Smart Meters and Public Acceptance: Comparative Analysis and Governance Implications

Citation: Hess, David J. 2014. Smart Meters and Public Acceptance: Comparative Analysis and Governance Implications. *Health, Risk, and Society* 16(3): 243-258.

Abstract

Although smart meters for electricity have received widespread acclaim as a means to achieve more resilient and sustainable electricity consumption, public opposition has emerged in several countries. In this article I examine the reasons for public opposition in North America and the role of concern with health risks. The article provides an analysis of reasons given for opposing smart-meters by 75 US and Canadian organisations listed in the 2013 EMF Safety Network, a review of all news reports (499) in the Lexis-Nexis database relating to smart meters in seven US states and one Canadian province from 2010-2013, and case studies of policy responses in the same seven states and province. Thirty-one of the organisations in the EMF network focused mainly on health concerns about EMF, and 44 organisations identified broader as well as health risks. The more politically conservative groups focused on issues

relating to privacy and government intrusion. Newspaper reports also identified health risks although they also identified issues relating to cost over-runs and privacy. The study of newspaper reporting in the seven US states and one Canadian province indicated that relevant agencies had responded to public concerns by developing opt-out provisions for meter installation, in some cases after protracted public campaigns. I consider possible patterns of opposition for future investigation: opposition may be higher where the roll-out of smart meters is rapid and without an opt-out provision; technological differences (for example wired versus wireless) may contribute to levels of public opposition; and challengers to incumbent parties of either the right or left may also contribute to public opposition. In the conclusion I compare two policy strategies, one of which views public opposition as a lack of good communication from utilities and the other of which views it as an opportunity for innovation in systems design and improvements in governance policies.

Keywords: smart meters, health, social movement, public understanding, risk

Introduction

As an important element of the smart grid, the smart meter enables communication between the electricity grid and appliances in a building. Notwithstanding the many potential benefits, the roll-out of smart-meter programmes created public opposition that often centers on health risks. The opposition is linked to other forms of public opposition to risks associated with other electromagnetic fields, such as those associated with mobile phone masts and high-voltage electrical wires. However, there are also significant differences because opponents of smart meters cite concerns about privacy, security, and home utility costs that do not appear in public opposition to other forms of ‘electrosmog’. Thus, an analysis of public opposition to smart meters can provide new insights into research on health, electromagnetic risks, and the public understanding of risks and reception of new technologies.

In this article I will present the first general comparative analysis of public opposition to smart meters in North America, the region of the world where opposition has been most developed to date. Smart meters and the smart grid offer many important sustainability benefits (such as time-of-day pricing and the capacity of the utility to turn off appliances during peak load), but as smart meter installations have spread, so has public opposition. In this article I examine the relationship between health risks and other kinds of risks and concerns that have emerged in public opposition to smart meters in North America, and I examine the response of agencies to public opposition. In this article I will focus on two key issues:

- The primary reasons given for opposition by anti-smart meter organisations in North America;

- The policy responses that have emerged at the state and provincial level.

After considering these issues, I will develop hypotheses about the conditions under which opposition emerges and discuss possible implications of public opposition for the design and governance of the smart grid.

Context: public opposition to smart-meters

Public opposition to smart-meter technology is complicated from the perspective of studies of health, risk, and society, because health risks are frequently linked to other risks and public concerns, especially those associated with privacy and security. Because smart-meter technology was installed in some locations before privacy and security rules were completely developed, regulatory agencies have had to play catch up to the numerous issues that have emerged (see National Institute for Standards 2010, Trans-Atlantic Consumer Dialogue 2011). There is pervasive anger at being forced to accept devices that can report on activities by appliance in a household and can lead to 'Big Brother' knowledge about what people are doing in their homes. When sampling of household-level consumption occurs at short intervals, such as every fifteen minutes, it possible to detect when people are at home and what appliances they are using. The knowledge raises new issues of domestic privacy that have not been evident in other health controversies involving electromagnetic fields, such as the installation of mobile phone masts or high-voltage electrical wires. In 2010 the State of California approved the first state-government privacy standards (SB 1476), which provided for an opt-in rule for sharing of consumption information with commercial third-parties (Forbush 2011). The Province of Ontario also developed a privacy guidance policy

(Ontario Information and Privacy Commissioner 2012). The broader issue of the smart grid also raises general political issues such as the level of centralisation or decentralisation of the energy system (Stephens et al. 2013).

The level of public concern with smart meters is variable, and it ranges from scepticism about benefits to mobilised opposition, such as demonstrations at the National Grid Week conference in 2012. For the U.S., a survey of the country as a whole indicated that people supported the claimed benefits of smart meters but were often sceptical that they would see the benefits (Lineweber 2011). The survey also showed that most customers had reservations about costs and privacy (questions about health were not included), that support was higher among Democrats with pro-environmental views, and that about 20 percent of customers were strongly opposed to installation. The high level of scepticism about the actual delivery of promises and the segment of strongly opposed customers suggest that conditions are ripe for mobilisation when installation is mandatory. The only systematic research to date on the reasons for opposition that includes health concerns is limited to California, where health concerns were the primary reason for public opposition in an analysis of several datasets of public commentary (Coley and Hess 2013). Other issues were also raised in the following order: privacy, accuracy (resulting in price spikes), security (capacity for thieves to known when people are home), transmission (interference with other household electronics), environment (criticisms of actual effects on carbon reduction), and hazards (fires).

One source of opposition to smart meters is people who self-identify as electrosensitives or as otherwise harmed by ‘electro-smog’ (de Graef and Bröer 2012,

Lezaun and Soneryd 2007, Soneryd 2007). However, opponents of smart meters in the U.S. and Canada include many persons who do not self-identify as electrosensitives and who argue that their health concerns are scientifically based (Coley and Hess 2013). Opponents sometimes point to the general research on health and non-thermal effects for non-ionising electromagnetic fields, especially research on mobile phones (see for example Maine Coalition to Stop Smart Meters 2013b). There are also experts with appropriate credentials who document non-thermal risks of microwave radiation (BioInitiative Working Group *et al.* 2012), and there are signs that consensus scientific advisory bodies are recognising some non-thermal risks for low-dose microwaves from mobile phones (International Agency for Research on Cancer 2011). However, many scientists, including but not limited to those who represent industry, also note that there is research on the relative safety of electromagnetic fields at non-thermal doses. Thus, the expertise on health risks for the non-thermal effects of microwave radiation remains sharply divided, and the public mobilisations are supported by some researchers who think that there is enough potential documented risk from microwave radiation to warrant a more precautionary regulatory approach (BioInitiative Working Group et al. 2012).

