To Surveil or to Sustain: Perceptions of Smart Meters in Rural Jamaica

By

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Dedication

This thesis is dedicated to the residents of *Bridgeville who warmly welcomed me into their homes and openly shared their life stories and experiences even at great risk to themselves.[1] Their resilience, diligence and contagious positivity are unparalleled, and I am most grateful for the time and information they shared with me. I would also like to dedicate this project to my maternal grandparents, Beryl and Gosnel Smith who made Bridgeville, a magical home away from home during my childhood years and taught me the importance of community through their kind words and service to others.

[1] Bridgeville is the alias used to protect the identity of the participants in the project, some of whom admitted to illegally abstracting electricity from the grid.

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This project would not have been possible without the support of my family members particularly my brother, Walter Phillips and my mother Ann Marie Smith who on numerous occasions provided much needed transportation, cups of tea, scrumptious food, warm hugs and listening ears. I am also grateful for my dearest cousin Andriana Byfield who on many evenings in June of 2019, joined me in collecting data and helped me to identify and connect with potential interviewees. Finally, I would also like to thank my friends, particularly those from my community of faith at the University of Michigan in Ann Arbor who continuously held me up with prayer (and sushi from Sadako).

Introduction

This article explores perceptions of and experiences with smart technologies amongst rural households, policy makers and utility managers in Jamaica. The study primarily draws on data collected in a community referred to as Bridgeville in Westmoreland. Using the lens and principles of energy justice, the paper explores how the use of smart meters may complicate, shift or transform users' and regulators' relationship with electricity as a commodity and its associated infrastructure. Particular focus is given to consumers who utilize illegal or informal means to gain access to electricity. This project aims to enhance collective understandings of the social, economic and environmental impacts of informal electricity access on energy systems. The study also explores how the introduction of smart technologies may help to address these challenges or perpetuate them. To ground the study, a literature review on the proliferation of smart technologies and the concept of energy justice is undertaken. Lastly, a case study of Bridgeville and the wider energy policy, regulation and management landscape in Jamaica is detailed.

Literature Review

Smart Technologies

Notions of Smart

The word "smart" increasingly connotes highly advanced technologies and environments that automate, optimize and, in some respects, minimize end users' effort to engage with a particular resource or product. Typically, the use of the word evokes images of futuristic, high-tech, efficient gadgets but there is often confusion about what exactly this word should mean. Broadly scholars have defined "smart" as distinguishing products, services and systems which have been developed with information and communications technologies (ICT) or employ ICT networks to accomplish various tasks.[2]

In her piece on smart technology and its benefits, Kelly Bowers shares that "smart" can be considered a "catch-all phrase" for a variety of technologies that self-monitor, analyze and report to optimize user interactions.[3] These technologies can no longer be considered static, inanimate, or passive but can be wired to sense and synthesize complex patterns and encourage particular human behaviors in real time. Worden et al. also emphasize the need for "smart" devices to react or respond to changing environments in their article. They state that to truly be considered smart, technologies must (i) possess an awareness of its environment, condition or motion and (ii) must be able to react to changes in that context.[4] In other words, "smart technologies must be able to detect shifts in their environment and enact measures to enhance their performance, efficiency, operating costs and/or endurance in response to these shifts.[5] This obtains regardless of the area of application.

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[2] Sesil Koutra, Vincent Becue, and Christos S Ioakimidis, "Searching for the 'Smart' Definition through Its Spatial Approach," *Energy* 169 (2019): 924–36, https://doi.org/https://doi.org/10.1016/j.energy.2018.12.019.

[3] "What Is Smart Technology and What Are Its Benefits?," accessed October 21, 2020, https://rezaid.co.uk/smart-technology-and-its-benefits/.

[4] Keith Worden, William A Bullough, and Jonathan Haywood, *Smart Technologies* (World Scientific, 2003).

[5] Worden, Bullough, and Haywood.

The Theoretical Urban-Rural Divide

The term *smart city* has become increasingly prevalent in the discourse on smart technologies and has become synonymous with urban development and sustainability. The success of this concept hinges on connectivity: it is primarily concerned with bridging information gaps and synthesizing real-time data across systems and components to optimize urban operations and infrastructure. The smart technologies which make up these cities promise to increase the efficiency of service delivery, to aid in decision making and to improve the quality of life in metropolitan centers.

Inherently, cities have been centered as the sites of development with the use of the concept and the technologies which have been tailored to address issues unique to urban contexts. It is the hope that by integrating new technologies into urban managements, smart cities will solve challenges related to sustainability, access and socio-economic inequality.[6] Much attention has likely been given to this locale because 55% of the world's population inhabits cities and that percentage is projected to grow to 68% by the end of 2050.[7] Furthermore, cities are the sites for the most important political and economic institutions and cultural resources. However, what has not been sufficiently discussed is the application of smart technologies in rural communities.

A few scholars such as Mohanty et al. have explored the idea of "smart villages" and "smart towns" which can be defined as self-sustaining and resilient communities with access to basic resources such as water, sanitation facilities,

[6] Håvard Haarstad and Marikken W. Wathne, "Are Smart City Projects Catalyzing Urban Energy Sustainability?," *Energy Policy* 129 (June 1, 2019): 918–25, https://doi.org/10.1016/j.enpol.2019.03.001.

[7] United Nations Department of Economic and Social Affairs, "68% of the World Population Projected to Live in Urban Areas by 2050, Says UN | UN DESA | United Nations Department of Economic and Social Affairs," accessed December 8, 2020, https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html.

waste management and public health services.[89] While there is emphasis on the provision of efficient and reliable services through innovation in the context of a village, there is much less focus on innovation, automation and higher levels of interconnectivity. One smart device rarely discussed in the technology literature on rural communities is the smart meter.

Smart Meters

Smart meters are arguably the most widely used and adopted devices under the larger umbrella of smart technologies. Private industry, which are the primary creators, producers, and proponents of these technologies, view smart cities and their components as essential to the future of cities, and governments have bought into this vision.[10]

The first iteration of smart meters was developed in 1972, however, its widespread use and adoption by utilities has only occurred within the last two decades.[11] A smart meter gathers information on household electricity consumption and wirelessly transmits this information at predetermined intervals to electric utilities. Smart meters can also be used to set limits on maximum electricity consumption in households. This system replaces the traditional metering system which requires personnel to visit each household to manually record consumption data and send it to the utility. It is also important to note that traditional meters typically do not store user data and meter data

[8] Siddhartha Sen, *Smart Village Technology: Concepts and Developments*, vol. 17 (Springer Nature, 2020).
[9] Pradeep Tomar and Gurjit Kaur, *Green and Smart Technologies for Smart Cities* (CRC Press, 2019).
[10] The electricity industry spent $18 billion deploying smart grid technologies from 2010 to 2013 and according to the Navigant Research group annual spending on smart-city technologies is expected to reach approximately $175 billion USD by 2020.Eric Woods and Noah Goldstein, "Smart Technologies and Infrastructure for Energy, Water, Transportation, Buildings, and Government: Business Drivers, City and Supplier Profiles, Market Analysis, and Forecasts," 2014.
[11] dataVoice International, "Understanding Smart Meter Technology," dataVoice International, July 31, 2017, https://www.datavoiceint.com/blog/news/understanding-smart-meter-technology/.

cannot be manually accessed. Furthermore, buildings or facilities which utilize traditional meters periodically receive estimated energy bills.

With the addition of each smart meter, a wider physical communication network is created which is primarily beneficial for energy distributors who are able to read meters, bill customers and manage the energy system more efficiently and at a lower cost. Smart meters can be used to collect diagnostic information about the distribution grid and home appliances; and they can also communicate with meters in close proximity. This digital communication network can be extended at any point so that new applications can be provided both for consumers, distributors and even to third parties. This is one of the main appeals of this smart technology — its ability to connect systems across sectors, interests, and geographies. Smart meters also allow utilities to tackle what is arguably their two most significant challenges: unsustainable electricity consumption and informal energy access or "electricity theft".

Smart Meters and the New Energy Regime

Smart meters have been introduced to accelerate the transition to more efficient low-carbon energy systems. In some jurisdictions, they are also used to track and identify non-technical losses from the grid which includes the illegal extraction of electricity.[12] Globally, utilities lose an estimated $96 billion USD each year from non-technical losses.[13] A significant portion of can be attributed to electricity theft, fraud and billing errors. Typically, smart meters are considered to be not only necessary but successful in achieving their intended purpose. However, some scholars have recognized that these new systems can in fact create unjust outcomes and vulnerabilities and, in some instances, exacerbate inequalities in pre-existing energy markets and systems. In their analysis of smart grid implementation, Milchram et al. highlight that there are

[12] "Electricity Theft and Non-Technical Losses: Global Markets, Solutions, and Vendors," 2017.

[13] Northeast Group LLC, "$96 Billion Is Lost Every Year To Electricity Theft," accessed December 8, 2020, https://www.prnewswire.com/news-releases/96-billion-is-lost-every-year-to-electricity-theft-300453411.html.

distributive and procedural injustices when the economic and environmental benefits of this new technological system are assessed.[14] There are concerns that utilities will keep the benefits of more efficient systems to themselves while passing the costs of the system to consumers or that only citizens in high economic brackets will be able to access the full suite of benefits afforded by the smart grid. They also highlight consumer mistrust and concerns about privacy and security in the discourse on smart meters.

Some of these concerns are echoed in the article, "Decarbonization and its discontent: a critical energy justice perspective on four low carbon transitions." In this piece, Sovacool et al. identify 120 distinct types of injustice within policy and energy regulation in four countries moving towards a low-carbon economy and using smart technologies to do so.[15] Of particular note was their study on the deployment of smart meters in Great Britain. They found that the installation of smart meters would not be as beneficial for low-income people and renters who were unable to invest in smart appliances and that people living in particular building types i.e. flats would not be able to enjoy a full range of smart functionality.[16] The authors also found that there were higher bills across the entire energy system even for consumers who did not adopt this technology as well as the lack of public participation and the use of dishonest tactics by utilities to pressure consumers into adopting smart meters. Baker et al. highlight that many of these injustices are not readily apparent.[17]

Given these findings, explicitly using an energy justice lens to understand the impact of smart technologies on energy access, affordability and use is critical.

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[14] Christine Milchram et al., "Energy Justice and Smart Grid Systems: Evidence from the Netherlands and the United Kingdom," *Applied Energy* 229 (2018): 1244–59, https://doi.org/https://doi.org/10.1016/j.apenergy.2018.08.053.
[15] Benjamin K Sovacool et al., "Decarbonization and Its Discontents: A Critical Energy Justice Perspective on Four Low-Carbon Transitions," *Climatic Change* 155, no. 4 (2019): 581–619.
[16] Sovacool et al.
[17] Sovacool et al.

This is because disruptions in energy supply have the potential to severely impede economic growth and societal development. This occurs even as the world transitions from fossil fuel dependent systems to a newer low-carbon regime. For this reason, the question of *energy justice* or the lack thereof, is essential in any attempt to create efficient, stable, and equitable societies and is important to consider in discourse on emerging energy technologies such as smart meters.

The Concept of Energy Justice

The Emergence of Energy Justice

The concept of energy justice has been employed in academia and in the private and public sectors.[18] The term was first used in practice by a non-governmental organization in the late 1990's to describe their work of exposing consumer fraud in the green electricity market industry and assisting communities across the United States to halt the construction of gas-fired power plants.[19] The organization called themselves the Energy Justice Network.[20] Since that time other NGOs across the globe such as the National Energy Action in the United Kingdom have used the term as an organizing framework for their work to end fuel poverty and to increase affordable access to electricity. By the early 2010s academics adopted this verbiage and have not only attempted to define the concept but have tried to understand and map its applicability across the different segments of the global energy regime. Scholars have also attempted to show the concept's relationship and relevance to a wide range of fields and issue including public health, education, and gender.[21]

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[18] Raphael J Heffron and Darren McCauley, "The Concept of Energy Justice across the Disciplines," *Energy Policy* 105 (2017): 658–67.
[19] Heffron and McCauley.
[20] "About Energy Justice Network | Energy Justice Network," accessed November 1, 2020, http://www.energyjustice.net/about.
[21] Michael Carnegie LaBelle, "In Pursuit of Energy Justice," *Energy Policy* 107 (2017): 615–20; Stefan Bouzarovski and Neil Simcock, "Spatializing Energy Justice," *Energy Policy* 107 (2017): 640–48; Elizabeth Allen, Hannah Lyons, and Jennie C Stephens, "Women's Leadership in Renewable Transformation, Energy Justice and Energy Democracy: Redistributing Power," *Energy Research & Social Science* 57 (2019): 101233.

