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DEMAND-SIDE MISMANAGEMENT: HOW CONSERVATION BECAME WASTE

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Executive summary

Ontario consumers have borne substantial costs for Demand-Side Management (DSM) programs that aim to promote more efficient use of electricity. DSM programs were underway from 1988 until 1996 and then again from 2004 until the present. The Ontario Power Authority (OPA) spent nearly $400 million on conservation programs in 2013 alone. Electric distribution utilities have also engaged in programs supervised by the Ontario Energy Board outside of those funded by the OPA, as have federal, provincial, and municipal governments. Plans are in place to expand these programs at least through 2020.

But do they actually save consumers money? Notwithstanding the billions of dollars spent on such programs over almost three decades, no independent audit based on verifiable field studies of actual usage has ever been made publicly available. In this report we examine the basis for claims that conservation programs save consumers money and we find it likely that they do not.

The term "negawatts" was coined 25 years ago to push the idea that, on a per-megawatt basis, it would be cheaper to subsidize conservation than to build new generating capacity. The idea became popular among politicians but has been resisted by economists because it implies that consumers systematically pay more for their electricity than they consider it to be worth. In other words, it implies that consumers make mistakes over and over in their purchases, and depend on government planners to tell them how to order their affairs.

Paternalistic assumptions permeate the literature on energy efficiency. One recent study of US government analyses showed that the assumption of systematic consumer irrationality now accounts for between 80 and 90 percent of the claimed benefits of new energy efficiency regulations.

Nor is energy efficiency necessarily a cost-saving option for firms. Businesses use a mix of energy, labour, capital, and materials to make goods and services. Forcing them to use less energy may simply push them to make costlier substitutions. Once firms have selected their cost-minimizing mix of inputs, forcing them to change that mix in order to reduce one particular input (namely energy) increases their overall costs, making it an inefficient use of society's resources overall.

Utilities often claim success for their conservation programs, but these numbers need to be carefully scrutinized. A well-known 1992 study found that utility program costs were understated and the benefits overstated. In particular, many utilities ignored whole categories of program costs, especially for implementation, monitoring, and evaluation, few utilities computed the costs to consumers of participating in the conservation programs, and utilities systematically overestimated the amount of electricity saved. The authors conservatively estimated that the actual cost of conservation negawatts was at least double what utilities were reporting.

An important study in 2015 out of Berkeley University looked at participants in the US Weatherization Assistance Program (WAP). This home retrofit program has been in operation since 1976, but in 2009 the budget was increased more than ten-fold to $5 billion annually. What makes this study particularly important is that the authors were able to construct a randomized sample of program participants and non-participants, making it the first ever experimental test of a major energy conservation program.

An apparent puzzle in the energy literature has been the low level of voluntary investment by households in efficiency improvements that, according to engineering estimates, would save them money. The Berkeley study shows that households were right and the engineering models were wrong. The study found that, on average, engineering models predicted 2.5 times more energy savings than were actually realized. And the cost of the energy efficiency program per household was about twice the value of the energy savings. In other words the program cost two dollars for every dollar saved in energy, even after accounting for the value of reduced air pollution emissions.

Queen's Park is betting heavily that conservation programs will provide an effective and low-cost means of managing power needs in the coming decades. Unfortunately, Ontario energy plans rely on unsubstantiated and overly optimistic claims. We closely examine the analyses behind the province's "Conservation First" plans, and find either an absence of credible data, or overly-optimistic numbers based on methodologies known to be unreliable.

Ontario seems determined to gamble on costly new energy conservation programs without first stopping to weigh the costs and benefits objectively. As with the Green Energy Act, we expect this experiment to end badly, with Ontario taxpayers and ratepayers paying far more for the programs than they save in power costs.

1. Introduction

Central to electricity sector policy debates is the question of whether conservation programs that focus on paying consumers to not consume the product—also referred to as subsidized demand-side management (DSM) programs—are wise or wasteful. This report considers this question with particular attention to Ontario's energy sector, especially electricity.

Ontario consumers have borne substantial DSM costs. Ratepayer-funded electric utility conservation programs were underway from 1988 until 1996 and then again from 2004 until the present. In 2013, the Ontario Power Authority (OPA) spent $335.2 million on conservation programs and $57.7 million on closely related demand response programs (OPA, 2013a).[1] Electric distribution utilities have also engaged in programs supervised by the Ontario Energy Board outside of those funded by the Ontario Power Authority.[2] In addition, substantial federal, provincial,[3] and municipal[4] taxpayer-funded energy conservation programs have been undertaken over this period, as well as gas utility programs.[5]

As we will discuss, under current plans electricity consumers will be paying for a large conservation program extending out until 2020. The scope

1. Slightly different figures appear in Environmental Commissioner of Ontario (2014). The cost figures used here follow, where available, reports of the Minister of Energy, Ontario Energy Board, Ontario Power Authority, and Independent Electricity System Operator. Note that these spending amounts do not include cost shifting from large industrial consumers to smaller volume consumers introduced in 2011 with the justification of promoting industrial energy conservation.

2. According to the Ontario Energy Board (2009), $163 million was spent over the period 2005–2008 by electric LDCs.

3. The Ontario Ministry of Energy (2012) indicates that, from April 2007 through March 2011, the government spent $64.3 million on home energy audits and $507.9 million on energy efficiency retrofits for private residences.

4. An example of a current municipal energy conservation subsidy program is the City of Toronto's Home Energy Loan Program, which provides subsidized loans for energy efficiency upgrades to private residences.

5. The Environmental Commissioner of Ontario (2014) indicates that in 2013, Union Gas and Enbridge Gas Distribution spent $60 million, with an additional $12.3 million in incentives provided to the utilities.

of this analysis does not include conservation programs that might focus on equipment labeling, consumer education, or minimum efficiency standards.

Many of the current Ontario electric utility subsidy programs date back 25 years or more. Examples of current programs mimicking programs from two decades ago or more include coupons to encourage household purchases of compact fluorescent light bulbs, commercial lighting upgrades, or ice storage systems for commercial air conditioning.[6] Notwithstanding the many billions of ratepayer and taxpayer dollars spent on such programs over almost three decades, no independent audit based on verifiable field studies of actual usage has ever been made publicly available.

This study considers the logic of subsidized DSM, whether there is evidence that such programs save money, whether energy efficiency is an *a priori* good, and Ontario's current and historic DSM policies and practices. We conclude that electricity conservation programs in Ontario are likely a waste of resources, or at best have not been established to be economically efficient. Since the program titles use words like "conservation" and "efficiency," this might seem a counterintuitive position to take. But a program that delivers less in benefits than the cost of implementing it is, by definition, inefficient, regardless of what it is called.

6. Ontario Hydro's Demand/Supply Plan, issued in 1989, included a program called Thermal Cool Storage, which was an ice storage cooling system for commercial air conditioners. Ontario Hydro's 1990 Annual Report reported rebates for residential consumers to buy compact fluorescent bulbs. Industrial energy conservation programs in 1990 included financial incentives for the purchase of energy efficient equipment for manufacturing plants, industrial audits, industrial lighting subsidies, and time-of-use pricing. All of these programs from 25 or more years ago are among the current government programs.

