter or online via Green Button's "MyAccount portal" and, as of 2017, to third parties via Green Button's "Connect My Data" function.[182] All authorized access, regardless of whether by customers or third parties, is provided free of charge.[183] Ameren promises to provide aggregated, anonymous data subject to the 15/15 Rule for the whole service territory in the near future.[184]

ComEd's Roadmap tells a similar narrative. It is currently capable of offering raw usage data in near real time, partially validated usage data in thirty-minute intervals by the next day, hour-interval billed consumption data also within twenty-four hours, and aggregated anonymous usage data—conforming to the 15/15 Rule—at thirty minute or shorter intervals similarly by the next day.[185] These data offerings can be delivered to customers through in-home devices, via Green Button's Connect My Data function, and on ComEd's website.[186] Authorized third parties can receive the energy data through the same formats on Green Button, or can undergo ComEd's anonymous usage data registration process to access this new data service.[187]

178. Ameren Ill. Co., *supra* note 169, at 3.

179. *Id.* at 7.

180. *Id.*

181. *Id.*

182. *Id.* at 8–11.

183. *Id.* at 13.

184. *Id.* at 11.

185. Commonwealth Edison Co., *supra* note 169, at 7.

186. *Id.* at 8.

187. *Id.* at 10; *see also* Press Release, Commonwealth Edison Co., ComEd Launches New, Industry-Leading Energy Data Product (Feb. 13, 2017), https://www.comed.com/News/Pages/NewsReleases/2017_02_13.aspx; *Anonymous Data Service*, COMED, https://www.comed.com/SmartEnergy/InnovationTechnology/Pages/AnonymousDataService.aspx (last visited Mar. 30, 2019) (providing a description of ComEd's anonymous data delivery services, instructions on how to access, and service agreement registration forms).

The ICC concluded that the "Open Data Access Framework provides beneficial considerations for data collection, security, management and means by which customers and third parties can access AMI data," and that "the Data Roadmaps of Ameren and ComEd represent sound and appropriate plans to develop various systems and services around AMI data for customers and third parties."[188] Under this regulatory environment, Ameren and ComEd have successfully leveraged smart metering. ComEd offers a Peak Time Savings program, a demand flexibility initiative that credits residential customers' monthly bills for delaying their "dishwasher, vacuum, clothes dryer, or other large electronics/appliances" use during peak demand hours.[189] The program has resulted in $1.2 million in bill credits to 166,383 customers since it started in 2015.[190] In August 2016, Ameren's demand flexibility program, Peak Time Rewards,[191] curtailed 30,100 kWhs.[192] Despite legislative support and successful programs, there is still pushback from Illinois residents.[193]

5. Texas

Following the passage of Senate Bill 7 in 1999 and its implementation in 2002, Texas restructured its retail electricity

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188. Order, The Citizens Utility Board and The Environmental Defense Fund; Proceeding to Adopt the Illinois Open Data Access Framework, Docket No. 14-0507 at 6 (Ill. Commerce Comm'n July 26, 2017), https://www.icc.illinois.gov/docket/files.aspx?no=14-0507&docId=255196.

189. *Peak Time Savings*, COMED, https://www.comed.com/WaysToSave/ForYourHome/Pages/PeakTimeSavings.aspx (last visited Jan. 31, 2019).

190. *See* David J. Unger, *After Five Years, Illinois Smart Grid Buildout Showing Results*, MIDWEST ENERGY NEWS (Apr. 27, 2017), http://midwestenergynews.com/2017/04/27/after-five-years-illinois-smart-grid-buildout-showing-results/.

191. *Peak Time Rewards*, AMEREN ILL., https://peaktimerewards.com/ (last visited Mar. 30, 2019).

192. *See* Unger, *supra* note 190.

193. *See* Naperville Smart Meter Awareness v. City of Naperville, 114 F. Supp. 3d 606 (N.D. Ill. 2015) (dismissing all claims and denying, with prejudice, a non-profit corporations motion to file a third amended complaint in opposition to a city's AMI deployment based on Fourth Amendment claim and on a claim for unreasonable search or an invasion of privacy in violation of Illinois' Constitution); *see also* Karen Kidd, *Belleville Resident Calls Ameren's Smart-Meter Plan a Bad Idea*, METRO EAST SUN (Jan. 15, 2018), https://metroeastsun.com/stories/511278652-belleville-resident-calls-ameren-s-smart-meter-plan-a-bad-idea.

