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Vulnerable Households and the Smart Grid in Ontario

Emerging Challenges and Opportunities

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by Ian H. Rowlands and Gord Stephen

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Metcalf Foundation

The mission of The George Cedric Metcalf Charitable Foundation is to enhance the effectiveness of people and organizations working together to help Canadians imagine and build a just, healthy, and creative society.

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Disclaimer

The information and views set out in this report are those of the authors and do not necessarily reflect the positions of any other individual or organization including those identified above and those interviewees listed at the end.

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FOREWORD

The goal of the Metcalf Foundation's Environment Program is to help build a low-carbon, resource efficient, and resilient Canada. Given the scale and complexity of the task of envisioning and realizing such a transformation, the Foundation sought to elicit a multiplicity of views and opinions, with a particular focus on southern Ontario.

In 2014, Metcalf commissioned a series titled *Green Prosperity Papers*. The aim was to contribute to the emerging policy conversation by connecting Ontario's robust university-based research capacity to timely public policy challenges. We invited proposals from a select number of researchers at Ontario-based universities who have a track record of producing research for public dissemination.

The six resulting *Metcalf Green Prosperity Papers* all address intersections of the environment and economy while taking up a range of topics from social justice, to fiscal reform, to democratic governance.

Since we commissioned the papers, Canada's commitments to climate action and growing a green economy have advanced substantially. The Foundation hopes the ideas explored in this series will assist in the crucial work, that is now underway, toward building a low-carbon, resource efficient, and resilient Canada.

Sandy Houston,
President and CEO
Metcalf Foundation

INTRODUCTION

Approximately 2 million Ontarians live in low-income households, many allocating a significant portion of their finances to powering their homes.[1] In these situations, electricity costs can force individuals to have to decide between paying energy bills and providing for other essential food, shelter, and clothing needs. This kind of "energy poverty" can lead to significant hardship, adverse health effects, and utility disconnections.[2] As electricity rates continue to rise faster than incomes, energy poverty issues can only be expected to deepen.

Meanwhile, electricity systems — of the kind that have served Ontario communities for more than a century — are undergoing unprecedented change. They are moving from relatively static, centralized transmission channels, to integrated, intercommunicating networks of distributed power resources. These physical digital network transformations produce and consume electricity dynamically in response to shifts in demand and supply. They are often referred to as the "smart grid," and will have significant societal impacts in the near future.[3]

These are two separate issues that demand attention. On the one hand, there is the issue of energy poverty advocacy and analysis. On the other hand, there is consideration of smart grid developments and power system transformations. These two developments have largely been separate from each other.

At present, energy poverty activism and policy design are focused on addressing socio-economic issues relating to the current, primarily traditional, state of electricity distribution. Little attention is given to anticipating future technological advancements. This is, of course, completely understandable. For those faced with a choice of "heat or eat," near-term decisions are critical as they are the ones that determine immediate outcomes. For those advocating on their behalf, the policy debates that are the most relevant are also the ones that are firmly rooted in the present. Their interest in the power grid is, understandably, dominated by concerns about the present cost of electricity service delivery and where those costs might continue to go in the future.[4] When the issue of smart grid enters the conversation, it usually manifests itself in terms of how power sector innovations are serving to drive costs higher.[5]

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1 This figure is based on 2013 data from Statistics Canada, *Table 111-0015 — Family Characteristics, Low Income Measures (LIM), by family type and family type composition.*

2 For an introduction to the broader set of issues, see, for instance, Brenda Boardman, *Fixing Fuel Poverty: Challenges and Solutions* (Sterling, VA: Earthscan, 2010).

3 For an introduction to the broader set of issues, see, for instance, International Energy Agency, *Energy Technology Perspectives 2014: Harnessing Electricity's Potential* (Paris: International Energy Agency, 2014).

4 See, for instance, "Long-Term Energy Plan a positive move, but affordable energy rate program needed to protect the vulnerable," (Toronto, ON: The Low-Income Energy Network, Media Release, 3 December 2013, http://www.lowincomeenergy.ca/news-events/2013/12/long-term-energy-plan-a-positive-move-but-affordable-energy-rate-program-needed-to-protect-the-vuln/).

5 Coverage in the popular press has highlighted this. See, for instance, Ben Spurr, "TCHC Tenants Overwhelmed by Hydro Bills," *The Toronto Star*, 21 April 2015.

Meanwhile, technology-centric projections of the potential impacts of power system transformations are focusing on what is possible. Much of this attention considers exclusively the perspective of the average consumer, if not the affluent early-adopter. It leaves those living in energy poverty underrepresented. Again, this is to be expected. Early adopters — those who are usually educated, affluent, and technologically savvy — are the trailblazers towards the future so their motivations, abilities, and situations dominate the debate. Cost considerations and economic challenges are not usually at the forefront of initial considerations. The focus is on the technology and how it can positively transform peoples' conditions. Thus, Ontario's smart home roadmap shows the stereotypical nuclear family (two parents and two children) in a neighbourhood of detached homes full of modern conveniences.[6]

The purpose of this report is to begin to bridge this socio-technical disconnect. By considering how energy poverty and the smart grid relate to each other, our aim is to provide early identification of potential problems and opportunities associated with vulnerable households and the smart grid.[7]

The importance of this connection is clear to us if we consider two factors. First, we agree that a thriving society must be an inclusive society that provides security and opportunity for all. Second, we believe that we are at the cusp of a system-wide change in how electricity services are delivered in communities around the world. Motivated by challenges, particularly climate change, as well as opportunities like advances in information and communication technologies, the ways in which life in Ontario is powered in 20 years will be quite different than how it is powered today.

Given these two considerations, we maintain that a dialogue between analysts and activists in energy poverty and smart grid is prudent and also strategic. It is prudent, because planning in the wake of potentially transformational changes must be made with all Ontarians in mind. And it is strategic because, if we get this "right" — that is, if we anticipate and react appropriately — then we could be able to show the world how to develop a sustainable energy future.

This report is laid out in four parts. Following this introduction, the next section introduces the reader to these two relatively independent sets of issues in the Ontario context — energy poverty issues and smart grid issues. The third section examines the relationships between energy poverty issues and smart grid issues, examining the impact of advanced metering technologies, highlighting the importance of electricity engagement, and offering a

6 See Independent Electricity System Operator, "The Ontario SmartHome Roadmap," (http://www.ieso.ca/smarthomeroadmap/default.htm).

7 While we encourage these connections, we also recognize those who made such links in the past (many of whom are referenced in this report). Indeed, one of the earliest is Richard Gilbert, *Electricity Metering and Social Housing in Ontario* (Toronto, ON: Social Housing Services Corporation, April 2006, http://www.richardgilbert.ca/Files/2006/Metering%20Report%20(Web).pdf).

longer-view that's focused on energy producer-consumers and the emerging sharing economy. In the fourth section a series of recommendations are offered with the intention of sparking a continuing dialogue.

SETTING THE CONTEXT

VULNERABLE HOUSEHOLDS AND ENERGY POVERTY

Our focus in this report is vulnerable households in Ontario's urban areas.[8] These are individuals who are less resilient to changes in social and economic conditions. A subset of these people is already finding it difficult to pay their monthly utility bills. They are particularly sensitive to impacts from changes in energy prices, rate structures, and the electricity system more broadly. They are the ones living in energy poverty.[9]

While the characteristics of those in energy poverty are difficult to measure directly,[10] those households dedicating at least 30% of their income to energy and other basic shelter costs (housing and other utilities) are more likely to experience this phenomenon. They can be considered "energy-vulnerable." In Ontario, in 2011, 27% of all households fell into this category.[11] Energy-vulnerable households are more likely to have lower incomes. The median total income for energy-vulnerable households was less than $28,000; the median income for non-energy-vulnerable households was over $85,000 — more than three times greater.[12]

Those who are energy-vulnerable are disproportionately likely to live in rental accommodations. In 2011, renters made up 28% of Ontario households overall, but 45% of energy-vulnerable households. The median income for those same energy-vulnerable renters was just over $21,000, compared to just under $37,000 for their energy-vulnerable homeowner counterparts. Older individuals in single-person households and younger single-parent families are also particularly energy-vulnerable.[13]

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8 While our focus serves to capture many Ontario households that are particularly sensitive to impacts from smart grid development, we recognize that it does not include all. In particular, issues associated with households located in rural areas, smaller towns, Northern and First Nations communities are not addressed explicitly in this report. Their omission here is not meant to suggest unimportance, but instead to reflect our restricted scope.