2. Arguments for and against subsidized DSM

2.1 Negawatts are cheaper than megawatts

An often-stated motivation behind DSM programs in the electricity market is that, instead of spending money to increase supply, utilities could spend money to induce consumers, including industry, to reduce consumption, and if the cost per kilowatt-hour (kWh) of the latter is less than that of building new supply it would save money for the overall economy. As long as the cost per kWh saved is less than the current market price for electricity, the policy yields a net benefit. This idea derives from longstanding claims about what conservation advocate Amory Lovins of the Rocky Mountain Institute (RMI) called "negawatts," or the costs per kWh to cut electricity demand.[7]

Kahn (1991) quoted numbers from Lovins claiming that US electricity consumption could be curtailed by an astounding 60 percent through DSM measures costing less than two cents per kWh. Less extreme but still optimistic estimates from the Electric Power Research Institute (EPRI) also tallied in Kahn (1991), claimed potential demand reductions of about 25 percent at less than 4 cents per kWh. For comparison, in an Ontario context, as reported by the Environmental Commissioner of Ontario (2014: Table 13), the Ontario Power Authority achieved a levelized delivered cost of energy efficiency over the time period 2011–2013 of 3.7 cents per kWh, which, taking account of inflation and the exchange rate, would be even lower than the RMI estimate addressed by Kahn.[8]

Economists have tended to be skeptical of such arguments based on the assumption that the electricity market, like any other market, involves informed buyers and sellers making decisions in their own best interest. This

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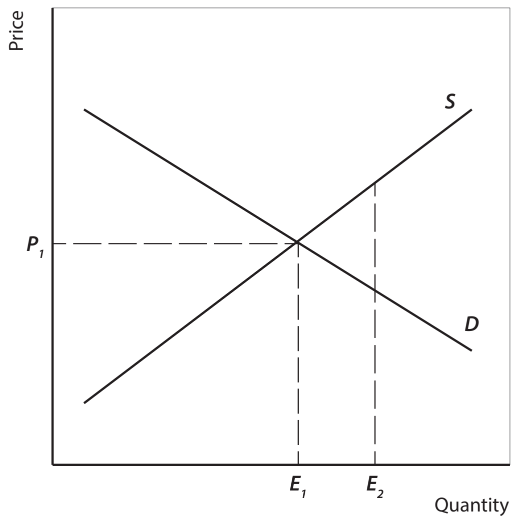
7. Lovins' first published use of the term "negawatts" appears to be in "The Negawatt Revolution," in the magazine *Across the Board* in 1990.

8. The Statistics Canada GDP deflator from 1981 to 2015 rose about 2.5-fold, and with a 20 percent exchange rate adjustment, 3.7 cents Canadian in 2015 equates approximately to 1.2 cents US in 1981.

view is summarized in **figure 1**, which shows a conventional demand and supply diagram. The price of electricity is on the vertical axis and the quantity is on the horizontal axis. The upward-sloping line denoted *S* is the supply curve for electricity, and the downward-sloping line labeled *D* is the demand curve. S slopes up because as price rises, successively higher-cost sources can find buyers so more supply becomes available. *D* slopes down because as the price falls, people use more.

Figure 1: Demand and supply in the market for electricity



Putting these concepts together, basic economic theory yields the following interpretations:

- A point on *S* indicates the marginal cost of producing another unit, which is an indicator of the marginal cost to society of giving up the resources needed to expand production of, in this case, electricity.

- A point on *D* indicates the marginal value to consumers of electricity, which can be interpreted as the willingness to pay for another unit, which in turn is an indicator of the marginal social welfare of consumption.

- The area under *S* over an interval (such as from E_1 to E_2) indicates the total cost of increasing production by that amount.

- The area under *D* over an interval indicates consumers' total willingness to pay for that increment, and is therefore a measure of the social welfare of the extra production.

- The point where the lines *S* and *D* cross is the optimal level of output, and is also the point to which market forces drive production levels.

Starting from the market equilibrium point at E_1 and moving to the left, in order to convince consumers to reduce electricity usage they have to be offered compensation at least as great as their willingness to pay for the foregone power, which is indicated by the height of the *D* line. The resource savings to society of doing so would be as indicated on the *S* line, which is lower than the *D* line when moving to the left of E_1. Hence conservation schemes that try to pay consumers to reduce electricity consumption below the market equilibrium level must, in principle, cost more at the margin than the savings from not generating the equivalent amount of electricity.

2.2 Inertia in the pricing systems

In the case of electricity, it is plausible that there are times when the supply price is less than the marginal cost of production. The market might get stuck at the point E_2 if sellers could only charge an arbitrary amount less than marginal cost. This might occur during peak hours, for instance, when purchases are governed by a pricing contract but the cost of bringing capacity online to cope with the temporary surge of demand exceeds the contracted price. However, in normal circumstances without policy intervention we do not expect these conditions to persist for extended periods, since sellers face strong incentives to avoid selling below cost. Our analysis herein is premised on the view that, if regulatory distortions are leading suppliers to underprice electricity, the efficient way to fix this is to remove those distortions, not to create additional ones on the demand side through conservation programs.

2.3 Consumers are irrational

Many observers of the energy conservation literature have noted that economists and engineers tend to talk past each other (e.g., Levine et al., 1994). Economists think in terms of demand and supply diagrams, as in the example above, whereas engineers think in terms of power usage and equipment. If a new appliance comes onto the market that costs more to purchase but uses less electricity over its lifetime compared to an older version, a rational purchaser would opt for it if the quality of its services are the same and the discounted present value of the energy savings exceeds the upfront cost differential. Economists assume rationality *a priori* and so view a refusal to make the purchase as evidence that the customer has decided that the quality of services are not the same and/or the likely savings are smaller than the extra purchase cost. Engineers attempt to estimate directly the service flow and the relative costs and benefits. If in their calculation the purchase is justified they conclude the consumers are irrational. The irrationality may take the form of using excessively high discount rates, inertia in buying habits, or other forms of systematic error.

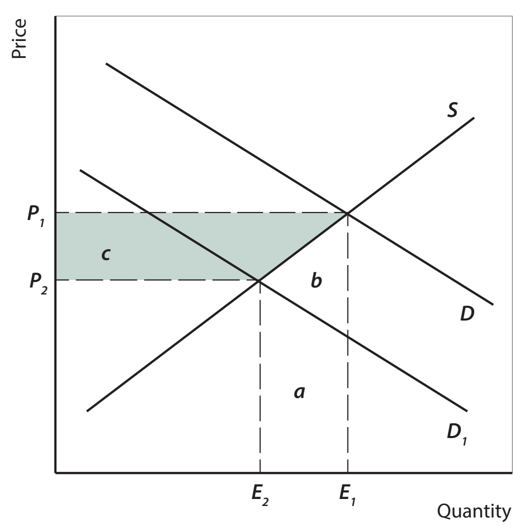
Levine et al. (1994) give examples where large numbers of consumers pass up appliances that seem, on the face of it, to provide exactly equivalent services with lower power usage, and the implied discount rate to rationalize this decision exceeds 30 percent. This implies, in terms of figure 1, that consumers are using irrationally high amounts of electricity, such as at point E_2. If we start from E_2 it would be possible to pay consumers to cut consumption by a small amount, and in doing so save a greater amount in resources, since the *S* line is above the *D* line.

For this argument to work on a large scale, there would need to be evidence that households and firms systematically make the wrong purchasing decisions, and that government planners are able to intervene at a low enough cost to direct them to make the correct decisions, without that intervention having significant negative impacts. Gayer and Viscusi (2013) point out that this is the premise behind subsidized energy conservation initiatives, accounting for between 80 and 90 percent of the projected benefits of new energy efficiency regulations.

We can adapt figure 1 to illustrate the nature of this dispute. Suppose that for some fixed expenditure *X* it is possible to shift the entire demand curve, which is shown in **figure 2** as the reduction from *D* to D^1.