There is widespread industry scepticism of public expressions of concern with health risks for smart meters. Industry research has found opposition rates of only 10 percent and has indicated that opposition is due to lack of knowledge (General Electric 2010). Thus, from an industry perspective the problem is the lack of public knowledge and a public misunderstanding of science. To some extent, the social science literature on electromagnetic fields also has been fairly sceptical of the scientific basis of health

concerns (see for example Burgess 2002, 2003). Social scientists have pointed to the lack of technical knowledge among the public, and some have suggested that media coverage may over-emphasise health risks (Classen *et al.* 2012, Cousin and Siegrist 2010, Elvers *et al.* 2012). Social scientists who work from this approach may explain public discourses of health risks as outcomes of other social factors, such as lack of political power, media sensationalism, and/or poor understanding of science.

The theory of 'phantom risk' can lead to interesting research questions about how social factors (such as misunderstanding of science and power inequalities) affect risk discourse, but the attempt to explain public expressions of health risk as due to other factors can be dismissive of the health risks in a way that is isomorphic with the dismissive approach taken by industry. In contrast to 'phantom risk' approaches, which assume that public concerns with health risks have no scientific basis, in this article I do not adopt a position on the scientific controversy about the health effects of non-thermal electromagnetic fields, and I do not attempt to evaluate public concerns as either well-founded or ill-founded with respect to the science. Rather, I treat health concerns as Durkheimian 'social facts' that have social and political effects. This approach recognises that public concerns with smart meters are in some cases connected with more general public opposition to having their communities or homes forcibly accept technologies without local consent and without a democratic decision-making process (Drake 2006, 2011). However, this approach does not reduce health concerns to differentials in political power. Rather, it seeks to understand the pattern of bundling of health concerns with other concerns, and it seeks to understand the political effects of these bundles of concerns. In contrast with approaches that wish to explain away public

discourse on health risks as due to other social factors, this more comprehensive approach to public understandings of electromagnetic fields and health risks can provide insights that might not otherwise be visible. Specifically, in the discussion and conclusion sections I will draw attention to technological design choices that are related to the health concerns. These design issues are relatively invisible in a phantom risk approach, which seeks explanatory factors only in the social world

Methodology

This article draws on two related analyses. The first analysis provides data on the reasons given for opposition to smart meters. It begins with the EMF Safety Network's (2013) listing of anti-smart-meter organisations and information sites, which included 87 entries for American states and Canadian provinces. All of the entries were reviewed and coded for the reasons given in opposition to smart meters and for political orientation. I also reviewed the Lexis-Nexis database using the search terms 'smart meter and (state/province)' for seven U.S. states and for British Columbia. There was no starting time limit, but most reports began in 2010, so the analysis effectively covered the four-year period from 2010 through late 2013. This search strategy resulted in a dataset of 499 articles (British Columbia 96, California 215, Maine 68, Maryland 19, Michigan 32, Nevada 34, Oregon 15, and Vermont 20). I made the following exclusions: duplicate content, no discussion of public concern or opposition, and no specific discussion of the state or province in question (such as a general article that only mentions the state briefly). These criteria reduced the dataset to 120 articles, which were coded based on the reasons for opposition: cost, fire hazard, health, privacy,

security (theft, terrorism), and other. The category of ‘other’ included one statement about the non-green conditions of smart-metering manufacturing and three statements about transmission interference with wireless routers in homes.

To examine policy responses to public opposition, in the second analysis I undertook brief case studies to explore the sources and reasons for public opposition and the policy decisions for the seven states that have passed legislation or have public utility commission decisions that support opt-out policies (California, Maine, Maryland, Michigan, Oregon, Nevada, and Vermont). I also considered British Columbia because it has the most active anti-smart-meter movement in Canada, and the provincial utility allowed an opt-out provision after a long public mobilisation. Opt-out rules were under consideration in other states by late 2013 (Florida, Hawaii, Georgia, Illinois, Indiana, Louisiana, Massachusetts, New York, and Pennsylvania), but information is much more sparse on those states, and analysis of those states and additional Canadian provinces is not undertaken in this article. I do not consider in this article action by attorneys general who have made statements against or taken actions against smart meters, generally based on the likelihood of excessive cost (Arizona, Connecticut, Illinois, and Michigan).

In this article I take a comparative approach, which provides a context in which more detailed and localised studies might be situated. This approach can also help avoid a tendency toward premature generalisation that is beginning to emerge, such as arguments that opposition is based only on right wing ‘Tea Party’ organisations.

Findings

Reasons for opposition

The EMF Safety Network provided links to 87 web sites that expressed anti-smart meter sentiment. Of those sites, 12 were not counted because they provided incomplete information or were not functioning. The remaining web sites were maintained by individuals, formal nonprofit organisations, community-based networks, and state-level coalitions. Of the 75 websites that provided reasons for opposition, only 31 cited health as the only or primary reason for opposition, and 44 websites provided more comprehensive list (including health). The health emphasis tended to be found in sites developed by persons who had experienced health effects and then became opponents of smart-meters and by organisations that were concerned with general issues of electromagnetic field safety for a wide range of devices (such as mobile phones and mobile phone masts). More comprehensive discussions of reasons for opposition tended to be found in the state-level anti-smart-meter coalition organisations, in community coalitions, and in right-wing organisations. The lists of reasons for opposition other than health nearly always included privacy, and they often included cost, safety (especially fire risk), and security.

In the U.S., researchers have become aware that anti-smart-meter sentiment has been especially strong among some right-wing groups, but in this data set the characterisation only applied to seven organisations. Opposition to smart meters predates the development of the ‘Tea Party’ movement, but the issue has been embraced by right-wing pundits and local Tea Party groups. In the seven cases, the websites focussed on privacy and government intrusion issues and were often critical of Local Agenda 21 (the United Nations effort to build sustainability at the local level) and

of alleged government plans to spy on individuals. These seven groups were active in California, Illinois, Michigan, Nevada, and Oklahoma, and they were particularly active in Texas, where opt-out legislation was being considered in the state legislature (Jeffrey 2013, Wilder 2012). In Texas Thelma Taormina, founder of the Houston-based *We the People Are the 912 Association*, gained fame in Tea Party circles when she used a gun to stop a smart meter installer from entering her property (Hooks 2013). In the town of Fountain, Texas, opponents gained enough signatures to place on the ballot a measure that would require replacement of the new digital meters with old analogue meters, citing the need to stop spying by Big Brother (Best 2013).

