The Neoliberal Politics of "Smart": Electricity Consumption, Household Monitoring, and the Enterprise Form

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ABSTRACT *This article investigates how digital technologies in the energy sector are enabling increased value extraction in the cycle of capital accumulation through surveillant processes of everyday energy consumption. We offer critical theory (Gramsci, Foucault) and critical political economy (Marx) as a guide for critical understanding of value creation in ICT through quotidian processes and practices of social reproduction. In this regard, the concept of the "prosumer" is extended beyond notions of voluntary participation in Web 2.0 to the political economy of energy use. Within this broad framework we investigate national and local level "smart grid" campaigns and projects. The "smartening" of the energy grid, we find, is both an ideological construct and a technological rationalization for facilitating capital accumulation through data collection, analysis, segmentation of consumers, and variable electricity pricing schemes to standardize social practices within and outside the home. We look at BC Hydro as one illustration of where such practices are being instituted.*

KEYWORDS *Smart grid; Surveillance; Marxism;[1] Foucault; Critical theory; Political economy; Labour; Prosumption*

RÉSUMÉ *Cet article examine comment les technologies numériques dans le secteur de l'énergie sont en train de permettre, grâce à la surveillance de la consommation de l'énergie au quotidien, une extraction de valeur dans le cycle d'accumulation du capital. Dans cet article, nous avons recours à la théorie critique (Gramsci, Foucault) et à l'économie politique critique (Marx) pour atteindre une compréhension critique de la création de valeur permise par les technologies de l'information et de la communication dans le cadre de pratiques et processus de reproduction sociale au quotidien. À cet égard, nous élargissons le concept de « prosommateur » au-delà de notions de participation volontaire au Web 2.0 en y ajoutant celui d'économie politique de l'utilisation de l'énergie. Dans cette optique, nous examinons des campagnes et projets sur les réseaux électriques intelligents aux niveaux national et local. À notre avis, l'idée qu'il faille améliorer le réseau énergétique est à la fois une construction idéologique et une rationalisation technologique pour faciliter l'accumulation de capitaux au moyen de la collection et l'analyse de données, de la segmentation des*

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marchés et de l'imposition de prix variables sur l'électricité afin de standardiser les pratiques sociales à la maison et au-delà. Nous examinons BC Hydro comme exemple d'un endroit où de telles pratiques ont lieu.

MOTS CLES *Réseau électrique intelligent; Surveillance; Marxisme; Foucault; Théorie critique; Économie politique; Travail; Proconsommateurisme*

> It is easy to tell when someone is in the shower, for example, based on the use of a water pump, water heater, bathroom light, and/or hair drier. In one field test, for example, I was not entirely sure of my interpretation of the output until residents confirmed what the plots indicated – that one occupant did routinely take noontime showers. In another home, one could easily determine when the bed in the master was made and when it was uncovered! The bed was a water bed, and its electrical heater cycled on for shorter periods when the blankets were in place to insulate it.
>
> —Hart, 1989, p. 14
>
> Let's be smart with our power
>
> —BC Hydro's Power Smart Website Slogan (2014)

In this article, we wish to discuss the relationship between the expansion and deepening of corporate encroachment on the household and everyday life through the emerging energy "smart grid." Every home is equipped with the rudiments of electrical infrastructure and commodities, ranging from the more modest forms of equipment, such as toasters and refrigerators, to the more extravagant, such as luxury hot tubs and full-scale entertainment complexes. But most people would not imagine that, apart from the bill they receive from their local electric utility, their every flick of an electrical switch integrates their cyberselves as an informational force of (re)production in the corporate capitalist accumulation process. Technology developments have broad applications and implications, but the smart energy grid that is being implemented across the United States and Canada, like the worldwide web, we argue, is being appropriated as part of a design to draw upon higher level data from dwellers (as surplus value) in the service of industrial profiteering and in the surveillance interests of industry and the state. The consumer's use value of electricity consumption is thus being transformed into exchange value, as well as creating new forms of social monitoring and control by agencies of government, and of violations of constitutional protections under the Fourth Amendment of the U.S. Constitution and Section 8 of the Canadian Charter of Rights and Freedoms. As recent exposés regarding National Security Agency data collection practices reveal, the clandestine state invasion of private lives and personal information on a sweeping scale would hardly be unprecedented.

With digital integration of energy infrastructure and the use of smart metering, new and more sophisticated means arise for those in the surveillant perches for collecting and reading sensitive personal information on the individual within the household. Smart meters are routinely being installed to record and report consumption microdata through a process of linking digital communication with electrical power

utilities' central servers. Such data are sources for surplus value (added) for utilities when analytics companies[2] are able to 1) process the data and provide algorithms that can be used to influence demand management schemes (Palensky & Dietrich, 2011; Siano, 2014); 2) show ways to redistribute and handle intermittent supply of electricity (Richter, van der Laan, Ketter & Valogianni, 2012); 3) indicate when variable pricing should be used to shave peak loads or increase productivity and profits for uses in different sectors (Faruqui, Harris & Hledik, 2010; Owen & Ward, 2006); and 4) reduce fraud and theft (McLaughlin, Podkuiko & McDaniel, 2010) and enable prepayment schemes (Coutard & Guy, 2007; Nelson & Orton, 2013).

There are three closely related core and mutually constituting issues we wish to discuss in this article. The first concerns the matter of deep surveillance of household life and what this suggests about the erosion of the right to privacy principle embedded in the Fourth Amendment and Section 8 of the Canadian Charter of Rights and Freedoms, as well as about the regulation of daily life by highly organized, technology-assisted external commercial and state forces. The second, which closely follows from and rationalizes the first, relates to the Foucauldian idea about the disciplining of citizens, which we see as achieved through ideology, discourse, and materiality linked to electrical energy use within the home, as well as to notions of "efficiency" that persuade people to adapt their behavior as "rational economic actors." This subjectivity acquiesces to the rules and regimentation of the corporate enterprise, leads to self-Taylorization of time and motion in consonance with presumed personal and environmental savings, and in general induces conformity to the norms that make for good neoliberal corporate state citizens. Third is the question of how consumers are subsumed in value creation, an investigation into whether energy consumers, as "prosumers," are concurrently producers of wealth by way of submission of their identities and use data that are appropriated in the process of capital formation (within its production and circulation functions)—anything from space/time use of appliances, to the ways by which self-regulation is commodified.[3]

Capitalization based on data gathering relies on consumer behavioral changes through which commercial gains and state objectives achieve legitimacy—and are treated as successful—in accordance with market logics of productive efficiency, innovative technology adoption, and profit maximization. Our principal concern here is about how the proliferation of the enterprise form throughout society (the "social factory"), as an ideological norm of neoliberal corporate-state power, is increasingly governing the everyday practices of social reproduction, and how smart grid technologies embody and enact these social relations of power.