An example would be if households spend *X* to replace their incandescent Christmas lights with LED ones, and thereafter always use less electricity regardless of the price level. The resource savings in electricity production are shown by the sum of the areas *a*+*b*. If *a*+*b* is greater than *X* then there is a net social benefit from this switch.

Figure 2: A demand shift in the market for electricity



We are assuming that the consumers replace one type of equipment or appliance with another type that is just as good even though it costs less to operate. In other words, people are just as well off using the technology associated with D^1 as they were with the technology associated with D. At the original market equilibrium people paid a total of $P_1 \times E_1$ for their electricity. After the change they pay $P_2 \times E_2$. The total amount they save is shown as a+b+c (where c is the shaded area). This amount has to be greater than a+b alone.

To justify a policy that forces such a switch we would need to believe that the cost of the new technology, X, is less than the resource savings (a+b). But if that is true, then obviously a+b+c is also greater than X. So the consumer gets a net private benefit from making the switch. This means that if the conditions are right for society to benefit from a technology change, households themselves must derive at least as much private benefit from doing so—so there is no need for a policy intervention to force it to happen.

This is the basic paradox: If steps that reduce electricity consumption were truly cost-reducing at the societal level, it has to be the case that they are also cost-reducing at the household and firm level as well, in which case there is no need for DSM programs to force their adoption. The only way to get around this and justify DSM programs is to assume that governments are competent to, and indeed ought to, routinely override individuals' private market decisions to their benefit. In their discussion of this issue, Gayer and Viscusi (2014) point out that advocates of this reasoning tend to apply it selectively. They would not, for instance, accept the idea that governments are competent to, and ought to, override individuals' private voting decisions to their benefit.

2.4 Externalities

Power production sometimes involves fossil fuel combustion, which is a source of conventional air pollution and greenhouse gas emissions. Conservation advocates therefore sometimes frame the benefits of DSM programs in terms of reduced air pollution.[9] In the Canadian context, it is often argued rather glibly that electricity is associated with damaging air pollution without acknowledging how much we have already spent reducing emissions from power plants since the 1960s.[10]

9. One particularly misleading form of this argument is to express a program in terms of equivalent numbers of "cars taken off the road." This comparison tells us more about how clean modern cars are than about how effective a program is. New cars are about 95–99 percent cleaner on a per-mile basis today than in the 1960s (McKitrick 2010: 28), which means that an equivalent reduction in emissions would take as many as 100 new cars off the road today for every one car in the mid-1960s.

10. The improvements in Canadian air quality and reductions in air emissions can clearly be seen at <http://www.yourenvironment.ca>, which publishes official Canadian air quality records for communities across the country.

There are two other problems with this kind of framing. First, most of Ontario's power comes from nuclear or hydro, which are non-emitting sources. Most users of electricity in Ontario do not contribute to air pollution at all, so conservation would not lead to reduced air pollution. Second, if the policy goal is to address air pollution and greenhouse gas emissions, it makes better sense to target them directly, as indeed is already the case, rather than to try to control them indirectly using energy conservation programs.[11]

2.4 Saving money by cutting consumption

Another argument behind energy conservation programs, including DSM and tighter appliance standards, is that it will directly save people money. In the case of households, if new appliances use less electricity, and if for firms new equipment uses less electricity, both groups will save money. That is presented as a self-evidently beneficial feature of such programs.

The deficiency of this logic is the fact that households and firms don't just use energy, they also use capital, labour, and materials to achieve some purpose. If the government enacts policy to force down the use of one of these categories, it will almost certainly lead to wasteful use of the others or a reduction in service quality.

In the case of a goods producing firm, this can be illustrated with a numerical example. Suppose a firm is going to produce 1,000 widgets, each of which will sell for $1. It will use capital (K), labour (L), energy (E), and materials (M). Suppose the relative costs per unit of each input are $4, $3, $2, and $1, respectively (just for illustration). And suppose there are four different production processes available, each of which will yield 1,000 widgets:

	K	L	E	M	Cost
1	100	50	50	25	675
2	100	50	25	25	625
3	75	60	30	30	570
4	120	70	20	25	755

11. See McKitrick (2015) for a discussion of the economic inefficiency of indirect regulatory targeting.

Comparing processes 1 and 2, the only difference is that process 1 uses more energy. “Conservation” would tell us to use process 2, thereby saving energy, and money, but then so would ordinary common sense. Economists assume that process 1 would never be considered in the first place, or would immediately be ruled out by the firm because it costs more than process 2 and yields the same output. So it’s a trivial and uninteresting comparison. You could not justify government policy on the assumption that there are lots of process 1’s out there and business managers are unable to notice that process 2’s are also available. Businesses succeed by choosing cost-minimizing strategies, and they put a lot of effort into identifying them. It doesn’t mean they don’t occasionally fail to notice a process 2, but it does mean that it is unlikely that such situations arise often enough to require government intervention, or that governments have exceptional skill in identifying genuine option 2’s from far away.

Now compare options 2 and 3. Option 3 uses less capital, but more labour, energy, and materials. Overall it costs less. So the firm would prefer it to option 2. Would the rest of society agree with that preference? If the prices in the example are set competitively, then yes, we would. Those prices indicate relative scarcity. In this example, capital is scarce relative to energy. Capital ultimately comes from the pool of savings, and if that is in short supply, we are better off having the firm use a bit more of everything else and free up capital for other firms.

Now compare options 3 and 4. Option 4 uses relatively little energy—in fact the least of all the cases. But it uses a lot of capital (and labour). If conservationist policies force the firm to use this option, it is true that the energy per unit of output is minimized, but it is actually the least efficient process overall because it costs the most. This problem wouldn’t be fixed by paying the firm a $200 subsidy so the cost is reduced to $555, making it the “cheapest” for the firm. That just increases the cost for everyone else, making them pay extra for a policy that wastes capital and labour in order to reduce energy consumption a little bit.

Some readers will take issue with the idea that the prices are indicators of relative social value, since there may be polluting emissions. Therefore, suppose power production and consumption create so-called “pollution externalities.” Thus energy is underpriced due to various air emissions. This means we have a *pricing* problem. Manipulating energy consumption, instead of correcting the price signal, is a less efficient solution. It bears noting, however, that adjusting prices does not necessarily change the quantities consumed, depending on changing economic circumstances. Advocates for price measures (such as a carbon tax) must recognize that once such a tax is in place, the outcome, looking narrowly at energy use, may remain the same as before, and if so, we have to agree that it is nonetheless the right outcome.

So in our example, let's add a 50 percent tax on energy to correct the pricing problem:

	K	L	E	M	Cost
1	100	50	50	25	725
2	100	50	25	25	650
3	75	60	30	30	600
4	120	70	20	25	775

Option 3 remains the least-cost among options 2—4, even though it uses the most now tax-burdened energy.

Of course this is just a numerical example, and could have been rigged to yield a different outcome. But the overall point is to explain why it is not necessarily valid to point to a reduction in energy consumption as evidence that firms or households are financially better off. The answer has two components:

1 Once firms have selected the cost-minimizing mix of inputs, forcing them to change that mix in order to reduce one particular input increases their overall costs, which means it is an inefficient use of society's resources overall.

2 If the problem is that price signals are inaccurate, then we should fix the price signals. Conservation policies don't do that. And once we have done it, then once again conservation policies are unnecessary and can only lead to inefficient outcomes.

3. The empirical evidence about DSM programs

The previous section reviewed what turn out to be long-running and seemingly intractable disputes between economists and engineers regarding the theoretical rationale for DSM programs. This section asks what empirical evidence there is that they yield net social or economic gains for society.