9 This group may be similar to those households facing "fuel poverty" or "energy precariousness" (terms discussed in, for instance, Stefan Bouzarovski, "Energy Poverty in the European Union: Landscapes of Vulnerability," *Wiley Interdisciplinary Reviews: Energy and Environment Vol. 3*, 2014, pp. 276-289).

10 Those receiving emergency financial assistance for their energy needs (such as from the Low-Income Energy Assistance Program, discussed below) could be considered energy-poor. Unfortunately, aggregate statistics profiling participants in these kinds of programs, while potentially valuable, are not publicly accessible. In general, energy-poor individuals are also often hesitant to self-identify, adding to the challenge of describing this segment of the population. For these reasons — and for reasons of differences in data dates, contextual factors (e.g., prevailing prices), sample sizes, and degrees of aggregation — we take two measures in this section to illuminate characteristics of those potentially in vulnerable predicaments.

11 Statistics Canada, *National Household Survey 2011: Data Table 99-014-X2011028*.

12 Statistics Canada, *National Household Survey 2011: Data Table 99-014-X2011028*.

13 Statistics Canada, *National Household Survey 2011: Data Table 99-014-X2011028*.

Turning to household energy expenditures, all Ontario households spent an estimated average of 5.2% of annual income on energy in 2009. This average figure, however, masks important variations. It is useful to note that there is a group of households in the province — fully 10.6% of the total — that allocated more than 10% of their annual income to energy.[14] Unsurprisingly, these households tended to have lower incomes. The average after-tax income of these households spending more than 10% of their annual income on energy was $26,579. For those spending less than 10%, it was $64,800. Direct ratepayers[15] who fell below the after-tax low-income-measure (LIM-AT) spent an average of 11% of their annual income on energy costs, compared to 4.5% for those direct ratepayers above the LIM-AT.[16]

Vulnerable households are also more likely to rent. For instance, 95% of Ontario Works beneficiaries in 2013 were renters, as were 78% of 2013 Ontario Disability Support Program beneficiaries.[17]

Rental units occupied by vulnerable households, including those in energy poverty, often lie on the lower end of Ontario's housing stock. They can be in older, less well-maintained buildings with poor insulation and electricity-intensive baseboard heating that drives energy bills higher during cold winter months. Vulnerable households are also more likely to experience unstable housing situations and be more transient than the general population. They also have reduced access to financial capital such as personal assets or credit.

Recognizing the special needs of these vulnerable households, the provincial government and associated agencies have coordinated various support programs to provide them with **short-term energy-related emergency financial assistance** (the Ontario Energy Board's Low-Income Energy Assistance Program), **rate reductions** (the needs-based Ontario Energy Support Program) and long-term **energy efficiency investment opportunities** (the Independent Electricity System Operator's Home Assistance Program).[18] Moving forward, emerging policy in other areas such as environment and climate change may be consequential as well.[19]

14 Statistics Canada, *Survey of Household Spending, 2009*.

15 By "direct ratepayers" we mean those for whom energy costs are not packaged with other accommodation charges.

16 Statistics Canada, *Survey of Household Spending, 2009*.

17 Social Assistance Business Intelligence System (SABIS) — Statistics Canada custom data.

18 See, for instance, Ontario Energy Board, "Help for Low-Income Consumers," (http://www.ontarioenergyboard.ca/OEB/Consumers/Consumer+Protection/Help+for+Low-Income+Energy+Consumers); and saveONenergy, "Home Assistance," (https://saveonenergy.ca/Consumer/Home-Assistance.aspx).

19 Specifically, the province's recently-released "Climate Change Action Plan," (https://www.ontario.ca/page/climate-change-action-plan) outlines a number of programs that may be relevant to low-income and renter households, including introducing new financing mechanisms to help private homeowners invest in energy efficiency technologies, providing energy retrofits in social housing developments, and developing incentives to encourage landlords to perform energy efficiency retrofits in multi-residential buildings.

SMART GRID

"Smart grid" is a widely used term that has attracted multiple definitions.[20] What is common to most definitions is the idea that the smart grid refers to the continued modernization of the power system through increased use of advanced information and communication technologies. For "the home," which is a focus of our consideration, this means the introduction of technologies like smart meters (interval meters with two-way communication that time-stamp consumption) and dynamic control mechanisms associated with on-site generation, storage, and consumption. Success with smart grids could well mean that additional energy services would be electrified and integrated into connected power systems — e.g., heating and transportation.

The smart grid provides opportunities to: reduce costs; create jobs; facilitate the integration of renewable energy resources to mitigate global climate change; enhance energy service reliability; and engage the network connectivity of multiple objects in the home, also known as the "internet of things."[21] Much work, worldwide, is underway with respect to future visions of the smart grid and how societies might achieve those goals.[22]

Ontario has been a global leader in smart grid development, particularly with respect to those parts of the electricity system that directly impact households and businesses.[23] Ontario was one of the first jurisdictions in the world to mandate smart meter installation in all households and small businesses. More than 4.5 million are now installed across the province. With that, the province also introduced a variety of programs (e.g., "time-of-use" electricity pricing and residential load-control strategies) designed to exploit new opportunities. Also worth noting is Ontario's Smart Grid Forum. The forum brings together stakeholders from various sectors to discuss issues related to smart grid development and has been at the forefront of the issue, often setting the smart grid agenda and influencing government legislation.[24]

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20 See, for instance, International Energy Agency, *Technology Roadmaps: Smart Grids* (Paris: International Energy Agency, 2011), p. 6; U.S. Department of Energy, "What is the Smart Grid?" (https://www.smartgrid.gov/the_smart_grid/index.html); and Vincenzo Giordano et al, *Smart Grid Projects in Europe: Lessons Learned and Current Developments* (Petten, the Netherlands: European Commission Joint Research Centre, Institute for Energy, 2011), p. 10.

21 See, for instance, *The Smart Grid: A Pragmatic Approach* (Ottawa, ON: Canadian Electricity Association, 2010), pp. 7-10; and *Accelerating Successful Smart Grid Pilots* (Geneva: World Economic Forum, 2010), p. 14. We further note that while our focus in this report is on the "smart grid," which means "electricity," many of our arguments have relevance for vulnerable households' "natural gas" issues as well (because of the use of both fuels simultaneously in home heating, in numerous instances). Additionally, with the internet of things connecting many activities within the household, it may soon be the case that discussions about "smart gas" gain more prominence. For more information about potential future evolution of the internet of things within households, see, for instance, *Consumers in 2030: Forecasts and Projections for Life in 2030* (London, UK: Which? Consumer Insight, January 2013, https://www.forumforthefuture.org/sites/default/files/project/downloads/future2030-finalreport.pdf). For more information about how natural gas could be part of an integrated "smart energy network" see, for instance, Nicholas Belanger and Ian H. Rowlands, *Smart Energy Networks: Progress and Prospects* (Waterloo, ON: Waterloo Institute for Sustainable Energy, University of Waterloo, SEN White Paper 1, June 2013).

22 See, for instance, Nazmiye Balta-Ozkan et. al., *Scenarios for the Development of Smart Grids in the UK - Synthesis Report* (London, UK: UKERC Report UKERC/RR/ES/2014/002, http://www.ukerc.ac.uk/programmes/energy-supply/scenarios-for-the-development-of-smart-grids-in-the-uk.html#sthash.z5SSh3Oi.dpuf, 2014).

23 For information about other jurisdictions in Canada, see Jennifer Hiscock and David Beauvais, *Smart Grid in Canada, 2012–2013* (Ottawa, ON: Natural Resources Canada, 2014).

24 Independent Electricity System Operator, "Ontario's Smart Grid Forum," (http://www.ieso.ca/Pages/Ontario's-Power-System/Smart-Grid/Ontario-Smart-Grid-Forum.aspx).

CONNECTING ENERGY POVERTY AND THE SMART GRID

ADVANCED METERING TECHNOLOGIES

Historically, consumers' consumption was recorded by a conventional meter that could only measure the total amount of electricity used over a particular billing period; it would then have to be read periodically by a utility employee. So-called smart meters, however, measure and record electricity usage during time-specific intervals and then regularly provide those data back to the utility and the customer. Globally, more than 300 million smart meters have been installed, and it is estimated that more than 1 billion could be in place by 2022.[25]

The Province of Ontario has been a global leader in the installation of smart meters. As noted above, more than 4.5 million are installed in households and small businesses across the province. As a result, both utility providers and consumers have detailed information about consumption. Such information can be empowering, and can have particular advantages for vulnerable and energy-poor households.