Thinking critically about the smart grid

Critical perspectives on technology start with the assumption that technologies are not value neutral; they cannot be isolated and understood outside their social, political, cultural, and political economic context; and that neither a determinist nor instrumentalist view by itself can fully capture their relation to society. Our analysis of smart grid technologies builds on the work of Andrew Feenberg, who employs a critical analysis drawn both from marxian and social constructionist theories, particularly Foucault, Marcuse, and Heidegger (Feenberg, 1999; 2002). Employing a critical analysis, we see the rela-

tionship between the social and technical not as neutral or deterministic but as dialectical and reflexive; that is, technology both shapes and is shaped by social forces.

Feenberg (1999) insists that technology is value-laden, controllable, and driven by social processes, but also has an embedded design "essence" of its own, geared toward instrumental rationality. This rationality is normalized and made socially rational and acceptable based on three tenets: (1) exchange of equivalents (in market transactions); (2) classification and application of rules (in bureaucratic organizations); and (3) optimization of effort and calculation of results (in technologies). Feenberg (2008) explains that these principles of social rationality permeate the entirety of society and that "[s]ocial life in our time thus appears to mirror scientific and technical procedures" (p. 7). In the very constitution of technologies and in their implementation, this rationality can be exceedingly biased. Feenberg (2008) suggests that types of "[f]ormal bias prevail wherever the structure or context of rationalized systems or institutions favours a particular social group. Marx's economic theory offers a first example of the analysis of a formally biased social arrangement" (p. 9). The integration of critical theory of technology and marxian political economy provides an analytical framework for unlocking these biases.

While Feenberg sees political economy as only one component of a larger technological framing and social rationality, it is clear that the social (class) relations within capitalism are constitutive in the (social) construction of technologies, embracing an instrumental logic that serves capitalist goals of segregating the social from the technical, striving for self-serving efficiencies, alienating labour, and fetishizing "things" to mask social relations.[4] Each of the commodification processes (alienation, exclusivity, rivalry, standardization) are important components of Feenberg's (2008) Instrumentalization Theory: alienation and exclusion decontextualize objects, while rivalry and standardization simplify them. Once objects are decontextualized and simplified, they can be incorporated into a rational system, such as the electricity market, through appropriate systematizations. The subject also becomes detached and alienated, assuming roles of mere users, consumers, and data, or capitalists concerned only with optimization and profit maximization. Subjects take on the socially rational demands of the corporate capitalist system and, in doing so, perform immaterial and unpaid "virtual" labour in the provision of personal data that enables the creation of value from such data.

Though contested and contingent, technologies generally align with hegemonic political power and the distinctive cultural characteristics of social formations. Feenberg uses the notion of "technical codes" in a constructivist framework to establish a way of dealing with the interconnectedness of the social and technical, a defining characteristic of technology. He explains that

> such fundamental imperatives or codes tie technology not just to a particular local experience but to consistent features of basic social formations such as class society, capitalism, and socialism. They are embodied in the technical systems that emerge from that culture and reinforce its basic values. In this sense technology can be said to be 'political' without mystification or risk of confusion. (Feenberg, 1999, p. 162)

This view undergirds the idea that technologies reflect dominant social relations and thereby reinforce modes of governance that further the hegemony of particular regimes. Langdon Winner (1986) makes a similar argument in his book *The Whale and the Reactor*, in which he argues that "specific features in the design or arrangement of a device or system could provide a convenient means of establishing patterns of power and authority in a given setting," and in some cases, "intractable properties of certain kinds of technology are strongly, perhaps unavoidably, linked to particular institutionalized patterns of power and authority" (p. 38). In one sense, technologies are flexible; in another, only one arrangement or design is at all possible, and there are "no genuine possibilities for creative intervention by different social systems – capitalist or socialist – that could change the intractability of the entity or significantly alter the quality of its political effects" (Winner, 1986, p. 38). These two types of understandings "overlap and intersect at many points" (Winner, 1986, p. 39). Winner and Feenberg concur that technologies are political in their own right, supportive of particular social arrangements, cultural practices, and political economies, but also open to alteration, re-appropriation, and repurposing, though limited within their prevailing context. The sphere of production and reproduction is largely subsumed within the logic of capital.

The design, development, and uses of technology in society is thus a fertile subject for critical analysis. In the case of smart grid technologies, relations of power are tied to and exercised through flows of information detailing energy use and identity, data that are essential to the creation of value. Central to the process of value creation is the use of ICTs and their utility in converging once discrete segments of production and in commoditizing areas once beyond reach, including the sphere of unpaid household labour. Remote surveillance commodifies household energy activity data and incentivizes residents to choreograph their energy use patterns out of economic motivation and environmental consciousness. The manner in which such data are collected uses intrusive monitoring that permits unnoticed or unwanted surveillance of everyday activities to capture the "externalized labor" (Huws, 2003, p. 182-186) of users' energy consumption patterns. Energy companies collect this data as a rent, which they then convert to profitable internal uses beyond the original system of electricity delivery or sell the data to third parties. Payment (wages) in exchange for this access to data in the form of reduced energy charges to the consumer is not guaranteed. Indeed, there is likely a net loss to the household user, as the principal forms of consumer savings requires the purchase of smart household utilities, smart ovens, smart toasters, smart refrigerators, and the like, while utility companies pass on the cost of smart meter installation to ratepayers.[5] Protecting ratepayers and reducing energy use is least assured under a neoliberal economic regime, particularly if the utility companies choose not to save but to sell unused electricity to businesses at premium rates.