3.1 The cost of negawatts

In principle, we expect that empirical estimates of the marginal cost of negawatts should be not less than the prevailing price of electricity. Looking again at figure 1, if the market is in equilibrium then the market price will be P_1. As long as price equals marginal cost, the cost of inducing a small reduction in electricity use will therefore be just above this amount on a per-kWh basis.

Optimistic estimates of the costs of DSM, such as those from EPRI and RMI quoted earlier, implied that DSM programs could effect large reductions in electricity consumption at very low costs, apparently contradicting the expectation from basic economic theory. But these claims have been clearly refuted in the literature. Joskow and Marron (1992) surveyed US utilities to find out how much they were spending on DSM and how effective the programs were, and they found the per-kWh rates were substantially higher than those estimated by EPRI and RMI. But in addition, after they looked in detail at how the utilities came up with their estimates, they concluded that even those numbers were biased downwards:

- Many utilities ignored whole categories of program costs, especially for implementation, monitoring, and evaluation.

- Few utilities computed the costs to consumers of participating in the conservation programs, including the cost of scrapping equipment prior to the end of its intended life.

- Utilities estimated the amount of electricity saved using engineering model forecasts rather than *ex post* measures of actual demand reductions. Joskow and Marron cite a series of US-based studies that found actual consumption reductions were typically 50–60 percent of prior estimates.

- Utilities ignored the effect of free riders, treating all program participants as incremental (in other words, households and firms that would not have undertaken the conservation measure except for the program). Since at least a fraction of the participants were being paid to take measures they would have chosen to undertake anyway, this overstates the incremental effect of the programs.

Taking these considerations together, Joskow and Marron conservatively estimated that the actual cost of conservation negawatts is at least double what utilities were reporting, and were thus far in excess of the prominent and influential estimates from RMI and EPRI, putting them well-above then-current market prices for electricity.

Arimura et al. (2011) calculated that DSM programs in the US over 1992–2006 yielded only about a one percent reduction in demand, clearly far below the EPRI and RMI estimates. This is not because spending was far below the RMI or EPRI price points. In their survey of the literature on costs of DSM, they found many econometric estimates of DSM spending centered around 5 cents per kWh, with some varying upwards to 15 cents or even higher. Arimura et al. themselves obtain an estimate of 5 to 6 cents per kWh, depending on whether a discount rate of 5 percent or 7 percent is used. This latter estimate is low compared to the prevailing market prices, albeit within the margin of error. However, their estimate of DSM costs relied on the spending reported by utilities themselves, an approach already heavily criticized by Joskow and Marron (1992). They also assume that DSM program spending between 1992 and 2006 has effects that persist for 20 years into the future, which greatly increases the assumed magnitude of energy savings attributable to past DSM spending, and thus reduces the cost per kWh.

3.2 Returns to public investment is energy efficiency

Fowlie et al. (2015) analysed the returns to energy efficiency in the US Weatherization Assistance Program (WAP). This home retrofit program has been in operation since 1976, but in 2009 the budget was increased more than tenfold to $5 billion annually. Fowlie et al. focused on Michigan, analysing general program data as well as data from a controlled field experiment in which random households were selected for participation. The authors claim their randomization design makes it the first experimental study to examine returns to a major public conservation program.

An apparent puzzle in the energy literature is the low level of voluntary investment by households in efficiency improvements that, according to engineering estimates, would save money. As part of their study, Fowlie et al. engaged a marketing firm to conduct extensive telephone and in-person outreach to target-area households to encourage participation. While this part of the program allowed for creation of random treatment and control groups, it still had a low success rate, apparently confirming the pattern of low willingness to invest. But the data coming out of the study shows that households were right and the engineering models were wrong. Participants in WAP all underwent an energy efficiency audit using the National Energy Audit Tool, a standardized engineering model used by state and local authorities, utility companies, and others. Fowlie et al. found that, on average, the model predicted 2.5 times more energy savings than actually were realized. And the cost of the energy efficiency program per household was about twice the value of the energy savings. Household reluctance to invest in every possible form of energy efficiency is rational; what is irrational is to subsidize programs that cost two dollars for every dollar saved in energy. Adding in savings from carbon dioxide abatement only yielded a net benefit if the emissions are valued at $329/tonne, about ten times the US government's estimated social cost of carbon (IWG, 2013).

An important point to add is that the methodology employed by Fowlie et al. relied upon cooperation from agencies whose economic interest is associated with the continuation of conservation subsidies.

3.3 Rebound effects

Another potential omission from cost estimates, or opportunity for overestimating program-induced savings, is the so-called "rebound effect." When DSM programs subsidize adoption of more energy efficient equipment, households and firms will tend to respond by increasing their usage rates, at least partly offsetting the estimated reduction in power use. For instance, a household that obtains a rebate to purchase a dishwasher that uses less energy than before may then opt to run it less full and therefore more often. It is also conceivable that some conservation programs might have spillover effects, whereby the program initiative might encourage consumers to adopt non-program conservation measures of their own accord, thereby mitigating rebound to some extent.

There has been an extensive empirical debate about the size of the rebound effect. Fowlie et al. (2015) found little evidence of a rebound effect in home heating in their study of WAP participants. Brannlund et al. (2007) presented econometric results from Sweden showing that a 20 percent increase in efficiency would yield total energy demand changes ranging from

-2.2 percent to +5.6 percent depending on the sector. In other words, the rebound effects and the effective rise in real income would cause, in many cases, an *increase* in energy consumption that would potentially more than wipe out the intended effect. Mizobuch (2008) criticized these results for neglecting the effects of capital costs on household spending. He estimated that by taking them into account the rebound effect would be cut by about three-quarters. However, this still implies that about 27 percent of the initial effect of the policy would be offset.

3.4 Empirical evidence: conclusions

Overall we can draw three main points from studies of DSM implementation:

- Projections from groups like RMI and EPRI, and from engineering simulation models, have historically overstated the reductions in energy use that will result from energy efficiency investments.
- The typical cost per kWh of savings is estimated to be close to or above the prevailing market price, so it is not a savings compared to expansion of existing supply options at the margin.[12]
- There is substantial theoretical and empirical evidence that households do not systematically and irrationally underinvest in energy efficiency.

Wirl (2000) presented a hard-hitting summary of US experience with conservation programs. He argued that distorted incentives exist between governments and utilities, and between utilities and consumers, making the programs inherently unlikely to succeed. First, while political leaders like the sound of the DSM programs because they appear to offer a free lunch, namely handouts to consumers that yield greater cost savings elsewhere, once they mandate the programs, the utilities themselves have no incentive to implement them in an efficient way, or to track standard measures of cost and effectiveness, since compliance with mandates is typically only evaluated based on superficial measures of implementation such as total spending or numbers of participants. In fact, it only adds to the utilities' cost of implementing the programs to assess their implementation properly.

Second, when households are presented with the menu of subsidies from utilities, they have no incentive to reveal their private information in

12. Note that it is almost a universal principle of rate design for electricity that at least some fixed costs be recovered in variable rates. It is therefore frequently the case that the marginal rate exceeds marginal cost.

such a way as to allow utilities to target the programs efficiently. Instead, the process of adverse selection drives consumers who are least likely to provide incremental efficiency improvements to exploit the programs the most. Wirl concludes that "the reported conservation exists largely on paper but not in reality." He draws four main lessons:

- "First, other countries should not imitate the American conservation programs" (p. 106).
- Second, and very presciently, in light of evidence that DSM programs were uneconomic on the originally proposed grounds (namely as a means to address the energy crisis of the 1970s and early 1980s) he warns that conservationists were likely to start trying to pad the estimated benefits with equally dubious arguments about such programs being "no regrets" strategies for global warming, a prospect he dismissed as likely "another illusion."
- Third, conservation programs that have any chance of working must correct the incentive problems inherent in their design. However, his analysis showed that to do so would likely require targeting the programs on rich households, which would be politically infeasible.
- Finally, DSM programs cannot accomplish better results than simple price instruments.