My analysis of newspaper reporting in the seven US states and British Columbia showed that in media reports of public opposition health concerns were paramount, a finding that is consistent with other research for California (see Coley and Hess 2013). However, in some reports, especially longer articles, issues of privacy, cost, and security issues were also important. The primacy of health concerns in media reports was not limited to California but was found in all states and provinces. When the reports in the other US states are aggregated (see Table1), the state with the largest number of reports (Maine) had twice as many mentions of health concerns than privacy, the second largest factor. Newspaper coverage tended to include cost over-runs issues at the start of a programme of smart-meter installations, whereas there was more reporting of health concerns after the meters were installed.

Table 1 Reasons for Public Concern in News Reports*

Public Concern	British Columbia	California	Other States
Number of articles	49	37	34
Cost (over-runs, accuracy)	16 (33 per cent)	15 (41 per cent)	8 (24 per cent)
Fire hazard	3 (6 per cent)	1 (3 per cent)	3 (9 per cent)
Health	37 (76 per cent)	31 (84 per cent)	26 (76 per cent)
Privacy	11 (22 per cent)	11 (30 per cent)	16 (47 per cent)
Security (theft)	3 (6 cent)	3 (8 per cent)	6 (18per cent)
Other	1 (2 per cent)	0	3 (9 per cent)

*Percentages are the number of articles mentioning the concern divided by the total for the regional category (e.g., 16/49 for cost for British Columbia). Because some articles identify more than one issue, the percentages total to more than 100.

Case studies: pattern of opposition and policy responses

In this section I examine in more detail the pattern of opposition and policy responses in the seven US states and British Columbia. In most of the states and the province, organisations that opposed smart meters focused on health risks, but some statewide organisations also had a comprehensive approach of listing a wide range of reasons for opposition. Right-wing groups in two states focused on privacy and government intrusion, and a business organisation in one state focused on cost concerns.

In three cases, there was an initial phase of local government resolutions against mandatory installation that preceded a policy response at the state or provincial level. In all cases discussed below, there was a policy response that enabled customers to opt

out of mandatory smart-meter installations. The response came from the utility (British Columbia, Michigan), state government legislation (Vermont), or the public utilities commission (other states). In Vermont the opt-out arrangement also includes a no-fee clause.

In each of the states and the province there was a different pattern of events, with different types of opposition and different policy responses, and in the remainder of this section I will discuss each in turn.

In *British Columbia*, the provincial government adopted a rapid installation approach, setting a deadline of 2012 for the installation of smart meters, and the energy utility responsible for the installation did not allow an opt-out provision. These decisions stimulated a strong opposition movement. The province's Coalition to Stop Smart Meters (2013) provides multiple reasons for opposition, including (in alphabetical order) cost, democracy, environment, health, loss of jobs, privacy, safety, and security. The other four main anti-smart meter organisations active in British Columbia focussed on health issues, but one also included concerns with privacy and fire hazards. On the issue of fire hazards, there were some media reports of fires associated with smart meter installations, but experts argued that other faulty wiring issues were to blame (McInnes 2012, Simpson 2012b).

Public opposition in British Columbia was linked to provincial party politics, because the roll-out of smart meters was supported by the governing Liberal Party (the right-wing or neoliberal party). The government's decision not to let the British Columbia Public Utilities Commission review and oversee the project fuelled public opposition and anger. Opponents locked their meters and posted signs, and BC Hydro responded by

sending out letters telling the opponents that the utility would break the barriers and would install the meters. In turn, the letters provoked widespread public outrage. John Horgan of the opposing party, the New Democratic Party, stated that if his party were to gain power, he would ask the province's public utilities commission to take over the programme (McInnes 2013, Shaw 2013).

The opposition group Citizens for Safe Technology Society appeared before the British Columbia Human Rights Tribunal to link health concerns to human rights violations by arguing that the installation of wireless smart meters violated the rights of electrosensitives. The Tribunal responded to this argument by telling the group it should narrow its claim to people medically diagnosed with electrosensitivity who have been advised by their physicians to avoid wireless technology (Simpson 2012a). The British Columbia Office of the Information and Privacy Commissioner (2011) also investigated BC Hydro, found some issues of noncompliance with privacy standards, and made some recommendations. The British Columbia Confederation of Parent Association Committees also entered into the debate in 2012 by issuing two related resolutions that reinforced general concerns with health and electromagnetic fields. Resolution 2012.17 requested that each Board of Education have one public school at each education level (including elementary, secondary) free of Wi-Fi, cordless phones, and mobile phones and that this school use only wired connections. The second resolution, 2012.18, called on Boards of Education to cease the installation of Wi-Fi in schools where it was technically feasible to do so (British Columbia Confederation of Parent Advisory Councils 2012).

In the absence of a response from the provincial government, opponents of smart meters in British Columbia turned to local resolutions by city governments. In 2011 the Union of BC Municipalities voted in favour of a moratorium on smart meters, but BC Hydro ignored the resolution. By 2013 59 municipalities had passed resolutions in favour of a moratorium or opt-out law (Citizens for Safe Technology 2012). The model ordinance cited 'the potential for wireless smart meters to cause harm or to compromise security', and it requested that the province institute 'a moratorium on mandatory installations of wireless meters' and that customers be offered 'safer alternatives at no cost to them' (Citizens for Safe Technology 2012). Thus, the wording of the resolutions clearly signaled a concern with health risks. In January, 2013, BC Hydro decided that it would not install the remaining 85,000 smart meters in its jurisdiction without permission of the homeowners. It had already installed 1.7 million smart meters, or about 95 per cent of the total planned installations, at a cost of approximately 1 billion Canadian dollars (CBC News 2013). The utility refused to remove smart meters from homes in which they were already installed, and in July, 2013, a yoga instructor with health concerns launched a lawsuit, inviting others to participate in class action against BC Hydro to force the removal of the smart meters they had installed in their properties (Luk 2013).

California As we have shown in California, health reasons feature in several datasets that record public opposition to smart meters (Coley and Hess 2013). The review of the EMF network for this article identified 18 anti-smart-meter organisations active in California, and in their websites 10 of these organisations identified health issues as the main reason for their opposition. The remaining 8 organisations provided

a wider range of reasons. Only one of the organisations in this group was clearly identifiable as politically right wing.