market to allow competition between retail electric providers.[194] The incumbent investor-owned utilities still maintain a regulated monopoly service territory over transmission and distribution to avoid inefficient overlap of multiple private power lines.[195] Since the incumbent transmission and distribution utilities also continue providing metering services,[196] AMI and energy usage data decisions go through the Public Utility Commission of Texas (PUCT).[197] In 2007, the PUCT accelerated smart meter deployment by allowing these transmission and distribution utilities to recover AMI installation costs from the rate base.[198] By 2016, Texas utilities deployed over 9.3 million AMI devices.[199]

PUCT supported AMI deployment with a series of technology requirements and policy goals for the transmission and distribution utilities managing customer energy usage data. The AMI must be capable of providing convenient, secure, and real-time access to customers, as well as providing data in fifteen-minute intervals and available by the next day to retail electric providers.[200] Access includes the capability to deliver data on devices within the premises like a load control device or home area network.[201] Standards and protocols must be open to the public and conform with industry standards.[202] The state

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194. *See* S.B. 7, 76th Leg., ch. 405, § 39 (Tex. 1999); *see also* TEX. UTIL. CODE § 39.001 *et seq.* (2018).

195. *See* JAKE DYER, CITIES AGGREGATION POWER PROJECT, INC., 10 YEARS OF SENATE BILL 7: THE HISTORY OF ELECTRIC DEREGULATION IN TEXAS 13 (2009), http://tcaptx.com/downloads/HISTORY-OF-DEREGULATION.pdf ("The companies that own, operate and manage the transmission and distribution system remained regulated.").

196. *See* TEX. UTIL. CODE § 39.107(a) (2018) ("[M]etering services . . . shall continue to be provided by the transmission and distribution utility . . . that was serving the area before the introduction of customer choice.").

197. *See generally* TEX. UTIL. CODE § 39.000 (2018).

198. *See* 16 TEX. ADMIN. CODE § 25.130(k) (2018); *see generally* Order Adopting New § 25.130 and Amendments to §§ 25.121, 25.123, 25.311, and 25.346, Project No. 31418 (Pub. Util. Comm'n of Tex. May 10, 2007), https://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.121/31418adt.pdf.

199. *See* U.S. ENERGY INFO. ADMIN., *supra* note 143.

200. 16 TEX. ADMIN. CODE § 25.130(g)(1)(E) (2018); 16 TEX. ADMIN. CODE § 25.130(j)(1) (2018).

201. 16 TEX. ADMIN. CODE § 25.130(g)(1)(J) (2018).

202. 16 TEX. ADMIN. CODE § 25.130(g)(1)(I)–(J) (2018); 16 TEX. ADMIN. CODE § 25.130(j)(3) (2018).

legislature assigned "ownership" to the customer,[203] and the PUCT recognizes this ownership by allowing customers to authorize energy usage data disclosures to any entity.[204]

Five of Texas' investor-owned electric transmission and distribution utilities responded in 2007 by collaborating on a centralized energy usage data portal called Smart Meter Texas.[205] This common web portal allows customers, retail electric providers, and authorized third parties to access energy usage data. Consumers can request "Daily Energy Data (15-minute intervals) and Daily Meter Read reports for up to 24 months of historical energy data."[206] Consumer monthly usage can be requested for up to two years of historical usage data.[207] Consumers with home area networks can view real-time energy data.[208]

As part of their "ownership" rights, electricity customers can allow third parties to access their account-level data on the Smart Meter Texas portal. Residential customers can share their account-level usage data with up to five friends, while business customers can manage access for other persons in their company.[209] In line with PUCT rules, "Third-Party Service Providers" other than the customer's retail service provider must be authorized via an Energy Data Agreement.[210] Smart Meter Texas supports three agreements: (1) Energy Data Agreements, which provide twelve months of read-only access to the customer's data; (2) In-Home Device Agreements, which allow the installation and connection of in-home devices with the customer's smart meter; and (3) In-Home Device Services

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203. TEX. UTIL. CODE § 39.107(b) (2018) ("All meter data, including all data generated, provided, or otherwise made available, by advanced meters and meter information networks, shall belong to a customer . . . .").

204. 16 TEX. ADMIN. CODE § 25.130(j)(5) (2018) ("A customer may authorize its data to be available to an entity other than its [retail electric provider].").

205. *See Frequently Asked Questions*, SMART METER TEXAS, https://www.smartmetertexas.com/CAP/public/home/home_faq.html#a1 (last visited Mar. 23, 2019) (describing the general operations of Smart Meter Texas, a collaborative effort among AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, Oncor Electric Delivery Company, and Texas-New Mexico Power Company).

206. *See id.*

207. *See id.*

208. *See* MURRAY & HAWLEY, *supra* note 67, at 18 ("Real-time data is available through the Home Area Network interface.").

209. *See* SMART METER TEXAS, *supra* note 205.