4. DSM and conservation in Ontario

We now turn to the specific experience of DSM in Ontario. Given the importance of electricity to a modern industrial economy like Ontario's, we take the view that the public interest would be best served if the planning process were rooted in reality. As we have shown, claims that conservation can be a reliable and low-cost means of matching supply and demand are theoretically dubious and unsupported by historical data. Therefore to the extent that Ontario invokes DSM or other conservation methods as important elements of its electricity planning, a prudent approach would include a clear recognition of past failures, detailed justification of the assumption that next time will be different, and scrutiny of actual results achieved.

Unfortunately, as we will now show, Ontario energy plans rely heavily on unsubstantiated and overly optimistic claims that are contradicted by the limited data the government has released. Compounding the problem of documenting the overall value of DSM programs, our efforts to investigate the province's official statements about the costs and benefits of conservation programs have revealed the costs to be understated and the benefits to be unsupported (see Section 5.3).

What oversight DSM programs do receive provides limited systematic insight as to how much was spent, and where, over time.

4.1 The "Conservation First" plan

After the 2003 election, as the Ontario government developed and then modified its two core energy priorities—terminating the use of coal-fired power generation in the province and reducing greenhouse gas emissions—energy conservation has been a constant associated policy. Then-Premier McGuinty launched his "culture of conservation" in April 2004 as part of a package of initiatives oriented around his decision to reverse a 2003 electoral promise to maintain a freeze on power rates initiated by his predecessor Ernie Eves (Ontario, 2004).

The connection between conservation programs and rate increases has proven to be a recurrent theme that we revisit later. Nonetheless, on its own, conservation sounds good and has been widely accepted by the general public.[13]

In July 2013, Premier Wynne reiterated her commitment to her predecessor's approach through a document called *Conservation First: A Renewed Vision for Energy Conservation in Ontario* (Ontario Ministry of Energy, 2013). The Conservation First Framework is a six-year conservation and demand management framework applying to the period 2015–2020. A version of the document was posted for public review from July to September 2013.[14] Linked to this review was a public review for the Ontario government's update to its Long-Term Energy Plan.[15] The Ontario Ministry of Energy (2015) issued a Provincial Policy Statement summarizing Conservation First in March 2015.[16]

Overall we find the information contained in the Province's conservation strategy nowhere near credible enough to overturn the strong expectation, based on decades of data reviewed in the previous sections, that DSM will cost Ontario a lot and yield very little.

The costs for the Conservation First initiative are to be borne by electricity ratepayers. The budget includes $1.8 billion for electricity LDC energy efficiency programs, $400 million for central services, and $400 million for demand response programs for industrial consumers and the costs of a program called peaksaverPLUS (OPA, 2014). In addition, pursuant to a July 2014 directive from the Minister of Energy, the Ontario Power Authority and now the Independent Electricity System Operator are undertaking a five year extension of a conservation program called the Industrial Accelerator program, under which transmission-connected industrial users receive subsidies for capital investment in energy-efficiency projects (OPA, 2015). $58.9 million was spent on the Industrial Accelerator program from 2010 through September 2015. From June 2015 through December 2020, a further $500 million is budgeted, of which $138 million is budgeted to subsidize industrial consumers to build load-displacement generation.[17]

13. Examples of the popularity of conservation programs include a 2013 opinion survey for the OPA (2013c), which found that 90 percent agreed strongly or somewhat that "[p]ursuing and funding electricity conservation practices should be a strategic goal for the province of Ontario". 84 percent agreed strongly or somewhat that "[c]onserving is always more cost-effective than generating and transmitting electricity." A 2013 survey for the Canadian Energy Efficiency Alliance found that 75 per cent of Canadians believe that conserving energy is very important (CEEA, 2013).

14. EBR Registry Number: 011-9614.

15. EBR Registry Number: 011-9490.

16. The document linked from the References section (Ontario, Ministry of Education, 2015) has replaced, on the government website, a different version we originally relied upon.

17. D. Doyle, IESO (email correspondence, October 21, 2015).

As Wirl (2000) warned, non-energy justifications have been added to the claimed program benefits. In October 2014, the Minister of Energy issued a directive to the OPA, one element of which is to require a 15 percent increase in the calculated benefits of programs, or what the Ontario government refers to as an "adder," to reflect what it claims are non-energy benefits for environmental, economic, and social impacts of programs (Ontario Ministry of Energy, 2014).

The basis for provincial estimates of the likely savings from conservation are difficult to identify. In the preamble for the Conservation First statement, the Energy Minister claims that "[f]rom 2005 to 2011, families and businesses across this province conserved enough to reduce demand by more than 1,900 megawatts, the equivalent of powering more than 600,000 homes." The document also claims that, "[b]etween 2006 and 2011, investing $2 billion in conservation allowed Ontario to avoid more than $4 billion in new supply costs." In Section 5.3, we review correspondence with the Minister's office in which we unsuccessfully sought a verifiable basis for these statements. An immediate difficulty in taking them at face value is the failure to adjust for external drivers. Ontario's weather-corrected peak demand fell from 23,848 MW in 2006 to 23,501 MW in 2011.[18] But over this interval, the commodity cost of electricity in Ontario rose from about $55/MWh to about $75/MWh, the economy went into recession, and there was a widely recognized expectation of future rate increases far above the pace of inflation. All these had a dampening effect on Ontario power usage. It is therefore implausible to attribute reduced demand entirely to conservation program activities.

Many other aspects of the policy are too vague to be plausible. For instance, the policy suggests that demand response, "smart" meters, and the "smart" grid could help accommodate more intermittent renewable generation, but provides no substantiation for the claims.

The policy statement indicates an intention to develop electricity storage:

> Electricity storage is emerging as another option to help address challenges such as peaking demand, efficiently integrating renewable generation, managing slight variations in output, and resolving congestion and power quality issues that reduce distribution system performance.

Yet an analysis performed for the government by Navigant Consulting and released June 5, 2015 concluded that "energy storage is not presently cost effective. The benefit-cost ratio is 0.7, on an expected basis, and may vary from 0.2 to 1.3" (Navigant, 2015: D-43).

18. IESO, 18-month Outlook, Outlook Tables, Table 3.3.2: Monthly Weather and Demand History Since Market Opening.

4.2 Conservation programs and rate increases

Competitive businesses don’t engage in programs to encourage, much less to subsidize, consumers to use less of their product. Yet by the late 1980s, conservation programs had become permanently embedded in Ontario energy policy and have remained so ever since, except for a brief period during Ontario’s failed attempt to introduce market principles into aspects of its electricity system.[19]

The financial arrangements underpinning Ontario’s power system as now configured ensure that the overall impact of any reduction in demand, whether attributable to conservation programs or not, is to raise rates. Almost all suppliers in Ontario’s power system receive regulated or contractual payments irrespective of market demand. The annual revenue requirements arising from the sum of all of these payments, as well as conservation programs, has risen every year since 2009 and is projected to continue to rise at least until 2016 (McKitrick and Adams, 2014: Appendix 1). But since 2005, demand has declined, so there are fewer paying customers to fund the rising system revenue needs. This would have driven an increase in rates even if conservation program costs were zero. But to the extent that conservation programs drive away paying customers, it deprives the system of funding that might help reduce rates. Any suggestion that conservation has allowed the government to reduce the amount of power it contracts for is contradicted by the fact that the government continues to enter into long term contracts for additional generation while Ontario is exporting surplus power at a sharp discount relative to cost, and is also paying generators to not generate.[20] Ontario is therefore in a situation in which it would help reduce power rates if we were to encourage greater domestic consumption by ordinary paying customers, rather than less.