In California, the state's Public Utilities Commission did not respond quickly to public concerns, and the lack of response triggered local government responses from four counties, nine cities, and one tribal community, which resolved to make smart meters illegal within their jurisdictions. Other counties and over thirty other cities and towns developed resolutions to have the utilities stop the smart meter installations, and some also issued statements in favour of the state government bill that required an opt-out policy but failed to pass through committees in the state legislature. In 2012 the California Public Utilities Commission responded to public opposition by approving an opt-out provision that allowed customers to keep their analogue meters for an initial fee (75 US dollars) and an additional monthly fee (10 US dollars).

Although Californians gained the right to opt out, some customers experienced difficulties with the implementation of the opt-out provision. The Center for Electrosmog Prevention (2013) reported that customers were not allowed to read their own meters even though they had previously been allowed to read their meters, in some cases for more than 30 years. The centre reported that some customers had taken the entire day off work, and then no one from the utility had come to read their meter. Some customers also reported difficulty obtaining the opt out (ibid.).

In Maine the Smart Meter Safety Coalition focused on health effects, whereas the Maine Coalition to Stop Smart Meters (2013a) cited a range of issues including 'adverse health effects, fires in the home, damage to appliances, electrical problems, and increased utility bills'. In 2011 opponents appeared before the state's Public Utilities

Commission to challenge the utility's right to install smart meters; opponents made the argument that installation was a violation of their property rights. The commission determined that customers could opt out but that the utility could charge a fee. Customers appealed against the opt-out fee before the state's Supreme Court, which ruled in favour of the Commission but also instructed it to address health and safety concerns (McCarthy and Hansen 2012). After winning the right to opt out, opponents shifted their goal to gaining approval for a no-charge opt-out bill under consideration in the legislature in 2013 (Thistle 2013).

In Maryland there is only one major anti-smart-meter organisation, Maryland Smart Meter Awareness, and it called for a moratorium, or at the minimum an opt-out provision, until smart meters were proved to be safe and reliable. Its approach was comprehensive, based on concerns with health, privacy, national security, safety, rate increases, and effects on the planet's ecosystem. A retired attorney from the Environmental Protection Agency, Jonathan Libber, led the state's opposition campaign and gave it considerable credibility. The Maryland Public Utilities Commission ruled that customers should be allowed to have an alternative to standard smart meters. About 3 percent of the customers wrote to the utility to request deferral of the installation of a smart meter without charge. At the time of writing, a committee in the state government's House of Delegates was studying the issue for further action (Hopkins 2013).

In *Michigan* individuals who experienced health effects formed the Smart Education Network, whereas Tea Party members formed the W4AR, which focussed on privacy issues and government spying. There were other organisations opposing smart

meters for a variety of reasons including health. By mid-2012 nine local governments had approved a moratorium on smart meters and requested studies of health effects (Greene 2012). The Association of Businesses Advocating Tariff Equity were also critical of smart meters based on the grounds that they represented an unnecessary cost for electricity in a state that already had high rates (ibid.). In response to consumer and business opposition, the Michigan Public Services Commission (2012) conducted additional research and gathered public comments; its analysis of 397 comments listed the desire for an opt-out provision as the top issue expressed in the comments. The tally of objections raised showed that health concerns were paramount (77per cent of responses), followed by privacy (49 per cent), legality (27 per cent), and security (18 per cent), and cost (17 per cent). Based on recommendations in the report, the utility Detroit Edison responded in 2012 with a plan for an opt-out provision, but State Attorney General Bill Schuette argued that the fees were excessive (Biolchini 2013). The Smart Meter Network also appealed in the Michigan Court of Appeals against the decision by the state's public service commission to accept the opt-out fee plan (Freed 2013). In February, 2013, state legislator Tom McMillan (2013) introduced a bill that would eliminate opt-out fees and would limit the number of times a utility could read a meter each month.

In Nevada the right-wing Nevada Constitution Alliance (2013) opposed smart meters primarily on grounds of privacy and government intrusion, but it also listed health and other concerns. Two other organisations expressed health concerns as their main issue. In 2012 the Public Utilities Commission allowed customers to opt out with a digital, wired meter, but after a request from the Bureau of Consumer Protection, the

commission decided in 2013 to allow consumers to request a new, sealed analogue meter but with an opt-out fee (an initial 53 US dollar fee, plus 9 US dollar monthly fee). An estimated 9,000 customers out of 1.45 million are on the postponement list (Robison 2013).

In Oregon, a 100-member group formed the Families for Safe Meters to oppose smart-meter installations. In one article, they cited vulnerability to cyber-attack and health effects as their primary concerns (Dietz 2012). The state's public utilities commission required utilities to implement an opt-out provision, but opt-out fees were controversial. Portland General Electric had a monthly charge of 51 US dollars for the opt-out, but the city council of Ashland developed a no-charge policy for opt-out (City of Ashland 2013).

In *Vermont* three opposition organisations identified a range of concerns including privacy, security, health, cost, energy saving, and electrosensitivity. In 2012 the Vermont state government approved a law that allowed customers to opt out without incurring a charge (Vermont State Legislature 2012). In Vermont, the opt-out rate in 2013 was 4 per cent, whereas in Maine, where the opt-out fee is a 40 US dollars for the initial rate plus 12 dollars per month, the opt-out rate as of 2013 was 1 percent (Thistle 2013). In 2011 two of Vermont's rural electricity cooperatives chose wired technology over wireless, even as the state's larger utilities, which serve a higher percentage of urban customers, opted to use wireless technology. The cooperatives cited cost considerations rather than health issues. Because the cooperatives serve customers in hilly, rural terrain, wired technology was deemed more effective (Dillon 2011).

Discussion

In summary, the analysis of opposition to smart meters in North America reveals several new findings: opposition is not restricted to one geographical region such as the West Coast; concern with health risks are paramount, but other important concerns are frequently raised; frequently campaigns of opposition are protracted, and in some cases they can involve city-government ordinances in an attempt to gain a response at the state or provincial level; and in several cases the government, public utilities commission, or utility have responded with opt-out provisions. The rise of public opposition to smart meters is to date an understudied topic in the developing literature on the design and governance of smart grids, and at this point the literature can benefit from a discussion of implications and questions for future research. Four main implications for additional research emerge from this comparative analysis:

Implication 1: Public opposition is heightened where there is no opt-out provision, as in the cases of British Columbia, California, and Maine. The diffusion of opt-out rules to minimise public opposition suggests that institutional isomorphism dynamics (that is, the spread of opt-out responses due to the copying of other policies instead of or in addition to grassroots opposition) will become increasingly evident, and countries and states may even anticipate public opposition by instituting opt-out rules. Such rules are likely to reduce opposition based on privacy and security more than on health, because opponents concerned with health risks are also concerned with spill-over effects from meters installed in neighbouring homes.