Definitions of Energy Justice

While there is no standard definition for the term, energy justice broadly speaks to fair decision-making around issues related to energy resource development, energy production, energy distribution, energy security, energy policy as well as the relationship between these areas and climate change. Some practitioners such as Jenny Saunders define energy justice by focusing on the affordability of this commodity and the role of markets in determining access. She asserts that energy justice is "ensuring that all can afford the energy for health and well-being."[22]

Hernandez takes it one step further by situating energy justice within a large systemic context. She defines energy as the "equitable distribution of energy benefits and burdens" by institutions. This definition highlights the critical role that governments and private businesses play in determining which stakeholders are responsible for the costs of the system and who are the beneficiaries of the system.[23] Guruswamy et al. highlight the importance of energy access as a pathway for sustainable development and socio-economic mobility. They also highlight the interdisciplinary nature of energy justice when they state that the concept applies the foundational tenets of justice and philosophy to enhance our collective understanding of the existing energy landscape.[24]

Sovacool et al. conceptualize a principles-based approach to energy justice. They posit that the energy regimes designed must be not interfere with

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[22] J Saunders, "Energy Justice: The Policy Challenges," in *Energy Justice in a Changing Climate: Defining an Agenda, INClUESEV Conference*, 2011; Sarah Marie Hall, "Energy Justice and Ethical Consumption: Comparison, Synthesis and Lesson Drawing," *Local Environment* 18, no. 4 (2013): 422–37.

[23] Diana Hernández, "Sacrifice along the Energy Continuum: A Call for Energy Justice," *Environmental Justice* 8, no. 4 (2015): 151–56.

[24] Lakshman Guruswamy, "Energy Justice and Sustainable Development," *Colo. J. Int'l Envtl. L. & Pol'y* 21 (2010): 231.

individual's ability to access basic resources.[25] This is referred to as the *Prohibitive Principle*. They also highlight the *Affirmative Principle* which states that if any basic commodities require the use of energy, then by default energy becomes a basic good as well[26]. Both views demonstrate that energy is a need and acknowledge the interconnectedness of the system. An analysis of these varying definitions makes clear that energy justice encompasses a wide range of issues from energy generation or production to consumption and industry regulation across multiple scales, that is, at the level of the individual, in communities, nationally and internationally.

In an attempt to operationalize and succinctly capture the nuances of this board concept, Jenkins et al. define energy justice as a framework that evaluates (i) where injustices emerge, (ii) which vulnerable segments of society are ignored, (iii) which processes exist for their remediation in order to identify and eliminate such injustices.[27] This last definition is arguably the most widely adopted framework or definition and is particularly helpful when thinking about energy in the context of policy and governance. In further describing this framework, Jenkins et al. note that it is comprised of three main components namely procedural justice, distributional justice and recognition.[28] The components are elaborated on below:

- Procedural justice not only concerns the inclusion of relevant stakeholders in decision-making on energy systems and processes but is also about the differential levels of access stakeholders have to these systems and processes. Thus, procedural justice speaks to both the fairness of proceedings and the appropriateness of the treatment meted

[25] Benjamin K Sovacool, Roman V Sidortsov, and Benjamin R Jones, *Energy Security, Equality and Justice* (Routledge, 2013).
[26] Sovacool, Sidortsov, and Jones.
[27] Kirsten Jenkins et al., "Energy Justice: A Conceptual Review," *Energy Research & Social Science* 11 (2016): 174–82, https://doi.org/https://doi.org/10.1016/j.erss.2015.10.004.
[28] Jenkins et al.

out as a result of these proceedings. Government regulations and legislative standards are key to this kind of justice but, it is also heavily influenced by societal norms and values. In their piece, Jenkins et. al highlight the disclosure of information, access to knowledge and high levels of institutionalization as key levers in the pursuit of procedural justice.[29] When thinking about procedural justice we might ask questions such as: To what extent was community input incorporated into decision-making? Were the stakeholders sufficiently represented at the table? Was the chosen regulatory or legal process appropriate given the desired outcome?

- Distributional justice acknowledges the inequitable allocation of environmental costs and benefits, including the inequitable distribution of responsibilities for costs. It requires the fair dissemination of benefits and ills on all members of society regardless of their identity (racial, gender, socio-economic etc.). Given its focus on both the costs and benefits, distributional justice not only concerns access to energy goods but the siting of energy infrastructure. When thinking about distributional justice we might ask questions such as: What are the benefits and costs of this action? Who is receiving the benefits and who the costs? Who should the beneficiaries be? Who is responsible for the cost? How may the consideration of historical context shift the distribution of benefits and costs?

- Recognition based justice prompts us to think about which segments of society are being left out, marginalized, or maligned. Jenkins et. al speak extensively about how misrecognition, misrepresentation or distortion of an individual's views or perspectives can also be a form of recognition-based injustice.[30] Therefore, to create recognition-based

[29] Jenkins et al.
[30] Jenkins et al.

> justice it is not only important that these individuals or groups are included but that they have access to correct or equitable representation and must have the same rights as other stakeholders. The divergence in perspectives whether they be as a result of socioeconomic, cultural, gender or racial differences should be acknowledged. When considering issues of recognition-based justice, we may ask questions such: Have all the relevant stakeholders, beneficiaries or responsible parties been identified? Are these stakeholders, beneficiaries or responsible parties included in the decision-making process? Have these stakeholders, beneficiaries and responsible parties been given sufficient time and space to share their perspectives, opinions and concerns?

This framework provides the foundation for an analytic and standardized decision-making tool for energy planners and policymakers. Sovacool et. al attempt to build on this foundation by designing a framework of eight decision-making principles to be employed by practitioners. They argue that decision-making around energy must enhance the (i) availability and (ii) affordability of this resource and must encourage (iii) the development and use of due process, (iv) sustainability, (v) good governance, (vi) intragenerational equity and (vii) responsibility.[31]

However, in the scholarship on energy technology, notions of justice are rarely explored. In the few instances where this matter is discussed, it is often with an explicit focus on fossil fuel driven systems.[32] New injustices and challenges with low carbon energy transition are only emerging and may not be yet evident or well understood by scholars and practitioners. As such, the discussion and application of energy justice frameworks on newer energy systems is limited.

[31] Benjamin K Sovacool and Michael H Dworkin, "Energy Justice: Conceptual Insights and Practical Applications," *Applied Energy* 142 (2015): 435–44, https://doi.org/https://doi.org/10.1016/j.apenergy.2015.01.002.
[32] Sovacool et al., "Decarbonization and Its Discontents: A Critical Energy Justice Perspective on Four Low-Carbon Transitions."

This is particularly the case in discourse on smart energy technologies such as smart meters.

Given this and other gaps in the literature, this paper seeks to apply energy justice frameworks to better understand how residential consumers perceive energy technologies and their attitudes towards them. Because the impact of smart technologies is usually explored in metropolitan and developed contexts, a case study of a rural community in a developing context i.e., Western Jamaica will be undertaken. Particular effort is given to assessing the policy and regulatory environment in which these technologies were adopted as well.

Methodology

Data for the study was drawn from a household survey and a series of interviews with residents in Bridgeville as well as through discussions with industry regulators and the utility. The name Bridgeville is a pseudonym used to protect the identity of the survey respondents and interviewees. The data collected was supplemented with information and filings from government entities, regulatory codes, press briefings, annual reports from the utility and newspaper articles.

The survey was administered in June of 2019 to 100 households in the community using a systematic sampling strategy and had a 68% response rate. The software and digital surveying tool Quick Tap was used. Bridgeville has two main streets with a number of small, adjacent lanes. The main roads and adjacent lanes are outlined in the map below. Every third household on the two main streets was selected for the survey. Every house on three adjacent lanes (one in the northern section of the community and two in the southwestern section of the community) were also surveyed. The survey had 51 questions to ascertain energy consumption habits, knowledge of smart technologies, attitudes towards sustainability and informal electricity access (Appendix B). Each participant was offered a $500.00 JMD ($3.44 USD equivalent)[33] phone credit as compensation for their time.

The interviews for this study were conducted in 2019 and 2020; four with local community members, one with the Office of Utilities Regulation (OUR) and one with the Jamaica Public Service Company (JPSCo). Transcripts of the interviews or meeting notes are detailed in Appendix C. Given the sensitive nature of the information shared by community members, preliminary briefs were held in June of 2019 and final, recorded interviews were conducted in 2020. Notes and/or the transcription from each interview were analyzed using

[33] The Jamaican to USD exchange rate is not fixed. The rate in December 2020 is approximately $145 JMD to $1.00 USD.

the online platform, Miro. To ensure confidentiality, the four community interviewees have been given the aliases “Cynthia”, “Racquel”, “Marcia” and “Sheila”. Ten community members were asked to be interviewed for the study. Of the six women and four men approached, these four individuals agreed to participate.

Case Study

Bridgeville, Westmoreland

A small rural district, Bridgeville has a population of approximately 2,500 individuals.[34] This farming community is located Western Jamaica. It has a vibrant history with sugarcane cultivation which continues to this day albeit on a much smaller scale. The Statistical Institute of Jamaica does not have data specific to the Bridgeville district but classifies it as a part of a larger constituency. Relative to the rest of the country this constituency has a higher proportion of homeowners to renters. However, there is higher percentage of households with unmet basic needs for lighting (a proxy for electricity access) (7.39%) relative to the rest of the country (5.56%). To better understand the experiences detailed in the survey and community interviews in Bridgeville, it is first important to understand the larger socio-political landscape for electricity consumption and production in Jamaica.

Jamaican Electricity Landscape

The structure, challenges and opportunities for Jamaica's electricity sector mirror those of other small island states across the globe. With the second highest total primary energy supply per capita in the region, Jamaica has very high consumption relative to its population and GDP.[35] The nation's electricity rates are high at $0.39 USD per kilowatt hour. The estimate is higher than other Caribbean nations' average rate of $0.33 USD per kilowatt hour and much higher than the global average of $0.13 per kilowatt hour.[36] The sector relies heavily on fossil fuels with more than 94% of electricity being generated from petroleum-based fuels.[37] Fuel costs constitute a significant portion of electricity

[34] Bridgeville is an alias used to protect the identity of participants.
[35] Inter-American Development Bank, Natacha Marzolf, and Jorge Perez Arbelaez, "Power and Possibility: The Energy Sector in Jamaica | Publications," accessed November 30, 2020, https://publications.iadb.org/publications/english/document/Power-and-Possibility-The-Energy-Sector-in-Jamaica.pdf.
[36] Emerson Reiter, "Energy Transition Initiative, Island Energy Snapshot - Jamaica (Fact Sheet), NREL(National Renewable Energy Laboratory)," 2015, https://www.nrel.gov/docs/fy15osti/63945.pdf.
[37] Reiter.

bills.[38] For example, between 2013 and 2017 the electricity costs in Jamaica averaged $0.32 USD per kilowatt hour. The fuel component of this bill was $0.16 or 52% of the costs.[39, 40]

In addition to the high cost of fuel, high levels of informal electricity access or electricity theft is another challenge faced by the sector. Estimates from the country's utility suggest that between 24 and 30% of the electricity produced is not paid for.[41,42] Estimates from the early 2010's indicate that there were over 130,000 informal connections to the grid. Experts believe that this number has ballooned to 180,000 in more recent times.[43] The illegal abstraction of energy has reportedly cost the utility nearly $9,000,000,000 JMD or $62,000,000 USD each year.[44,45] The sector's infrastructure is also subject to high levels of theft. In fact, at the time of writing this article, the country's security forces were investigating the theft of newly installed smart LED streetlights in St. Catherine. Two years ago, a similar act occurred; when thirty newly installed streetlights were stolen from one of the nation's busiest thoroughfares, the Mandela Highway.

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[38] Fuel costs are in reference to the share of the bill that goes towards purchasing petroleum-based goods for electricity generation.

[39] Zia Mian, "Zia Mian | High Cost of Electricity in Jamaica! | In Focus | Jamaica Gleaner," accessed December 4, 2020, http://jamaica-gleaner.com/article/focus/20190421/zia-mian-high-cost-electricity-jamaica.

[40] Approximately, 9% of Jamaica's gross domestic product is spent of fuel imports.[40]

[41] S. Brian Samuel, "S. Brian Samuel | Why Are the Electricity Tariffs so High? | Commentary | Jamaica Gleaner," accessed December 5, 2020, http://jamaica-gleaner.com/article/commentary/20200915/s-brian-samuel-why-are-electricity-tariffs-so-high.