19. Since the OEB issued its July 1993 decision in the case EBO 169-3, where the underlying economics of conservation programs were debated, Ontario’s natural gas distribution utilities have administered subsidized energy conservation programs.

20. The total payments to generators to not generate and corresponding volume of curtailed energy are not officially disclosed. In September 2015, the IESO issued a report indicating the need for additional capacity beginning in 2021. <http://www.ieso.ca/Documents/generation-procurement/NUG-Framework-Assessment-Report.pdf>

4.3 Obstacles to credible analysis of Ontario program costs and benefits

Detailed empirical analysis of the costs and benefits of DSM in Ontario is not possible with available data. The data that would be required to undertake such work is either not collected or not released by the government. What official analyses are available are focused on supporting existing Ontario government policy. The best that can be said about the methods for official measurements of conservation program results is that they are based on engineering methodologies, often developed by the US Department of Energy. However, these are the instruments found by Fowlie et al. to overstate, by a factor of 2.5, the actual energy savings experienced by program participants.

But perhaps the biggest problem with Ontario's implementation of the evaluation procedures is that the evidentiary value is compromised by the inclusion of explicit instructions to find evidence supportive of DSM programs.

The primary methodological document used by the Province to estimate power savings from DSM programs is *Evaluation, Measurement and Verification [EM&V] Protocols and Requirements*, published by the OPA (2013b). The opening paragraphs state:

> EM&V is critical in establishing Conservation and Demand Management (CDM) as a credible and reliable "first choice" resource in meeting future electricity supply needs of Ontario … It provides an administrative protocol; governing the "who," "how," "what," and "when" of EM&V. In addition to what has been described above, the "why" is to ensure that the Province and all market players can depend on CDM as a resource.

Page 11 provides even more specific direction:

> The Evaluation Administrator should clearly identify at least one (if not more than one) pathway (referred to as an attribution pathway) leading from program resource expenditures directly to energy and demand savings. By identifying an attribution pathway, the connection between program intentions and verified program energy and demand savings, including unintended savings impacts, can easily be seen.

Page 13 then prescribes the conclusions:

> When conducting evaluations, one must develop a robust analytical approach that yields statistically significant findings. Part Two of this guide provides guidance on the assessment of conservation programs.

> The manner in which a program is offered must be considered in the assessment. Therefore, all EM&V plans must provide a strategy that will result in evaluated savings estimates associated with the program.

A related document, released in October 2010 by the Ontario Power Authority, is the *Conservation and Demand Management Cost Effectiveness Guide* (OPA, 2010). This outlined the methodology to be used for assessing the costs and benefits of DSM programs. The second sentence of the Cost Effectiveness Guide stated:

> The ability to demonstrate cost effectiveness reinforces that CDM is typically a least-cost resource that can defer or avoid the need for investment in more expensive forms of electricity infrastructure and provides tools for customers to manage their electricity bills.

Perhaps in recognition of the prejudicial nature of this statement, it was removed from the 2014 update (OPA, 2014).

The data produced by practitioners using these documents underpins the Ontario government's energy policy. Unfortunately, little else does. On June 18, 2015, we sent a set of inquiries to the Ontario Minister of Energy's Office asking for the factual basis behind the Minister's claims about the savings from conservation policy. As shown in the Appendix, no valid information was forthcoming. Consequently, to the best of our knowledge, decision making at the highest level in Ontario regarding the costs and benefits of energy conservation programs is based entirely on evaluation methodologies that are already known to grossly inflate the benefits of the programs, and which are made worse by their inclusion of explicit instructions for practitioners to generate results that support the government's DSM agenda.

Conclusions

An energy theory of value that narrowly focuses on maximizing the efficiency of one or many economic inputs is a threat to overall economic efficiency. Overvaluing the efficient use of energy at the expense of capital, labour, and materials is harmful to economic efficiency in the same way that overvaluing any other input at the expense of the others would be harmful.

Billions of dollars of Ontario ratepayers' and taxpayers' funds have been consumed through conservation subsidies since the late 1980s. $3.1 billion have been earmarked for these programs over the period 2015–2020. Despite this vast commitment of resources, no independent audit of the actual impacts of conservation programs in Ontario based on verifiable field studies has ever been disclosed.

Methods used by the government to estimate and evaluate savings have long been known to be flawed. Recent field experiments in the US confirm earlier empirical studies that show the likely reduction in electricity consumption is a fraction of what standard methodologies estimate, and that the rate of return on energy conservation programs is negative.

We consider it highly likely that the current DSM programs are a net loss to the province and should be discontinued. But our review of the situation mainly points to the conclusion that there is a serious need for comprehensive, valid, and objective information on the costs and benefits of such programs in Ontario. In light of the massive amounts being spent on DSM programs, and the peril that would await us if programs accounting for such a large portion of our future electricity needs fail to deliver, we strongly recommend that the Province of Ontario commission a series of independent research projects that will undertake field experiments and conduct proper econometric evaluation of the actual consumption responses to DSM programs and the full social costs of their implementation.

Appendix 1

Correspondence with Energy Minister's Office

On June 18, 2015 we sent to the Ontario Minister of Energy's Office the following inquiries:

> The Conservation First policy document (and the Ministry's 2013/14 annual report) says, "Between 2006 and 2011, investing $2 billion in conservation allowed Ontario to avoid more than $4 billion in new supply costs." Do you have the breakout of conservation spending amounts by year and by agency?
>
> Please direct me [Adams] to any external audit performed on the Ontario Home Energy Savings Program or the Ontario Home Energy Audit Program.

On August 21, 2015, having had no response either to the email or to follow-up phone calls, we sent the following additional inquiry to the Minister's Office:

> Minister Chiarelli has a letter today in the Financial Post. In that letter, he states "over the past four years … we've conserved enough energy to power a city the size of London for two years or every hospital in the province for a year." He also states that conservation is "a plan that with every dollar invested results in two dollars in savings." He also claims that "the energy savings Ontarians have achieved have resulted in lower bills." Please refer me to the sources for these claims.

On September 2, having received no response, we gave a reply deadline of September 3, following which we would conclude for research purposes that no information was available. On September 3 we received a reply providing the following information.

> In response to the first query, the Minister's Office sent a breakdown of total spending by year, but not by agency. For further details we were told to consult the 2014 edition of the CEG, but it contains no spending data.

In response to the second query we were told the following:

> The Ontario Home Energy Savings Program and the Ontario Home Energy Audit Program were compliant with directives and policies issued by the Minister of Finance, Treasury Board and the Management Board of Cabinet. External financial audits were not performed on these programs.

In response to our query for the source behind the Minister's claim about the magnitude of energy savings, we were given information showing that London, Ontario uses about 3 terawatt-hours (TWh) per year, and Ontario's hospital sector uses about 6 TWh per year, so to substantiate the Minister's claim required data showing that conservation yielded about 6 TWh of savings over the 2011–2014 interval. The only source we were given was the 2014 Q4 Conservation Progress Report from the IESO, which contains a colour bar chart showing that the estimated savings in electricity consumption was about 6 TWh over the 2011–2014 interval (IESO, 2015a). That report, in turn, cited as its source the EMV document, which contains no actual estimates of electricity savings.