Implication 2: Although health-related reasons are likely to be prominent in most North American opposition campaigns, several factors may mitigate the importance of

public concern with the health risks of smart meters. In this data set, organisation type was related to type of concern. Specifically, broad state-level groups tended to embrace the full range of reasons for opposition as a framing strategy to build broader coalitions, and likewise right-wing political groups tended to be more concerned with privacy and 'Big Brother' issues. There may also be national differences with respect to concern with health risks. Evidence from countries outside North America suggests that public concern with health risks in comparison with other types of risks and concern may be lower, but the available evidence is currently limited. For example, in Australia, large-scale wireless smart meter installations at the time of writing (2013) were limited to the state of Victoria, where the state's auditor general was critical of the costs to consumers, and public opponents frequently cited cost overruns and rate increases a s the source of their opposition (Smith 2013, West 2012). In the U.K., the consumer organisation *Which?* opposed an immediate roll-out, and 500 respondents to its opposition statement stated that their main concern was cost (Driscoll 2012). In the U.K., a survey of 1000 consumers by Tripwire, Inc. (2013), identified concerns with privacy, security, and control of household data, but this survey did not include questions about health concerns. In the Netherlands, opposition also centred on privacy issues with push-back against the original legislation in 2006 and 2008, which mandated installation and required that information from household electricity consumption be forwarded every fifteen minutes (Cuijpers and Koops 2012). The Dutch Data Protection Authority determined that the laws violated privacy rules, and the Minister of Economic Affairs changed the reporting to daily intervals with an opt-in

provision for fifteen-minute intervals plus guidelines for data use (Cuijpers and Koops 2012).

If it is confirmed that there is a relatively lower salience of health risks in other countries in comparison with North America, there may be several reasons for the difference. In some countries the roll-out of installation is not yet complete, and health concerns may grow as the roll-out progresses. Indeed, health concerns appear to be growing with the roll-out of smart meters in Australia and in the U.K. (see Stop Smart Meters Australia 2013, Mason 2013). Countries that preempt opposition with voluntary installation and opt-out provisions may mitigate opposition based on health concerns. For example, Swedish utilities allowed individuals who were electrosensitive to opt out of smart meters, and the utilities have also assisted with shielding (EI Wellspring 2011). Likewise, in Germany installation was voluntary for most consumers, and the U.K. also has developed opt-out provisions (Balmert, Grote, and Petrov 2012; Jamieson 2013; Mason 2013). Technological differences may also play a role. In Europe the primary technology for smart meters is ‘power line communication’, in contrast with the wireless technology that is commonly used in North America and Australia. Power line communication technology can also generate electromagnetic fields inside the house, and advocates and analysts concerned with health issues prefer fibre-optic cable lines and telephone lines; however, the use of wired rather than wireless technology may explain some of the differences in concerns with health effects (EI Wellspring 2013, Jamieson 2013).

If technological differences are a contributing factor, we would expect lower levels of opposition in areas of the U.S. with smart-meter systems based on wired

technologies. For example, the EMF Safety Network lists no anti-smart meter organisation for Idaho, where Idaho Power has adopted wired transmission. Our searches of media reports could identify only sporadic individual opposition but no organised movement equivalent to that of other states and provinces (Idaho Power 2013). With respect to privacy, the utility also collects information only four times per day, and it does not sell customer information (Idaho Power 2013) Two American cities (Fairfield, Iowa, and Chattanooga, Tennessee) are also using fibre-optic systems, which we would also expect to lead to reduced opposition.

Implication 3: Although there is evidence for a relationship between right-wing political views and opposition to smart meters among some organisations in the U.S., the likely general pattern with respect to party politics is that opposition is associated with out-of-power or marginal political parties and groups. Opposition campaigns may exhibit a ‘strange bedfellows’ phenomenon; for example, opponents who attended a smart-meter protest in Los Angeles included both Tea Party (right-wing) and Occupy (left-wing) groups (Stop Smart Meters 2013). Furthermore, the comparison of British Columbia with the U.S. cases is important because in the Canadian province the right-wing government supported smart-meter installation, and the more left-wing opposition party opposed it. In Ontario the leader of the opposition Progressive Conservative Party promised to unplug smart meters, which he described as tax machines devised by the premier of the incumbent Liberal Party (Stricker 2011). In the U.S., smart meters tend to be linked to the Obama administration, and opposition is strong amongst right wing Tea Party groups. Thus, the provisional hypothesis is that when smart-meter installations

become linked to party politics, the party that is out of power may take up the issue as part of its general opposition programme.

Implication 4: When a government or utility allows an opt-out provision, opposition may dissipate somewhat, but it tends to move on to related issues. The comparative analysis shows that opt-out rates range from 1 per cent in Maine to 4 per cent in Vermont to 18.3 per cent in one part of British Columbia (Skelton 2013). It is likely that some opponents will lose interest in the issue once they have opted out, because having an opt-out provision shifts the terms of the debate to a consumer choice, akin to installing a Wi-Fi system in one's home. However, in the state of Maine the opposition shifted to support for a no-fee opt-out provision, and it also supported a bill (LD 1456) that would require the return to electromechanical meters and would support local renewable energy (Maine Coalition to Stop Smart Meters 2013c). There is also a case in Texas where there is an effort to return to analogue meters, and in Fairfield, Iowa, the utility is shifting its water meters to fibre-optic technology. In California there is also a focus on opt-out charges and implementation irregularities. Thus, a range of issues is emerging as the next area of opposition after opt-out provisions are obtained.

Conclusion

In addition to research implications discussed above about the factors that shape public opposition and the role of concern with health risks in the opposition, this article also has potential implications for regulators and utilities who are confronting public opposition based on health risks. Utilities view growing interest in opt-out provisions with

concern, and they are devising strategies to reduce the number of customers who elect to opt out of smart-meter installation (Evans 2012). The standard policy response, shared by the industry and most government regulators, has been to:

- Dismiss health-related concerns and precautionary arguments by arguing that measurements of radio frequencies from wireless smart meters are within regulatory guidelines.
- Attempt to prevent governments from developing opt-out laws and no-fee provisions for continued use of analogue meters.
- Develop stronger communication and outreach programmes, and develop non-mandatory opt-in incentives for households that allow smart meters to communicate with thermostats and appliances to allow remote control by the utilities during peak load.