[42] Sacha Phillips, "Interview with Representative from the Jamaica Public Service Company," (2020).

[43] Phillips; Sacha-Rose Phillips, "Interview with Representative from the Office of Utilities Regulation," (2020); Steven Jackson, "JPS to Invest $6.5b in Smart Meters, Estimates Illegal Connections of 180,000 | Business | Jamaica Gleaner," Jamaica Gleaner, May 24, 2016, http://jamaica-gleaner.com/article/business/20160525/jps-invest-65b-smart-meters-estimates-illegal-connections-180000.

[44] Phillips, "Interview with Representative from the Jamaica Public Service Company."

[45] "Thieves Drive up Light Bills by 18% - JPS Losses from Abstraction Top J$9 Billion | Lead Stories | Jamaica Gleaner," accessed December 5, 2020, http://jamaica-gleaner.com/article/lead-stories/20190414/thieves-drive-light-bills-18-jps-losses-abstraction-top-j9-billion.

Industry Players

As illustrated in Figure 1, the key players in this small island nation's energy sector includes the Government of Jamaica which provides policy oversight through the Inter-Ministerial Committee of Energy Policy and Analysis and the Ministry of Science, Energy, and Technology and several national agencies which regulate the industry such as National Energy Solutions Limited and Office of Utilities Regulation. The Jamaica Public Service Company, the island's sole electric utility is also a critical part of the sector.

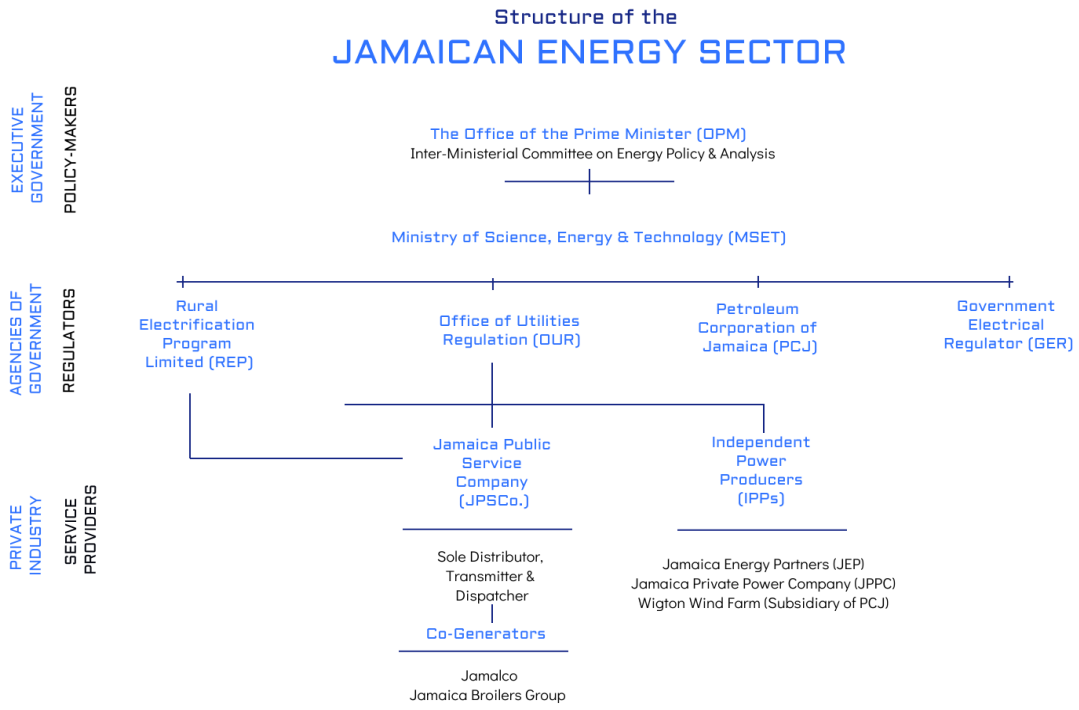

Figure 1 Illustrating the structure of the Jamaican Energy Sector. The Ministry of Science, Energy and Technology along with the Inter-Ministerial Committee on Energy Policy and Analysis are responsible for setting national policies and goals for the sector. Executive agencies such as the Petroleum Corporation of Jamaica and the Office of Utilities Regulation are responsible for enacting policies, rulemaking and ensuring compliance by industry stakeholders. Private entities such as the Jamaica Public Service Company are responsible for the transmission, generation and distribution of the county's energy resources.

- Ministry of Science, Energy & Technology (MSET)

The key mandates of the Ministry of Energy, Science and Technology are determined by the sectors which fall under its portfolio. As such, the entity's primary role is to create an enabling environment for citizens to access sustainable and secure energy resources and for the development of science, innovation and technology.[46] At the time of writing this paper, the Ministry is responsible for sixteen agencies and nine internal divisions some of which monitor the country's energy supply, lead investments in and the development of renewable energy resources and spearhead energy conservation efforts.[47]

- National Energy Solutions Limited (NESOL)

The National Energy Solutions Limited, formally the Rural Electrification Program Limited (REP), was an executive agency of the government created to carry out rural electricity expansion.[48] As articulated in the then Ministry of Science, Energy, Technology and Mining's Performance Report for the fiscal year 2014-2015, the primary role is to give rural householders "affordable access to electricity", "engender the removal of the threat to personal safety posed by [the] illegal abstraction of electricity and faulty house wiring" and to "provide electrical engineering services to other government and private sector entities."[49] Much of NESOL's work involved constructing electrical distribution pole lines in non-electrified areas and the provision of loans to

[46] "Overview – Ministry of Science, Energy & Technology," accessed December 5, 2020, https://www.mset.gov.jm/overview/; "Science, Energy and Technology - Jamaica Information Service," accessed December 5, 2020, https://jis.gov.jm/government/ministries/energy-science-and-technology/.
[47] "Science, Energy and Technology - Jamaica Information Service"; "Overview – Ministry of Science, Energy & Technology."
[48] Ministry of Public Utilities and Transport, "Rural Electrification Limited Annual Report 1977," *Ministry Paper No. 12, National Library of Jamaica*, January 17, 1979, http://www.nlj.gov.jm/MinistryPapers/1979/no. 12.pdf.
[49] Energy, Technology and Mining Ministry of Science, "Ministry Paper 62: Rural Electrification Program," Ministry of Sciency, Energy Technology and Mining Ministry Papers, 2015, https://japarliament.gov.jm/attachments/article/1452/1452_2015 Ministry Paper 48 - 67.pdf.

residential consumers who needed assistance wiring their homes in electrified areas through the Revolving Fund Program.[50]

REP relied heavily on government subsidies and concessional funds. According to the Inter-American Development Bank approximately 90% of rural areas were electrified by the end of the 2010s, a 30% increase from 1970 levels.[51] In 2011, the REPs scope of work was broadened to execute the Urban Electricity Regularization Programme which aimed to reduce the number of illegal or informal connections. In the late 1990s efforts were made by the REP to provide electricity access to remote areas using renewable technologies due to the high costs associated with extending the distribution grid. However, the program was discontinued due to administrative and technical challenges.[52] In December 2019, NESOL was shuttered due to corruption allegations and administrative failures. Its responsibilities were subsumed into MSET. [53]

- Office of Utilities Regulation

Both JPSCo. and Independent Power Producers (IPPs) are regulated through the Office of Utilities Regulation. The OUR's mandate as outlined in the 1995 Office of Utilities Regulation Act is to ensure that customers receive quality service at a "reasonable cost", craft and maintain transparent and "objective rules for the regulation of utility service providers", provide an avenue of appeal for consumers who have grievances, promote the provision of utility services

[50] Ministry of Public Utilities and Transport, "Rural Electrification Limited Annual Report 1977"; Inter-American Development Bank, Marzolf, and Arbelaez, "Power and Possibility: The Energy Sector in Jamaica | Publications."
[51] Inter-American Development Bank, Marzolf, and Arbelaez, "Power and Possibility: The Energy Sector in Jamaica | Publications"; Inter-American Development Bank, Natacha Marzolf, and Jorge Perez Arbelaez, "Power and Possibility: The Energy Sector in Jamaica | Publications," accessed November 30, 2020, https://publications.iadb.org/publications/english/document/Power-and-Possibility-The-Energy-Sector-in-Jamaica.pdf.
[52] Inter-American Development Bank, Marzolf, and Arbelaez, "Power and Possibility: The Energy Sector in Jamaica | Publications."
[53] "NESOL Paid out Millions without Written Contract | Loop News," accessed November 30, 2020, https://www.loopjamaica.com/content/nesol-paid-out-millions-without-written-contract.

in alignment with government policy and national development goals and to do these tasks independently and impartially. Every five years the OUR conducts a rate review and also conducts annual assessments and adjustments.

- The Jamaica Public Service Company (JPSCo)

The energy sector is arguably centered around JPSCo as it is responsible for electricity transmission, distribution and dispatch.[54,55] Independent Power Producers (IPPs) also supplement the country's electricity supply and compete for long-term generation contracts to supply JPSCo with additional electricity. The market also has two private co-generators namely the Jamaica Broilers Group and Jamalco which sell their surplus capacity to the grid.[56] From its inception in 1970 to 2001, JPSCo was primarily owned by the GOJ. Today, the utility is jointly owned by Marubeni Corporation, Marubeni TAQA Caribbean, the GOJ and a few other private entities.[57]

Information provided in JPSCo's 2019 annual report indicates that the company serves 594,567 residential consumers and this accounts for approximately 33.5% of its billed energy sales.[58] After taxes, JPSCo generated $23,143,000 USD in profits at the end of 2019. In 2008, petroleum represented 95% of the electricity installed capacity and wind and hydro accounted for 5% of electricity generated by JPSCo. Almost 12 years later, petroleum accounts for 74.1%, natural gas accounts for 11.1 %, wind accounts for 10%, hydro accounts for

[54] National Conference of State Legislatures, "States Walk the Line: Current State Action Towards More Efficient, Secure, and Cost Effective Electricity Transmission," NCSL, accessed April 28, 2019, http://www.ncsl.org/research/energy/current-state-action-on-electricity-transmission.aspx#mn.
[55] Government of Jamaica, "All Island Electricity License 2016" (Kingston, January 27, 2016), https://www.our.org.jm/ourweb/sites/default/files/documents/sector_documents/jps_electricity_licence_2016_-_ja_gazette_wed_2016_jan_27_0.pdf.
[56] Inter-American Development Bank, Marzolf, and Arbelaez, "Power and Possibility: The Energy Sector in Jamaica | Publications."
[57] Inter-American Development Bank, Marzolf, and Arbelaez, "Power and Possibility: The Energy Sector in Jamaica | Publications"; Jamaica Public Service Company, "Our History," Jamaica Public Service Company, 2019, https://www.jpsco.com/our-history/.
[58] Jamaica Public Service Company, "JPS 2019 Annual Report: Powering What Matters" (Kingston, 2019).

2.8% and solar accounts for 2% of electricity generated. This demonstrates the efficacy of the island's public policy in encouraging a shift to a renewable energy regime.[59]

Policies

The Government of Jamaica in both its National Development Plan, Vision 2030 and its 2009-2030 Energy Policy: Securing Jamaica's Energy Future, articulated a number of key goals which aim to create a modern, efficient, diversified and environmentally sustainable energy sector.[60] Of particular note is the government's desire to expand the country's energy generation capacity and the provision of safe, reliable and affordable energy to homes and communities. This policy is to be revised and the government has set the target of 50% of generation from renewable sources by 2030.[61,62] In accordance with these goals the Ministry of Science, Energy and Technology with the input of the Jamaica Public Service Company, created an Integrated Resource Plan and Roadmap (IRP) in 2018 (revised in January 2020) which outlines a strategy for greening the country's' energy mix and to increasing system efficiency through investments in infrastructure.[63] The plan calls for the modernization of the grid and highlights the introduction of smart city technology, specifically smart meters, as central to this endeavor.[64]

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[59] Tanesha Mundle, "Gov't To Revise National Energy Policy - Jamaica Information Service," Jamaica Information Service, November 28, 2019, https://jis.gov.jm/govt-to-revise-national-energy-policy/.
[60] Ministry of Energy and Mining, "Energy Policy: Securing Jamaica's Energy Future 2009-2030," Government of Jamaica , October 2009, https://www.mset.gov.jm/wp-content/uploads/2019/07/National-Energy-Policy_0.pdf.
[61] Mundle, "Gov't To Revise National Energy Policy - Jamaica Information Service."
[62] *Vision 2030 Jamaica National Development Plan "Planning for a Secure & Prosperous Future,"* 2009, www.pioj.gov.jm.
[63] Ministry of Science Energy and Technology, "Integrated Resource Plan: A 20 Year Roadmap to Sustain and Enable Jamaica's Electricity Future." (Kingston, 2020).
[64] Technology.