Prosumption and surveillance

Surveillance of information, what Roger Clarke (1988) calls "dataveillance", is the "systematic use of personal data systems in the investigation or monitoring of the actions or communications of one or more persons" (p. 499), and as such may be defined as *personal* or *mass* surveillance. This distinction breaks down in Internet surveillance because of the massive networks of communication and the forms of mass advertise-

ments that are tailored and targeted to users based on personal data collected. Internet surveillance is therefore both personal and mass surveillance. This mirrors the situation in the case of energy consumption data collected by smart meters. Christian Fuchs (2009) posits that ICT and the Internet need to be situated in a larger societal context to be properly understood: these technologies should be addressed as a "concretization of the analysis of the development dynamics of capitalist society" (p. 73).

A critical theory of the Internet has three dimensions: (1) the ontology of dynamic materialism that tells us that "the Internet is embedded in the antagonisms of capitalist society" (Fuchs, 2009, p. 74); (2) the epistemology of dialectical realism that "identifies antagonistic tendencies of the relationship between Internet and society and their opportunities and risks" (Fuchs, 2009, p. 74-75); and (3) the axiology of negating the negative, telling us "how the two competing forces of competition and cooperation result in class formation and produce potentials for the dissolution of exploitation and oppression" (Fuchs, 2009, p. 75).

In an informational political economy, information is largely treated as a commodity, lodged within a networked system of distribution that is dominated by consumer industries, informational and promotional services, and finance. Informational networks both extend and undermine capital accumulation. As Fuchs (2009) argues, "in global informational capitalism, information has become an important productive force that favors new forms of capital accumulation" (p. 78). Surveillance is now a core feature of networked information systems, improving the efficiency of the various industries that capitalize on its use by reducing both market risk and use of new forms of data in new pathways toward capital accumulation. In surveillant applications, digital technologies are able to store data on Internet usage, clicking patterns, searches, and site visits to track the online activity of users.

In the commercial sphere of the Internet, the user is both a consumer and contributor of data, the compilation of which is sold to advertisers and other interested third parties. Advertisers either purchase the data to develop their own marketing segments, or pay an Internet content source for access to marketing segments. Advertisers then use this data or access to segments for targeted promotion. The same individual browsing that consumes Internet content as a commodity also constitutes a kind of informal labour, inasmuch as it produces exchange value for advertisers—hence the "prosumer" (Fuchs, 2008; Sussman, 2012). Terranova (2004) acknowledges that online-based free labour is not typically viewed as work, but argues nonetheless that as it creates value for capital and as such is labour (Cohen, 2008; Huws, 2003; Terranova, 2004). Fuchs further argues that this personalized advertising is a method of controlling knowledge flows and access to information such that individuals are "activated to continuously participate in and integrate themselves into the structures of exploitation, during as well as outside wage labor time" (2009, p. 82), this being an expression of the trend towards a Deleuzian "society of control."

Internet users may "opt-out" of such participation and surveillance schemes resulting in a loss of revenue for Internet firms. Not all participation and surveillance schemes afford the user this path, and some inflict financial penalties when they do. Given the unequal power relations between users and providers, there is considerable

financial interest in seeking profit through the power differential in such schemes. Electronic surveillance has both political and economic aspects: political surveillance, such as by secret services or police, subjects individuals to state violence or repression; economic surveillance targets and coerces individuals into consumptive behaviour and a passive, subaltern status in social reproduction (Fuchs, 2011).

Surveillance of electricity use in its political aspect is related to the need for management and regulation of energy consumption to assuage regulators, to reinforce pricing structures, and to track illegal activities such as energy theft or fraud. Acknowledging the importance of this type of surveillance, however, we focus here mainly on economic surveillance, and how economic surveillance is related to "prosumption" and the reinforcement of neoliberal ideology. We understand this connection similarly to Fuchs (2012b), who argues that "[e]conomic surveillance of user data and user activities, thereby commodifies and infinitely exploits users and sells users and their data as Internet prosumer commodity to advertising clients in order to generate money profit. … It instrumentalizes all users and all of their data for creating profit" (p. 44).

At the same time, consumer surveillance for marketing and advertising fundamentally undermines and contradicts the notion of consumer sovereignty, which is a core tenet of the market model (Manzerolle & Smeltzer, 2011). In a parallel manner, in the case of smart energy meters, the process of abstraction and appropriation of data, while not necessarily used for targeted advertising (though it is likely it will), will be utilized by data analytic companies to produce consumer segments based on energy-usage profiles with the purpose of maximizing profits for energy utility companies. Surplus value is achieved through consumer segment-based pricing and tariff structures (pricing and demand management), consumer segment-based messaging to reduce energy use (demand management), a reduction of labour costs for meter readers (reduced labour costs), and improved maintenance and operations by relaying data about power quality, outages, and distributed supply (reduced operating costs).

The process of data collection via smart meters is analogous to prosumption in Web 2.0 applications and the creation of targeted advertisements, but in this case, analytic products and management platforms that feed on user data, rather than advertisements, are at the heart of the accumulation process. Surveillance and prosumption are indeed central to capital accumulation in smart meter deployment. The prosumer commodity, as in Dallas Smythe's (2006) "audience commodity," here refers to the exploitation of labour (surplus value creation) through processes of coercion, alienation, and appropriation, enabled by digital technology and the harvesting of personal data (Fuchs, 2012a). Fuchs (2012b) discusses this process in terms of "Google Capitalism," whereby surveillance is invested in the circuit of capital accumulation, and wherein the Internet prosumer is both commodity and commodifier—as identity and consciousness are mined for data ("extracted knowledge") as a natural online digital resource in the formation of the advertisement commodity. In a similar manner, energy use data collected through smart metering infrastructure are packaged as segmented consumer information that is used to create more targeted messages to consumer segments about ways to conduct themselves in their homes for reduced energy use.