210. *See id.*

Agreements, which authorize third parties to send messages and events over the customer's home area network.[211]

A general complaint about Smart Meter Texas is that its technology is outdated and "clunky,"[212] so effectively using it incurs high transaction costs which makes it unappealing to most residential and business customers.[213] To upgrade the centralized Smart Meter Texas platform to "SMT 2.0," the PUCT engaged the Joint Transmission and Distribution Utilities operating Smart Meter Texas and Texas' energy data stakeholders.[214] The upgrades seeks to do two things: (1) streamline the authorization process from ten steps—five of which require the customer to affirmatively act—to a three step process; and (2) introduce the latest Green Button Connect application program interface.[215] The PUCT approved the changes in May of 2018.[216]

California, Illinois, and Texas have developed decentralized data management systems where the incumbent investor-owned utilities take primary responsibility over smart meter data. State public utility commissions then guide their access and

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211. *See id.*

212. *See* Jeff St. John, *Texas Takes a Big Step in Improving Access to Smart Meter Data*, GREENTECH MEDIA (Feb. 6, 2018), https://www.greentechmedia.com/articles/read/texas-smart-meter-data-access#gs.nm9DSRM (stating that the platform is "clunky" largely because it was "built on last decade's technology, and cumbersome rules [] have dissuaded a vast majority" of households and business from taking part).

213. *See* KING & BEVILL, *supra* note 79, at 6–8 (stating that the consumers expect a certain level of simplicity and convenience of online services that the Smart Meter Texas program has not met).

214. *See* Michael Murray, *Smart Meter Texas Goes Big: Settlement Calls for Green Button Connect API*, MISSION: DATA (Feb. 2, 2018), http://www.missiondata.org/news/2018/2/2/smart-meter-texas-goes-big-settlement-calls-for-green-button-connect-api.

215. *See id.* (discussing the three-step process and stating that SMT 2.0 will use the latest Green Button API).

216. Order, Commission Staff's Petition to Determine Requirements for Smart Meter Texas, Docket No. 47472 (Pub. Util. Comm'n of Tex. May 29, 2018), http://interchange.puc.texas.gov/Documents/47472_126_981735.pdf (subsequently modified by Order, Commission Staff's Petition to Determine Requirements for Smart Meter Texas, Docket No. 47472 (Pub. Util. Comm'n of Tex. July 12, 2018), http://interchange.puc.texas.gov/Documents/47472_138_986459.PDF); *see also* R.A. Dyer, *PUC Green Lights Smart Meter Texas 2.0, Expected Live in 2020*, TEX. COALITION FOR AFFORDABLE POWER: POL'Y & REFORM BLOG (June 4, 2018), https://tcaptx.com/policy-and-reform/blog-puc-green-lights-smart-meter-texas-2-0-expected-in-2020d.

privacy decisions through tariffs and rulemaking regulations. The lack-of-access issues that persist under these decentralized models, and the recent European trend toward more centralized data management structures, indicate it is time for states to seriously consider the benefits of the centralized data hub model.

II. ANALYSIS

State energy data hubs offer a more efficient meter data management structure. Previous analysis of centralizing energy meter data highlighted the reduced burden on electric utilities to collect, aggregate, and release the data, the greater ability to police data disclosures, and the benefits of a central research unit with the necessary statistical expertise.[217] A centralized data hub offers additional economic benefits that outweigh concerns over added bureaucratic costs. For one, a state data hub can prevent utilities from exercising inefficient market power over meter data access and privacy when it also participates in competitive energy services markets. Second, a centralized data hub may promote greater municipal and cooperative utility involvement, creating more comprehensive and representative datasets of state energy consumption. Finally, a politically accountable data hub better democratizes decisionmaking and enforcement of data disclosure and energy regulations, providing greater public control.

U.S. state governments are no stranger to intervening in U.S. energy markets because they are prone to "market failures."[218] Emerging data markets similarly face significant market failures.[219] It comes as no surprise, then, that smart meter data at the intersection of these two fields requires government correction. For example, energy usage data is at its core simply information about the flow of electrons into or out of a consumer's home or business (or individual smart appliances

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217. *See* Klass & Wilson, *supra* note 8, at 1150–57.

218. *See, e.g.*, Anthony C. Fisher & Michael H. Rothkopf, *Market Failure and Energy Policy*, 17 ENERGY POL'Y 397, 398–404 (1989) ("When the 'energy crisis' of a decade ago forced economists and policymakers to take a hard look at the role of government, there was a sense that energy was special, that the fundamental theorem of welfare economics (market allocation is efficient) might not apply.").