The power of electricity consumption data

The shape of the household electricity load curve — that is, how much electricity was used during a particular hour — can be revealing. When daily consumption is cross-tabulated with outdoor temperature, for instance, electricity consumption anomalies can be exposed. A higher-than-expected baseload figure (that is, electricity consumption independent of cooling and heating) could point to the presence of an inefficient refrigerator.[26] Additionally, analysis of finer-resolution data can reveal the influence of individual devices through their electronic signatures. For example, a window air conditioner that is cycling on and off too frequently could be identified; a simple "fix," like positioning the thermostat sensor more properly, could easily follow.[27] The results of these kinds of investigations could conceivably be used in a variety of constructive ways to the benefit of energy-poor households. Consider the following examples:

25 See, for example, Lisa Alejandro et al, *Global Market for Smart Electricity Meters: Government Policies Driving Strong Growth* (Washington, DC: Office of Industries Working Paper, U.S. International Trade Commission, No. ID-037, June 2014, http://www.usitc.gov/publications/332/id-037smart_meters_final.pdf); and *The Smart Meter (R)Evolution: Maximizing the Technology Dividend & Transforming Your Utility* (Oracle Utilities and OPower, May 2014, http://www.oracle.com/us/industries/utilities/utilities-smart-meter-wp-2203421.pdf).

26 See, for instance, Benjamin J. Birt, Guy R. Newsham, Ian Beausoleil-Morrison, Marianne M. Armstrong, Neil Saldanha and Ian H. Rowlands, "Disaggregating Categories of Electrical Energy End-Use from Whole-House Hourly Data," *Energy and Buildings* (Vol. 50, July 2012), pp. 93-102.

27 See, more generally, R.S. Butner et al, *Non-Intrusive Load Monitoring Assessment: Literature Review and Laboratory Protocol* (Richland, WA: Pacific Northwest National Laboratory, prepared for the U.S. Department of Energy, PNNL-22635, July 2013, http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22635.pdf).

- For householders wanting to manage their finances closely, daily updates could be provided with emphasis on where their consumption stands vis-à-vis their self-declared monthly electricity budget.[28]
- In advance of a scheduled home energy audit or any kind of interaction between an outreach worker and a householder, these data could generate a preliminary diagnostic. With this information in front of all parties, the interaction could more quickly focus on core priorities.[29]
- A utility or social agency could proactively identify those households where "easy" remedies could lead to reduced costs and improved comfort. An appropriate communication piece — be it an insert with the utility bill, a suggestion from an outreach worker, or an image on an in-home electricity display — could then be crafted and transmitted. If the communication is directly customized to the recipient it will help ensure interest and uptake.[30]
- Ongoing monitoring and analysis of energy consumption information and, potentially, supporting data could signal alerts to social agencies if, for instance, electricity demand patterns significantly change or stop completely; similar alerts could be sent if room temperatures fall below healthy levels.[31]
- In emergency situations — extreme cold, storms, etc. — households that are vulnerable to that particular event could be quickly identified and assisted. In this instance it would be homes that have less thermal mass and/or less insulation, for they may lose heat more quickly than others. In some service territories, these homes could have a disproportionately high share of low-income occupants.[32]

Privacy concerns from smart meter data

Smart meters, however, also raise privacy concerns. Concerns include what might be known about a household from the electronic profile that is generated by the smart meter, and that this information is in the hands of the utility and potentially obtainable by others. While the Province of Ontario

28 Ian H. Rowlands et al, "Developing Smart Tools for Householders: Making the Smart Grid Work," *Municipal World* (Vol. 123, No. 1, January 2013), pp. 5-8.

29 See the work of, for instance, M. Zeifman, "Smart Meter Data Analytics: Prediction of Enrollment in Residential Energy Efficiency Programs," *in Systems, Man and Cybernetics (SMC), 2014 IEEE International Conference* (2014, http://doi.org/10.1109/SMC.2014.6973942), pp. 413-416.

30 "Because many low income consumers have both money and time constraints, program designers and implementers must ensure that information is supplied at just the right time. Consumers will be most interested in enrollment if the utility is addressing a relevant situation or problem, rather than pushing information out that may be technically sound, but not useful at the moment." (Nat Treadway, *New Vision Required to Better Serve Low Income Customers in Utility Sector* (EcoPinion, Survey Report, Issue 20, January 2015), p. 12.)

31 See, for instance, Cathy Mannion, "The Role of Smart Meters in Tackling Fuel Poverty," *Energy Action Conference 2012* (Dublin Castle, 7 February 2012).

32 And, more generally, data collection, analysis and action can help to advance important societal goals. The Center for Data Innovation, however, reminds us that: "individuals must have access to high-quality data about themselves and their communities. If certain groups routinely do not have data collected about them, their problems may be overlooked and their communities held back in spite of progress elsewhere. Given this risk, policymakers should begin a concerted effort to address the 'data divide' — the social and economic inequalities that may result from a lack of collection or use of data about individuals or communities." (Daniel Castro, *The Rise of Data Poverty in America* (Washington, DC: Center for Data Innovation, 2014).)

has been at the forefront of working to ensure that privacy is embedded into the sheer DNA of the electricity system,[33] many remain concerned about who has these data and what they are doing with them.

For all households, one potential concern is how smart meter data can disclose when the home is empty and thus susceptible to theft. For low-income households, a further anxiety may arise from how these data can reveal purchasing patterns or the number of occupants in a household. More generally, this concern may well sit within a broader landscape of a mistrust of institutions of authority. Indeed, for some of the population, there is a perceived need, or desire, to stay "under the radar." Thus, should any evidence be found to support the narrative that smart meters = Big Brother, then constructive engagement could prove to be extremely difficult.

The impacts of dynamic pricing

The introduction of smart meters enables the implementation of dynamic pricing for electricity. In Ontario, that has meant a three-tier time-of-use pricing system, with on-peak periods between 11am–5pm in the summer-time, and between 7am–11am and 5pm–7pm in the wintertime. Figure 1 provides more details.

Do time-of-use rates affect low-income and energy-poor households differently than the population as a whole? Evidence to support a variety of perspectives can be found. Faruqui et al, for instance, argue that low-income households have less peaky load-curves (that is, they use relatively less electricity at high-demand times) than wealthier households, so they would naturally benefit with such a change.[34] Perverse cross-subsidizations — whereby low-income households help to pay for high-income households' central air conditioning demands during heatwaves — are reduced.

By contrast, Horowitz and Lave find the opposite — namely, that low-income households have peakier load profiles and thus would not benefit.[35] In other words, they would pay more for electricity because of their disproportionate share of consumption during peak-demand periods. Still others find little difference.[36] Rowlands and Furst undertook one investigation in Ontario, arguing that lower-use households, though not necessarily lower-income, would be relatively worse off with such a move. They suggest

33 See, for instance, *Operationalizing Privacy by Design: The Ontario Smart Grid Case Study* (Toronto, ON: Information and Privacy Commissioner, 2011).

34 Ahmad Faruqui, Sanem Sergici and Jennifer Palmer, *The Impact of Dynamic Pricing on Low Income Customers* (Washington, DC: Institute for Electric Efficiency Whitepaper, 2010).