Thus, smart metering schemes are analogous to online prosumer activities in that they allow for the collection of fine-grained consumption data for targeted messaging; however, there is also further interest in controlling consumer behaviour achieved through "making electricity networks visible" to consumers (Cotton & Devine-Wright, 2010; Hargreaves, Nye & Burgess, 2010). Consumers, acting under economic logics, accordingly respond to market-led signals of appropriate levels and times of energy use. The commoditization in this case is a process of capturing the user's "consciousness" and disciplining behaviour toward market-oriented, pecuniary-minded actions in the home. Thermostat setting, for example, would no longer be based primarily on subjective levels of comfort, but more on the economic rationality of saving energy dollars. Compared to the uncompensated labour of the usually unknowing Web 2.0 prosumer, the more conscious logic of the energy consumer is "income" in the form of savings. The reasoning process of the latter will be alloyed with a range of considerations and values, such as environmentalist-individualistic logics of using less energy and conserving resources, thereby reducing one's own contribution to environmental pollution (or, in the case of less environmentally conscious individuals, reinvesting savings in *more* energy consuming activities). Motivated by either economic or ecological concerns, perhaps both, data collected through surveillance of electricity consuming activities can be used to extract informational labour of users for profit, while further reinforcing a neoliberal subjectivity.

Economic surveillance, informational governance, and neoliberal subjectivity

In his lectures delivered at the Collège de France in 1979–1980, Michel Foucault laid out his description and critique of neoliberalism. Foucault (2008) explained that the proliferation of "enterprises" was a central tenet within the governance structure, suggesting that the role of homo-economicus is not so much a consumer as much as a person of "enterprise and production." He argued that the "generalization of forms of 'enterprise' by diffusing and multiplying them as much as possible … within the social body is what is at stake in neoliberal policy. It is a matter of making the market, competition, and so the enterprise, into what could be called the formative power of society" (Foucault, 2008, p. 147-8). His investigation into American neoliberalism explains the procreation of enterprise into the social fabric and reveals its central importance as a reinforcement of neoliberal subjectivity

> through the putting in place, and the transformations in our culture, of "relations with oneself," with their technical armature and their knowledge effects. And in this way one could take up the question of governmentality from a different angle: the government of the self by oneself in its articulation with relations with others. (Foucault, 1994, p. 88)

Following Peter Miller and Nikolas Rose's (1990) work on governmentality and biopolitics, which argues for the "importance of an analysis of language in understanding the constitution of the objects of politics, not simply in terms of meaning or rhetoric, but as 'intellectual technologies' that render aspects of existence amenable to inscription and calculation" (p. 1), we argue that the concept of enterprise as state indoctrination

can be extended into the informational (self-)governance of home energy management through the shaping of discourse and standards of practice, among other "intellectual technologies." Governing is used in the Foucauldian notion of governmentality:

> programmes of government [that] have depended upon the construction of devices for the inscription of reality in a form where it can be debated and diagnosed. Information in this sense is not the outcome of a neutral recording function. It is itself a way of acting upon the real, a way of devising techniques for inscribing it (birth rates, accounts, tax returns, case notes) in such a way as to make the domain in question susceptible to evaluation, calculation and intervention … It is through technologies that political rationalities and the programmes of government they articulate become capable of deployment. (Miller & Rose, 1990, p. 7–8).

This informational mode of (self-)governance is reliant on the operation of governing *through* subjects, in particular in what Lois McNay (2009) calls "self as enterprise" and what Matthew Huber (2012, 2013) calls the "entrepreneurial life," or the formation and shaping of neoliberal subjectivity. The concept of the "cultural politics of capital" (Huber, 2013) refers to the practices and meanings through which capitalist power is naturalized—and aestheticized. Huber describes the process by which historical material transformations of social reproduction focused on home ownership and private property, and how oil-dependent geographies of mobility were central to the subordination of everyday life under capital. In the same way, the cultural politics of capital shift from the formal to the real subsumption of labour in production through both a social relation of wage-labour and a sociotechnical transformation where machinery dominates living labour. In the realm of reproduction, the cultural politics of capital transitions from the formal to the real when "one's own life is seen as an individualized product of hard work, investment, competitive tenacity, and entrepreneurial 'life choices'" (p. 19).

This view of life, a capitalist mode of life, is based on wage-labour relations and social relations based on commodity exchange. For Huber (2013), it is "where subjectivity itself mirrors the entrepreneurial logics of capital," which is key to the transition process in the realm of social reproduction to "the real subsumption of life under capital … [wherein] *life appears as capital*, what Foucault calls 'the enterprise form' so central to neoliberal subjectivities" (p. xix; emphasis in the original). In this way, Huber connects the technological and material transformation in the realm of "life," made possible more generally through fossil-fuelled development, to the normalization of capitalist power in the realm of social reproduction and, further, to the cultivation of neoliberal subjectivity.

We argue that this "entrepreneurial life" is central to the implementation, political legitimacy (in fact, *depoliticization*), and "success" of smart meter technologies. The promise of smart meters relies, in one part, on behavioural changes of users, such that demand management objectives are met to offset peak loads and eliminate the necessity of adding more electricity production through expensive power production facilities. The role of information about energy consumption is relayed back to individuals in order to inform them about their energy use. In this sense, smart meter "success"

presupposes a rational market actor or a form of power/knowledge relations where users manage their lives as enterprises according to neoliberal rationality.