219. *See, e.g.*, MARTIN PEITZ, CTR. ON REGULATION IN EUR., BIG DATA MARKETS (Mar. 28, 2018), https://www.cerre.eu/sites/cerre/files/180328_CERRE_BigDataMarkets_ProfPeitz_Slides.pdf.

communicating with the meter). That record is an "impure public good" or "club good,"[220] meaning that while it is non-rivalrous—two firms can simultaneously review and use the same smart meter dataset—the high cost of recording, transmitting, and storing smart meter data[221] essentially allows the controlling firm to exclude others from accessing it.[222]

To prevent the natural tendency of impure public goods resulting in inefficient natural monopolies, the government may create a publicly-regulated monopoly.[223] That default solution underlies the California, Illinois, and Texas experiences—their state governments delegate data management decisions to the utility data-monopolists with the expectation that the utility company follows regulatory mandates regarding access and privacy. That traditional solution, represented by the fully decentralized utility-centric approach, fails to provide the most socially efficient balance between meter data access and privacy. Unfair market power, principal-agent, and coordination problems plague the decentralized model in ways that a centralized data hub model would reduce or remove—resulting in a better data access-privacy balance.

A. THE PRINCIPAL-AGENT AND MARKET POWER PROBLEMS

The decentralized, utility-based approach tempts private utilities to deviate from the socially-optimal access-privacy balance by exerting unfair market power.[224] While government

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220. *See* James M. Buchanan, *An Economic Theory of Clubs*, 32 ECONOMICA 1 (1965).

221. *See* Soma Shekara Sreenadh Reddy Depuru et al., *Smart Meters for Power Grid: Challenges, Issues, Advantages and Status*, 15 RENEWABLE & SUSTAINABLE ENERGY REVS. 2736, 2739–40 (2011) (describing how implementing AMI involves billions of investment dollars which makes it difficult to justify).

222. The high cost explains why smart meter deployment only occurs when an energy utility receives regulatory approval to recover rollout costs by increasing customer rates. *See* EDISON ELEC. INST., EEI SUMMARY OF STATE REGULATORY SMART GRID DECISIONS (2011), http://smartgrid.eei.org/Toolkit/2011-12-27-eei-state%20regulation-chart.pdf. The "controlling firm" becomes that regulatorily-privileged utility company.

223. *Cf.* Jeffery A. Dubin & Peter Navarro, *How Markets for Impure Public Goods Organize: The Case of Household Refuse Collection*, 4 J.L. ECON. & ORG. 217, 217–18 (1988).

224. *See* Zachary Abrahamson, *Essential Data*, 124 YALE L.J. 867, 873–74 (2014) (describing the private motivations for "data monopolists" to "refuse to deal" to ensure competing products and firms do not "supplant the monopolist's

regulation can attempt to correct for market power, an agency problem often reduces the effects of regulatory efforts.[225] With insights gained from smart meter data, many utilities will likely enter non-traditional energy services markets[226] on its unregulated or "below-the-line" side of its business.[227] To sustain a competitive edge over others in these markets, a utility with control over the necessary meter data might exploit poorly drafted regulations and rules.[228]

An example would be a utility implementing overly restrictive security and technical requirements on third parties if given the right to "institute a process for the approval of third parties . . . if such requirements are related to data security, and the ability to receive the transmission of data in an efficient manner."[229] By increasing third party transaction costs to meet excessively high privacy requirements, the utility can overly

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product"); *cf.* Craig Konnoth, *Health Information Equity*, 165 U. PA. L. REV. 1317, 1330 (2017) (describing how recipients of health research data "are known for seeking to maintain data monopolies," making it "harder to agglomerate private data").

225. *See* Paul L. Joskow & Richard Schmalensee, *Incentive Regulation for Electric Utilities*, 4 YALE J. ON REG. 1, 16–18 (1986) (discussing the imperfect ability of regulators to monitor the regulated electric utilities); *cf.* JOSE MIGUEL ABITO, MEASURING THE WELFARE GAINS FROM OPTIMAL INCENTIVE REGULATION 2 (Nov. 24, 2017), https://faculty.wharton.upenn.edu/wp-content/uploads/2018/07/abito_pollutionpriceregulation.pdf (discussing a corollary agency problem between regulators and energy utilities in the context of rate of return regulation).

226. *See* Herman K. Trabish, *Time-Travel, Utility-Style: Outlines of the Utility of the Future Appear*, UTIL. DIVE (Mar. 5, 2018), https://www.utilitydive.com/news/time-travel-utility-style-outlines-of-the-utility-of-the-future-appear/517788/; Justin Worland, *Why Your Power Company Wants to Sell You More than Electricity*, TIME (May 18, 2017), http://time.com/4783926/power-company-more-than-electricity/.