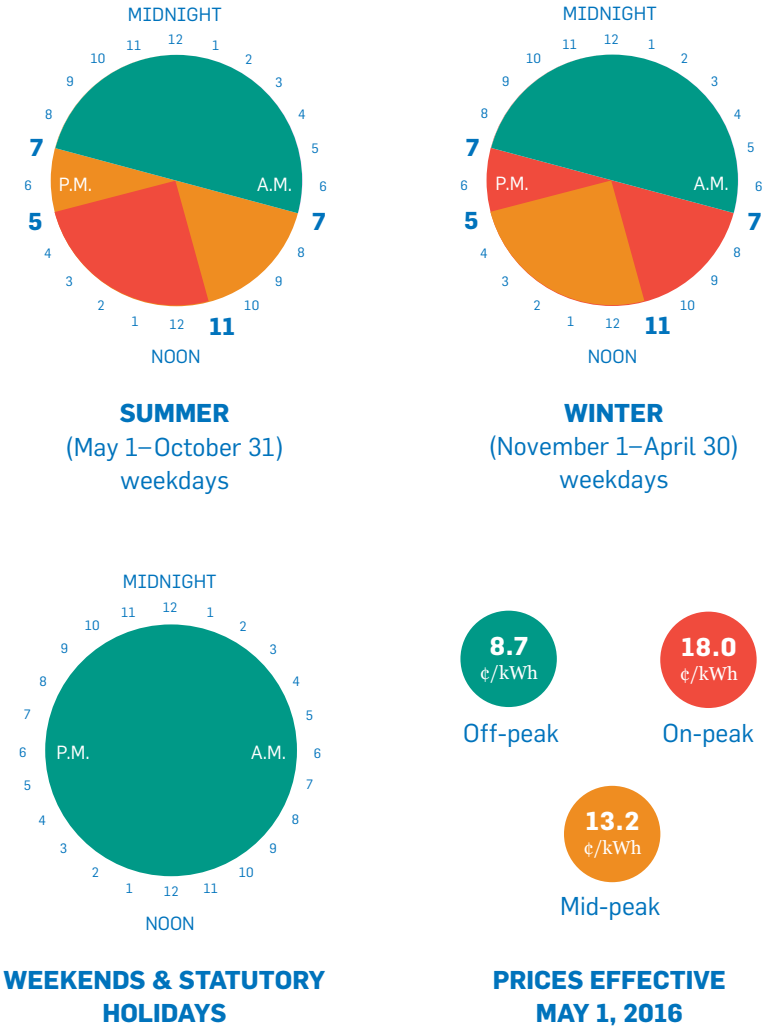
35 Shira Horowitz and Lester Lave, *Equity and Efficiency in Residential Electricity Pricing* (Pittsburgh, PA: Carnegie Mellon Electricity Industry Center working paper CEIC-12-02, 2012).

36 Severin Borenstein, "Effective and Equitable Adoption of Opt-In Residential Dynamic Electricity Pricing," *Review of Industrial Organization* (Vol. 42, Issue 2, 2012), pp. 127-160. See, as well, his recent blog entry entitled, "Winners and Losers from Flattening Tiered Electricity Prices," (The Energy Collective, 1 July 2015, http://www.theenergycollective.com/severinborenstein/2245186/winners-and-losers-flattening-tiered-electricity-prices).

FIGURE 1: Time-of-use Pricing in Ontario

Time-of-use pricing means that the cost of electricity varies with time. In Ontario, it is more expensive during the province's higher-demand periods — 7–11am and 5–7pm on weekdays in the "wintertime" (1 November to 30 April) and 11am–5pm on weekdays in the "summertime" (1 May to 31 October). Rates are set every six months.

Source: Ontario Energy Board, http://www.ontarioenergyboard.ca/oeb/_Documents/For%20Consumers/TOU_prices_Summer.pdf



that this may be because of the move away from an inverted flat-block tariff, where the first tranche of monthly electricity consumption (600 kWh in the summertime, 1,000 kWh in the wintertime) was billed at a lower-rate than the next tranche.[37]

Dynamic pricing is meant to encourage load-shifting — that is, movement of electricity demand from on-peak periods to off-peak periods. Generally, it is argued that vulnerable households will have fewer "discretionary" loads to shift. Consequently, if they are not natural beneficiaries of the change

37 Ian H. Rowlands and Ian M. Furst, "The Cost Impacts of a Mandatory Move to Time-of-use Pricing on Residential Customers: An Ontario (Canada) Case-study," *Energy Efficiency* (Vol. 4, Issue 4, 2011), pp 571-585.

in rates, then they will not benefit at all. The few studies that have investigated this phenomenon have supported, though not unanimously, this hypothesis.[38] One study from Ontario offers mixed results. Simmons found little evidence of shifting time-of-use, but some evidence of conservation.[39] Finally, both the Ontario Energy Board and the Ontario Power Authority commissioned investigations into the impact of time-of-use rates upon residential electricity consumption. Unfortunately neither disaggregated their findings across socio-economic indicators.[40]

In any discussions of rate design in Ontario, it is critical to consider the case of low-income and vulnerable households. As noted earlier in this report, their heating systems are disproportionately electric and so require electricity during on-peak periods in the winter. Additionally, for reasons of age, health, disability, family status, or employment status, they may be at home disproportionately more during on-peak pricing periods and thus use relatively more electricity during these periods than the "average" consumer. They may also be particularly reliant upon electricity services during these periods. For example, for health reasons they may require higher ambient temperatures or continually functioning medical equipment. Ways in which higher costs during particular periods may lead to problems in energy-poor households — using unsafe, alternative heating devices[41] or letting temperatures plunge or rise to unhealthy levels — deserve particular attention.

Prepayment options

Irrespective of the particular tariff selected, the smart grid offers the possibility of prepayments. This entails establishing a system whereby the electricity customer can purchase, in advance, a set quantity of power and be delivered with the same. The presence of smart meters further enables the option of prepaying because "there is no special, more costly, meter to install."[42] Consequently, for those who think that a prepayment system can assist with managing power use effectively, the development of the smart grid is a "positive." It may also help those who have had their electrical service disconnected, or those who could not afford a security deposit, by providing them with the opportunity to acquire utility service.

38 For reviews, see, for instance, Sarah J. Darby, "Metering: EU Policy and Implications for Fuel Poor Households," *Energy Policy* (Vol. 49, 2012), pp. 98-106; Kevin B. Jones and David Zoppo, *A Smarter, Greener Grid: Forging Environmental Progress Through Smart Energy Policies and Technologies* (Santa Barber, CA: Praeger, 2014), p. 237; and *Vulnerable Customers and Energy Efficiency, Low Carbon Networks Fund, Project Progress Report — January to June 2014* (London, UK: Power Networks, 2014).

39 Sarah Ivy Simmons, *Investigating the Impacts of Time-of-use Electricity Rates on Lower-income and Senior-headed Households: A Case Study of Milton, Ontario* (Canada) (Waterloo, ON: Faculty of Environment, University of Waterloo, 2010).

40 *Time of Use Rates in Ontario, Part 1: Impact Analysis* (Toronto, ON: Navigant Consulting Ltd. for the Ontario Energy Board, 2013); and Ahmad Faruqui et al., *Year Two Analysis of Ontario's Full Scale Roll-out of TOU Rates* (Cambridge, MA: The Brattle Group for the Ontario Power Authority, 2014).

41 A recent tragic case comes from Maryland, where use of a gasoline-powered generator — in place of disconnected electricity — may have led to the death of eight people through carbon monoxide poisoning ("8 Die of Carbon Monoxide Poisoning in Maryland," 8 April 2015, http://www.wmur.com/news/8-die-of-carbon-monoxide-poisoning-in-maryland/32256114).

42 Darby, op. cit., in note 38, p. 103.

Alternatively, for those who "fear that low-income elderly and disabled customers would face barriers to properly understand the technology and to make the payments for the prepaid service,"[43] the development of the smart grid is a "negative." Moreover, there is a concern that smart grid-enabled prepayment arrangements make it easier for low-income households to have their power cut off.[44] This likelihood, one argument puts forward, is increased because the human contact — which could be seen "as an important safeguard that provides additional security to disadvantaged populations"[45] — is now absent.[46] The debate continues.[47]

From bulk metering to suite metering

Consideration of advanced metering technologies, in the context of vulnerable households, must direct attention to the issue of moving from "bulk metering" to "suite metering" in rental accommodation buildings.

While some rental units have always had individual utility billing, many have traditionally been — in aggregation with other rental units — served by a single or a small number of building-wide bulk meters. In these cases, a landlord would pay utility bills on behalf of all tenants in the building and incorporate an estimated average cost for utilities into a tenant's monthly rent. Suite metering technologies now enable landlords to know the individual electricity consumption of each rental unit in a building. Utility bills can be passed on to tenants directly. This creates both new opportunities for conservation and emerging causes for concern.

Many argue that directly exposing tenants to the true costs of their consumption is critical for incentivizing electricity conservation behaviours. Research from Ontario notes that sub-metering in multi-residential buildings can reduce total consumption by 20%.[48] However, shifting responsibility for tenant utility bills away from a landlord also has the effect of significantly decreasing incentives for investing in the building's energy efficiency. This creates the effect of the classic "split incentive" dilemma. (We return to this point below.)

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43 David Conn et al, *Energy Affordability and Energy Service Choices: Three Perspectives* (Washington, DC: DEFG for the Low-Income Energy Issues Forum, October 2014, http://www.smartgridclimatechange.org/wp-content/uploads/2014/10/DEFG-Low-Income-Forum-Energy-Affordability-vf.pdf), p. 8.

44 Jeff St. John, "What Low-Income Utility Customers Want From the Smart Grid," (21 September 2012, http://www.greentechmedia.com/articles/read/what-low-income-utility-customers-want-from-the-smart-grid).