Thus, the formation of neoliberal subjects is central to the strategy of governing through energy users for smart grid implementation. Operating the home and the self as enterprise with goals for optimization and efficiency, rather than comfort, cultural sensibility, and membership in a public collectivity, is one example of the manifestation of this individualized, competitive subjectivity. McNay (2009) notes that in the enterprise society

> [i]ndividuals would be encouraged to view their lives and identities as a type of enterprise, understood as a relation to the self based ultimately on a notion of *incontestable economic interest.* Foucault's discussion of self as enterprise highlights, inter alia, dynamics of control in neoliberal regimes which operate not through the imposition of social conformity but through the organized proliferation of individual difference in an economized matrix. (p. 56, emphasis added)

This understanding highlights the character of energy-saving rationalities, sanctioned as "best practices" and as modes of improving one's own economic status. Rose and Miller (2010) term this indirect governance as "government at a distance"—the control of individuals "not through explicit forms of domination, but through rationalized techniques and devices which orient action to certain socially useful ends – the 'conduct of conduct'" (McNay, 2009, p. 60). In the context of uneven power relations, "socially useful ends" often means in service to elite groups for the further accumulation of capital, entrenching and naturalizing capitalist modes of life and work. The notion of market and consumer self-regulation, an essentially conservative ideological trope, transfers responsibility for energy policy and regulation from government to the market sector from which household members derive their sense of citizenship.

The smart grid: Smart for whom?

The electrical grid has long been integrated with information and communication technology (ICT). The use of ICT by electrical companies has been primarily to increase the efficiency of operations, but was also important in enabling vertical integration (generation, transmission, and distribution) in the 1960s and 1970s, and later (the 1990s) for liberalization, decentralization, and state deregulation (Hughes, 1983). Computers were used to help plan electric grids and to automate and control production on increasingly larger power systems. Rebecca Slayton (2013) explains that large centralized computers "supported, and were supported by" regulatory structures that allowed utilities to operate as vertically integrated monopolies during this period. Through the 1980s and 1990s, in response to the growing insecurity of energy supply and the concern over issues of reliability, more decentralized generation and organization was facilitated by the growth of smaller, microprocessor-based computers that allowed management of distributed energy resources. Researchers, policymakers, and utilities promoted competition in electricity markets with the idea of better serving customers, improving reliability, and increasing profits (Farhangi, 2010; Slayton, 2013). Support for a competitive market grew in tandem with technological advancements

in ICT, rooted in a determinist vision of smart grid transitions that would bring social benefits and economic efficiency through "transactive" and spot markets for electricity.

In the late 1990s and early 2000s, electrical grids were being plotted for "smart" modernization and development. Increased concerns over terrorist attacks, cyber-security, and aging infrastructure were viewed as significant vulnerabilities (Clemente, 2009; Farrell, Zerriffi, & Dowlatabadi, 2004; FERC, 2006; U.S. DHS, 2010). Yet despite the increased attention given to the power grid, the number of large power outages rose from 76 in 2007 to 307 in 2011. More recently, actions toward resolving these concerns have been underway: 25 U.S. states have already adopted policies relating to smart grid technology; at least nine states discussed smart grid deployment bills in 2011 legislative sessions; and more than 70 million smart meter units were deployed in 2010, up from 46 million in 2008 (ASCE, 2013). As a part of the broader energy grid system, smart meters are a central component of advanced metering infrastructure (AMI) and are supposed to deliver regulatory and financial incentives for energy consumers. However, smart meters and the smart grid, reliant on two sets of technologies, open the system to surveillance.

The first set of technologies includes the infrastructure of digital ICT, enabling two-way communication between an electrical meter installed outside the house and the electrical utility company. As explained in the IEEE magazine, *Power & Energy*, the

> difference between information gathering and information networking serves to reemphasize an established fact: though remote access to information and control inputs may be obtained easily and inexpensively via networking, access does not provide useful information without installation of potentially expensive and intrusive sensor array. (Laughman, Lee, Cox, Shaw, Leeb, Norford, & Armstrong, 2003, p. 56)

The second set communicates data on the network. The smart meter, monitoring and collecting energy load data from households, makes non-intrusive[6] appliance load monitoring (NIALM) possible. NIALM is the process of analyzing the measurements of the current and voltage of a household's total electrical load to determine the usage signatures of different appliances. Applying this analysis method, a load-monitoring device such as a smart meter could determine, for example, when a computer or even a light bulb is turned on or off, and distinguishes between the on and off states of the two devices simultaneously (Hart, 1992; Hart, Kern Jr., & Schweppe, 1989).

The installation of smart meters by energy utility companies forms a large sensor array that measures the time-of-day energy consumption of millions of households. The intrusiveness of the sensor array lies not just in the ability of smart meters to measure energy consumption, but also in its ability to determine the number, types, operation length, and time-of-day uses of devices in any smart meter equipped household through NIALM (Nelson, 2008; Zeifman & Roth, 2011). The smart meter acts as single sensor at the electricity service point (Zeifman & Roth, 2011). Using smart meters as a sensor array, communicating the information to the electrical utility, and applying NIALM algorithms, the electrical utility has the technical capacity to determine when devices are being used in any household that it services (Nelson, 2008; Nelson & Berrisford, 2010). Additional data may be inferred from energy usage, as illustrated in our initial epigraph.

Smart grid deployment

American federal legislation has supported and initiated a massive research and development effort into modernizing electricity infrastructure in the United States (U.S. DOE, 2012). In October 2009, speaking to the Smart Grid initiatives, President Obama spoke of its necessity in terms of laying "a foundation for lasting growth and prosperity" (U.S. DOE, 2014). In the same year, President Obama and Prime Minister Harper formed the Canada-U.S. Clean Energy Dialogue (CED) in efforts to increase awareness of smart grids, collaborate on smart grid R&D, and share smart grid knowledge among a host of other technologically oriented energy initiatives. Environment Canada and Natural Resources Canada led the CED for Canada, and the U.S. Department of Energy (DOE) led the CED for the United States. The prominence of smart grids is obvious not only for CED, but for the energy sector as a whole. The DOE claims that the upgrade to the smart grid is necessary for a twenty-first century economy and will

> increase the reliability, efficiency, and security of the country's electrical system; encourage consumers to manage their electricity use; reduce greenhouse gas emissions; and allow the integration of all clean energy sources and electric vehicles into the grid of tomorrow. (U.S. DOE, 2014)

As a result of this active federal campaign for smart grid technology, a new market sector has been nurtured, developed, and transferred to private industry that is merging ICT with energy systems. Funding in the U.S. comes from the Smart Grid Investment Grant Program (SGIGP) as a part of the American Recovery and Reinvestment Act of 2009. As of March 2012, SGIGP had reported that the U.S.$2.9 billion spent on projects had yielded a total economic output of U.S.$6.8 billion, producing some 47,000 jobs in the high tech, industrial and service businesses (usually involved in smart grid projects) with "higher than average labor income" (US DOE, 2012). This stimulated market sector has led to a flood of private investments in research and development, a speculative market for new products and energy infrastructure, and a growing marketing agenda pushing "green energy" and "smart" solutions for nearly every problem.