227. *See Glossary of Terms Used by Utilities and Their Regulators*, N.Y. STATE PUB. SERV. COMM'N http://www.dps.ny.gov/glossary.html#D (last updated Nov. 17, 2014) (defining "Below-the-Line" as "[a]ll income statement items of revenue and expense not included in determining utility net operating income.").

228. *See* ABRAMS ENVTL. LAW CLINIC, *supra* note 69, at 32 ("[A]s the California model [nondisclosure agreement] and DOE's Voluntary Code of Conduct demonstrate, even more specific rules can still leave some discretion to the regulated entities . . . ."). Previous experience with poor regulatory design in the electric industry illustrates the disconnect between social efficiency and the actual conduct motivated by private incentives. *See* Peter Bondarenko, *Enron Scandal*, ENCYC. BRITANNICA, https://www.britannica.com/event/Enron-scandal (last updated Jan. 31, 2018).

229. CITIZENS UTIL. BD. & ENVTL. DEF. FUND, *supra* note 170, at 2.

restrict access to the available data and maintain a high barrier to entry in energy services markets.[230] Monitoring and correcting this market power problem is likely to be expensive, and even with frequent reporting requirements, these reports may be read and interpreted on a delay—if at all.[231] When inefficient market power is eventually found, it will require costly antitrust negotiations or litigation.[232]

A centralized state energy data hub, on the other hand, would eliminate the utility's private incentive to increase market entry barriers and replace it with the government's public incentive to maintain competitive markets. Upfront data hub costs may result in long term cost reductions such as avoided monitoring efforts or reactive enforcement efforts because of poorly-crafted regulations. Energy consumers and the groups representing their interests can also monitor and correct an energy data hub's management more effectively than the politically unaccountable utility management team (or, even worse, multiple unaccountable data managers for states with more than one energy utility). In short, a state energy data hub would better "democratize" energy meter data decisions by providing consumers with more competitive markets, greater meter data control, and a clearer path to intervention.[233]

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230. *See* LEE & ZAFAR, *supra* note 148 at 1–2 ("An ongoing concern is whether, and to what extent if any, the utilities act against the interests or wishes of the customer and erect barriers to limit the opportunity for authorized third parties to obtain customer usage information. An additional concern is whether the utility acts as barrier against the sharing of aggregated data with governmental organizations that are seeking data for research or operational purposes.").

231. *Cf.* Jonathan R. Macey, *A Pox on Both Your Houses: Enron, Sarbanes-Oxley and the Debate Concerning the Relative Efficacy of Mandatory Versus Enabling Rules*, 81 WASH. U.L.Q. 329, 330 (2003) ("The Enron collapse demonstrates, however, that the 'sunlight' that disclosure brings about is useful only if market mechanisms are in place that are capable of observing and interpreting the information that the 'sunlight' brings into view.").

232. *See* Jonathan M. Jacobson, *Tackling the Time and Cost of Antitrust Litigation*, 32 *Antitrust* 3 (2017).

233. *See* Shelley Welton, *Grasping for Energy Democracy*, 116 MICH. L. REV. 581 (2018) (discussing the shift toward democratizing energy decisions to provide more consumer choice, exert greater local control, and achieve better access to process).

B. Coordination Problems

Coordination problems occur when multiple firms lack sufficient communication methods to coordinate their activities toward a common interest.[234] Here, coordination problems may cause utilities to fail to cooperate in creating complete, uniform, and state-wide databases. Without complete datasets, state benchmarkers, policy drafters, environmental interest organizations, and energy efficiency service providers looking at state-wide markets will lack necessary data to inform their activities. A smart meter data hub would provide three coordination benefits: (1) a standardized data platform and format; (2) the participation of cooperatives and municipal energy utilities outside public utility jurisdiction; and (3) consolidated data storage and processing facilities to maximize cost effectiveness.

First, standardization serves a central role in coordinating meter data activities.[235] Participation in energy data markets is less costly when the potential participant only needs to invest in a single software, particularly if one must pay multiple utilities for meter data access. Texas' incumbent utilities created the Smart Meter Texas central web portal to standardize data aggregation and formatting for third parties.[236] Similarly, the major electric utility providers in California, Illinois, and Texas voluntarily use the Green Button platform to standardize data collection and dissemination methods.[237] A smart meter data hub would necessarily unify a state's data format and software, accomplishing standardization by its very nature instead of relying on multiple utilities to voluntarily coordinate.

Second, some U.S. states exclude cooperative and municipal electric utilities from public utility commission jurisdiction,[238] making their participation in a centralized energy data system

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234. The common interest has a higher payout for all firms involved, yet without commitments to coordinate most firms will choose lower-cost, lower-payout actions. *See* Jack Ochs, *Coordination Problems and Communication*, *in* THE NEW PALGRAVE DICTIONARY OF ECONOMICS 1130, 1130–32 (Palgrave Macmillan ed., 2008).

