Letter of transmittal

October 31, 2008
The Honourable George Smitherman
Minister of Energy and Infrastructure
Queen's Park
Toronto

Dear Minister Smitherman,

Further to Order-in-Council 129-2008, we have the honour of presenting to you our report and recommendations on achieving Ontario's ambitious goal of 100,000 solar roofs across this province.

We owe thanks to the many individuals and organizations whose insights and suggestions helped to shape our deliberations. We also express our sincere gratitude to the members of your Ministry's staff who greatly assisted us throughout the course of our work.

Minister, we are confident that the course of action outlined in this report will help to make solar hot water technology a key part of this province's energy sustainability and its goal of growing innovative, green jobs in Ontario for years to come.

Respectfully,

The Solar Task Force

Executive summary

The timing is right for Ontario and its Ministry of Energy and Infrastructure to take the lead on supporting the adoption of solar hot water for households in this province. We believe that if our recommendations in this report are acted on quickly Ontario can achieve its ambitious goal of 100,000 solar roofs within 15 years.

We recognize that creating a market and growing the industry to lift Ontario from its current position of roughly 1,000 residential installations will take sustained effort on the part of the Province, the industry and others. The experience of other jurisdictions – for example Austria, where 20% of homes use solar heating – shows that concerted effort can result in very high growth rates, especially in the initial stages of market expansion.

We also believe that the Province has an essential role to play not just in supporting market expansion, but in coordinating early efforts to ensure they are efficient and effective.

The road to success

While our work identified a number of challenges to greater adoption, all of these concerns can be addressed successfully in Ontario as they have been elsewhere. Several strong positive factors, including the Province's commitment to a target of 100,000 solar roofs and its leadership on greenhouse gas reduction, underline this ability.

We believe that a phased approach will ensure orderly growth that supports the development of an Ontario manufacturing industry to meet increased demand. This will ensure that jobs in manufacturing, installation and maintenance of solar hot water systems have a strong position in Ontario's shift to a "green" industrial base.

Phase 1 will "prime the pump" by raising public awareness, improving economic incentives and increasing the capacity of the industry. Phase 2 will see a broadening of the market and substantial new installations. The 100,000-roof target will then be achieved in Phase 3. As Phase 3 continues, the technology will become widely accepted and adoption will increase well beyond the target level.

Phase 1. Priming the pump: 2009-2011

Ontario can reach at least 5,000 installations in the three years and move from 60-100 installations a year to more than 2,000 a year. This will create the experience and the critical mass needed to expand the market broadly across all segments of the home market in Ontario. This would be achieved through the following actions led by the provincial government:

1. Put in place a broad consumer information program
2. Grow the culture of conservation in the schools
3. Work to make all new homes solar ready

4. Place more solar systems into subdivision model homes and sales centres
5. Increase residential rebates to the level provided to businesses and institutions
6. Work with federal officials to develop ways of compensating solar hot water system buyers for the cost of the current audit requirement and to make the rebate available to all homeowners
7. Provide a zero-interest loan program across the province
8. Exempt solar hot water systems from retail sales tax
9. Allow consumers to benefit from all available programs
10. Support increased training as an element of the industry's expansion
11. Act immediately on the risk assessment of solar hot water to the water supply
12. Review building code treatment of solar hot water collectors
13. Allow municipalities to use local improvement charges for supporting renewable and energy efficiency improvements on private property
14. Get municipalities involved in pilot and more broadly-based programs
15. Expand the mandate of the Ontario Power Authority to explicitly include energy sustainability.
16. Take a lead in developing a national performance database for solar hot water systems
17. Provide provincial support for certification, testing and facility upgrades
18. Support development of better information on the solar hot water industry and its products
19. Move to enact "right to light" legislation as an element of a "green energy" act

Phase 2. Broadening the market: 2012 - 2017

By the end of Phase 1, Ontario will have installed at least 5,000 roofs. While that may seem like a low number, it represents a five-fold increase from the current level. Even more important, reaching this level will put in place the infrastructure for significant sustained growth.