45 Jones and Zoppo, op. cit., in note 38, p. 38

46 See, as well, the perspectives advanced in John Howat, *Prepaid Electric Utility Service: The Need for Essential Consumer Protections* (Boston, MA: National Consumer Law Center, presentation at the New York Low-Income Forum on Energy, 24 June 2015).

47 Richard Hanks and Zoe McLeod, *Smart Metering Prepayment in Great Britain: Making prepaid energy work in a smart world* (London: Accenture and Consumer Focus, 2013, https://www.accenture.com/il-en/~/media/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Industries_10/Accenture-Smart-Metering-Prepayment-Executive-Summary-Report.pdf).

48 Donald N. Dewees and Trevor Tombe, *The Impact of Sub-Metering on Condominium Electricity Demand* (Toronto, ON: University of Toronto, Department of Economics, Working Paper 407, 13 July 2010). Other Ontario experiences include H. Burak Gunay et al, "On the Behavioral Effects of Residential Electricity Submetering in a Heating Season," *Building and Environment* (Vol. 81, 2014), pp. 396-403; and *Evaluation of the Impact of Sub-metering on Multi-residential Electricity Consumption and the Potential Economic and Environmental Impact on Ontario* (Toronto, ON: Navigant Consulting Ltd. for EnerCare Connections Inc., 18 April 2012, https://2.enercare.ca/sites/default/files/submetering-conservation-report.pdf).

From a landlord's perspective, suite metering is a valuable technological advancement. It transfers risks associated with variable energy consumption and costs on to tenants, eliminating the possibility of losing money due to tenants with higher-than-expected energy bills, or energy costs that rise faster than allowed rent increases.

For tenants, the impacts of suite metering are generally less positive. While low-consuming tenants are no longer required to cross-subsidize their neighbours, high-consuming tenants are forced to pay the true costs of their consumption. For all tenants, leaving the rent-regulated, sheltered, and predictable environment of a "utilities-included" lease means that they are directly exposed to the vagaries of the energy markets. Rates may rise twice a year and/or independently of rent increases, and bills will now vary across seasons.[49] The fact that changes in price are both unpredictable and potentially significant is especially problematic for energy-vulnerable ratepayers who are managing tight financial budgets. The risk is now being borne by the tenant, who does not usually have as many resources as the former risk-bearer, the landlord, to absorb negative shocks.

Third-party suite metering services — that is, services managed by a private landlord or a contractee of the same — potentially create and/or accentuate power imbalances between the landlord and the tenant. While the relationship between a vulnerable household and the local electricity distribution company may raise its own set of issues, the introduction of a privately-owned third party intermediary with market incentives to serve the needs of the landlord, not the tenant, can raise additional concerns, particularly in relation to data access and privacy.

ELECTRICITY ENGAGEMENT

Traditionally, electricity systems have delivered energy in a manner far removed from citizen or customer involvement. Electricity utility monopolies in Ontario were closely connected with government, and they tended to have only two links with householders. One was the actual wires; the other was the bill-money exchange. To the utility, the householder was a "load," characterized in terms of kilowatt-hours (and occasionally kilowatts). To many householders, the utility was something they thought of only when paying their electricity bill.

That relationship is now changing rapidly. Utilities have been joined by other service providers on the energy landscape, and many are touting that a sustainable energy future requires system-wide participation and engagement. We need, the argument continues, a web of meaningful relationships,

49 Power disconnections also become a possibility (and thus serve as an additional source of stress).

with exchanges of electrons, information, ancillary services, and resources occurring 24/7.[50]

While this leads to some broad questions, a particular set of issues is raised when attention turns to vulnerable customers. Before they are demand-responding, carbon-trading, network-optimizing participants in our electricity system, careful consideration will need to be given to what they need in terms of their own capacity and available partnerships.

Energy literacy

Increasing demands are being placed on the capacity of everyone to understand energy issues. Electricity bills have been made more complex not only by the introduction of time-of-use rates, but also by the diversity of components on them. Additionally, more and more options are available. This includes the number of electricity service providers as there are now traditional energy providers like Direct Energy, and also new entrants like Rogers, which are bundling energy management services into some of their telecommunications packages.[51] There is also more range of technologies to manage electricity use in the home, for example advanced programmable thermostats and plug-load monitors. Indeed, to exploit the benefits of a modern electricity system, engagement with such options would appear to be mandatory.

Are people ready for this? And, in particular, are vulnerable households prepared? At this time, answers to this latter question are by no means clear. But there are enough pieces of evidence to suggest that in Ontario the question warrants more attention than it is receiving.

Indeed, experience with the internet shows that while it is certainly an achievement to make the physical connections to vulnerable households — to lay down the fibre-optic network, for instance — it is altogether another challenge to empower those same households to make full use of the internet and thus secure significant benefits from being a participant in cyberspace. Table 1 develops this argument more fully. Similarly, while the universality of smart meters in Ontario presents opportunities, the next step — meaningful engagement with data-driven services — cannot necessarily be assumed to follow.

50 See, for instance, Sarah Darby et al, *Smart Metering Early Learning Project: Synthesis Report* (London, UK: Department of Environment & Climate Change, March 2015); and *Smart for All: Understanding Consumer Vulnerability During the Experience of Smart Meter Installation* (London, UK: Department of Energy & Climate Change, November 2012, http://www.nea.org.uk/wp-content/uploads/2015/07/Smart-for-All-Understanding-consumer-vulnerability-during-the-experience-of-smart-meter-installation.pdf).

51 See, for instance, *The New Energy Consumer: Understanding Business Value in a Digital World* (London, UK: Accenture, 2015).

Other jurisdictions have this on their agendas. Experience from the United Kingdom, for instance, has led the Department for Energy & Climate Change to observe that: "Low literacy and numeracy levels among some customers increase the imperative to design [in-home displays] and support materials using clear formats and plain language."[52] In Australia, the particular cognitive capacity of older people — they tend "to review less information, eliminate choices more quickly and rely more on rules/principles and prior life experience"[53] — has been factored into system design.

TABLE 1:
Internet Adoption and Effective Use: A Historical Analogue?

In the mid-1990s, personal computing and networking technology reached a point of maturity and accessibility that allowed the mainstream public to make use of such technologies on a regular basis. As adoption grew, the population became increasingly aware of the educational, economic, and democratic opportunities these technologies afforded to users.[1]

It was during this period that the term "digital divide" was coined to describe the growing socio-economic opportunity gap between those with access to information technology and those who remained without. In 1999, the National Telecommunications and Information Administration (NTIA) released its report Falling Through the Net: Defining the Digital Divide, which found strong evidence for access divides across lines of income, race, and educational attainment. It concluded that the "haves" were becoming more information-rich, while the "have nots" were lagging behind.[2]

At the time, the issue was understood and framed primarily as an affordability and physical access problem. This led to discourse and solutions that focused primarily on providing equality of access for citizens through programs such as community access centres.[3] It was argued by others that market forces would be sufficient to close the gap as technological progress and competition would drive down prices over time, eventually eliminating barriers to access. The 2002 NTIA report A Nation Online: How Americans Are Expanding Their Use of the Internet supported that assertion, stating that "whether measured against income, education, family type, or race/Hispanic origin, the distribution of Internet use at home has moved in the direction of lower inequality."[4]

As the physical access gap began to shrink (although it still persists to this day), it became apparent that access to online opportunities was still not uniformly distributed across the socio-economic spectrum.[5] As a result, societal understanding of the digital divide began to shift from an issue of physical access to a more literacy-centric concern over the capacity for effective use. In other words, computers and internet connections are required, but not sufficient, to take full advantage of the opportunities provided by information technologies.[6] In light of this reframing, more

recent efforts to close the digital divide have refocused around education, outreach, and lifelong learning.[7]

The internet adoption experience yields clear parallels to ongoing energy systems transitions. Like personal computers, physical artifacts associated with energy technologies (solar panels, batteries, electric vehicles, etc.) can provide significant value when deployed in networks, but require access to capital in order to acquire and to use. While these technologies have historically been expensive and inaccessible, market forces have brought down prices over time and are expected to continue to do so into the future. Until such technologies become so accessible as to become ubiquitous, policy makers should remain conscientious of opportunity disparities arising from differing levels of access. During the rise of the internet, community technology access programs provided all members of the public some ability to make use of emerging technologies. The emergence of novel community energy models may present an analogous means for providing shared public access to distributed energy resources.[8]

Much as the concept of effective use has come to characterize longer-term issues in internet equity, residential consumers will also need to develop strong digital and energy literacy skills to make full use of consumption feedback tools and interactive home energy management systems, and to make strategic time-of-use decisions related to dynamic pricing programs. Whereas public support for internet adoption initially focused on providing access before eventually changing focus to effective use, support programs through the smart grid transition can, and should, address these challenges in parallel, if not in the reverse order. In the case of conservation programs and load-shifting under dynamic pricing regimes, advanced household technology investments are not a prerequisite for generating value for end-users. In these cases, education and skill development should certainly be prioritized before access to new technologies.