Similarly in British Columbia, Canada's 2010 Clean Energy Act has claimed to set "the foundation for a new future of electricity self-sufficiency, job creation and reduced greenhouse gas emissions, powered by unprecedented investments in clean, renewable energy across the province" (BC Hydro, 2010, paragraph 1). Under the province's then premier, Gordon Campbell, this act had specific provisions and regulations for smart meters and grids (BC Hydro, 2010). However, it also had promulgated a discourse of technological determinism, suggesting that the smart meters and the associated policy

> will allow ratepayers to better manage their electricity use and save on power bills by taking advantage of new electricity pricing programs aimed at encouraging conservation and smart use of electricity during off-peak periods. (BC Hydro, 2010, paragraph 23)

Canada's then Minister of Natural Resources, Christian Paradis, spoke to the less than two-year-old CED at a policy leadership conference in January 2011. Paradis rationalized smart grid deployment technologies to a crowd of industry insiders, stating:

> [d]eveloping and expanding smart grid technologies will lead to green jobs, put more renewable energy into the system, help consumers reduce their consumption, and also help to address climate change. (Paradis, 2011, paragraph 9)

The CED selected participants to form working groups to create a new action plan for collaboration across both countries. When the action plan was released in 2012, smart grid technologies were an important aspect. The workgroup identified "exchange information about consumer awareness and receptivity to smart grid and time-of-use pricing by building on experiences in Ontario and the U.S. Smart Grid Consumer Collective" (Canada-U.S. Clean Energy Dialogue, 2012, p. 10).

Smart meters and demand management

Current developments focused on smart meters are relatively conservative, focusing on the same sorts of demand-side management (DSM) approaches that were being implemented in the 1980s. Smart meters can track electricity consumption of individual households on a semi-hourly basis, allowing time-of-use pricing and targeted marketing to "encourage" consumers to use electricity at times when it is less expensive for utilities to produce, or periods of low demand that do not necessitate purchasing electricity from other utilities or bringing online "peaking" or back-up power plants. Utilities have pursued DSM strategies largely because it allows them to defer investments in new sources of electricity generation, including renewables or other "clean" energy sources. Furthermore, regulatory agencies like public utility commissions have allowed utilities to recover the costs of investing in smart meters on the grounds that they can save consumers money in the near term, and as such, have made plans and projections that include energy conservation and efficiency as a resource on the supply side (Behr, 2011; EPRI, 2011).

BC Hydro, a publicly owned electric utility, which generates and distributes electricity to approximately 1.8 million consumers in British Columbia, set a goal in their *Integrated Resource Plan* to meet "at least 66 percent of the expected increase in demand through conservation and efficiency by 2020" (BC Hydro, 2013, p. 3). The pivotal role of AMI technologies and DSM behavioural modification are crucial to the success of these goals. Toward this objective, BC Hydro began deploying smart meters. Itron and Cisco were awarded a contract in April 2011 to execute the deployment of nearly 2 million smart meters, the smart grid architecture, and the software and platforms needed for gathering, storing, communicating and analyzing data (Tweed, 2011). The data collected cannot be shared or sold, in compliance with Canada's *Freedom of Information and Protection of Privacy Act* (FIPPA). Under FIPPA, energy use is considered personal information. The data is used by BC Hydro to develop psychographic energy market segments based on electricity consumption behaviour. These segmentations are used to develop targeted marketing and advertising based on energy market segments for DSM. Traditional forms of segmentation involve collecting information about a subset of customers through surveys, then extrapolating the data to an entire customer base. The energy market segments developed from surveilling large numbers of smart meter users allows for BC Hydro to fine-tune their energy market segments (Pedersen, 2008). The more data, the more nuanced the energy market segments can

be, and thus better DSM results from targeted marketing messages or energy efficiency programs could be achieved. While BC Hydro smart meters already collect information more regularly than the electricity meters they replaced, far more nuanced energy market segments are technically possible with the use of these meters. With near-instant meter measurements, detailed psychographic energy consumption segmentations can be developed to promote highly targeted DSM-based customer segments to generate surplus value (by virtue of corporate savings created by consumer/producer attention and behaviour modification) without violating FIPPA.

The BC Hydro load management research group is exercising the smart meter's existing technical capacity to capture data by the minute (Nelson, 2008) and using load monitoring to monitor individual appliance usage (Nelson & Berrisford, 2010). The potential for cost savings through improved market segmentation and the associated switch from monthly meter readings to readings communicated to the utility by the minute through digital ICT represents a significant opportunity for value production. Consumer energy use data in minute increments improves the capacity to generate detailed consumer segments and to implement time of day (even sub-hourly) pricing schemes. Recently, BC Hydro contracted multinational management consulting and technology services company Accenture, a company with close contractual ties to the U.S. Department of Homeland Security and its Office of Biometric Identity Management,[7] to analyze the massive amounts of data collected through load management research toward the development of better energy market segments.

Smart pricing: Toward instantaneous time-of-use pricing and subject formation

The market for smart meters has recently flattened as smart grid demonstration projects come to an end and markets mature, and now AMI vendors are seeking new revenue streams with data analytics that promises an "attractive opportunity" based on its scalable, recurring revenue-based model. Smart meters, as a preliminary and important component of AMI, enable data collection and collation for analytics. The cumulative global smart grid market expenditure is expected to surpass U.S.$400 billion, with U.S.$73 billion in revenues, by 2020 (Groarke, Pollack, & Kellison, 2013; Navigant Research, 2014), attracting the attention of many of the largest technology firms.