As a result, in this second phase, as many as 60,000 solar roofs could be added. With strong demand, there will be important investment and job-creation opportunities. This phase will focus on broadening public education efforts and expanding the concept of systems in model homes to "model subdivisions" in which all homes come equipped with solar systems.

Detailed recommendations for this phase will suggest themselves as the market for solar hot water and conventional energy evolves. We suggest the following actions at a high level:

1. Introduce "right to light" provisions as part of a "green energy" act
2. Ramp up public education programs
3. Build capacity in the solar hot water manufacturing sector in Ontario through tax incentives and other mechanisms
4. Evolve the adoption of solar hot water from model homes to model suburbs

Phase 3. Reaching sustainability: 2018+

In Phase 3, going beyond 2017, energy prices are likely to be such that consumer subsidies will not be as necessary and may be reduced. With sustained support, Ontario would start to have world-level installation numbers. The focus of government efforts could be more on industrial expansion, turning Ontario into an international export powerhouse, benefiting from the groundwork laid in the first two phases.

A natural evolution

Finally, we note that a fully integrated energy policy for Ontario that includes conservation and renewable sources of energy, including sunlight, would be the next natural step in the evolution of Ontario's energy policies.

It would also provide strong encouragement for investments in jobs in renewable energy, to the benefit of workers and society as a whole. This is a strategy that our major trading partners understand and are acting on. Like them, Ontario's support for renewable energy can help to address in a responsible way the challenges created by global economic conditions.

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I. Introduction

Canada's daily consumption of hot water is estimated to be as high as 80 litres a day for every person, which would make us the largest users of hot water on earth. Our consumption level is so high, in fact, that it accounts for almost one-quarter of total energy costs for a typical home, or about $500 a year. It is the single largest use of household energy after home heating.

Yet heating water with sunlight – a safe, clean and renewable technology – is almost unheard-of in this province. The sun delivers about 170,000 kWh to the area taken up by an average-sized Ontario house every year. We notice its warmth even on cloudless winter days, and in the summer its energy is so intense that it can buckle pavement. Other places have embraced the technology – Germany, for example, adds about 90,000 new solar roof systems every year. But in Ontario the sun's potential to heat our water or homes goes almost entirely untapped.

The benefits of solar heating

This is in spite of the major benefits that solar hot water offers to homeowners and society as a whole:

- For many houses, it represents the single largest step that can be taken to reduce greenhouse gas emissions and improve air quality;
- Solar hot water is a local solution, owned and operated by individual Ontario homeowners, that eases the strain on energy infrastructure, diversifies energy sources, and improves security of supply;
- Panels on a homeowner's roof send a strong visual signal of a commitment to conservation;
- On a large scale, it would create ongoing jobs in Ontario to manufacture, install and maintain systems, presenting a potential export market;
- It ensures that the energy dollars that Ontario spends are kept in Ontario, paying for Ontario jobs and wealth creation;
- Adding solar hot water will reduce the incentive for households now heating with gas to switch to electrical hot-water heating when time-of-use billing is implemented;
- Using sunlight is a key component of an innovative mix of renewable energy sources for water and space heating in the green housing of the future; and
- It provides a hedge against volatile energy prices.

Despite these individual and social benefits and the high cost of heating the large volumes of hot water Ontario households use every day, only about 1,000 solar roofs have been installed in

Reducing greenhouse gases

For the average family of four in Ontario, adding a solar system would remove about 700 kilograms of carbon dioxide from the air every year. That is equivalent to driving about 3,000 fewer kilometres a year in the family car.

Hitting the 100,000-roof target would reduce carbon dioxide emissions by more than 70,000 tonnes, helping to meet Ontario's greenhouse gas reduction targets. It would significantly reduce smog as well.

The Province's Go Green Plan for the environment notes that "no place in Canada is committed to producing more real GHG reductions than Ontario."

Its targets:

Reduce Ontario's greenhouse gas emissions to 6 per cent below 1990 levels by 2014 – a reduction of 61 megatonnes relative to business-as-usual.

By 2020 Ontario will reduce greenhouse gas emissions to 15 per cent below 1990 levels – a reduction of 99 megatonnes relative to business-as-usual.