235. Klass & Wilson, *supra* note 8, at 1152 ("Programs to identify energy efficiency opportunities, whether private or municipal, will require standardized data inputs to be developed at scale.").

236. *See supra* notes 205–216 and accompanying text.

237. *See supra* notes 129–133 and accompanying text.

238. *Compare* MINN. STAT. § 216B.02, subd. 4 (2018), *and* ILL. COMP. STAT. act 5 § 3-105 (2018), *with* CAL. PUB. UTIL. CODE § 216 (2018).

less likely. Negotiating data-sharing agreements with each public utility would likely outweigh any privately-profitable insights these alternative utilities might gain from data outside their service territories.[239] If left to private piecemeal transacting under the decentralized model, the nonparticipation of municipal and cooperative utilities would leave significant gaps in a state's energy meter datasets as municipal and cooperative service territories can cover large portions of a state.[240] This would isolate municipal and cooperative energy customers from beneficial insights and energy services, as well as increase transaction costs for academic researchers and state regulators with limited budgets. Centralizing meter data would present municipalities and cooperatives with a single party to negotiate with, on nondiscriminatory grounds, significantly reducing transaction costs for creating a complete and representative state energy consumption profile.

Finally, a smart meter data hub would consolidate the costs of establishing and maintaining a data facility. Under a decentralized model, each utility must build and service secure data centers for its customers' smart meter data. Centralization coordinates these efforts into a single process that will reduce energy and real estate costs,[241] as well as reduce the burden public utilities would otherwise pass down to their ratepayers. A centralized data hub additionally increases a state's overall

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239. That's not to say that the total *social* benefits wouldn't outweigh these costs. Researchers and service providers with state-wide scopes would benefit from data profiles that included municipal and cooperative service territories, but the problem is the utilities would not privately capture those benefits or add them to its own cost-benefit analysis.

240. Colorado's state constitution, for example, exempts municipally owned utilities from public utility commission jurisdiction, exempting about seventeen percent of the state's electricity consumers from the commission's authority. *See* COLO. CONST. art. 25 (added Nov. 2, 1954); *About Public Power*, COLO. ASS'N OF MUNICIPAL UTILS., http://www.coloradopublicpower.org/about (last visited Mar. 24, 2019).

241. *Cf.* Grant Gross, *This Wave of Data Center Consolidation Is Different from the First One*, DATA CTR. KNOWLEDGE (Feb. 8, 2018), http://www.datacenterknowledge.com/manage/wave-data-center-consolidation-different-first-one; Bob Violino, *How Data Centers can be Energy Efficient, High Performing and Secure*, BITDEFENDER (Mar. 15, 2016), https://businessinsights.bitdefender.com/data-centers-optimization-energy-efficient-performing-secure (explaining the federal government's Data Center Optimization Initiative aims to "consolidate inefficient infrastructure, optimize existing facilities, achieve cost savings, and transition to more efficient infrastructure, such as cloud services and inter-agency shared services.").

energy efficiency by powering and cooling the servers at scale.[242] Lastly, removing facility construction and operation responsibilities away from the utilities also reduces their perverse incentive to recover more by over-investing capital on such facilities.[243] Reduced costs, improved energy efficiency, uniformity, and more complete state data profiles illustrate the additional coordination achieved by the state energy data hub model.

C. PRINCIPAL-AGENT PROBLEMS IN DATA PRIVACY

A smart meter data hub provides efficient privacy protections against data breaches and unapproved uses of energy data. Centralized privacy protection benefits energy consumers better than the decentralized, utility-centric approach in two ways. First, centralization aligns privacy regulations with actual implementation in a more cost-effective manner. Second, a centralized data hub can better align enforcement decisions under privacy protection mechanisms like contracts with the public's privacy interests.

Privacy values and implementation decisions differ between federal agencies because of the "principal-agent problems inherent in administrative delegation."[244] A decentralized data management structure would likely result in the similar disparate treatment of energy customers' privacy rights. For one, public utility companies are less responsive to poor public relations that otherwise motivate most private, data-collecting firms to make optimal customer privacy protection decisions.[245]

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242. *See Economies of Scale Impact Data Center Costs*, FACILITY EXECUTIVE (Aug. 23, 2016), https://facilityexecutive.com/2016/08/economies-of-scale-impact-data-center-costs/ (citing PONEMON INST., COST TO SUPPORT COMPUTE CAPACITY (2016)).

243. *See* Herman K. Trabish, *Tackling the Perverse Incentive: Utilities Need New Cost Recovery Mechanisms for New Technologies*, UTIL. DIVE (Mar. 6, 2018), https://www.utilitydive.com/news/tackling-the-perverse-incentive-utilities-need-new-cost-recovery-mechanism/518320/.