This strategy may prove successful in some regions, but it could underestimate the extent of the challenge that is emerging. Assurances to the public that there is no risk whatsoever involve a one-sided reading of an intense scientific controversy about the non-thermal health effects of electromagnetic fields, and they ignore the spill-over effects from research and policy decisions on mobile phones, mobile phone masts, and wireless Internet transmissions. Thus, the strategy of dismissing the science on health concerns for wireless microwaves involves entering into a scientific controversy in which there are experts with appropriate credentials who support the view that there are health risks from at least some forms and locations of wireless smart meters (see for example BioInitiative Working Group et al. 2012) and for which international bodies have begun to recognise health risks for the related area of mobile phones (International Agency for

Research on Cancer 2011). Furthermore, the strategy of attempting to prevent governments from developing opt-out laws runs into conflict with powerful political frames involving household-level privacy and rights to control over residential property, and the trend is for increasing support for opt-out provisions. The opt-out provisions could mollify the most vocal opponents, but it is also possible that the number of customers who wish to opt out could grow if there are no fees and penalties; if security and privacy violations begin to emerge and receive public attention; if more customers become convinced that claims of health risks are well founded; and if customers find time-of-use incentives to be unduly burdensome and costly. Because the reasons for opposition often include a mixture of health, privacy, security, and cost concerns, public opposition could continue even if education campaigns convinced the public that health concerns were not well founded.

A more proactive strategy would view the opposition to wireless smart meters not as a scientific, communication, and political challenge to be surmounted but instead as a technical challenge that can be the basis of continued experimentation with system design and governance. This strategy is consistent with the one proposed by Lineweber, who has argued:

> Ultimately, the data reported here suggest that the industry needs to think about the challenge of communicating with residential customers about Smart Grid investments as less an education task (since it is not just about 'educating customers' about promised downstream benefits) and more a reassurance task (communicating to customers why they can and should

> trust the promises made to them by their utility on these issues). (Lineweber 2011: 99).

This position is also consistent with the general findings of the science and technology studies literature on the public understanding of science as essentially an issue of public trust in experts rather than public lack of knowledge (Wynne 2006). As costs decline for on-site energy generation and storage, customers who do not believe in assurances of health, security, and privacy may abandon the grid for more resilient, secure, and sustainable off-grid systems. An innovative approach to the design of smart meters would include the following elements:

- Experimentation with fibre-optic and telephone lines, wake-up meters (which transmit only when prompted), prepaid meters, shielding, and other design changes in order to gain information about the effects of design innovations on customer acceptance, cost, and security vulnerability relative to wireless and power line communication systems.
- Development of strict industry privacy standards such as the Dutch guidelines of daily reporting with an opt-in provision for more frequent intervals and an opt-in provision for sale of information to commercial third-parties.
- Exploration of other, perhaps less expensive ways to manage peak load (such as through distributed energy storage) that may not require changes in customer-oriented technology and habits.

By treating the concerns of a small but vocal mobilised public as an opportunity rather than as a threat, it would be possible construct a technological system that has a high level of public acceptance and is more resilient to future knowledge about health and other risks posed by the new technology. This approach might develop innovations that reduce long-term political conflict and also provide savings on the costs of system redesign in the future.

References

Balmert, D., Grote, D., and Petrov, K., 2012. Final report: development of best practice recommendations for smart meters rollout in the energy community [online]. Prepared for the Energy Community Secretariat by KEMA International. Available from: http://www.energy-community.org/pls/portal/docs/1460178.PDF [Accessed 1 December 2013].

Best, J., 2013. More meter madness: Tea Party Texans accuse meters of spying. *Smart Grid News*, Sept. 13. Available from: http://www.smartgridnews.com/artman/publish/Technologies_Metering/More-meter-madness-Tea-Party-Texans-accuse-smart-meters-of-spying-6023.html/#.UjscGz8piyE. [Accessed 1 December 2013].

BioInitiative Working Group, Sage, C., and Carpenter, D., eds., 2012. *BioInitiative report: a rationale for biologically-based public exposure standard for electromagnetic fields radiation* [online]. Available from: http://www.bioinitiative.org/report/wp-content/uploads/pdfs/BioInitiativeReport2012.pdf [Accessed 1 December 2013].

Biolchini, A., 2013. Attorney general says DTE Energy smart meter opt-out fees not justified [online]. Feb. 25. Available from: http://www.annarbor.com/news/attorney-general-says-dte-energys-smart-meter-opt-out-fees-not-justified/. [Accessed 1 December 2013].

British Columbia Confederation of Parent Advisory Councils, 2012. Statement of member resolutions as of December 2012—BCCPAC [online]. Available from: http://www.bccpac.bc.ca/sites/default/files/record_of_resolutions_dec2012rev_0.pdf. [Accessed 1 December 2013].

British Columbia Office of the Information and Privacy Commissioner, 2011. Investigation report F11-03 [online]. Available from: www.oipc.bc.ca/investigation-reports/1244. [Accessed 1 December 2013].

Burgess, A., 2002. Comparing national responses to perceived risks from mobile phone masts. *Health, risk, and society*, 4(2), 175-188.

Burgess, A., 2003. Review of *The precautionary principle in the twentieth century*. *Health, risk, and society*, 5(1), 105-107.

CBC News, 2013. Hydro BC backs down on smart meter installation [online]. Jan 30. Available from: http://www.cbc.ca/news/canada/british-columbia/story/2013/01/30/bc-smart-meter.html. [Accessed 1 December 2013].

Center for Electrosmog Prevention, 2013. Where smart meters are optional/free or fee [online]. Available from: http://www.electrosmogprevention.org/stop-ca-smart-meter-news/where-smart-meters-are-optional/. [Accessed 1 December 2013].

Citizens for a Safe Technology, 2012. Moratorium/opt-out request tally of municipal councils re smart meters in B.C. [online]. Oct. 23. Available from:

http://citizensforsafetechnology.org/Moratorium-Requests-from-Municipal-Councils-re-Smart-Meters-in-BC,85,1354. [Accessed 1 December 2013].

City of Ashland, 2012. Resolution No. 2012-14 [online]. Available from: http://www.ashland.or.us/SIB/files/2012-14%20AMR%20Opt%20Out%20Policy.pdf. [Accessed 1 December 2013].