Though sustainability is one goal of the smart meter rollout program, both JPSCo and the government have identified the reduction of system losses, specifically theft, as another main objective of the program.[65,66] According to the IRP, consumers with smart meters would also receive access to individualized "Energy Portals" which allow them to view and manage their energy consumption at shorter time intervals (e.g. hourly as opposed to monthly), thereby helping them to reduce energy costs and encouraging sustainable consumption. However, this feature has not yet been provided to consumers.[67] The plan also highlights that the installation of meters will help JPSCo better identify and manage system losses which will improve their billing operations and improve customer service.[68]

Industry & Regulation

The 2015 Electricity Act and the 2016 Electricity License are the primary legal documents which are used to regulate the industry and to define JPSCo's operational strategy. The 2016 License in particular grants JPSCo the exclusive right to transmit, dispatch and distribute energy until 2027. While the utility had exclusive rights to expand the island's generation capacity for the first three years of the original license (i.e., from 2001 to 2004), other entities are now able compete for the right to develop new generation capacity. The utility is also responsible for crafting a Least Cost Expansion Plan for submission to the OUR under this license.

The OUR also uses the provisions in the Electricity Act and the Electricity License to determine its General and Guaranteed Standards. The fifteen

[65] Steven Jackson, "JPS Says Self-Insurance Fund Enough to Pay for Recovery | Business," Jamaica Gleaner, 2012, http://jamaica-gleaner.com/gleaner/20121104/business/business4.html.
[66] Jackson, "JPS to Invest $6.5b in Smart Meters, Estimates Illegal Connections of 180,000 | Business | Jamaica Gleaner."
[67] Phillips, "Interview with Representative from the Jamaica Public Service Company."
[68] Technology, "Integrated Resource Plan: A 20 Year Roadmap to Sustain and Enable Jamaica's Electricity Future."

Guaranteed Standards are performance measures which guide the provision of services delivered by all utilities on the island and can be described as punitive. They cover issues including but not limited to billing accuracy and punctuality, response to customer queries, wrongful disconnection and changes to meters. A full list of the standards can be seen in Appendix A. There are no Guaranteed Standards that state or suggest how JPSCo should deal with customers who have overdue bills or have breached the terms of service. However, JPSCo has crafted its own protocol to deal with such matters. Typically, JPSCo provides its customers with a seven-day grace period to pay overdue bills after which their electricity service is liable for immediate disconnection without notice. To regain service after a disconnection customer are required to:

(i) pay a reconnection fee JMD$1,500.00 + General Consumption Tax. (GCT)[69]

(ii) pay a deposit increase (where applicable), plus all outstanding amounts in full, before electricity can be restored.

According to company policy, reconnections are done within 24 hours after all payments are made, and the JPSCo is notified.[70]

National Smart Meter Rollout

In 2011, JPSCo began its foray into the world of smart meters with the Residential Automated Metering Infrastructure (RAMI). The program was initially framed as an anti-theft solution and to date it has been deployed in 80 communities across the country.[71] In keeping with the initiative's aim these 80

[69] GCT is charged at a rate of 15% on goods and services. A few basic goods are exempted (zero rated). "General Consumption Tax (GCT) Rate Reduces from 16.5% to 15% Effective April 1, 2020 - Ministry of Finance & Public Service," accessed December 8, 2020, https://mof.gov.jm/mof-media/media-centre/press/2634-general-consumption-tax-gct-rate-reduces-from-16-5-to-15-effective-april-1-2020.html.

[70] "JPS Says It Never Had a '30 Days for Disconnection' Policy | Loop News," accessed December 1, 2020, https://www.loopjamaica.com/content/jps-says-it-never-had-30-days-disconnection-policy.

[71] JAMAICA PUBLIC SERVICE COMPANY, "THE JAMAICA PUBLIC SERVICE CO. LTD. ANNUAL TARIFF ADJUSTMENT SUBMISSION," accessed December 6, 2020, http://www.our.org.jm/ourweb/sites/default/files/documents/sector_documents/jps_2012_annual_tariff_submission.pdf.

communities were chosen because levels of theft are high, and the success of the smart meter program may have been compromised if losses were not first secured there.[72,73] JPSCo aims to roll out over 600,000 smart meters by 2023.[74]

Prepaid meters or the "Pay-As-You-Go" (PAYG) option was first introduced to Jamaican consumers in 2015 with a pilot in McGregor Gardens in Kingston and given its functionality can be considered a type of smart meter.[76] Customers can go online, or to select brick-and-mortar stores to purchase credit for their meters.[77] Once the payment is made, it is automatically credited to their household for immediate use. The meter displays the consumer's balance, displays levels of consumption and notifies the customer when they need to add additional credit. .[78]

Since 2015, the program has expanded to all parishes and the latest estimates from the utility show that there are approximately 10,000 customers who are utilizing this facility.[79,80] JPSCo aims to expand this program in the future. While one rationale given for these programs is to "provide greater efficiency and flexibility for billing operations and improving service delivery to customers", another is to assist the company in loss management and detection.[81] In the case of Bridgeville, estimates from officials at the Jamaica

[72] Phillips, "Interview with Representative from the Jamaica Public Service Company."
[73] Phillips.
[74] Jamaica Public Service Company, "JPS 2019 Annual Report: Powering What Matters."
[76] "JPS Begins Installation of Prepaid Meters," accessed December 6, 2020, http://www.jamaicaobserver.com/news/jps-begins-installation-of-prepaid-meters-_19153558&template=MobileArticle.
[77] "JPS Expands Its Prepaid Pay As You Go (PAYG) Service Island-Wide – JPS Co.," accessed December 6, 2020, https://www.jpsco.com/jps-expands-its-prepaid-pay-as-you-go-payg-service-island-wide/.
[78] "JPS Expands Its Prepaid Pay As You Go (PAYG) Service Island-Wide – JPS Co."
[79] "JPS Expands Its Prepaid Pay As You Go (PAYG) Service Island-Wide – JPS Co."
[80] A parish is a territorial division or the main unit of local government in Jamaica. Jamaica has 14 parishes.
[81] "JPS Expands Its Prepaid Pay As You Go (PAYG) Service Island-Wide – JPS Co."; "All Households To Have Smart Electricity Meters In Three Years - Jamaica Information Service," accessed December 6, 2020, https://jis.gov.jm/all-households-to-have-smart-electricity-meters-in-three-years/.

Public Service Company show that of the 423 accounts in this community, 29 use smart meters. Four hundred and sixteen (416) of these accounts are active and 8 are inactive. Of the meters deployed, four are RAMI-type smart meters, 171 active electronic or digital meters and 218 active analog or electro-mechanical meters.

Table 1: Displaying Estimates of Meters Types in Bridgeville, Westmoreland

Account Status	*Total*	*Smart Meter*	*Smart Meter RAMI*	*Digital*	*Analog*
Active	416	24	4	171	218
Inactive	8	1	-	1	5
Total	423				

Bridgeville Survey Results

Demographics and Household Characteristics

The survey targeted the primary energy decision-makers in each household, that is, the individual with responsibility for securing or paying for the household or family's electricity supply. As outlined in Table 2, 56% of survey respondents identified as female and 44% identified as male. Thirty-seven percent (37%) were between the ages of 45 and 59 and nineteen percent (19%) were between the ages of 18 and 29. While 69% respondents had completed secondary school, 21% had completed some form of tertiary education and 10% had completed their primary schooling. Approximately twenty percent (20%) of respondents were unemployed while 80% were employed. Of those employed, 9 worked in the private sector, 36 were self-employed and eight worked in the public sector. The average monthly household income was $65, 375 JMD or $448.00 USD.

Table 2: Displaying Demographic Data on Gender, Age, Education and Employment for Bridgeville Survey Respondents.

Gender	
Male	44%
Female	56%
Age	
18-29	19%
30-44	21%
45-59	37%
60-64	9%
65+	15%
Level of Education	
Below Secondary	10%
Secondary School	69%
Tertiary	21%
Employment	
Unemployed	20%
Employed	80%
Private Sector	17%
Public Sector	15%
Self- Employed	68%

The average age of the homes in which respondents' lived was 25.25 years. While 97.06% of respondents owned their homes, 2.94% rented their homes. While 73.5% of respondents lived-in single-family style homes, 26.5% lived in communal living spaces or tenement yards. Twenty-six respondents reported the number of rooms they had with other households. Rooms were defined as the number of self-contained spaces in the home and included kitchens, bathrooms, living areas and bedrooms. The average size of each household was 4.5 rooms and the average number of persons living in each household was 3.2.

Electricity Access

Ninety-seven percent (97%) of the 68 respondents had some form of access to electricity (Table 3). To gauge levels of electricity theft, respondents were asked whether their households received an electricity bill from the utility or whether

they paid an electric bill to JPS. As shown in figure 3, , 16% of respondents did not receive or pay an electric bill to JPSCo while 81% of households surveyed received and/or paid an electric bill to JPS (Table 3).[82] All the twelve respondents who were willing to share that they did not pay an electric bill provided the following reasons as to why they did not, were unable to or unwilling to do so.

One respondent paid their electric bill to a landlord. Another individual shared that they refused to pay for electricity as infrastructure issues had destroyed some of their appliances in the past and he did not want to pay an electric bill as compensation for their loss. Five of these individuals stated that the cost of electricity was too high for their households. Four respondents paid and/or relied on a neighbor to informally supply them with electricity. One of these respondents who paid his neighbors stated that he was too far from the main road to access the JPS' infrastructure and did not have the resources to build that infrastructure himself. One respondent was an electrician and shared that he primarily used a generator to supply his house with electricity. However, there was visible evidence that he was informally accessing energy from the surrounding electricity infrastructure.

The number of years that these respondents had used an informal electricity supply ranged from 1 year to 18 years. The average number of years without a formal connection was 7.25. When asked "Do you think that the cost of electricity is low, high or about right?" 34 individuals or 50% of respondents said about right and 34 or 50% of respondents said that the cost of electricity was too high. Ninety-seven percent (97%) of respondents reported experiencing a blackout of three hours or more within the year (Table 3). Thirty-two respondents reported the number of times they had experienced the loss of

[82] It is important to note that bill payment does not always indicate that a person is legally consuming all the electricity they use.

electricity in the last year for more than three hours. The responses ranged from once in the last year to up to fifteen times in a single year.

Table 3 Displaying Responses to Questions on Electricity Access in Bridgeville

Do you have access to electricity?	
Yes	44%
No	56%
Do you receive a bill from JPSCo for your consumption of electricity?	
Yes	81%
No	16%
No Response	3%
Do you think the cost of electricity is low, high or about right?	
Low	0%
High	50%
About Right	50%
Have you experienced a blackout lasting more than 3 hours in the last year?	
Yes	94%
No	6%

Energy Consumption Patterns

All respondents were asked if they knew the average of kilowatt hours of electricity they consumed in a month. Most were unable to recall this detail, but 11 were able to present their electricity bills. The number of kilowatt hours consumed in a single billing cycle ranged from 47 to 522. The average number of kilowatt hours was 165.5. The average monthly cost of electricity for respondents was $7005.00 JMD. This average includes the four respondents who reported paying their neighbors for access to electricity. Electricity costs account for 2.5% to 45% of a household's income. On average, it accounted for 19.01% of respondents' monthly expenses.

As shown in Table 4, ninety-three (93%) of households used the electricity to power entertainment devices including television and radios; ninety percent (90%) of households used electricity for refrigeration, while another ninety percent (90%) electricity to power small kitchen appliances such as toasters and blenders.

Table 4 Displaying the Proportion of Respondents who Use Specific Household Appliances or Devices.

Appliance or Device	**Percentage of Households with Appliance or Device**
Entertainment Devices (e.g., television sets, radios etc.)	93%
Refrigerators	91%
Small Kitchen Appliances (e.g., blenders, toasters etc.)	91%
Washing Machines	40%
Computing Devices	21%
Air Conditioning Units	7%
Dryers	4%
Electric Stoves	4%

Seventy-four percent (74%) of the respondents reported primarily using fluorescent energy saving lightbulbs, while eighteen (18) used incandescent lightbulbs.

When asked how much thought they gave to saving energy in their households, 66% of respondents said, “a lot”, “15% said “a fair amount”, 12% said “not very much” and 6% said “never” (Table 5). When asked if they were familiar with the energy star ratings on their appliances 60.6% of the respondents said “no”, while 39.4% of respondents said “yes”. When asked which of their appliances were energy efficient 35% of respondents shared that their

refrigerators were energy efficient, 4% reported that their television had an energy saving feature and 2% of respondents reported that their washing machines had energy saving features.