244. Kenneth A. Bamberger & Deirdre K. Mulligan, *Privacy Decisionmaking in Administrative Agencies*, 75 U. CHI. L. REV. 75, 83 (2008).

245. *See* ALESSANDRO ACQUISTI, ORG. FOR ECON. CO-OPERATION & DEV., THE ECONOMICS OF PERSONAL DATA AND THE ECONOMICS OF PRIVACY 21 (2010) ("Consumers may also punish firms that they perceive as not adequately protective of their data indirectly. A Ponemon Institute survey suggests that about one consumer out of five terminated their relationships with a company that compromised their data.") (citation omitted). One recent example is the adverse effect on Facebook's stock and the #deletefacebook movement following

Public utilities enjoy set service territories and a monopoly over a particular electricity service for captured customers within those boundaries.[246] Customers displeased with their utility company's meter data protection cannot simply change electricity providers (at least in traditionally regulated states). The inability of energy customers to switch to another a public utility's services—whether retail electricity in traditionally structured states or distribution services in restructured states—insulates many utilities from the full brunt of public retaliation, which reduces their private incentive to expend resources on preventing unauthorized disclosures or misuses of energy data. Politically accountable officials in a state data hub, however, would be more sensitive to potential breaches and better align public privacy expectations with actual privacy protection efforts.

One manifestation of the data hub's improved privacy protection incentive is more proactive implementation and enforcement. A concern with simply regulating a private utility's data privacy conduct is that "[r]egulatory compliance often comes in after the data breaches have happened."[247] Again, effective monitoring can be expensive and difficult to maintain.[248] If compliance costs and penalties for noncompliance are high, the utility may act overly-cautious and offer suboptimal access to its customers' meter data. Multiple utilities in one state multiplies these monitoring and compliance costs, raising the social cost of achieving an optimal access-privacy balance. Instead, it is likely less costly and more uniformly applied across every utility's customers if handled by the regulators themselves. The centralized data hub offers a cost-effective opportunity to proactively and uniformly protect energy data privacy.

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the Cambridge Analytica revelations. *See* Ben Popken, *Facebook Stock Takes Hit on FTC Probe and News It Records Users' Call Logs*, NBC NEWS (last updated Mar. 26, 2018, 12:10 AM), https://www.nbcnews.com/tech/social-media/facebook-confirms-it-records-call-history-stoking-privacy-furor-n860006.

246. This statement applies to both traditionally-regulated and restructured states since it is the incumbent utilities, rather than the competitive retail electricity providers, acting as the data holders. *See, e.g.*, DYER, *supra* note 195, at 13.

247. Dancey Balough, *supra* note 25, at 185 (quoting *Ontario's Privacy Commissioner Urges Halting Smart Grid*, SMARTGRIDTODAY (Apr. 8, 2010), http://www.smartgridtoday.com/public/1447.cfm? sd=31).

248. *See* Macey, *supra* note 231, at 330.

Uniformity and responsiveness to public privacy concerns can also be increased when a central hub directly controls privacy protection mechanisms, such as disclosure contracts. Contractually obligating data recipients can effectively define the scope of energy data uses based on the characteristics of the recipient, allocate liability to recipients to encourage greater privacy protection efforts on their end, and better democratize litigation decisions or compel corrective actions in the event of data breaches.[249] The Family Educational Rights and Privacy Act, for example, requires recipients of personally identifying education data to enter written agreements with provisions requiring destruction of data once the recipient no longer needs it.[250] Another useful contractual obligation is found in California's Student Online Personal Information Protection Act which prohibits use of disclosed data beyond the scope of the contracted purpose.[251]

Regulation might require a utility in a decentralized structure to include such terms, but the regulations "teeth" may be diluted by the utility's decisions on whether to enforce them. Here again, any misalignment between a utility's private interests and the overall public interest may result in suboptimal resources being expended on remedial actions for breaches or misuses. The centralized data hub approach provides superior enforcement discretion because it can utilize experienced legal resources like state consumer protection units. A centralized government data manager could also provide a clearer path to relief for harmed data subjects, both by being a party to the contract with power to enforce it and by explicitly allowing private rights of action under state administrative procedure acts to review non-enforcement decisions. Finally, economic analysis has shown governments provide more efficient consumer protection litigation decisions because they internalize the full benefits of legal precedent.[252] The greater

249. *See* ABRAMS ENVTL. LAW CLINIC, *supra* note 69, at 2, 40–42, 67–70 (identifying various contractual approaches under current structures and describing how pre-disclosure contract provisions can "assign liabilities for mishaps or data breaches," require parties to purchase insurance or agree to indemnify data holders).