By 2050 Ontario will reduce greenhouse gas emissions to 80 per cent below 1990 levels.

Ontario over the past two decades. If Ontario is to meet the ambitious target of 100,000 solar roofs that it has set, it is essential to understand and solve that seeming paradox.

That was our task. Constituted as the Solar Task Force earlier this year, we were asked to provide advice to the Minister of Energy and Infrastructure on how to expand the residential solar hot water market and better reap the benefits of the technology. In carrying out our mandate, we looked specifically at how to move from our current level of installations, which is among the lowest in the world on a per-capita basis, to one in line with that of leading jurisdictions. Our biographies appear as Appendix A.

Ontario positioned to lead

Ontario is well positioned to become a leader in solar hot water technology in Canada and perhaps even in North America. It has a strong manufacturing base, a flexible workforce and training system, positive public attitudes to green technologies, and a firm government commitment to renewable energy and greenhouse gas reduction. For these reasons, we believe Ontario can achieve its 100,000-roof target – and even surpass it. We recognize that it will take a strong commitment on the part of government and the industry over a sustained period of time, but it can be done.

We reached our conclusions through several months of consultation and discussion. To help shape and support our findings, two consulting firms were engaged to look in more detail at market conditions and the public policy environment. The Gandalf Group assessed the potential market for solar systems and the profile of the key "early adopter" groups that will help to build public interest in solar systems. Marbek Resource Consultants Ltd. looked at the characteristics of Ontario – including hot water consumption, solar resource, energy costs and public policy – against those of other jurisdictions with significant solar hot water usage. Their report also described the current state of the solar hot water industry in Ontario. We thank both firms, on whose findings and analyses we have relied heavily. Their reports appear on-line at:

http://www.energy.gov.on.ca/index.cfm?fuseaction=conservation.solartaskforce

We also heard from a range of participants in the solar hot water industry, as well as home builders, building officials, homeowners and others with an interest in the technology. A list of those who made presentations is provided as Appendix B. Our thanks to all of those who took the time to share their insights and advice with us.

The Ministry of Energy and Infrastructure provided us with administrative support and with background and analysis of existing programs and policies. We thank the staff of the Ministry for their hard work, dedication and thoroughness over several months of discussion and deliberation. We also extend thanks to staff at Natural Resources Canada, the federal department responsible for renewable energy programs, for their help in filling in the solar hot water picture in Ontario and across Canada for us.

The remaining sections of this report look at:

- The characteristics of Ontario's hot water heating market;
- The potential market for solar domestic water heating in Ontario;
- The industrial and employment potential of the technology;
- The experience elsewhere;
- The challenges to more widespread adoption; and
- Our proposed solutions – including a roadmap to achieving not just the current target, but much greater adoption of this important technology in Ontario.

Ontario has set a challenging target of 100,000 solar roofs, a target that we fully endorse. We are extremely hopeful that our advice and recommendations will help the Province achieve that goal as quickly and effectively as possible.

Part of an integrated strategy

Our mandate called for a focus on solar hot water for residential purposes, and we have responded with that focus in mind. We are strongly of the view, nonetheless, that solar energy of all kinds has a very large role to play in Ontario's future.

We see solar technologies as key parts of an integrated renewable energy strategy – one that would harvest sunlight through passive, thermal and photovoltaic technologies and use it for water and space heating as well as electricity generation.

We recognize that creating such a strategy and integrating it with energy needs and other supply sources will be a complex exercise with impacts on energy and other infrastructure. It will involve multiple ministries and other orders of government, as well as expertise across a

range of disciplines. We look to the Ministry of Energy and Infrastructure to lead in developing and acting on a comprehensive and effective strategy to ensure Ontario of a sustainable energy future. Such a strategy should inform Ontario's industrial policies and support a responsible shift to "green" jobs and companies.

By improving the ways in which we make use of our natural and renewable energy sources, Ontario is already helping to ensure a cleaner, healthier environment and reducing our dependence on the world's dwindling supplies of fossil-based fuels. Taking this evolution to the next level will benefit not only today's residents, but will continue to pay dividends for those who come after us.