In response to our query about the claim that every dollar spent on conservation yields two dollars in savings, we were directed to the 2012 OPA Conservation Results Report. That report does claim (without substantiation) a 2:1 benefit cost ratio, but only for the Program Administrator Test, not using a Total Resource Cost test, for which the ratio falls to 1.3:1. And, once again, both tests rely on the reported results from users of the CEG and EMV guides.

In defence of the claim that conservation measures reduce electricity costs we were told:

> When customers participate in conservation programs, they use less electricity than they would have if they had not participated. Therefore, a participating customer's bill would be lower than it would have otherwise been had they not participated in the conservation program.

We were also referred to the government's estimates that conservation measures only cost around 3.5–4.0 cents/kWh.

Appendix 2
Examining the IESO Conservation Results Report

After the main body of this report was finalized, the IESO released its *2011–2014 Conservation Results Report* on December 23, 2015, and a report on the peaksaverPLUS Residential Demand Response program on January 27, 2016. The report on peaksaverPLUS relies on a previous report, *peaksaverPLUS® Program 2014 Load Impact Evaluation*, dated August 2015 and authored by the consulting firm Nexant.

2011–2014 Conservation Results Report

The 2011–2014 Conservation Results Report claims that conservation programs "help save on annual electricity costs" and that report provides "data" on "successes from Ontario's energy saving and demand management programs and other conservation activities." The IESO claims 6.553 TWh of energy savings over the period and 928 MW of capacity savings by the end of the period.

We comment in the main body of the report on reasons to be skeptical of these energy and capacity savings volumes estimates. However, even accepting the IESO's volumes estimates, the methodology behind the IESO's reported conservation program benefits does not stand up to scrutiny.

The cost to consumers, including program costs and equipment costs, of the IESO's conservation programs over 2011–2014 was $1.749 billion using the Total Resource Cost (TRC) test. The TRC test is intended to capture an overall societal perspective of cost. These costs reflect program administration costs and participant costs, which include the incremental cost of purchasing energy efficiency equipment over the standard baseline equipment. The overall cost of the programs appears to be reasonably estimated.

The benefits of the program, however, are not reasonably estimated. The IESO claims the overall benefits to consumers of the programs at $2.166

billion. If this estimate was reliable, it would indicate a benefit/cost ratio of about 1.2—a modest net benefit from the programs.[1]

The IESO calculates the benefits of saved energy based upon values contained in Appendix A of the OPA's 2010 CDM Cost Effectiveness Test Guide. Over the period of 2011–2014, the IESO has used avoided costs for energy that were about double the actual market values for power, except for a short period in the winter of 2014 when forecast and actual prices were similar. During the overall period, the IESO also assumed a price for avoided capacity of $140/kW-yr. In fact, over this period Ontario consumers were forced to pay substantial amounts to Ontario generators to not generate and to export customers to take excess power, all while the Ontario government continued to procure additional generation resources.

In her 2015 annual report, Ontario's Auditor General found that from 2009 to 2014, Ontario had to pay generators $339 million for curtailing 11.9 TWh of surplus electricity and paid export markets $32.6 million to take negatively priced exports. Since curtailment volumes and the frequency of negative market prices increased over the period, it appears that the volume of curtailed energy over the period 2011–2014 might well have exceeded the IESO's claimed conservation savings over that period.

The IESO defends the practice of evaluating conservation program results, not on a mark-to-market basis for the value of saved energy and capacity, but on the basis of predicted energy values at the time the programs were initiated.

> The avoided costs used to assess the 2011–2014 value of conservation reflect the assumptions used for long-term energy planning. Using avoided costs from an integrated resource plan to assess the value of conservation is industry best practice, as it accurately takes the long-term view to calculate the future benefit to the system.[2]

Estimating the conservation program benefits for the actual avoided value of the saved energy and capacity —again accepting the IESO's claims about the volumes of saved energy due to its programs—suggests program costs were approximately a complete deadweight loss.

1. Even this exaggerated estimate is further exaggerated in government pronouncements. In a February 19, 2016 announcement for additional funding to promote the Ontario government's energy agenda in schools, the Ministry of Energy states: "For every $1 invested in energy efficiency, Ontario has avoided about $2 in costs to the electricity system." <https://news.ontario.ca/mei/en/2016/02/ontario-investing-in-energy-literacy-to-help-fight-climate-change.html>

2. Email from Terry Young, IESO VP for Conservation and Corporate Relations, January 8, 2016.

Although the IESO provides no breakout of the claimed savings between energy and capacity, it appears that by applying a value of saved capacity at $140/kW-yr, in the order of $500 million in capacity savings were included in the overall value savings estimate of $2.166 billion. In light of the Auditor General’s findings regarding payments to generators to not generate and payments to export markets to take excess power over the period 2009 to 2014, the actual value to consumers of saved capacity due to conservation programs would be a cost (not a benefit) of at least $200 million. If the actual volume of saved capacity were less than the IESO estimated, then the deadweight loss of the programs would be somewhat mitigated.

Considering only the value of saved energy exclusive of saved capacity would indicate a benefit cost ratio of about 0.6 or less.

Applying the actual values for capacity and energy over the period 2011–2014, the IESO’s conservation programs appear to have resulted in little if any benefits to offset the $1.749 billion costs. Any benefits to individual conservation program participants were simply transfers from other consumers.

peaksaverPLUS

Unique among Ontario’s energy conservation programs, the peaksaverPLUS program has been the subject of empirical field verification studies using randomized control trials. Nexant reports that as of December 2014, approximately 300,000 control devices were installed on central air conditioners in Ontario, nearly all of them at residential premises. In addition, roughly 190,000 In Home Displays had been installed at participant premises. Over the period 2011–14, the average cost to the IESO per participant was $344. Since the program began in 2005, the overall cumulative cost to consumers now far exceeds $100 million.

The IESO’s *2011–2014 Conservation Results Report* lauds the peaksaverPLUS program.

> The peaksaverPLUS program was a successful tool in helping to get energy-saving information into the hands of customers across the province. The program included energy displays that helped drive participation and build awareness of energy efficiency in Ontario.

The IESO’s evaluation of the program concentrates on “brand awareness.” The IESO’s report notes “peaksaverPLUS® has the highest awareness (82% aided and 54% unaided) of participants engaged in other residential programs.”

The 2011–2014 Conservation Results Report claims 126 MW of capacity savings for the peaksaverPLUS program in 2014. In fact, due to moderate summer temperatures and excess capacity, the program was not activated at all in 2014 except for testing purposes.

Nexant's measurements indicate that energy savings achieved from the "In Home Display" element of the program are not statistically distinguishable from zero (Nexant, 2015: 49).

Communication failure with the peaksaverPLUS load control devices is a growing problem. The communication failure rate originally assumed was 1 percent. The actual failure rate in 2009 was 3 percent, as found in a study by the consulting firm KEMA. In 2014, of the distribution utilities offering the peaksaverPLUS program, Nexant's sampling found the best one to have a failure rate of 9 percent, with the worst performer with a measured communication failure rate of 29 percent (Nexant, 2015: Table 4-1). The failure rate has risen notwithstanding a recommendation in 2010 from KEMA to improve the communication failure rate.

The original plan to proceed with the program assumed that it would realize 1.1 kW of savings per participant. Nexant's measurement is that the actual savings in 2014 is one quarter of the expected rate—0.29 kW per participant at 29 degrees C (Nexant, 2015: Table 1-1).