Table 5 Displaying Responses to Question on Attitudes Toward Household Energy Conservation.

How much thought do you give to conserving energy in your home?	
A lot	67%
A fair amount	15%
Not very much	12%
Never	6%

While 42% of respondents either used the utility's mobile or online platforms, 57% did not. Of those who did use the utility's online or mobile applications, 13% used them to pay bills, 84% used the platform to receive service delivery notifications from the utility and 3% used the platforms to submit service delivery queries or complaints. None of the respondents reported using the platforms to track their consumption of electricity.

Table 6 Displaying Responses to Questions on Use of JPSCo's Mobile and Online Platforms.

Do you use JPSCo's mobile and/or online applications?	
Yes	43%
No	57%
If you do use JPSCo's platforms, what do you use them to do?	
Pay Bills	13%
Receive Service Delivery Notifications	84%
Submit queries or complaints	3%
Monitor my consumption of electricity	0%

Attitudes Towards Electricity, Energy Technologies & the Environment

Sixty-nine percent (69%) of respondents stated that they had no knowledge of smart meters, while 31% reported having some knowledge of this technology. Of those who had knowledge of smart meters, 81% reported that they did not understand how they worked. Of the 68 respondents, 14.8% had received some information from the JPSCo about the new technology, while 84% reported that they had not received information about this meter type. One person reported receiving a smart meter in December of 2017 due to their use of solar panels. This individual was the only individual surveyed who used renewable energy technologies.

Thirty-two (32) respondents answered questions on their knowledge of pre-paid meters. As detailed in Table 7, 78% of these 32 respondents did not know about prepaid meters and 22% had some knowledge of pre-paid meters. None of the respondents were enrolled in JPS' prepaid meter program. When the program was explained to them 59% expressed interest in enrolling, 34% expressed disinterest in enrolling, 4% were undecided and 3% stated that it would depend on the personal investment required or the cost structure provided by the utility for the technology. Of the forty (40) respondents who expressed disinterest in the program, 31% cited the complexity of the enrollment process as their primary reason for not wanting to adopt this meter type, while 26% cited the limited availability of information as a reason for their disinterest.

Table 7 Displaying Responses to Questions on Knowledge and Use of Different Meter Types.

Do you know what a smart meter is?	
No	69%
Yes	31%
Are you familiar with JPSCo's prepaid meter option?	
No	78%
Yes	22%
Would you be interested in participating in JPSCo's prepaid meter program?	
No	34%
Yes	59%
Would you be interested in participating in JPSCo's prepaid meter program? (cont'd)	
Maybe/ Undecided	4%
Depends on investment, cost framework, incentives etc.	3%

Sixty-nine (69%) of respondents expressed interest in generating their own electricity to become partially or wholly self-sufficient using renewable energy sources. Eleven percent (11%) expressed disinterest, 12% reported that it would depend on the investment costs required or the available market incentives and 9% were undecided. When asked how important a political party's energy policy was to their vote, 45% of respondents reported that it was extremely important and 14% reported that it was somewhat important, 6% reported that it was neither important nor unimportant. However, when asked about the importance of a political party's environmental policy when voting, an even larger number of respondents (84%) said that it was extremely important and 3% reported that it was somewhat important.

Ninety-five percent (95%) of respondents reported that non-payment for electricity services was a challenge in Jamaica, while 5% disagreed with this sentiment.

When asked to share more why they thought non-payment was a challenge, five respondents provided the following responses:

"But JPSCo is dishonest as well"
"It is a sickness"
"Some people can't afford it"
"Sometimes I take light too when I am working on my house"
"They are robbing us, if you follow the system, you'll end up in prison. We have to beat the system."

Interview Results

Given the results of the survey, more in-depth information was sought from community members who informally access electricity, the utility and representatives from the Office of Utilities Regulation through interviews. The insights from each of the six interviews were classified under the eight principles of energy justice noted by Sovacool et al. (Appendix C). There were 21 insights categorized under "accessibility", 24 insights under "affordability", 18 insights under "good governance", 14 under "responsibility", 3 under "intergenerational and intragenerational equity", 23 insights under "sustainability" and 11 insights under "development and use of due process." In conjunction with the results of the survey, the findings of the interviews will be detailed.

Analysis of Interviews & Discussion of Results

Availability

Under the All-Island Electricity License of 2016, the Jamaica Public Service Company is required to provide equal access and quality of service to their customers regardless of their geographic locale.[83] As such, there should be no difference in access to electricity between rural and urban communities. This holds even though it is often difficult to service rural communities due to their distance from sites of electricity generation and the operational and infrastructure costs associated with providing access in rural areas. Yet, as evidenced with the 16% of survey respondents who did not have regularized access to electricity in Bridgeville, significant challenges remain for rural communities. In this energy insecure environment, two pathways are typically used by residents to gain electricity: (i) informally accessing electricity directly from electricity infrastructure or (ii) sharing energy resources with their neighbors.

One interviewee, *Cynthia lost her formal connection between 2005 and 2006 after the death of her father. Her family had accumulated overdue bills and was unable to pay the outstanding $25,000 JMD. This would be the equivalent of $69, 860.00 JMD in 2018 dollars.[84] Since that time, her family has been tapping into the public infrastructure to access energy. However, their connection remains unsecure. The 38-year-old reported losing access to electricity up to three times in a single day. Her informal connection only services one or two outlets in her home and she relies on extension cords to power her fan, television and iron. Another interviewee, *Sheila, accesses electricity from a neighboring shop which utilizes a formal connection. Like, Cynthia she is familiar with the challenges of informal electricity access. Twelve years ago, *Sheila lost her

[83] Government of Jamaica, "All Island Electricity License 2016."
[84] Using the World Bank's CPI for Jamaica, the inflation rate between 2005 and 2018 would be 179.45%.

first home in a fire after a mishap with the electrical wiring shared between herself and a former neighbor.

This experience demonstrates the high levels of vulnerability informal electricity users contend with. It is important to note that supplying electricity or receiving monetary compensation as in the case Sheila's neighbor, is illegal as JPSCo has the sole right to distribute, supply and transmit electricity. However, the regulatory officials interviewed hypothesize that JPSCo may be less inclined to remove these connections if at least one of the parties has a working meter which tracks all consumption. This obtains even though they may not receive the fixed costs. Both Cynthia and Sheila's experiences demonstrate the great risks households are willing to take to source their own electricity even as they contend with an environment in which there is limited access.

The JPSCo representative interviewed confirms this notion when he described the savvy means informal consumers use at times to access electricity.

> *"tampering takes many different forms. People put things inside of their walls, they run physical wires underground, they have load-type switches inside their homes. So, they only switch it on at night when they come in, or they switch it on at 1:00 – all kind of different mechanisms is in this, that takes time and effort for you to detect and identify."*

While this level of sophistication was not observed in Bridgeville, it suggests that smart meters may not always be able to identify all varying strategies used to access electricity from the grid.

Affordability

The results of the survey show that electricity costs account for 2.5% to 45% of a household's income. On average, it represented for 19.01% of respondents'

monthly expenses indicating that Bridgeville residents have high energy burdens. Bridgeville residents who were also JPSCo customers wanted to pay 48.8% less for electricity on average. It is important to note that all respondents and interviewees expressed a desire to pay some amount for their consumption of energy. This was the case even for those who did not earn consistently, as in the case of Cynthia. On days she is able to earn, Cynthia makes approximately $1000.00 JMD day selling ice cream and other treats in her community. Her partner is without a consistent source of income, placing the household's monthly earnings around $30,000 JMD. She shared that a reasonable electricity bill would be $3000.00 a month or 10% of her monthly income. When the pre-paid meter option was presented and explained as a possible pathway to a formal connection, the mother of two toddlers expressed the inadequacy of the solution for her household:

> *Interviewer: Have you ever heard about JPSCo's prepaid meter option?*
>
> *Cynthia: That's, that's the one that they set up at your house and then you go to the shop and you pay the bill like a phone bill?...Yes, I heard about that one…For me, I don't like it because what if I don't have the money? It's like having a plan on your phone and purchase megabytes on your phone. What if you don't have the money to purchase megabytes on your phone? You jus haffi mek it runoff [you just have to let it run off]…. I don't believe in that [pre-paid meters] because if I don't have any cash you don't have any light so basically it is the same thing [that I am experiencing now].*[85]

The sporadic nature of Cynthia's income creates much uncertainty around her ability to purchase electricity on a daily, weekly or monthly basis from a pre-paid meter.

[85] Sacha-Rose Phillips, "Interview with Community Member #1-*Cynthia," n.d.

Sheila's situation also highlights the challenges with affordability. Each month, the elderly woman's son sends her a $100 USD, which she primarily uses to purchase medication. Since the housefire, she has not been able to repurchase essential items such as a refrigerator. As such, she makes painstaking effort to conserve and only has a radio, a lamp and bulb to light the exterior of her home so as to not increase her monthly expenses.

Interviewer:	*… I know you said that you try to be conscious of how you use your electricity, yuh try nuffi burn current too much [you try to minimize your use of electricity].*
Sheila:	*Yes.*
Interviewer:	*So, in your house, what do you use it for when you're trying to conserve, which things you use electricity for?*
Sheila:	*You know I don't have a bulb in the house, if I am looking for something, I have a lamp that I plug in. I'll have it on for maybe for 5 minutes or up to a half an hour then I turn it off and I use the light from the outside bulb, and I can see enough.*
Interviewer:	*Oh ok. So, you just use an outside bulb or the lamp. Yuh. [Do you] have a radio?*
Sheila:	*Yes. I don't turn on the radio. You don't turn on the radio. Sometimes only one time for the month on a Sunday.*
Interviewer:	*OK, do you, do you have a fridge.*
Sheila:	*No. It got burnt up and I haven't gotten any back.*
Interviewer:	*OK, uh and you have your cell phone that you charge?*
Sheila:	*Yeah. This phone that I am talking on? I charge it.*
Interviewer:	*All right. Do you have like a toaster or a blender or a mixer or any other stuff?*

Sheila: *No, no, no. I have an iron, but i scarcely use because all my clothes is wash and wear.*[86]

Shelia receives electricity from her neighbor who is formally connected to the JPSCo's system. She pays $1000.00 JMD or approximately $6.90 USD to her neighbor each month.[87]

The economic constraints faced by both Sheila and Cynthia, highlights the need for special electricity rates for low-income and/or vulnerable consumers. As a part of its mandate, the OUR cannot set differential rates for consumers or vary their contributions to the utility's capital investments based on their socio-economic status. However, one pathway used to lower costs for the most economically vulnerable users is the Lifeline Rate. However, as corroborated by the survey, rural users are less likely to have energy efficient appliances and are likely to consume more electricity as a result. The difference in rates for users who consume 100 kWh and users who consumer 101 kWh or more is quite significant. At 100 kWh or less the rate is $9.66 JMD. At 101 kWh or more, the rate is $22.49 JMD.[88] The average monthly consumption of the 11 respondents who were able to provide a copy of their electricity bill was 165.45 kWh. With the current rate structure, this would result in an average bill of $2400.00 JMD. For those unable to present a bill, the average estimated cost was $7873.33 JMD. In its 2019-2024 Tariff application, JPSCo requested that the Lifeline Rate be reduced to 50 kWh.[89] They also requested that the energy charge for consumption below 50 kWh be lowered to $8.95 JMD and that the

[86] Sacha-Rose Phillips, "Interview with Community Member #3-*Sheila," n.d.
[87] This US dollar estimate was calculated using the US dollar to Jamaican dollar exchange rate of $144.72 JMD for $1 USD.
[88] Jamaica Public Service Company, "JPS Rate Schedules and Duties 2018-2019," Jamaica Public Service Company, 2018, https://s26303.pcdn.co/wp-content/uploads/2020/01/40908-JPS-Rate-Schedules-2018-2019-22-x-14-Tabloid-Pull-Out_Print-Artwork.pdf.
[89] "JPS Tariff Application 2019-2024," Jamaica Public Service Company, December 2019, https://s26303.pcdn.co/wp-content/uploads/2020/01/JPS-2019_24-Rate-Application-Public-Version.pdf.

energy charge for consumption between 50 kWh and 500 kWh be increased to $29.33 JMD per kWh.[90] Under this new structure, the monthly cost of electricity would be $3820.45, a 59% increase in the cost for Bridgeville respondents. This tariff application is currently under review by the OUR, but if approved, could exacerbate the existing consumer challenges with affordability.