II. Background

This chapter looks at how water is heated now in Ontario, as well as the technology and economics of solar hot water.

The current Ontario market

More than 90% of single-family homes in Ontario currently use either electricity or natural gas to fuel a conventional system – one which heats water in a central tank from which it is piped to its end use in the house. Natural gas dominates as a fuel source, powering close to two-thirds of all Ontario domestic water heaters.

A unique characteristic of the Ontario hot-water heating market is the very high proportion of water heater rentals, which account for close to 90% of residential installations. The practice of renting is so widely accepted that it is written into the real estate industry's standard agreement of purchase and sale for homes in Ontario.

The local gas and electricity utilities that once provided rentals were required to divest themselves of that business in 1999. As a result, two entities – Reliance Home Comfort and Direct Energy – dominate the rental market, with portfolios of roughly 1.5 million and 1.4 million heaters respectively. In a few places, however, municipally-owned corporations are still in the water-heater rental business.

The rental cost covers installation, removal and a range of maintenance and repair services. There is a range of rental fees, starting at about $10 a month and going up to about $40 depending on the size and efficiency of the system. Most newly-installed tanks rent for about $20 a month.

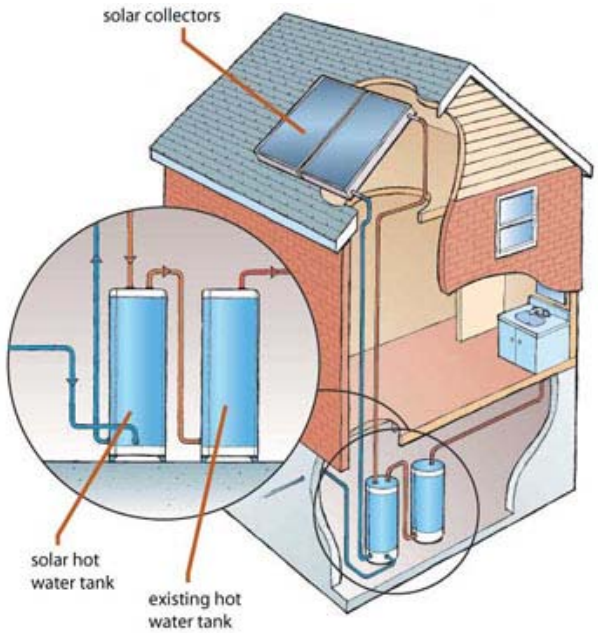
Conventional hot-water heaters in Ontario vary in their energy efficiency. The Ontario Energy Efficiency Act requires them to meet a minimum efficiency threshold of .60 EF (energy factor), less a factor for tank size. The standard hot water tank provided to builders, which holds 50 gallons, is .57 EF. This means that the average energy efficiency of a conventional water heater is estimated to be less than 60% – that is, more than 40% of the energy it consumes goes to exhaust venting and heat lost through the tank jacket. In comparison, new furnaces installed in Ontario must by law be 90% efficient.

The market has recently introduced natural gas high-efficiency water heaters with an EF between .80 and .85. The EnergyStar program has released standards for hot water tanks and heaters effective January 1, 2009 and January 1, 2010 that will require products carrying their label to have a minimum efficiency of .65 EF.

How solar hot water systems work

Appendix B provides background information on the technology behind solar domestic water heating. These systems are not "photovoltaic" – that is, they do not create an electric current from sunlight. Instead, they capture the heat of the sun in tubing on the roof and pump it into

the house to heat the water supply. The following diagram gives an overview of how the technology, called solar hot water, operates in a residential setting.



Solar hot water systems are not always used just to heat water for household consumption: they can provide combined water and home heating. This approach is used in European countries, particularly Austria and Germany, and technology is evolving quickly in this area.

The economics of solar hot water

The website of Natural Resources Canada estimates the average solar energy across Canada is great enough to allow a solar system to meet about one-half the water heating needs of a family of four.