Claassen, L., Smid, T., Woudenberg, F., and Timmermans, D., 2012. Media coverage on electromagnetic fields and health: content analysis of Dutch newspaper articles and websites. *Health, risk, and society*, 14(7/8), 681-690.

Coalition to Stop Smart Meters. 2013. Concerns [online]. Available from: http://www.stopsmartmetersbc.ca/html/?page_id=173. [Accessed 1 December 2013].

Coley, J., and Hess, D., 2013. Wireless smart meters and public acceptance: the environment, limited choices, and precautionary politics. *Public understanding of science*, preprint version.

Cousin, M., and Siegrist, M., 2010. The public's knowledge of mobile communication and its influence on base station preferences. *Health, risk, and society*, 12(3), 231-250.

Cuijpers, C., and Koops, B., 2012. Smart metering and privacy in Europe: lessons from the Dutch case. *In* S. Gutwirth *et al*., eds. *European data protection: coming of age*. Dordrecht: Springer, 269-293.

De Graef, M.S., and Bröer, C., 2012. We are the canaries in the coal mine: establishing a disease category and new risk. *Health, risk, and society*, 14(2), 127-147.

Dietz, D., 2012. “Smart” meters crossroads. *The Register-Guard*, April 17 [online]. http://projects.registerguard.com/web/newslocalnews/27908710-41/eweb-smart-meters-customers-meter.html.csp. [Accessed 1 December 2013].

Dillon, J., 2011. In smart grid debate, co-ops pick hard-wire over wireless to cut cost [online]. *Vermont public radio*, Nov. 11. Available from: http://www.vpr.net/news_detail/92462/in-smart-grid-debate-co-ops-pick-hard-wire-over-wi/. [Accessed 1 December 2013].

Drake, F., 2006. Mobile phone masts: protesting the scientific evidence. *Public understanding of science*, 15(4), 387-410.

Drake, F., 2011. Protesting mobile phone masts: risk, neoliberalism, and governmentality. *Science, Technology, and Human Values*, 36(4), 522-549.

Driscoll, J., 2012. Stop and rethink the smart meter roll-out [online]. *Which? Conversation*, Jan. 15. Available from: http://conversation.which.co.uk/energy-home/stop-smart-meter-roll-out-uk-government-electricity-gas/. [Accessed 1 December 2013].

EI Wellspring, 2011. Smart meters in Sweden: accommodating people with EHS [online]. Available from: http://www.eiwellspring.org/index.html. [Accessed 1 December 201313].

EI Wellspring, 2013. Smart meter information [online]. Available from: http://www.eiwellspring.org/smartmeter.html. [Accessed 1 December 2013].

Elvers, H., Jandrig, B., Kathrin, G., and Tannert C., 2009. Mobile phones and health: media coverage study of German newspapers on possible adverse health effects of mobile phone use. *Health, risk, and society*, 11(2), 165-179.

EMF Safety Network, 2013. Find smart meter organizations in your area [online]. Available from: http://emfsafetynetwork.org/?page_id=6914. [Accessed 1 December 2013].

Evans, J., 2012. The opt-out challenge [online]. *Electric Light and Power*, March/April. Available from: http://bv.com/docs/articles/the-opt-out-challenge.pdf. [Accessed 1 December 2013].

Forbush, J.R., 2011. Regulating the use and sharing of energy consumption data: assessing California's SB 1476 Smart Meter Privacy Statue. *Albany Law Review*, 75(1), 341-377.

Freed, B., 2013. Ann-Arbor based group files appeal of DTE advanced meter mandate [online]. Ann Arbor News, June 19. http://www.annarbor.com/business-review/ann-arbor-based-group-files-appeal-of-dte-advanced-meter-mandate/ [Accessed 1 December 2013].

General Electric, 2010. National survey: Americans willing to embrace new energy behaviors to affect change [online]. June 24. Available from: http://www.genewscenter.com/content/detail.aspx?ReleaseID=10490&NewsAreaID=2&PrintPreview=True. [Accessed 1 December 2013].

Greene, J., 2012. DTE meter plan hits interference. Rate increase sought; court orders PSC hearing. *Crain's Detroit Business*, May 23, p. 3.

Hooks, C., 2013. As towns say no, signs of rising resistance to smart meters. *New York Times*, May 18. Available at: http://www.nytimes.com/2013/05/26/us/as-texas-towns-say-no-signs-of-rising-resistance-to-smart-meters.html?_r=0. [Accessed 1 December 2013].

Hopkins, J., 2013. Trying to change minds in smart-meter debate [online]. *Baltimore Sun*, March 22. Available from: http://www.baltimoresun.com/business/bs-bz-jonathan-libber-smart-meters-20130317,0,4437036.story?page=1. [Accessed 1 December 2013].

Idaho Power, 2013. Smart meter quality and security [online]. Available from: http://www.idahopower.com/ServiceBilling/Residential/Billing/AMR_QualitySecurity.cfm. [Accessed 1 December 2013].

International Agency for Research on Cancer, 2011. IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans [online]. IARC Press Release 208. Available from: http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf. [Accessed 1 December 2013].

Jamieson, I., 2013. Comments on health, human rights, environmental, and security concerns. Report filed with the British Columbia Utility Commission [online]. Available from: http://www.bcuc.com/Documents/Proceedings/2013/DOC_33386_C9-10-1_CSTS_Jamieson-Evidence.pdf. [Accessed 1 December 2013].

Jeffrey, J., 2013. Legislation to outsmart Texas smart meters filed [online]. *Austin Business Journal*, April 11. Available from: http://www.bizjournals.com/austin/blog/abj-at-the-capitol/2013/04/legislation-to-outsmart-texas-smart.html?s=print. [Accessed 1 December 2013].

Lezaun, J., and Soneryd, L., 2007. Consulting citizens: technologies of elicitation and the mobility of publics. *Public understanding of science*, 16(3), 279-297.

Lineweber, D., 2011. Understanding residential support for—and opposition to—smart grid investments. *Electricity Journal*, 24(8), 92-100.

Luk, V., 2013. Lawsuit launched against BC Hydro over smart meters. *Prince George Citizen*, July 24, p. 4.

Maine Coalition to Stop Smart Meters, 2013a. Intervenor-filed submissions by category and number [online]. Available from: http://www.mainecoalitiontostopsmartmeters.org/2013/04/intervenor-evidence/. [Accessed 1 December 2013].

Maine Coalition to Stop Smart Meters, 2013b. Health archive. [online]. Available from: http://www.mainecoalitiontostopsmartmeters.org/category/health/. [Accessed 1 December 2013].