250. *See* Klass & Wilson, *supra* note 8, at 1134–36.

251. *See id.* at 1137.

252. *See* Timothy J. Muris, *Economics and Consumer Protection*, 60 ANTITRUST L.J. 103, 103–04 (1991) ("Litigation produces not just a resolution of the dispute before the court—which is what the parties are primarily, if not

resources and better aligned incentives of government-based enforcement suggest the state data hub model supplies greater privacy protection.

D. Government Control and Bureaucracy

The main complaints against smart meter data hubs are: (1) they require large administrative and bureaucratic costs;[253] and (2) that consumers are weary of government access to personally identifying data.[254] The cost of an added bureaucracy, however, is likely less than the avoided costs of suboptimal access, uncoordinated efforts, or multiple regulatory compliance monitoring programs that result from the government regulating from the sidelines. The agency problems inherent in delegating access and privacy protection decisions create social costs external to an energy utility's ledger. A more sophisticated calculation of actual costs and benefits of centralizing data management is warranted and should not be easily dispelled based on nebulous claims of extra bureaucracy alone.

State policymakers remain cognizant of significant public skepticism toward public and private institutions' ability to safely handle personally identifiable information.[255] As for mistrust of government access to private energy consumption data, the concerns are likely overgeneralized and overstated.[256] In the wake of major data breaches against private corporations like Facebook, Equifax, and Yahoo,[257] the difference between government management and private management of personally identifying data is likely minimal. It is at least ambiguous whether the government or private companies

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exclusively, interested in—but it also often produces a precedent to guide others, usually in the form of a written opinion. Many can obtain the benefit of that precedent for their legal planning without paying for it."). If two energy utilities in a multi-utility state experience similar data breaches, one may wait to "free ride" on the other to create favorable precedent and reduce its potential legal costs.

253. *See* The Utility Reform Network, *supra* note 9, at 3–5.

254. *See* Duarte, *supra* note 93, at 1156–60; McNeil, *supra* note 93, at 205.

255. *See* Aaron Smith, *Americans and Cybersecurity*, PEW RES. CTR. (Jan. 26, 2017), http://www.pewinternet.org/2017/01/26/americans-and-cybersecurity/ ("[M]any Americans lack faith in various public and private institutions to protect their personal information from bad actors.").

256. *See* Klass & Wilson, *supra* note 8, at 1158.

257. *See* Smith, *supra* note 255.

deserve the least public trust as managers of private data.[258] In light of this ambiguity, the greater democratization of data privacy achieved by a centralized smart meter data hubs cuts in favor of picking this lesser of two evils.[259]

III. CONCLUSION

Electricity metering is evolving. AMI allows grid operators to interact with consumers and their electricity-consuming things in real-time. It also creates a detailed record of consumption data that presents a myriad of potential applications. If properly managed, this data will benefit stakeholders along the electricity supply chain. The predominant decentralized, utility-based management approach underperforms at this critical data management, however. Instead, centralizing these data management responsibilities in state energy data hubs would likely improve data accessibility, completeness, and privacy.

Centralized state data management reduces transactional burdens on electric utilities, improves the policing of data disclosures, and would better democratize policy decisions. The smart meter data hub also reduces the social costs of agency problems that cause inefficient market power imbalances and suboptimal regulation implementation. Centralizing data management could also provide for better cooperation and coordination of consumption data collection, storage, and dissemination. These reduced social costs outweigh any added bureaucracy and warrant greater discussion of the role for state energy data hubs in facilitating the future promised by smart meters.

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258. *See* Ana Marie Cox, *Who Should We Fear More with Our Data: The Government or Companies?*, GUARDIAN (Jan. 20, 2014), https://www.theguardian.com/commentisfree/2014/jan/20/obama-nsa-reform-companies-spying-data.

259. *See* Welton, *supra* note 233. Centralizing energy data would capture some of the benefits driving more extreme suggestions like nationalizing corporate entities that possess massive amounts of private citizen data to better align public interests with their data disclosure and protection practices. *See* Nick Srnicek, *We Need to Nationalize Google, Facebook and Amazon. Here's Why*, GUARDIAN: TECH. (Aug. 30, 2017), https://www.theguardian.com/commentisfree/2017/aug/30/nationalise-google-facebook-amazon-data-monopoly-platform-public-interest. *But see* Joe Kennedy, INFO. TECH. & INNOVATION FOUND., THE MYTH OF DATA MONOPOLY: WHY ANTITRUST CONCERNS ABOUT DATA ARE OVERBLOWN (2017), http://www2.itif.org/2017-data-competition.pdf.

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