Ontario is in line with that estimate. Appendix B provides maps showing the average solar resource across the province in summer and winter. Our average "solar resource" amounts to 3.6 kWh/m^2/day – this means that on average, the sun delivers 3.6 kWh of energy to every square meter of solar panelling every day. The actual energy varies, of course, with cloud cover and time of year. On a sunny day, a solar system can provide enough energy to meet average hot water needs. At other times, however, when sunlight is weaker and there may be more cloud cover, the water needs to be heated further using conventional energy.

Clearly, the less supplementary energy needed, the greater the benefit to the homeowner. With two identical systems, each costing the same to install, the one that needs less supplementary heat will have lower costs over time and will save the homeowner more. We estimate that for a family of four in Ontario, adding a solar hot water system translates into savings of roughly $325 a year if electricity is used for water heating, or $200 a year if it is natural gas.

As noted, natural gas now dominates as the energy source for domestic water heating. Its market share has grown steadily over the past two decades, reflecting the relative movement of its price against that of electricity. At present, over the expected life of the equipment and including up-front as well as operating costs, it costs an estimated 13.7 cents/kWh to use natural gas for water-heating, compared to 17.0 cents/kWh for electricity, taking into account the efficiency of both heating technologies. (This is for an owned system; the estimates are similar for rental.)

The economics of heating with electricity will change in 2010, when the province moves to "smart meters" for electricity. These will permit lower rates for electricity used at times of lower demand, which is called time-of-use billing. Some consumers who use electricity for water-

heating may be able to meet most of their demand at such off-peak times and thus lower their bill.

A convergence of factors could cause those currently using natural gas to heat water to shift to electricity, a change known as fuel-switching. One of these is the move to time-of-use billing. If natural gas prices remain volatile with an over-all upward trend, householders using that fuel source may see switching to off-peak electric water heating as a highly attractive option. Other factors, such as the higher efficiency of electric heaters, may increase the incentive to do this.

A shift from natural gas to electricity will create new pressures on the electricity system. Encouraging those using natural gas to add a solar heating system would reduce their costs and thus reduce the incentive to switch to electricity.

"Tankless" systems: a good fit with solar

"Tankless" or "on-demand" water heaters are emerging as a new technology that uses less energy than a conventional tank system. Rather than storing hot water in a tank, these systems heat cold water as it passes through the heater on its way to the end use. Usually about the size of a suitcase, a tankless unit can be powered by natural gas or electricity. The average EF of a tankless natural gas system is about .80, while those using electricity as the power source have an EF of .90. Units can be placed at various points in the house near where the hot water is needed, or one unit can replace a conventional tank.

While used widely elsewhere in the world, tankless heaters have not gained wide acceptance in the North American market, mainly because they are more expensive than conventional storage tank water heaters. Because the units use less energy and are responsible for less emission of greenhouse gases, however, this technology has become more common in North America in recent years.

In combination, tankless and solar hot water minimize the amount of energy needed to provide hot water to a house. Feeding solar-heated water into the tankless system reduces the already small amount of energy needed to bring it up to the desired end temperature. This combination of systems has the lowest operating costs, but is the most expensive to install. It might appeal in particular to committed environmentalists and those looking for energy independence. The following chapter discusses the characteristics of these and other potential buyers of solar systems.

III. The solar market in Ontario

The widest definition of the potential market in Ontario for solar hot water is every house with an unobstructed roof of suitable design and orientation. This could mean many as 65% of Ontario's single-family detached houses, which currently total 2.9 million, as well as many of the other types of homes across the province. (Some types of housing, such as high-rises, are less suitable because of the small area of roof available relative to the number of people living in the building.)

Getting to this level will require sustained effort over time. Ontario, with an estimated 1,000 solar roofs at present, is clearly in the very early stages of market growth. Experience elsewhere has shown that growth rates can be very high, especially in the early years of concerted effort to develop the market.

Early adopter target groups

Research in Canada and other jurisdictions has focused on identifying "early adopters" for solar domestic water heating. These are the consumers who will buy systems in the initial phase of market development. Identifying and reaching them is a critical step in showcasing this relatively unknown in Ontario technology. It will help to develop wider acceptance of solar hot water, as well as expanding the capacity of the industry.