1. Mark Warschauer, *Technology and Social Inclusion: Rethinking the Digital Divide* (Cambridge, MA: The MIT Press), p. 11.
2. National Telecommunications and Information Administration, *Falling Through the Net: Defining the Digital Divide* (Washington, DC: U.S. Department of Commerce, 1999), Part I.
3. Songphan Choemprayong, "Closing Digital Divides: The United States' Policies," *Libri* (Vol. 56, Issue 4, 2006).
4. National Telecommunications and Information Administration, *A Nation Online: How Americans Are Expanding Their Use of the Internet* (Washington, DC: U.S. Department of Commerce, 2002), p. 87.
5. Paul DiMaggio and Eszter Hargittai, "From the 'Digital Divide' to 'Digital Inequality': Studying Internet Use as Penetration Increases" (New Haven, NJ: Princeton University, Center for Arts and Cultural Policy Studies, Working Paper # 15, 2001).
6. Karen Mossberger, Caroline J. Tolbert, and Mary Stansbury, *Virtual Inequality: Beyond the Digital Divide* (Washington, DC: Georgetown University Press, 2003).
7. Choemprayong, *op. cit.*, in note 3.
8. Jason Coughlin et al., *A Guide to Community Shared Solar: Utility, Private, and Nonprofit Project Development* (Washington, DC: U.S. Department of Energy, 2012).

Energy partnerships

Our electricity system is increasingly characterized by a web of relationships. The ways in which those relationships are conceived, formed, and maintained are important to scrutinize.[54]

There are multiple ways that customers can receive information in a modernized electricity system. While "in-home displays" appear to be quite popular at the moment — and are increasingly linked to some kind of mobile app — we should not assume that everyone receives information, or wants to receive information, in the same way. A survey in the United States found that the telephone was the more preferred mode of communications for low-income customers: 43% of them were content with getting automated calls from the utility asking them to change power use to take advantage of peak-time rebates or time-of-use pricing, while only 23% of other respondents wanted to get such calls. The numbers for email alerts were 17% and 26%, respectively.[55]

Another question to ask is: Who will be providing that information (or command, or resource, or anything else that could be relevant in an electricity exchange) in the future? Alternatively: Who might the vulnerable household empower to act as their "electricity agent" in the future? While the average Ontarian may be courted by their local distribution company's competitive entity, other energy service providers, or any of the aforementioned new entrants, vulnerable households may not have as attractive accounts to offer. They have lower energy consumption, fewer discretionary loads, less space for siting renewable energy or storage technologies, more fragile credit ratings, and higher transaction costs arising from more frequent relocations, etc. Consequently, vulnerable households may have fewer suitors with less attractive offerings. This is both unfair and a lost opportunity.

Vulnerable households may also have weaker and/or fewer personal connections that are relevant to smart grids. In the United Kingdom, for instance, it was found that because tenants moved more often on average than homeowners, "[they] would seem likely to have more limited local knowledge and social networks."[56] As a result, they have fewer avenues of support for learning and information sharing more generally.

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52 Darby et al., *op. cit.*, in note 50.

53 *Tariff Switching Among Older Energy Consumers* (Melbourne: Consumer Utilities Advocacy Centre, June 2014), p. 19.

54 This is a key theme of the aforementioned Accenture report: "The power of collaboration continues to be a fundamental current of change in the [energy] industry," (*The New Energy Consumer, op. cit.,* in note 51, p. 37).

55 Survey work completed by the Smart Grid Consumer Collaborative, and reported upon by St. John, *op. cit.*, in note 44. See, also, Aaron Smith, "U.S. Smart Phone Use in 2015," (Pew Center, 1 April 2015, http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/).

56 Darby et al, *op. cit.,* in note 50. See, as well, Piya Malik and Helen Stockton, *Smart for All: Consumer Experiences of Smart Meters, Report from Phase 2 of Research* (Newcastle upon Tyne: National Energy Action for the Department of Energy and Climate Change, 2013, http://www.nea.org.uk/wp-content/uploads/2015/07/march-NEA-Smart-for-All-2-FullReport-FINAL.pdf).

THE FUTURE

Prosumers

"Prosumer" is a term being used to describe what the traditional electricity consumer will become, or is becoming. It refers to a householder who not only "consumes" electricity, but one who also "generates" electricity (perhaps by means of solar photovoltaic panels on the rooftop), "stores" electricity (through, for instance, batteries in the basement), and "exchanges" electricity and other ancillary services in the marketplace. This is the householder envisioned by Ontario's smart home roadmap (referenced above).

A future full of prosumers is conceivably a much more capital-intensive future. Today, means of participation in the electricity system involves purchase of a fuel (the electrons) that is produced by someone else's capital (a power plant, which is located elsewhere). Consequently, the cost of participation is minimal to begin, but there are significant ongoing costs. In the smart grid world, however, participation will involve production of a fuel (again, electrons), and its associated services (e.g., capacity, responsiveness, and carbon credits), but conceivably by the consumer's own capital (a solar panel, for instance, located on-site). Accordingly, there would be substantial costs to initiate participation in this way, but minimal ongoing costs. For those with access to inexpensive capital and resilience in the face of uncertainty, it is a feasible and potentially attractive option. Low-income and vulnerable households, however, do not have those characteristics. Consequently, there are risks that must be acknowledged and managed.[57]

As alluded to earlier — and now briefly expanded upon here — the fact that many low-income and vulnerable households are tenants exacerbates the situation. In particular, private renters paying their own utility bills find themselves in a "split incentive" situation where economically attractive energy management investments are greatly disincentivized, as the building owner (i.e., the landlord) and the ratepayer (i.e., the tenant) are financially distinct entities.[58] Tenants would like to harness the benefits of advanced energy technologies such as modern appliances, improved building envelope, or solar panels on the roof. There is not, however, any guarantee that their tenancy will be sufficiently long so as to recoup that initial investment. Nor are they likely to have the authority to install such technologies. For their part, landlords would ideally like to see advanced energy-using appliances installed so that the value of the units is increased, but there are not sufficient financial returns to encourage this action. This provides another barrier to smart grid uptake.

57 While we recognize that innovative financing mechanisms (for instance, rooftop solar leasing) can help to address this barrier, access to the rooftop itself (ownership, longevity of residency) may still prove to be a barrier that is insurmountable for low-income households.

58 Stephen Bird and Diana Hernández, "Policy Options for the Split Incentive: Increasing Energy Efficiency for Low-income Renters," *Energy Policy* (Vol. 48, 2012), pp. 506-514.

The sharing economy

Technological innovations, in terms of advances in information and communication technologies, are contributing to the development of significant social innovations that enable decentralized exchanges of excess capacity and personal resources. The term "sharing economy" is often used to capture the set of changes under consideration here. AirBnB and Uber may be the two best-known business examples of this transformation. Similar discussions are going on in the electricity industry. Many are exploring how these kinds of innovations might ultimately manifest themselves in terms of power supply to householders.[59] Some envision a situation in which an individual in Ontario, looking to get a boost for their mobile device on a community wireless charger, logs into an "electricity-sharing" site, submits their need — in terms of kWh, charge-time, electron "source" (i.e., wind, solar, natural gas, etc.), social performance of the generator (e.g., activities relevant to their corporate social responsibility portfolio) and cost — and then waits for suppliers' offers to come in. While we in Ontario might only be able to imagine something like this, those in Europe can use services offered by companies like Vandebrong, a startup in the Netherlands, to currently do just that.[60] For our purposes in this report, we wonder what such developments would mean, in particular, for low-income and vulnerable customers.

First and foremost, many of the themes raised throughout this report — the importance of paying attention to issues related to both energy literacy and energy partnerships (including who might be interested in offering what kinds of electricity services to which kinds of customers) — are only heightened in importance. Additionally, should the sharing economy spark demands for new kinds of energy generation, there may be more and more energy project-siting choices that are decided by those who are the most powerful, politically. As a consequence, low-income neighbourhoods could be left to host those kinds of distributed energy facilities (or, alternatively, "back-up facilities") that no other neighbourhood wants.[61] And, finally, local electric distribution utilities may be forced to rethink their roles in the wake of widespread "grid defections" (wealthier, larger-load customers leaving the centralized, electric grid altogether). These utilities' subsequent re-examinations and potential re-inventions would then have important implications for how they serve vulnerable households.