The smart grid relies on a network of actors working to implement a system of "transactive" energy, what the manager of electricity infrastructure for the Pacific Northwest National Laboratory describes as "a means of using economic signals or incentives to engage all the intelligent devices in the power grid – from the consumer to the transmission system – to get a more optimal allocation of resources and engage demand in ways we haven't been able to before" (Kennedy, 2013, paragraph 1). Transactive energy is driven by the idea of "energy value," treated as a commodified market value. The smart grid allows—with distributed generation, load management, and ancillary services—for dynamic pricing, based on time of use, and automated demand response, enabled by digital transformations of the grid and home for control by utilities or to allow consumers to make energy-use decisions based on price signals. This transactive relationship highlights an envisioned transition to an über-liberalized

electricity market wherein consumers have "choice" and receive price signals through time-of-use pricing.

Smart metering is central to making this market landscape possible. The collection of energy use data, and the sequestered behavioural information, is absolutely essential to realizing this transformation. This means

> [n]o more per kWh pricing based on what the public utilities commission will give you. Instead, it's all about what it costs to make, what it costs to 'ship' and what the market will demand. And, yes, that will take massive analytical thinking to juggle by the minute. (Davis, 2013, paragraph 4)

But the market is not truly free, and thus the benefits of such a system will be unevenly distributed. Utilities are "natural" monopolies, and as such, government economic regulation has been instituted for maintaining what its decision-makers determine are fair prices and universal access to electrical service. This regulatory compact between government and utilities, private or publicly owned, has historically shifted between more neoliberal, market-oriented relationships that favour corporate accumulation and the more social liberal government regulatory approach that favours redistribution (Hess, 2011). Electricity markets are highly regulated, but implementation of smart grid technologies that enable tracking, sorting, storing and analysis of data, which could make transactive energy a reality, ultimately has to enable a "free market" to make this system possible.

Smart intrusion: Opening homes to government and corporate surveillance

Not only does the "smartening" of the grid entail greater consumption data collection for analytic capabilities and profit-making activities, it also enables deeper surveillance of home life and its everyday activities. This invokes concern about whether the anonymous observation of mundane (vacuum cleaning), personal (what time one sleeps), or even intimate activities (heating a waterbed) porously violates rights of privacy. In most cases, a private corporation that records personal data about the household, such as landline telephone calling or electrical usage, would not fall under the purview of the U.S. Fourth Amendment or Section 8 of the Canadian Charter of Rights and Freedoms. However, if the state were involved, directly or indirectly, such as in the way that computer search engines record and share data on personal computer usage in conjunction with the federal government, it would be a different matter. And given the enormous and egregious liberties that the National Security Agency has in fact taken in gathering data on citizen telephone, email, and website usage, there is little reason to doubt that federal authorities are already doing the same thing on a massive scale with regard to household electrical usage. For example, Google, which has provided data to the NSA on search engine usage, is itself, especially since the purchase of Nest, a supplier of home security devices.

It is a matter of record that utility companies are already sharing personal data gleaned from smart metering with state agencies. In California, the utility companies "disclosed the energy-use records and other personal information of thousands of customers" to government agencies, in some cases to track down individuals. According

to a consumer health watchdog group, EMF [electromotive force] Safety Network: "If someone analyzes the data coming from smart meters, they can tell when you're home, when you're cooking a meal, when you're watching TV" (Baker, 2013, paragraph 15). When the government seeks access to one's personal data through a third party, in this case electric utility companies, in the United States, the Fourth Amendment and recent legal jurisprudence on the matter have afforded little protection. One legal analysis finds that

> the continued conclusion that personal information contained in third party business records is outside the Fourth Amendment is poised to obliterate what the Supreme Court has identified as the 'firm line [the Fourth Amendment draws] at the entrance to the house.' (Lerner & Mulligan, 2008, paragraph 9, brackets in original)

Insofar as private companies can secure information on one's electrical usage, such usage effectively becomes a form of communication, of unintended speech. If corporate intrusion on household electrical usage obliterates the Fourth Amendment, it might also be construed as obliterating the First Amendment, inasmuch as the Bill of Rights not only guarantees the right to speak, but also, as the Supreme Court has ruled, the (negative) right not to speak. There is a reasonable expectation that one is secure in the home. It would be difficult to defend that assumption when an outside party has free access to what goes on inside the home. Under a regime of expanded accumulation, the inviolability of home life is further compromised.

It is not merely the specific uses of electricity that one is entitled to keep private. Home electrical use is merely the consumptive practice of everyday life. What is more invasive about smart panoptic metering is the mode of networked regulation that a corporate entity, backed by a corporate state, seeks to impose upon the habits of the people—a future not only without privacy, but with radically reduced freedom of thought and action. In the long term, smart metering, and the innovations that are likely to be built upon it, with ever-greater capacities to examine behavioural microdata, represents an assault upon individual, and in its collectivity, social, cultural, and political identity. Data deposits are a source of value, economic and political, with which electric utilities, in conjunction with the state, can profit financially (reducing costs, increasing pricing), culturally (normalizing habits of consumption), and politically (social control).

As a commodity, electricity is unlike most others. It is essentially invisible, electrons flowing through grid networks to power refrigerators, washing machines, air conditioners, and, perhaps, a lighting source for indoor marijuana growing. Consuming electricity is thus lodged within the social and cultural practices of everyday life. It is the activity and outcomes associated with energy use—things like comfort, computing, and entertainment, not electricity consumption itself, that one desires. The social and cultural politics of consumption are part of the routine practices that are then negotiated, restrained, and structured by social and political economic relations of power. This understanding complicates the seemingly simple relationship between electricity users and providers.

Smart meters enable more precise and dynamic options in DSM strategy for potential energy conservation through externally directed/internally assigned behav-

ioural change. The communication of electricity consumption information is designed to encourage social practices that are altered in response to constructed economic stimuli corresponding to energy prices signals or through normative messaging (for example, emoticons on energy bills). As such, everyday life is inundated by market logic and imperatives—a rational calculus for imagined self-government akin to making business decisions. This shift is accompanied by a structural change in electricity infrastructure that creates market opportunities for production and implementation of the suite of smart grid digital technologies (such as smart meters), data collection, and analytics (Faruqui et al., 2010). Data analytics, in turn, presupposes collection of large amounts of data enabled by smart grid infrastructures and, further, is fuelled by inducements toward energy savings through shifts in everyday energy consumption habits.