The criteria by which the IESO has declared peaksaverPLUS to be a "successful tool" seems more to do with the high level of consumer awareness of the program than with its performance.

References

Ontario Government reports

Environmental Commissioner of Ontario (2014). *Annual Energy Conservation Progress Report*. Government of Ontario.

Independent Electricity System Operator [IESO] (2015a). *Quarterly Conservation Progress Report, 4th Quarter 2014*. Government of Ontario. <http://www.ieso.ca/Documents/conservation/Quarterly-Conservation-Report-Q42014.pdf>

Independent Electricity System Operator [IESO] (2015b). *2011–2014 Conservation Results Report*. Government of Ontario. <http://www.ieso.ca/Documents/2011-2014_Conservation_Results_Report.pdf>

Independent Electricity System Operator [IESO] (2016). *Options for the Future of peaksaverPLUS® Residential DR*. Webinar. Government of Ontario. <http://www.ieso.ca/Documents/consult/sac/SAC-20160210-Item-6-PeaksaverPLUS.pdf>

Office of the Auditor General of Ontario (2015). *2015 Annual Report*. Government of Ontario.

Ontario, Office of the Premier (2004). *McGuinty Government Building Culture Of Conservation*. Press Release. Government of Ontario. <https://news.ontario.ca/opo/en/2004/04/mcguinty-government-building-culture-of-conservation.html>

Ontario Energy Board (2009). *Third Tranche Conservation and Demand Management Spending Staff Report*. Government of Ontario.

Ontario Hydro (1989). *Demand/Supply Plan 1989*. Government of Ontario.

All websites retrievable as of March 8, 2016.

Ontario, Ministry of Energy (2012). *2011/12 Annual Report*. Government of Ontario.

Ontario, Ministry of Energy (2013). *Conservation First: A Renewed Vision for Energy Conservation in Ontario*. Government of Ontario. <http://www.energy.gov.on.ca/en/conservation-first/>

Ontario, Ministry of Energy (2014). Letter from the Minister to the CEO of the Ontario Power Authority. Government of Ontario. <http://www.powerauthority.on.ca/sites/default/files/news/MC-2014-2415.pdf>

Ontario, Ministry of Energy (2015). *Energy Conservation, Efficiency and Supply*. Government of Ontario. <http://www.energy.on.ca/en/files/2016/02/pps-infosheet-energy-conservation-efficiency-and-supply-en.pdf>

Ontario Power Authority [OPA] (2010, 2014). *Conservation and Demand Management Cost Effectiveness Guide*. Government of Ontario. <http://www.automaticpage.com/mycv/sites/default/files/OPA%20CDM%20Cost%20Effectiveness%20Test%20Guide%20-%202010-10-15%20F.pdf> <http://www.powerauthority.on.ca/sites/default/files/conservation/CDM%20EE%20Cost%20Effectiveness%20Test%20Guide%20Final%20v1_10312014.pdf>

Ontario Power Authority [OPA] (2012). *Conservation Results Report*. Government of Ontario. <http://www.powerauthority.on.ca/sites/default/files/conservation/Conservation-Results-Report-2012.pdf>

Ontario Power Authority [OPA] (2013a). Annual Report. Government of Ontario.

Ontario Power Authority [OPA] (2013b). *Evaluation, Measurement and Verification (EM&V) Protocols and Requirements*. Government of Ontario. <http://www.powerauthority.on.ca/sites/default/files/conservation/Conservation-First-EMandV-Protocols-and-Requirements-2015-2020-Apr29-2015.pdf>

Ontario Power Authority [OPA] (2013c). *Energy Conservation Attitudes and Behaviours Study 2013, Final Report*. Government of Ontario. <http://www.powerauthority.on.ca/sites/default/files/conservation/2013-OPA-Market-Research-Energy-Conservation-Attitudes-Behaviour-Study.pdf>

Ontario Power Authority [OPA] (2014, December 16). *Target and Budget Allocation Methodology: Conservation First Framework LDC Tool Kit*. Government of Ontario. <http://www.powerauthority.on.ca/sites/default/files/conservation/LDC-Target-and-Budget-Allocation-Methodology-Summary-v2%20 2014-12-16.pdf>

Ontario Power Authority [OPA] (2015). *Directives from Minister of Energy*. Government of Onatrio. <http://powerauthority.on.ca/about-us/directives-opa-minister-energy-and-infrastructure>

Other sources

Arimura, Toshi, Shanjun Li., Richard G. Newell, and Karen Palmer (2011). *Cost-Effectiveness of Electricity Efficiency Programs*. NBER Working Paper No. 17556. National Bureau of Economic Research. <http://www.nber.org/papers/w17556>

Brannlund, R., T. Ghalwash, and J. Nordstrom (2007). Increased Energy Efficiency and the Rebound Effect: Effects on Consumption and Emissions. *Energy Economics* 29: 1–17.

Canadian Energy Efficiency Alliance [CEEA] (2013). *Energy Efficiency and Canadians: Opinion Research for The Canadian Energy Efficiency Alliance*. Canadian Energy Efficiency Alliance. <http://energyefficiency.org/resources/reports/opinion-research-executive-summary-april-2013/>

Fowlie, Meredith, Michael Greenstone, and Catherine Wolfram (2015). *Do Energy Efficiency Investments Deliver? Evidence from the Weatherization Assistance Program*. Berkeley University Working Paper.

Gayer, Ted, and V. Kip Viscusi (2013). Overriding Consumer Preferences With Energy Regulations. *Journal of Regulatory Economics* 43: 248–64.

Inter-Agency Working Group (2013) *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*. Inter-Agency Working Group.

Joskow, Paul L., and Donald B. Marron (1992). What Does a Negawatt Really Cost? Evidence from Utility Conservation Programs. *The Energy Journal* 13, 4: 41–74.

Kahn Alfred E. (1991). An Economically Rational Approach To Least Cost Planning. *The Electricity Journal* 4, 5: 11–22.

Levine, Mark D., Eric Hirst, Jonathan G. Koomey, James E. McMahon, and Alan H. Sanstad (1994). *Energy Efficiency, Market Failures and Government Policy*. Lawrence Berkeley Laboratory Discussion Paper LBL-35376.

Lovins, Amory (1990, September 9). The Negawatt Revolution. *Across the Board* XXVII: 9. <http://www.thewindway.com/pdf/E90-20_NegawattRevolution.pdf>

McKitrick, Ross (2010). *Economic Analysis of Environmental Policy*. University of Toronto Press.

McKitrick, Ross, and Tom Adams (2014). *What Goes Up: Ontario's Soaring Electricity Prices and How to Get Them Down.* Fraser Institute.

McKitrick, Ross R. (2015) The Principle of Targeting in Energy and Environmental Policy. Fraser Institute Research Bulletin, Vancouver BC.

Mizobuchi, Kenichi (2008). An Empirical Study on the Rebound Effect Considering Capital Costs. *Energy Economics* 30: 2486–516.

Navigant (2015). *Ontario Smart Grid Assessment and Roadmap*. Navigant Consulting Ltd. <http://www.ontarioenergyreport.ca/pdfs/Navigant-Smart-Grid-Assessment-and-Roadmap-Final-Report-.pdf>

Nexant (2015). *peaksaverPLUS® Program 2014 Load Impact Evaluation.* <http://www.powerauthority.on.ca/sites/default/files/conservation/2014-Evaluation-peaksaverPLUS.pdf>

Wirl, Franz (2000). Lessons from Utility Conservation Programs. *The Energy Journal* 21, 1: 87–108.

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