In the same application, JPSCo proposed the establishment of an Electricity Affordability Assistance Program. Under this initiative the GOJ would provide direct payment assistance to vulnerable citizens eligible through the Programme of Advancement Through Health and Education (PATH) program.[91] It is unclear exactly how this program will be structured, however, children, unemployed adults, the elderly, persons with disabilities, pregnant and lactating women as well as "victims of disasters" would qualify under the current definition of PATH beneficiaries.[92] If this definition remains both Cynthia who is underemployed and Sheila who is over the age of 65, could benefit from this initiative.

At this juncture, it is also important to note that though Sheila has relocated since her first home was destroyed by fire, she cannot afford the infrastructure upgrades needed to provide a formal connection to her second home and she continues to purchase supply from her neighbor. In the Electricity Act, the Government of Jamaica has mandated that the OUR establishes a fund through its rate structure to help citizens receive the necessary electrical infrastructure upgrades to their home.[93] The OUR is currently in the process of designing such a program.[94] Before its closure NESOL would have managed the disbursement

[90] "JPS Tariff Application 2019-2024."
[91] "Public Assistance Division (Overview) – Ministry of Labour and Social Security," accessed December 6, 2020, https://www.mlss.gov.jm/departments/public-assistance-division-overview/?artid=23.
[92] "Public Assistance Division (Overview) – Ministry of Labour and Social Security."
[93] Government of Jamaica, "The Electricity Act 2015," *Government of Jamaica* (Kingston, August 17, 2015), https://japarliament.gov.jm/attachments/article/341/The Electricity Act, 2015 No.18.pdf.
[94] Phillips, "Interview with Representative from the Office of Utilities Regulation."

and use of these funds. It is unclear which entity MSET will tap to carry out this function once the fund is established.

One of the rationales frequently given for high electricity costs in Jamaica is the fact that there are high levels of theft and paying consumers absorb these losses. In some instances, smart meters can provide the data needed to identify informal access. Furthermore, the introduction of smart meters will likely reduce operational costs for the utility, eliminating the human resources and transportation costs for meter maids. However, the mere installation of smart meters or increased identification of theft is not sufficient to address the issue of informal access. Additional support programs may be needed for vulnerable users who informally abstract electricity from the grid.

Inter-generational Equity & Intra-generational Equity

The challenges related to affordability also illustrate issues of inter-generational and intra-generational equity. This is illustrated through the interviews with Marcia and Sheila. Marcia is a 63-year-old shop owner in Bridgeville. Her adult children lived with her and were responsible for paying the electricity bill which averaged $3000.00 each month. However, at the end of 2019, all of her children emigrated to the United States. As is common in many Caribbean households, the family agreed that the children would continue to contribute to the household by paying the electricity bill. However, this not done for an extended period of time. Eventually, Marcia's account registered a balance in excess of $60,000.00 JMD. Her meter was removed in early 2020 and she was left without electricity as a result. Marcia shared that she does not have sufficient capital to pay that amount in a single lump sum as is required to regularize her connection again.

In Sheila's case, her children also indirectly pay her electricity bill through her monthly stipend of $100.00 USD. However, these payments have become increasingly sporadic as her children have fallen on challenging economic

times. In fact, her daughter moved next door to her and currently cannot afford access to electricity in her own home:

Sheila: She don't have any light enuh [you know].
Interviewer: She doesn't have any light? So, if she needs light she has to come to your house?
Sheila: Yeah.
Interviewer: OK. And how is she planning to deal with that over time? What's the plan? Is she going to try and get her own light, or is she going to take from you or from [neighbor's name].
Sheila: No, she wouldn't get it from her because, you know, she have business doing and sometimes it burns too much. She cyan tek more on it [she can't take on anymore connections]. She have two fridge in har shop [She has two refrigerators in her shop].[95]

As evidenced in the dialogue above, both Sheila and Marcia are over sixty and rely on their children's income to gain access to electricity. Without their support, they are unable to maintain both formal and informal connections. From Sheila and her daughter's experiences, it is also clear that energy insecurity is cross-generational. Though they are live in close proximity to one another, Sheila's daughter is unable to share her mother's electricity connection due to concerns that there may be too much load on her neighbor's connection to the grid. Sheila's daughter and grandchildren must venture daily to her mother's house to meet their energy needs.

Responsibility

In the survey of Bridgeville, 95% of respondents reported that non-payment for electricity services was a challenge in Jamaica, while 4.76% disagreed with this sentiment. These figures illustrate that there is largely consensus that informal access to electricity in Jamaica is problematic. However, there is less consensus

[95] Phillips, "Interview with Community Member #3-*Sheila."

around who is responsible addressing this issue. The concept of "responsibility" was a common theme in the discussions with the JPSCo and OUR representatives. In their article, "Energy decisions reframed as justice and equity concerns," Sovacool et al. offer one approach to responsibility within energy justice literature when they state that "an important dimension to justice goes beyond concepts and analysis to decisions and thus decision-making, including policy-makers and regulators ordinary students, jurists, homeowners, businesspersons, investors, and consumers." Like Sovacool et al. there was a recognition by the JPSCo representative that electricity theft or informal electricity access is a socio-cultural issue that permeates every aspect of Jamaican society and as a result is the responsibility of every citizen. They shared the following:

> *"I think we're lost on the reality of what really is the Jamaican environment. The social environment does not just exist on a residential scale, it also exists on a commercial scale... So, it's not as it's made out to be. And you also have to realize that some of the persons who are on the residential side cannot afford the sophistication of mechanisms that will be adopted by some of the commercial persons to steal energy. So, it is very significant. It's a significant problem. And, again, it stems from a large social issue…"*[96]

This realization is echoed by Jenkins et al. who goes further by stating that if structural injustices are to be tackled, models of responsibility must transition from an individualized or household level focus to collective approached where individuals recognize their connections beyond their immediate context. Thus, it is important to understand when groups are perceived to be responsible for and are capable of directly tackling energy injustices.[97]

[96] Phillips, "Interview with Representative from the Jamaica Public Service Company."
[97] Kirsten Jenkins, Darren Mccauley, and Charles Warren, "Attributing Responsibility for Energy Justice: A Case Study of the Hinkley Point Nuclear Complex," n.d.

In their interview, the OUR representative also highlighted notions of personal responsibility and collective responsibility in addressing this issue. To emphasize his point, the interviewee spoke about the success of community led solar projects in jurisdictions such as Puerto Rico, and how they hinged on the entire communities taking collective responsibility for the equipment and infrastructure. They were unsure that such initiatives would be successful in the Jamaican context because of individuals hesitation to take personal and collective responsibility. As an example, he referenced local community-led water access projects which have failed because of a lack of ownership on the part of community members and a failure to take responsibility for the plant's functioning. The OUR representative also highlighted the role of political leaders in taking responsibility for the electricity theft challenge in Jamaica:

"People have to understand how society works and the responsibility of each party. When one party does not appreciate the efforts of another or the resources of another things can just come tumbling down. And so, you know, I believe that, you know, leadership is part of the process to get people into a particular frame of mind and thinking… they don't tell the people that did you see the electricity, it's a criminal offense and you will report it. They don't tell them that. They give them the impression as if everything and electricity is free… you basically don't believe that you should pay for water or electricity because that is what has been conveyed…The government or the leadership of the country or the local government have to inspire the people, they have to implore them that in electricity comes at a cost."[98]

The importance of political leadership in the management of the energy sector was evident in the survey as well. When asked about the importance of a political party's energy policy when voting, 45% of respondents said that it was extremely important, and 11% said that it was somewhat important.

[98] Phillips, "Interview with Representative from the Office of Utilities Regulation."

However, both the OUR representative and the JPSCo representative lamented the lack of serious action on the part of the GOJ in addressing the root causes of this issue. In March of 2020, JPSCo's Chief Financial Officer reported that they were lobbying the government to create a task force to "combat electricity theft on the island". In a public consultation with customers on JPSCo's 2019-2024 rate review he said the following:

"This is a monster that impacts us [JPSCo] and you, our customers. The JPSCo took down 200,000 'throw ups' last year.[99] *We are not a police force. We have asked the Government to create a special task force to deal with utility theft, both electricity and water, so that we can have a police unit that works with us constantly.*

Another dimension of responsibility that emerged from the data was that of being a "good neighbor". Both Marcia and Racquel, another interviewee considered sharing electricity access with those nearby as one's neighborly duty and as a part of being a kind community member. In the case of Raquel, she willingly shared her electricity supply with her neighbor.

Interviewer:	*Did you have any hesitations? I just want to understand what was going through your mind at a time.*
Racquel:	*Ok. The only thing is that sharing that current is a little bit um <pause> because that current is a little bit more expensive than the general house one because that is commercial light.*
Interviewer:	*Oh, ok.*
Racquel:	*OK, yes, that is commercial. And normally people don't share commercial light because it is a little bit more expensive than the general one that you use in the house.*

[99] Throw-ups refer to illegally connected wires that are used to abstract electricity from JPSCo's power lines.

Interviewer:	*Right.*
Racquel:	*So they charge you a higher rate for that one.*
Interviewer:	*OK*
Racquel:	*But seeing that she is in age and whatsoever, I just don't stress that point with her mi just give har the light [Given that she is an elderly woman, I didn't stress that point. I just gave her access to the electricity].*
Interviewer:	*OK, um, does JPSCo know that you have this and that you're sharing with her?*

Racquel:	*Yes. Because there's a wire there to show.*
Interviewer:	*OK, but has anyone come to talk to about it explicitly?*
Racquel:	*No, no, no, no.*
Interviewer	*But it's not like you're not<pause> you're not trying to hide it or anything.*
Racquel:	*No, no because it's very public. Anyone can see it.*[100]

In her interview, she expressed that her only hesitation was that her neighbor may have ended up paying a higher rate because she was connected to her business' electricity supply again. Though the activity is technically illegal she made not attempts to hide or conceal the connection even at the risk of being prosecuted or penalized by JPS. It is important to note that though it is clearly visible, no JPSCo representatives have asked her about the matter in the last 12 years. As a younger neighbor, Racquel asserts responsibility for her older neighbor.

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Good Governance

The energy justice tenet of good governance posits that "all people should have access to high quality information about energy and the environment and fair,

[100] Sacha-Rose Phillips, "Interview with Community Member #4-*Racquel," n.d.

transparent, and accountable forms of energy decision-making."[101] Thus, this aspect of energy justice hinges on the availability of information. In their interview, the JPSCo representative expressed the company's desire to give users access to information to encourage more sustainable consumption. In fact, the utility has invested significant resources into the design of savvy mobile apps and online platforms to help users track their usage. The applications provide information on customer consumption patterns, costs and even include budgeting tools. However, as evidenced in the survey where 57.35% of respondents reported not using the utility's mobile or online platforms, many rural consumers are being left behind. Of those who did use these applications, none reported using them to track their consumption.

The challenge with access to information also extended to consumers knowledge of meter types. None of the interviewees were familiar with the term "smart meters". The survey also indicated that 55% of respondents had not enrolled in the pre-paid meter program because of "lack of information about the program". Bridgeville residents' limited knowledge of these new meter types and low use of the information sharing apps undoubtedly has implications for the ability of smart meters to lower household electricity costs for them.

Like other utility regulators around the globe, the OUR uses a number of regulatory instruments including codes, determinations, orders, guaranteed standards and policies to communicate the quality service standards to both customers and utilities. Many of these instruments are applicable to and have guided the process of the smart meter roll-out thus, fat. For example, under the All-Island Electricity License JPSCo is not allowed to sell consumer information to third parties and therefore, cannot share consumer data from smart meters for profit.[102]

[101] Sovacool and Dworkin, "Energy Justice: Conceptual Insights and Practical Applications."
[102] Phillips, "Interview with Representative from the Office of Utilities Regulation"; Government of Jamaica, "All Island Electricity License 2016."

This regulatory information is easily accessed through the OURs website and the entity frequently conducts community education campaigns to inform citizens of their rights and responsibilities as customers of JPSCo.[103] However, gaps in the accountability process remain many of which may lie outside of the OURs gambit as a regulator of utilities. For example, the OUR does not have explicit standards which state how a customer should be notified before a disconnection or the timeline within with they should pay. This is because the OURs standards are primarily punitive and in the words of the representative interviewed:

"we could not penalize JPSCo for not reminding customers to pay their bills"[104]

There are also no definitive standards, mechanisms and processes on how vulnerable consumers of electricity (i.e. the elderly, person with disabilities) should be treated with when they are unable to pay, informally access electricity or have safe connections.