Homo consumo: Discipline and punish

With the smart grid, electrical and human energy are merged and converted into commodified units of data with which utilities—and potentially the state—actualize a deeper opening and intrusion of households toward the instrumental interests of economic, social, cultural, and increasingly political control. These acts of intervention are undertaken in the name of efficiency, environmental sustainability, and household cost savings. Internalization of the rules of the smart grid (*pace* Gramsci) instills a market-oriented discipline in its consumers, reinforcing neoliberal subjectivities, which David Harvey (2005) sees as practices and modes of thought "incorporated into the common-sense way many of us interpret, live in, and understand the world" (p. 3). Consumer energy savings associated with smart meter technology is premised on behavioural change associated with "rational-economic-actors." The main benefits, which are played down in industry promotions for infrastructural change, namely the utility's cost-effective efficiencies and profit maximization, are not for the most part employed for the benefit of the consumer (except possibly through improved reliability of supply). The ability to better determine one's energy use, receive price signals through dynamic pricing and other economic incentives are set up by digital smart meter technology to inspire energy consumers to use less energy (or at least use less at peak periods). Consumers may save money from reduced electricity usage during peak demand; however, the savings from DSM will not necessarily be passed down to them. Moreover, most people do not conform to the market definition of "rational economic actors." Thus surveillance of energy consumption habits, we argue, acts as a mode of disciplinary power that punishes, financially and socially, through norms set up outside the public sphere.[8]

As a hierarchical policy-making project, smart energy systems are enjoined with ICT metering and massive amounts of data garnered by energy utility companies to generate added revenue streams. At the heart of these new revenue sources is the use of a communication and feedback loop developed through "big data" analytical methods to create predictive capacities with the use of aggregated data. Data analytic companies see a major profit potential of smart energy metering systems; one such company claims "significant financial rewards to companies that successfully glean predictive insight from their data" (SAS, 2012, p. 1). Each computerized device on the network has sensors to collect energy consumption data, recording every individual

time/use on the system, which enables a deeper panoptic oversight and functional integration of *specific* end users and their data profiles by the energy company (and anyone else with whom they share the data, intentionally or otherwise).

Second, "dataveillance," through big data analytics, can be used to segment customers based on usage patterns, socio-demographic data, dwelling data, or data inferred through the combination of various data sources aimed at strategic reduction of energy consumption at particular times of day. The data gathered by virtue of identity appropriation and recoding can also be sold to and used by data firms for granular and targeted marketing and advertising and, ultimately, lead to expanded, not reduced, energy use, defying claims that the smart grid is a positive response to the global warming crisis. The process of smart surveillance also enables the expansion of unpaid "prosumer" activity (consumption that in the market is in some way also productive, as in supermarket self-checkout), which in this case means the valorization of consumers' identity data (given as free, albeit abstract, immaterial labour or "identity labour") and thus their uncompensated contribution to market surplus value. And third, energy surveillance technology may also serve the interests of the state in the collection of data for deeper profiling of particular targets or for the utilities conferred by metadata analysis for social regulation and political control. The exposés of the NSA's massive surveillance of Americans' household Internet and telephone use as well as its wholesale violations of Constitutional privacy protections are highly instructive in this regard.

The smart grid fuels an exploitative and more alienating relationship in the realm of social reproduction wherein value is created in the quotidian use of energy and extracted in the accumulation of data and subsequent analysis that is not only "free," but also gained through a service consumers are charged for, electricity. This disciplining, prosumer, panoptic, hegemonic relationship is made possible by digital technology transformations of the grid and its surveillant capacities of sensing and metering, essentially creating a commodity from everyday life activities of energy consumption. This relationship between surveillance, production, and consumption speaks to the inherent bias of technology and the fetishized electrical use value in the home. It also suggests that technical solutions to demand-side management assume a specific role and behaviour for consumers as market-oriented rational, self-interested, knowledgeable, and economically calculative actors, that is to say, reconstituted "smart" neoliberal subjects.

Notes

1. We use marxism, marxian, marxist, etc. in lower case to assert that these terms are assimilated in the language as much as capitalism, socialism, communism, etc.

2. Big data processors including famous companies such as IBM and smaller start-ups like Sqrrl, a database "for private enterprises that relies on technology created by the National Security Agency" (Blattberg, 2013, paragraph 6).

3. The advent of the computer as a productive instrument of everyday life in virtual time and space leads to a breakdown in the traditional distinction between producer and consumer, particularly with respect to immaterial commodities (e.g., knowledge, information, design); hence, the consumer simultaneously may be a co-producer in providing data from which exchange value can be harvested. The consumer-as-labour is now an established, though controversial, point of debate, drawing on the seminal work of Dallas Smythe (2006). Huws (2003) discusses this in terms of the transfer of "self-service" labour to consumers, who take on unpaid tasks, such as using an ATM machine, previously as-

signed to paid workers (tellers), who are then eliminated.

4. The electrical grid is fetishized as simply a service for operating households and other built structures, hiding a broad range of social relationships that procure its provision, including the widespread use of violence in securing the sites of fossil fuel extraction.

5. About half of American homes are on equalized billing programs to avoid high payments during spike use periods (such as summer air conditioning) and thereby cannot adjust their energy use to "real time pricing"—the energy companies' strategy for pricing energy use differentially during peak periods and other times of the day.

6. "Non-intrusive" here means that sensors are not part of each electrical device in the household—instead, the sensor is on the outside of the house.

7. "Since the smart grid is both a commercial asset and a national security target, robust security is critical to prevent disgruntled employees, foreign agents, and others from compromising the grid" (Accenture, 2014).

8. Smart grids may punish household members in other ways, including suffering the effects of thousands of pulsed microwave transmissions and radiation that emanate from the meters (del Sol, 2013).

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