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59 See, for instance, Matthew Crosby, "An Airbnb or Uber for the Electricity Grid?" (Rocky Mountain Institute, 2 September 2014, http://blog.rmi.org/blog_2014_09_02_an_airbnb_or_uber_for_the_electricity_grid). Other relevant investigations about the future of electricity systems include: Peter Bronski et al, *The Economics of Grid Defection: When and Where Distributed Solar Generation Plus Storage Competes with Traditional Utility Service* (Boulder, CO: Rocky Mountain Institute, 2014); Advanced Energy Economy, "21st Century Electricity System," (San Francisco, CA, https://www.aee.net/initiatives/21st-century-electricity-system.html); Peter Kind, *Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business* (Washington, DC: Edison Electric Institute, 2013); and Owen Zinaman et al, *Power Systems of the Future: A 21st Century Power Partnership Thought Leadership Report* (Golden, CO: National Renewable Energy Laboratory, Technical Report NREL/TP-6A20-62611, 2015).

60 Ben Schiller, "The Sharing Economy Takes On Electricity, So You Can Buy Your Power From Neighbors," (30 September 2014, http://www.fastcoexist.com/3036271/the-sharing-economy-takes-on-electricity-so-you-can-buy-your-power-from-neighbors).

61 *Case 14-M-0101 — Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision, Staff White Paper on Ratemaking and Utility Business Models* (Albany, NY: State of New York, Department of Public Service, 28 July 2015), p. 45.

CONCLUSIONS AND RECOMMENDATIONS

This report's central premise is that strategies are needed to connect issues and challenges of energy poverty to the issues and possibilities of the smart grid. While some are working hard to make linkages, we believe that there is critical work to be done to bridge the gaps between these two issue areas.

The province's local electric distribution companies (LDCs) — community-focused entities, which are often also community-owned — are being pushed away from a thorough consideration of the differing needs of all of their customers.[62] Recent changes to the mechanism by which LDCs generate revenue, shifting to a single, fixed charge for all of their residential customers irrespective of electricity consumption level,[63] seems regressive and potentially harmful to low-income customers who are also low-consuming.

For their part, low-income and vulnerable customers often feel disillusioned about the province's electricity system. While the impacts of rising electricity rates are, of course, contributing to this sentiment, so too is the feeling that they are not sharing in many of the benefits of the "green energy economy."[64]

Consequently, a new set of conversations needs to be initiated. The following three recommendations encourage discussion and action on critical issues we have highlighted in this report. We also point to international activities to show that important work is already underway.

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62 Each LDC has a single conservation and demand management target, and a single associated budget, for the 2015-2020 period (though collaboration to achieve collective targets is possible). (See "LDC CDM Target and Budget Allocations, as of October 31, 2014," (http://powerauthority.on.ca/sites/default/files/conservation/LDC%20CDM%20Targets%20and%20Budgets_10312014.pdf) for details.) Logically, the most cost-effective programs are being prioritized. Thus, while low-income programs are somewhat sheltered from that requirement (see, for instance, the Ministerial Directive of 31 March 2014 (*2015-2020 Conservation First Framework* (Toronto, ON: Ontario Ministry of Energy, 31 March 2014, http://www.powerauthority.on.ca/sites/default/files/news/MC-2014-856.pdf)), it is nevertheless the case that the Ontario Power Authority's Achievable Potential Study showed that the industrial and commercial sectors had more and cheaper electricity savings potential than the residential sector (ICF Marbek, *Achievable Potential: Estimated Range of Electricity Savings from Energy Efficiency and Energy Management* (Ottawa, ON, 26 March 2014)). The first progress report addressing these new targets revealed where the action is: less than 8% of the 159 GWh net energy savings reported emerged from the residential sector as a whole; "business and industrial initiatives" dominated (*Conservation Progress Report, First Quarter 2015* (Toronto, ON: Independent Electricity System Operator, 2015)).

63 *Board Policy: A New Distribution Rate Design for Residential Electricity Customers* (Toronto, ON: Ontario Energy Board, EB-2012-0410, 2 April 2015, http://www.ontarioenergyboard.ca/oeb/_Documents/EB-2012-0410/OEB_Distribution_Rate_Design_Policy_20150402.pdf#page=13). The Policy does address low-income customers in particular (pp. 14-17), noting, for one, that such customers that are relatively large users of electricity (because of electric heating) will be better off, financially, as a result of the change.

64 It has been noted that feed-in tariffs, for instance, are "likely to have a regressive impact unless accompanied by other policies to encourage take-up among low income households." This is because of the significant capital investment initially required to participate. (William Baker and Vicki White, *Towards Sustainable Energy Tariffs* (London: Centre for Sustainable Energy for the National Consumer Council, 2008, https://www.cse.org.uk/downloads/reports-and-publications/policy/towards-sustainable-energy-tariffs.pdf), p. 28.) More recent experience gives substance to this kind of supposition. In Los Angeles, CA, some argue that, "Low-income households, they say, are paying higher electric bills to subsidize solar arrays that only wealthier people can afford." (Evan Halper, "Minority Groups Back Energy Companies in Fight Against Solar Power," *Los Angeles Times* (9 February 2015, http://www.latimes.com/nation/la-na-solar-race-20150209-story.html).)

DETERMINE THE VALUE PROPOSITION FOR INCREASED VULNERABLE HOUSEHOLD ENGAGEMENT IN THE SMART GRID

There has not been sufficient effort at determining, in an evidence-based manner, the benefits and costs arising from greater participation of vulnerable households in the smart grid. This reflects the broader challenges against Ontario's smart grid strategy.[65] This kind of "value proposition" needs to be articulated more clearly for at least three reasons:

1. to help vulnerable households (and others) decide whether engagement is worthwhile, and if it is, what kinds of engagement with which parts of the smart grid. If engagement is not worthwhile, develop new innovations for the smart grid and/or offer alternate compensation;
2. to encourage consideration of the multiple and linked kinds of benefits that can arise from an enhanced smart grid, such as employment opportunities, and;
3. to be part of a broader effort to educate about energy sustainability.

This effort must be cognizant of the fact that the electricity system is a complex one. Even now, different citizens get different value from it in addition, that is, to meeting their immediate electricity service demands. In a smart grid future, different users could offer various kinds of "value back" to the system. For instance, this could be responsive loads or renewable energy siting possibilities. Investigations exploring the diverse sets of costs and benefits have been undertaken,[66] and should be more thoroughly investigated in Ontario.[67] (We offer some examples in the section above entitled, *Advanced metering technologies*.)

ENGAGE VULNERABLE HOUSEHOLDS IN THE SMART GRID

A sustainable energy system is one in which all citizens are engaged. While discussed under different banners — for example, "social licence" in the popular press[68] and "public acceptability" in academic literature[69] — it is widely accepted that all stakeholders must be involved in the development of both specific energy projects and broader energy transformations. Without such engagement communities can become disillusioned, misunderstanding and miscommunication can become commonplace, and public opinion can turn. At present, vulnerable households are not actively engaged in the smart grid in Ontario and there are relatively few efforts focused on changing that.

65 Office of the Auditor General of Ontario, *Annual Report 2014* (Toronto, ON: Queen's Printer for Ontario, 2014), section 3.11.

66 *Ontario Smart Grid Assessment and Roadmap* (Toronto, ON: Navigant for the Ontario Ministry of Energy, 2015).

67 This could potentially complement the recent addition of consumer education to the Ontario Energy Board's objectives (Bill 112, "Strengthening Consumer Protection and Electricity System Oversight Act, 2015").

68 See, for instance, CBC News, "Fredericton Group Seeks Social Licence for Resource Projects," (28 May 2015, http://www.cbc.ca/news/canada/new-brunswick/fredericton-group-seeks-social-licence-for-resource-projects-1.3090858).

69 Christina Demski, Catherine Butler, Karen A. Parkhill, Alexa Spence and Nick F. Pidgeon, "Public Values for Energy System Change," *Global Environmental Change* (Vol. 34, September 2015), pp. 59-69.