Development and Use of Due Process

Process for Smart Meter Rollout

Due process requires the participation of all stakeholders in the energy decision-making processes. It also requires the creation of pathways for recourse in administrative and justice systems. While JPSCo consumers cannot opt out of the smart meter program, there is a pretty rigorous protocol for informing customers when a smart meter is to be installed. During their interview, JPSCo representative detailed the process:

...we have a standard approach of communicating before and communicating after. Communicating before takes several forms. There's broadcast, radio and

[103] Phillips, "Interview with Representative from the Office of Utilities Regulation."
[104] Phillips.

TV, about smart meter changes coming in specific areas. There is a letter that you send to the customer's home and the bill that you get has a notification on it when your meter is changed, and there's a notification left at the house when a meter is changed. So, there are a number of forms that we have communicated with; multiple before and at least two after…The person who changes the meter leaves a notification at your house that your meter has been changed. And then your next bill after the meter change has a notification on it that the meter has been changed.

Of the 68 persons surveyed, 2 indicated that they had received a smart meter and had received information from JPSCo on how it worked. But both respondents reported that they did not understand the technology. This suggests that the communication efforts of JPSCo may need to be refined to better communicate information about smart meters.

Management of Smart Meter-Related Complaints and Queries

Since the beginning of 2020, there has been a substantial increase in the number of complaints with the introduction of smart meters. The OUR representative interviewed estimated that the entity has received nearly 100 meter-related complaints to date.[105] The OUR's protocol for complaints or appeals process requires customers to try to resolve the matter with the utility before filing a charge with the OUR.[106] Consumers are required to place their complaint in writing. If the matter is not resolved at the level of the utility, then customers are encouraged to submit their concerns to the OUR via email, via social media, via telephone or at their offices. The OUR then reviews the matter and provides JPSCo a specific timeline within which they must address these complaints. In response to the sharp increase in formal complaints, the requested that JPSCo conduct a study. The results and methodologies used in that study were unsatisfactory and as a result, the OUR administered a study

[105] Phillips.
[106] Phillips.

using a sample of 308 accounts to investigate if smart working meters were fully functional and providing correct consumption figures.[107] The findings of the study were published in August if 2020 and concluded that the meters were recording accurate usage data.[108] In some instances the previously owned analog meters were providing incorrect readings, thereby skewing customer consumption and billing data.[109] As a result, of the study the OUR has pledged to design a process to track meter installations to allow for additional monitoring and meter audits.[110] They also plan to do occasional audits to test samples of old meters shortly after their removal and to investigate meter replacements completed after June 2019. [111]

Process for Non-Payment of Bills

Similar to the smart meter rollout protocol, JPSCo has a system for managing users who may be behind on bill payments. If one stops paying a bill, JPSCo will first check to see if the premises is occupied.[112] If it is occupied and electricity is being consumed, they decide on a case-by-case basis whether to prosecute if there is theft or require the person to pay arrears.[113] On the rare occasion, JPSCo conducts debt amnesty's where they allow customers to negotiate off up to 70% of their debt.[114] The last debt amnesty was conducted in 2015.[115] JPSCo chooses this approach in part because the local justice system is ill-equipped to deal with the mammoth issue of electricity theft. On this matter the representative from JPSCo said:

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[107] Office of Utilities Regulation, "OUR CONCLUDES INVESTIGATION ON JPS ADVANCED (SMART) METERS," accessed December 7, 2020, www.our.org.jm.
[108] Office of Utilities Regulation.
[109] "Staff Directory," accessed April 28, 2019, https://mn.gov/puc/about-us/our-team/staff/.
[110] Phillips, "Interview with Representative from the Office of Utilities Regulation."
[111] Office of Utilities Regulation, "OUR CONCLUDES INVESTIGATION ON JPS ADVANCED (SMART) METERS."
[112] Phillips, "Interview with Representative from the Jamaica Public Service Company."
[113] Phillips.
[114] "JPS Announces Debt Amnesty," accessed December 7, 2020, http://www.jamaicaobserver.com/news/JPS-announces-debt-amnesty.
[115] "JPS Announces Debt Amnesty."

"The reality is that the justice system itself will come under significant pressure if you were to try and arrest every single person who steals light. Meaning, you don't have enough space in the jail for that and we don't have enough space in the courts for that. You would consume the legal system if you look at the extent to which persons are stealing, the number of people who are stealing and you try to do that, you will consume the entire legal system"[116]

The justice system's inability to deal with the mammoth challenge again points to the need for the development of more robust systems of accountability. It not only poses a challenge for the utility, but also for consumers who may not be able to resolve matters with the OUR but may need to go to the courts to seek redress.

Sustainability

Sovacool et al. define the energy justice tenet of sustainability as the use of natural energy resources so as to ensure that we can "meet the needs of the present without compromising the ability of future generations to meet their own needs."[117] While this definition primarily concerns the conservation of tangible energy resources, it also has relevance to the suitability and survivability of energy systems as whole.

In their interview for this study and in mass media, JPSCo has indicated that the rollout of smart meters will improve billing accuracy and will give users access to information from meters to inform more sustainable consumption. Smart meters will help to better detect theft and lowers operational costs associated with combating this issue. However, given the level of sophistication used to informally access electricity, the installation of smart meters alone, may not deter theft.

[116] Phillips, "Interview with Representative from the Jamaica Public Service Company."
[117] Sovacool and Dworkin, "Energy Justice: Conceptual Insights and Practical Applications."

As such, regulators are cautious about the efficacy of these technologies to curb theft especially if the systems of recourse and to rectify are not efficient. The country's experience with the CAMI, RAMI and Energy Efficiency Improvement Fund (EEIF) demonstrates as much. The first iteration of RAMI began in 2009 and was funded through the EEIF. Each year JPSCo received approximately $13,500,000 through the fund. During the first iteration of the program, high levels of theft persisted. This was because citizens in participating communities were still able to access and rewire the infrastructure to informally abstract electricity. JPSCo had to change their strategy. In their interview, the JPSCo representative provided more context for this issue:

Prior to [this iteration of] the RAMI program, there was a metering program that was called Metering Enclosure. This enclosure was outside of the customer's premises, it was on a pole outside. And still, persons were still cutting the wires and cutting the panels because it was just about 6 feet from the ground. It was there to give the customer the ability to still read their meter physically.

The metering infrastructure was down 6 feet, it had cables running down to our meter panel that had about 4 meters on it…So you could walk up to the pole and touch it with your hands. So what that does is it gives general and normal people the thinking that, "Maybe I can do something." What the RAMI does is move this infrastructure from 6 feet on the ground up to 18 or 20 feet on the pole. A lot of the times it's connected directly to the transformer. So you have energized equipment within the space of it. People don't interfere with that. [118]

However, even after this modification challenges persisted. The EEIF was terminated by the OUR in 2017 because of the inability of the RAMI/CAMI programs to effectively curtail non-technical system losses. In fact, during this

[118] Phillips, "Interview with Representative from the Jamaica Public Service Company."

period system losses began to increase. The representative interviewed from the OUR offered the following perspective:

After our assessment in 2014 we believed that the fund was not being used effectively by JPSCo in terms of the meter rollout and the reduction of system losses which was one of the main aims of the program in the first place. So we thought that the efficacy of the program was questionable. Monies were being spent and we weren't seeing the type of impact we were anticipating. So in 2016 we reduced the amount of funding by 50% and in 2017…we terminated it. [119]

When asked about the reason that the program may have failed, the interviewee hypothesized that the loss drivers were likely not understood, or the program's design was misdirected. They emphasized the need to address non-technical losses stemming from theft swiftly:

OUR Representative: When you deal with losses you can't take your foot off the accelerator. Once you take your foot off the accelerator you're going to lose.

Interviewer: And why is that? Why is that the case? Why does it have to be that aggressive?

OUR Representative: If you are in a neighborhood and you see people not paying and JPSCo is not even coming there to read meters and then they just have a price hike. Then the legitimate customer who is normally paying they won't bother to pay again…So, they say well I am going to steal as well because they are not being penalized. There is no, there's no, there's no punishment.

[119] Phillips, "Interview with Representative from the Office of Utilities Regulation."

So, people are stealing electricity and there is no measures. So because of that it breeds an environment that causes problems and causes it to proliferate. [120]

These insights suggest that the rollout of smart meters must be accompanied by efficient program design and transformational public communication campaigns which clearly communicate the benefits of having a formal connection to individuals and to society. The structure and unique context within which the Jamaican electricity sector operates in also creates sustainability challenges. Unlike markets in other jurisdictions, the Jamaican electricity market is small and cannot capitalize on the economies of scale in generation and distribution. While not completely unfeasible, creating a competitive market or facilitating the entry of another electric utility may not lower costs thereby lowering the likelihood of informal access. This is because the new utility would be need to invest significant capital in infrastructure and would need to fund these investments through their rate structure.

Given these limitations, creative solutions are needed. While disaggregating licensing for transmission, supply and generation to increase competition and lower electricity costs is possible, doing so for distribution function may be hard because it this where most system losses due to theft occur. As a result, large utilities and other commercial entities may be less inclined to purchase this right on its own. However, individual citizens and rural communities such as Bridgeville may be able manage generation and small-scale distribution on their own. Formalizing the shared economies that already exist for electricity may be a pathway to creating a more sustainable, affordable system. Individual citizens would not only generate their own electricity but supply their neighbors as well. In the long run, this pathway may be more cost-effective and may leverage well-established community relationships to ensure cooperation. The sixty-nine

[120] Phillips.

percent (69%) of Bridgeville residents who expressed interest in being energy independent, suggests that rural users be more inclined to this model.

One potential roadblock to this approach is that the current regulatory and legal framework does not permit sharing because JPSCo has the sole right to supply, distribution and transmission. Changes to this framework may not be possible until 2027 when their current license expires. However, recent efforts to establish and refine the net-billing and power wheeling policies suggest that creating the appropriate framework for sharing electricity resources may not be afar off.

Another challenge to this proposed model is the infrastructure costs associated with the establishment of such a system. This is especially the case for a rural district like Bridgeville with significant economic constraints. The expansion of benefits under the PATH program and the National Housing Trust may provide a mechanism for funding. The National Housing Trust is the government agency tasked with increasing the availability of affordable housing in Jamaica. NHT is funded through deductions from employers, self-employers and voluntary contributors. Each contributor is eligible for loans to assist in building, buying and repairing homes. The agency now offers financing for the installation of solar panels and this can be expanded to meet the needs of vulnerable users to the benefit of the entire grid.

Conclusion

Energy systems around the world are undergoing rapid transformations that will dramatically shift the way we fuel our transportation, power our homes and manage our industries. The dramatic changes are the result of several factors such as changing customer behavior, shifts in regulatory, competitive and policy frameworks and the emergence of novel technologies, such as smart meters. In theory, these technologies should facilitate more sustainable, affordable consumption. But, in a jurisdiction such as Jamaica which has a unique operational context, technological shifts will not suffice.

Volatile fuel prices and foreign exchange rates continue to negatively impact the country's electricity sector. There are still significant challenges with equitable electricity access and the pervasive problem of informal access has severely impacted the cost of electricity service delivery. As evidenced by the data collected in this study, the challenge of informal access is largely a socio-economic problem which cannot solely rely on the introduction of surveillance technologies. As such, the conventional measures of successful smart meter implementation which focus on reduced energy consumption and environmental benefits used in other are insufficient for this locale.

Given this, the introduction of smart technologies may be best complimented by a transformation the traditional utility model. The creation of a system which facilitates greater levels of affordable ownership, energy independence, access to information and accountability may be necessary. Formalization of the unlawful model of sharing electricity resources may be one such pathway.

Appendix

Appendix A: Table 1 Displaying the Approved Guaranteed Standards for Jamaican Utilities

Focus	Description	Performance Measure
Access	Connection to Supply- New & Simple Operations	New service installations within five (5) working days after establishment of contract, includes connection to RAMI system. **Automatic Compensation**
Access	Complex Connection to Supply	From 30m to 100m of existing distribution line: (i) Estimate within ten (10) working days; (ii) Connection within thirty (30) working days after payment. **Automatic Compensation**
Access	Complex Connection to Supply	From 101m to 250m of existing distribution line: (i) Estimate within fifteen (15) working days; (ii) Connection within forty (40) working days after payment. **Automatic Compensation**
Response to Emergency	Response to Emergency	Response to Emergency calls within five (5) hours – emergencies defined as: broken wires, broken poles, fires.