Maine Coalition to Stop Smart Meters, 2013c. LD 1476 would provide safe, secure energy to Mainers [online]. Available from: http://www.mainecoalitiontostopsmartmeters.org/2013/05/ld-1456/. [Accessed 1 December 2013].

Mason, R., 2013. British families at risk from smart meters, campaigners tell MPs [online]. *Daily Telegraph*, April 24. Available from: http://www.telegraph.co.uk/earth/energy/10015679/British-families-at-risk-from-smart-meters-campaigners-tell-MPs.html. [Accessed 1 December 2013].

McCarthy, K., and Hansen, L., 2012. Smart grids/smart meter [online]. State of Connecticut, Office of Legislative Research Report 2012-R-0392. Available from: http://www.cga.ct.gov/2012/rpt/2012-R-0392.htm. [Accessed 1 December 2013].

McInnes, C., 2012. Evidence-based approach to smart meters a nice change: study finds installation poses no increased fire hazard. *The Vancouver Sun*, Aug. 17, A3.

McInnes, C., 2013. Dumb decisions plague BC's smart meter roll-out. *The Vancouver Sun*, Feb. 1, A1.

McMillan, T., 2013. HB 4315 [online]. Available from: http://www.legislature.mi.gov/documents/2013-2014/billintroduced/House/pdf/2013-HIB-4315.pdf. [Accessed 1 December 2013].

Michigan Public Service Commission, 2012. U-17000 report to commission [online]. Available from: http://www.w4ar.com/MPSC_decision_June_29_20112_ALLOW_OPT_OUT.pdf. [Accessed 1 December 2013].

National Institute of Standards, 2010. Guidelines for smart grid cyber security: vol. 2, privacy and the smart grid [online]. Available from: http://csrc.nist.gov/publications/nistir/ir7628/nistir-7628_vol2.pdf. [Accessed 1 December 2013].

Nevada Constitution Alliance. 2013. Why we oppose smart meters [online]. Available from: http://www.nevadaconstitutionalalliance.com/why-we-oppose-smart-meters/. [Accessed 1 December 2013].

Ontario Information and Privacy Commissioner, 2012. Building privacy into Ontario's smart meter data management system: a control framework [online]. Available from: http://www.ipc.on.ca/images/Resources/pbd-ieso.pdf. [Accessed 1 December 2013].

Robinson, J., 2013. Nevada smart meters battle ends for good. *Las Vegas Review Journal*, Jan. 9 [online]. Available from: http://www.reviewjournal.com/business/energy/smart-meters-battle-ends-good. [Accessed 1 December 2013].

Shaw, R., 2013. NDP pledges to seek alternatives for people who don't want smart meters [online]. *Times Colonist*, March 12. Available from: http://www.timescolonist.com/news/local/ndp-pledges-to-seek-alternatives-for-people-who-don-t-want-smart-meter-1.89467. [Accessed 1 December 2013].

Simpson, S., 2012a. Smart meter foes told to narrow complaint: B.C. Human Rights Tribunal prepared to hear electrical sensitivity argument. *The Vancouver Sun*, Aug. 31, A2.

Simpson S., 2012b. "Unusual" number of fires, smart meters linked: Ontario fire marshal says faulty base plates could be the cause, similar to Mission blaze. *The Vancouver Sun*, Aug. 4, A5.

Skelton, C. 2013. Gulf Islanders far more likely to refuse smart meters. *The Vancouver Sun*, Aug. 13, A1.

Smith, J., 2013. Smart meters in Victoria: information and concerns [Version 3; online]. Available from: http://stopsmartmetersau.files.wordpress.com/2011/10/smart-meters-in-victoria_information-and-concerns_version_3.pdf. [Accessed 1 December 2013].

Soneryd, L., 2007. Deliberations on the unknown, the unsense, and the unsayable? Public protests and the development of third-generation mobile phones in Sweden. *Science, technology, and human values*, 32(3), 287-314.

Stephens, J., Peterson, T., & Wilson, E., 2013. Transformation or status quo: competing visions of ‘smart grid.’ Paper presented at the annual meeting of the Sustainable Consumption Research and Action Network, Clark University.

Stop Smart Meters. 2013. Anti-smart meter protests disrupt smart grid conference [online]. March 22. Available from: http://stopsmartmeters.org/2013/03/22/anti-smart-meter-protesters-disrupt-smart-grid-conference/. [Accessed 1 December 2013].

Stop Smart Meters Australia. 2013. Dizziness [online]. Available from: http://stopsmartmeters.com.au/category/dizziness/. [Accessed 1 December 2013].

Stricker, L., 2011. Tim Hudak would scrap smart meters [online]. *Sudbury Time*s, April 21. http://www.thesudburystar.com/2011/04/20/tim-hudak-would-scrap-smart-meters. [Accessed 1 December 2013].

Thistle, S., 2013. Bill would eliminate $12-per-month ‘opt-out’ fee for smart meters in Maine [online]. *Bangor Daily News*, March 27. http://bangordailynews.com/2013/03/27/politics/bill-would-eliminate-12-per-month-opt-out-fee-for-smart-meters-in-maine/. [Accessed 1 December 2013].

Trans-Atlantic Consumer Dialogue, 2011. Resolution on privacy and security related to smart meters [online]. Doc. No. INFOSOC 44-11. Available from: http://tacd.org/index.php?option=com_docman&task=cat_view&gid=83&Itemid=40. [Accessed 1 December 2013].

Tripwire, Inc., 2013. Tripwire UK smart meter poll [online]. Available from: http://www.tripwire.com/company/news/smart-meters-privacy/. [Accessed 1 December 2013].

Vermont State Legislature. 2012. An act relating to the Vermont energy act of 2012. S. 214 [online]. Available from: http://www.leg.state.vt.us/database/status/summary.cfm?Bill=S.0214&Session=2012. [Accessed 1 December 2013].

West, M., 2012. Power plays not such a clever move for households. *Sydney Morning Herald*, Nov. 28, p. 2.

Wilder, F., 2012. Texas Tea Parties take on the menace of “smart meters.” *Texas Observer*, March 30. Available from: http://www.texasobserver.org/texas-texas-parties-take-on-the-menace-of-smart-meters/. [Accessed 13 Sept. 2013].

Wynne, B., 2006. Public engagement as a means of restoring public trust in science: hitting the notes, but missing the music? *Community Genetics* 9(3): 211-220.