It is well-known that many of the smart grid's emerging technological opportunities for residential ratepayers will require new behind-the-meter capital investments, most likely from dwelling occupants themselves or other private investors (e.g., smart home energy management systems). This, in turn, is likely to skew the distribution of new benefits in the short- to medium-term towards more affluent ratepayers. However, what is not as well known, or not as widely discussed, is that not all new ratepayer-facing innovations need to be behind-the-meter. The electricity meter itself represents an important new investment that has already been made widely accessible to Ontarians through the smart meter rollout program. Under the stewardship of community-oriented LDCs, the wealth of new data provided by this technology can be harnessed for the mutual benefit of utilities and ratepayers alike. With a stronger focus on simple but secure ratepayer data accessibility and consumer-oriented applications, such data can enable and empower households to take control of their energy use without the requirement for cost-prohibitive financial investments.[70] Some LDCs have begun to adopt standardized electricity data sharing formats, and natural gas distributors are now considering similar actions.[71]

For equal access to the opportunities enabled by these data, other utilities and rental unit submetering companies should be strongly encouraged, if not required, to adopt such practices. There is information and findings that appreciate the particular circumstances of vulnerable households — how they receive information, where they receive it, etc. With respect to the smart meter there are general strategy documents,[72] as well as specific initiatives, worthy of consideration for possible replication or simply inspiration. These include leveraging emerging forms of media and the novel engagement opportunities they present.[73] Inspired ways to catalyze the participation of vulnerable households in distributed renewable electricity generation can also be found by looking elsewhere. "Community solar"[74] in general, and "social solar" in particular,[75] have received much attention in the United States.[76]

70 The winners of Ontario's Apps for Energy competition (http://energyappsontario.devpost.com/submissions) provide locally developed, first-generation examples of such engagement opportunities.

71 Components of the Green Button data standard have been adopted or trialed by at least 10 LDCs in Ontario, and a Natural Gas Working Group has been formed with representation from the province's major natural gas utilities to investigate adoption of the standard in that industry.

72 See, for example, *Smart Meter Extra Help: Ensuring All Consumers Benefit from the Rollout of Smart Meters* (London: Citizens Advice Bureau, September 2014, https://www.citizensadvice.org.uk/Global/Migrated_Documents/corporate/smart-meter-extra-help-scheme-position-paper-final.pdf); and Darby et al., *op. cit.* in note 50.

73 See, for example, Delta Institute, "Reimagining the Smart Meter Experience," (5 June 2015, http://delta-institute.org/2015/06/reimagining-the-smart-meter-experience/).

74 U.S. Department of Energy, "Community Renewable Energy: Community Shared Solar FAQ," (http://apps3.eere.energy.gov/greenpower/community_development/community_solar_faq.html).

75 Julie Hirschfeld Davis, "Obama Plan Would Give Poor Easier Access to Solar Energy," *The New York Times* (7 July 2015).

76 Darby reminds us that such engagement will need support — as she puts it, "substantial institutional or collective backing," (Darby, *op. cit.,* in note 38, p. 104).

TAKE A HOLISTIC APPROACH IN ENERGY POVERTY/SMART GRID POLICY-MAKING

Good policy cannot be made and implemented in a silo. As argued throughout this report, these two issue-areas need to be considered together. Others have acknowledged this. Ireland, for example, recognizes that it must "address special consumer classes that may not easily benefit from smart grids."[77] Closer to home, the State of New York has the concerns of low-income households at the heart of its Reforming the Energy Vision discussions.[78] This message should be heeded in both the short- and long-terms. With respect to the former, ongoing discussions about electricity rate design should not lose sight of the potential impacts upon vulnerable households.[79] With respect to the latter, new construction of social housing should be made "smart grid-ready" — giving consideration to solar orientation and communications connectivity. Indeed, what is a truly "joined-up" policy response[80] should not restrict itself to simply these two areas,[81] but recognize that work has to be undertaken both across sectors and across different time horizons. Different institutional players come to the table with diverse mandates, core competencies, datasets, and policy or program tools. But all stand to benefit from participating in a collaborative, integrative effort that enables Ontario to navigate its technical energy system transformation while improving social equity and economic resilience.

77 *SmartGrid Roadmap* (Dublin: Sustainable Energy Authority of Ireland, 2012, http://www.seai.ie/Publications/Statistics_Publications/SEAI_2050_Energy_Roadmaps/Smartgrid_Roadmap.pdf), p. 4.

78 See, for instance, *Staff White Paper on Ratemaking and Utility Business Models* (Albany, NY: State of New York Department of Public Service, 28 July 2015, http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b48954621-2BE8-40A8-903E-41D2AD268798%7d).

79 "One solution is to offer multiple rate options, which will allow less flexible customers to choose the rate that serves them best. Another solution is to offer across the board percentage discounts for low income customers, which would allow these customers to still receive the same price signals as other customers, but simply pay a lower bill." (Devi Glick, Matt Lehrman, and Owen Smith, *Rate Design for the Distribution Edge: Electricity Distribution for a Distributed Resource Future* (Boulder, CO: Electricity Innovation Lab, 2014), p. 39.) The Ontario Electricity Support Program, introduced in 2016 and noted above, represents another approach to this kind of rate-affordability program, "Ontario Electricity Support Program," (Toronto, ON: Ontario Ministry of Energy, http://www.energy.gov.on.ca/en/ontario-electricity-support-program/).

80 Lucie Middlemiss and Ross Gillard, "Fuel Poverty from the Bottom-Up: Characterising Household Energy Vulnerability through the Lived Experience of the Fuel Poor," *Energy Research & Social Science* (Vol. 6, 2015), p. 154.

81 A footnote is worthy of inclusion here to remind the reader that while we encourage policy-making that looks across multiple sectors, there are nevertheless gains to be made by a closer consideration of the two areas we focus on. For instance, particular policy and/or program innovations may not only result in physical energy savings and increased energy literacy, but also help a family avoid missing bill payments, which thus returns benefits to society as a whole in the form of decreased collections overhead, elimination of lost revenue to utilities, reduced workload for social service agencies and increased well-being, stability, and productivity for the ratepayers involved. As an example, the Low-Income Energy Network's comments to the Ontario Energy Board during the development of the Ontario Electricity Support Program (OESP) highlight evidence from other jurisdictions regarding the ability of bill assistance programs to reduce ratepayer defaults, decreasing collection costs and lost revenue to utilities. ("Supplemental Comments to Ontario Energy Board Regarding Stakeholder Consultation: Ontario Electricity Support Program (OESP)," 10 November 2014, http://www.rds.ontarioenergyboard.ca/webdrawer/webdrawer.dll/webdrawer/rec/455562/view/).

We are excited by the opportunities that an integrated, community wide strategy for smart grid development presents. Evidence-based investigation of options, consideration of a breadth of factors when engaging, and policy that recognizes, understands, and acts upon multiple sectoral and temporal linkages has the opportunity to bring prosperity to all. Ontario is well positioned to take advantage by combining its technological prowess and its wealth of community capital, for the benefit of the province. In turn, Ontario can contribute to discussions and progress both nationally and internationally.

LIST OF INTERVIEWEES

The following individuals agreed to be interviewed for this report. The authors appreciate having the opportunity to hear their perspectives on these issues. (Please see Disclaimer at the start of this report.)

Anonymous × 2

Clare Butterfield, Program Director, Illinois Science and Energy Innovation Foundation (ISEIF), Chicago, IL

Eileen Campbell, Vice President, Customer Services, Horizon Utilities, Hamilton, ON

Jon Dogterom, Venture Services Lead, Cleantech, MaRS, Toronto, ON

Christine Fischer, Supervisor, Intake Services, The Regional Municipality of Waterloo, Social Services Department, Waterloo, ON

Katie Fotheringham, Residential Lead, Independent Electricity System Operator (IESO), Toronto, ON

Heidi Gohs, The Regional Municipality of Waterloo, Social Services Department, Waterloo, ON

Brent Mayled, Intake Coordinator, The Regional Municipality of Waterloo, Social Services Department, Waterloo, ON

Paul Murphy, Board Chair, Advanced Energy Centre, MaRS, Toronto, ON

Jeff Quint, Manager, Conservation and Corporate Communications, Waterloo North Hydro, Waterloo, ON

Caitlin Ryan, Senior CDM Manager, CLEAResult, Toronto, ON

Mary Todorow, Advocacy Centre for Tenants Ontario, Toronto, ON

Van Vilaysinh, Manager, Housing Stability, Housing Services, Region of Waterloo Community Services, Waterloo, ON

Bethany Wagler-Mantle, Social Planning Associate, Region of Waterloo Community Services, Waterloo, ON

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By Ian H. Rowlands and Gord Stephen

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