		Claim
First Bill	Issue of First Bill	Produce and dispatch first bill within forty (40) working days after service connection. **Automatic Compensation**
Complaints/Queries	Acknowledgements	Acknowledge written queries within five (5) working days. **Automatic Compensation**
	Investigations	Complete investigations and respond to customer within thirty (30) working days. Where investigations involve a 3rd party, same is to be completed within sixty (60) working days. **Automatic Compensation**
Reconnection	Reconnection after payments of overdue amounts	Reconnection within twenty-four (24) hours of payment of overdue amount and reconnection fee. **Automatic Compensation**
Estimated Bills	Frequency of Meter Reading	Should NOT be more than two (2) consecutive estimated bills (where company has access to meter). **Automatic Compensation**
Estimation of Consumption	Method of Estimating Consumption	An estimated bill should be based on the average of the last three (3) actual readings.

Meter Replacement	Timeliness of Meter Replacement	Maximum of twenty (20) working days to replace meter after detection of fault which is not due to tampering by the customer. **Automatic Compensation**
Billing Adjustments	Timeliness of Adjustment to Customer's Account	Where it becomes necessary, customer must be billed for adjustment within three (3) months of identification of error, or subsequent to replacement of faulty meter. **Automatic Compensation**
Disconnection	Wrongful Disconnection	Where the company disconnects a supply that has no overdue amount or is currently under investigation by the OUR or the company and only the disputed amount is in arrears. **Automatic & Special Compensation**
Reconnection	Reconnection after wrongful Disconnection	The company must restore a supply it wrongfully disconnects within five (5) hours. **Automatic & Special Compensation**
Meter	Meter Change	The company must restore a supply it wrongfully disconnects within five (5) hours.

Compensation	Making Compensatory Payments	Accounts should be credited within one (1) billing period of verification of breach **Automatic Compensation**
Service Disruption	Transitioning Existing Customers to RAMI System	Where all requirements have been satisfied on the part of the company and the customer, service to existing JPSCo customers must not be disrupted for more than three (3) hours to facilitate transition to the RAMI system. **Automatic Compensation**

There are fifteen standards which cover issues related to wrongful disconnection, meter changes, service disruption, consumer complaints and queries. JPSCo must provide customers with monetary compensation of these standards are breeched. There are two kinds of compensation JPSCo customers can receive namely automatic compensation ($1,500 JMD + GCT) which is credited to the customers next bill and special compensation ($3000 JMD + GCT). For any other grievances not classified with the "automatic compensation" designation, claims must be submitted to JPSCo.[121]

[121] Office of Utilities Regulation, "Guaranteed Standards" (Kingston, February 16, 2018), www.our.org.jm].

Appendix B: Survey Questions and Community Participant Interview Questions

April 2, 2019

Dear Participant:

My name is Sacha-Rose Phillips, and I am a graduate student at the University of Michigan. For my master's thesis, I am investigating the impact of smart metering on household energy consumption in Jamaica.

I am inviting you to participate in this research study by completing the attached survey. **The following questionnaire will take approximately 15 minutes to complete. All participants will receive a $500.00 JMD phone b card for successful completion of the survey**. In order to ensure that all information will remain confidential, please do not include your name. If you choose to participate in this project, please answer all questions as honestly as possible. Participation is strictly voluntary, and you may refuse to participate at any time. Thank you for taking the time to assist me in my educational endeavors.

If you require additional information or have questions, please contact me at srphil@umich.edu or at (202) 751-7542. If you are not satisfied with the manner in which this study is being conducted, you may report (anonymously if you so choose) any complaints to the University of Michigan's Ethics, Integrity and Compliance Office at (734) 764-0304 or at compliancecoordinator@umich.edu.

Sincerely,
Sacha-Rose Phillips
(202) 751-7542
srphil@umich.edu

This project explores the impact of smart electricity meters on household consumption habits. This survey has been developed to gather feedback regarding your electricity consumption habits and your experiences with smart meters. We value your honest and detailed responses. The survey will take approximately 15 minutes, and your responses are completely anonymous. For successful completion of the survey, you will be compensated with a $500.00 JMD prepaid phone card. We really appreciate your time and value your perspective!

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1. Do you have electricity?
    - Yes
    - No

2. Do you and/or a member of your household receive electricity bills?
    - Yes
    - No

3. Why do you not pay for or have electricity?

4. Which of the following do you use electricity for?

    - Entertainment (television, stereos, game consoles etc.)
    - Washing Machine
    - Dryer
    - Lighting
    - Refrigeration
    - Electric Stove/ Oven
    - Kitchen Appliances (e.g., toaster, blender, electric mixer)
    - Air Conditioning
    - Electric Car
    - Dishwasher
    - Computer

5. What is your average monthly cost for electricity?

6. How much electricity do you consume on average each month in kilowatt hours?

7. Do you think that the current cost of electricity is?
   - High
   - Low
   - About right

[If the respondent thinks the cost of electricity is too high]

8. Why do you think the cost of electricity is too high?
   - World crude oil prices
   - Lack of government regulation
   - Electricity theft
   - Overcharging from the utility
   - Infrastructure challenges

9. How much would you like to pay for your monthly electricity bill?

10. How much electricity do you consume on average each month (in kilowatt hours)?

11. How much thought do you give to saving energy in your home?
   - A lot
   - A fair amount
   - Not very much
   - Never

12. Are you familiar with the energy star ratings on your electrical appliances?
   - Yes
   - No

13. Which of the following appliances in your household are energy efficient:
   - Washer
   - Dryer
   - Refrigerator
   - Stove

- Television
- Dishwasher

14. What kind of lightbulbs do you primarily use in your home?
    - Incandescent
    - Fluorescent
    - Halogen

15. What kind of meter do you have in your home?
    - Smart
    - Digital
    - Analog

16. Do you know what a smart meter is?
    - Yes
    - No

17. Do you understand how smart meters work?
    - Yes
    - No

18. Were you given any information by your utility about smart meters and how they operate?
    - Yes
    - No

19. Does your house use a smart meter?
    - Yes
    - No

[If household has a smart meter]

20. When was it installed? (Month/ Year)

21. What was your average monthly cost for electricity before the smart meter was installed?

22. How much electricity (in kilowatt hours) did your household consume before the smart meter was installed?

23. Were there any changes in the following after the smart meter was installed?

- Number of persons in your household
- Number of kitchen and recreational appliances
- Installation/Use of Air Conditioning Units

24. Are there any other changes that might have an impact on your energy consumption or bill? If so, what are they?

- Yes
- No

[If household does not have a smart meter or once questions about smart meter usage are complete]

25. In the last year, have you had a blackout or lost electricity service for three hours or more?

- Yes
- No

26. Do you use JPSCo mobile or online applications?

- Yes
- No

27. If so, what do you use these platforms to do?

- Pay my bills
- Monitor my energy consumption
- Submit service delivery queries and/or complaints
- Report Outages
- Receive notifications from the utility

28. Are you familiar with JPS' prepaid meter option?

- Yes
- No

29. If yes, are you enrolled in the program?

30. Would you be interested in participating in this program?

- Yes
- No

31. Why have you not enrolled in this program?
    - Lack of information about program
    - Complexity of enrollment process
    - Don't see the need to
    - Other

32. Are you interested in generating your own energy, to become partially or wholly self-sufficient, at some point in the future (if you are not already doing it)?

    - Yes
    - No

33. How many times have you lost electricity service for three hours or more in the last year?

34. How many adults reside in your household?

35. How many children reside in your household?

36. What is the age of your home?

37. How many rooms do you have in your household? Include your kitchen and living spaces in your estimate.

38. What type of home do you live in?
    - Single Family
    - Apartment
    - Townhome
    - Tenement Yard

39. Do you own or rent your home?

40. How old are you?
    - 18-29
    - 30-44
    - 45-59
    - 60-64
    - 65+

41. What is your gender?
    - Male
    - Female
    - Other

42. Are you employed?
    - Yes
    - No

43. If so, do you work for the public sector, the private sector or are you self-employed?
    - Self-employed
    - Private Sector
    - Public Sector

44. Number of years of education
45. What is your highest level of education?
    - Below Secondary
    - Secondary
    - Tertiary

46. How much do you earn each month?

47. Do you think that non-payment for the consumption of electricity is a challenge in Jamaica?

48. How concerned are you about climate change?
    - Very concerned
    - Fairly concerned
    - Not very concerned
    - Not at all concerned
    - Don’t know

49. How important is a party's environmental policy when voting?
    - Extremely unimportant
    - Somewhat unimportant
    - Neither important nor unimportant
    - Somewhat important
    - Extremely important

50. How important is a party's energy policy when voting?
    - Extremely unimportant
    - Somewhat unimportant
    - Neither important nor unimportant
    - Somewhat important
    - Extremely important

51. Thinking about the causes of climate change, which, if any, of the following best describes your opinion?
    - Climate change is entirely caused by natural processes
    - Climate change is mainly caused by natural processes
    - Climate change is partly caused by natural processes and partly caused by human activity
    - Climate change is mainly caused by human activity
    - Climate change is entirely caused by human activity
    - I think there is no such thing as climate change
    - I Don’t know

Appendix C: Additional Interview Questions

Jamaica Public Service Company

Smart Metering

1. Why did JPSCo start the smart metering program in Jamaica?
2. When was the first pilot program done and where?
3. How were pilot communities for the smart metering program selected?
4. As of May 2019, how many households across the island use smart meters?
5. What is the protocol for smart meter implementation in a community or household?
6. Does JPSCo inform customers when meters are changed? If so, how?
7. What kinds of smart meters are being deployed, what kind of data do they collect and how often does the device send data back to the utility?
8. Has the utility seen changes in consumption patterns in communities with these technologies and if so to what degree?
9. Does JPSCo intend to use "time of use" pricing with smart meter customers?
10. Does JPSCo intend to incorporate or offer in-home consumption tracking systems or interfaces for its customers?
11. What are future plans or next steps for the smart metering program?

Electricity Theft

1. What is JPSCo's current energy generation capacity?
2. When JPSCo identifies non-compliant consumers of electricity, what steps does the company take to encourage or ensure compliance?
3. What strategies in the past has JPSCo used to curb electricity theft?
4. Which of these strategies were successful/unsuccessful?
5. How does JPSCo determine which communities have high levels of theft and which communities have low levels of theft?
6. Which communities across the island have the highest levels of theft? Which communities across the island have the lowest levels of theft?
7. What is the level of consumer engagement with the "My JPS" app and the online accounting system? Is there a difference in engagement for consumers with and without smart meters?
8. In the Office of Utilities Regulation's 2019 report titled "Addendum to Final Criteria Jamaica Public Service Company Limited 2019 – 2024 Rate Review Process" they stated the following: "JPSCo has indicated that the application of SMART technology has provided insight into factors driving the System losses and that smart meters can assist with detection but not sustainable prevention and recovery."

Why is it the case that JPSCo can detect but cannot sustainably prevent NTLs and recover these losses? What barriers remain?

Office of Utility Regulations (OUR)

1. Prior to the rollout of smart meters and pre-paid meters in 2016, did JPSCo consult with the OUR on the introduction of these technologies? What was this consultative process like?

2. Since the first rollout in 2016, has the OUR instituted specific regulations or guidelines for the introduction of smart meters or pre-paid meters?

3. In their filing for the 2019-2024 review, JPSCo requested that the rates for all classes be increased to account for the investment in smart meter infrastructure. While the OUR was willing to increase rates for class 10 consumers, it was unwilling to do so for rate classes 20, 40, 50, 60 & 70. What is the rationale for this decision by the OUR? (Reference: OUR's Addendum to Final Criteria Jamaica Public Service Company Limited 2019 – 2024 Rate Review Process).

4. Are there guidelines/rules/regulations that govern how JPSCo and other utilities can use data from smart technologies and if so, what are these guidelines/rules?

5. Has the OUR received complaints, questions, or concerns about smart meters? If so, does the OUR have a specific number of queries that it can site?

6. When utilities identify non-compliant consumers of electricity, what steps does the OUR encourage utilities to take to encourage and/or ensure compliance?

7. When a consumer is disconnected from electricity from non-payment does JPSCo have any obligation to contact that consumer within a specific period of time to inquire about service reconnection?

8. If and when a consumer wants to generate their own electricity (e.g., via a solar panel) are they required to notify the OUR or the JPSCo.?

9. If a citizen wanted to generate their own electricity and share their supply with neighbors (for free or for a fee) would that be permissible? Is there a regulatory framework for micro-scale generation and distribution?

10. Does the OUR have communication standards for utilities particularly as it relates to the information provided on consumer bills? Are these standards universal i.e., are there special communications provisions made for particular segments of their consumer base?