The report from Gandalf commissioned for us concluded that there are four potential early adopter groups:

- Committed environmentalists;
- Cost savers with environmental leanings;
- Those with a focus on energy independence who are technologically minded; and
- New home buyers.

Gandalf notes that a mass market consisting of "early adopters" does not yet exist in Ontario. This market will have to be created. Improving awareness is the first step, and the benefits and challenges of the product itself will then determine who buys. This table shows the characteristics and sales opportunities for each of the first three groups of potential early adopters:

Group	Characteristics	What would make them buy
Committed environmentalists	Motivated by over-all benefits to society and the environment, not cost savings	Greater awareness of the environmental benefits, assurance as to product quality
Cost-savers with environmental	Environmental benefit must be supported by cost savings.	Greater awareness of product; seeing

leanings	Likely to be at or near retirement and concerned about expenses on a fixed income.	economic value in purchase
Energy independence seekers	Concerned about energy costs and security of supply	Greater awareness of technology as a hedge against prices; seeing economic value in purchase

Together, these early adopter markets represent the most important opportunity in the initial stages of market development. They collectively total and might even exceed the market needed to reach Ontario's 100,000-roof target in the near future.

Elements of the fourth group, new home buyers, may share some of the characteristics of the other three early adopter groups. What makes them unique is the ease with which they can be reached, especially if they are buying a new home in a subdivision. For that reason, it is worth looking in more detail at the new home market.

The new home segment

Additions to Ontario's housing stock are dominated by subdivision developments that consist of anywhere from a handful to hundreds of houses, all designed and built on a mass scale. This is very different from Europe where most new building is done on a one-off, custom basis as urban in-fill.

There are strong reasons to target buyers of new subdivision homes as a specific group.

- Developers build 30,000 or more new single-family detached homes in Ontario every year. By capturing only 10% of buyers in that market, Ontario could add more than 3,000 new solar roofs a year.

- Potential buyers of new subdivision homes are a captive audience. Having a solar system in a model home in every development and including the basic installation requirements in every home in the development is one way of building awareness among buyers to choose such a system as an option.

- Another approach would be installing a solar hot water system in every home up-front, especially bundled with environmentally-friendly features in a "green" subdivision. Particularly attractive to forward-thinking consumers, these communities would in turn drive interest in the technology in broader society and increase its appeal to all homeowners. New directions in building, such as the "integrated program process" that integrates design with sustainability and net zero energy homes, are likely to help expand the ways in which solar energy can be used to meet a development's energy needs.

- There are well-defined marketing channels for water heating systems, with two rental companies together providing essentially all new water heaters in subdivisions.

- Making new homes "solar-ready" through pre-plumbing, solar roof orientation and planning guidelines for optimal harvesting of sunlight can be encouraged with economic incentives or mandated by government without adding significant cost to new houses.

- When included in a new home, the up-front cost of a system is easier to spread out over time by including it in the mortgage or creating a rental arrangement similar to those used for conventional water heaters.

- Builders or rental companies might be able to bundle subsidy applications to reduce paperwork for buyers and gain administrative economies of scale.

Retrofits to existing homes

The market for retrofits, although harder to reach out to as an identified group, is critical for wider adoption. The stock of existing homes is much greater than the incremental number of new ones added each year, so it represents a large potential market. It is also a market that covers more of the province, because new subdivisions tend to be concentrated in a limited number of areas.

Urbanized areas are expected to have limited large-scale new builds in future, so retrofits will have to be the major way of getting a large number of roofs there. As energy demand grows, these areas might benefit more than others from solar installations because of transmission constraints.

Because of the case-by-case nature of this market, it will require a different strategy. For example, neighbourhood groups in established areas can be a valuable channel for getting information out and organizing larger-scale purchases and installations that might save money for individual homeowners.

As well, success at capturing the retrofit market will require partnering with municipalities. Careful coordination among provincial ministries will be key to ensuring this happens in a coherent fashion that encourages market growth. This must be an element of the coordinated approach to an integrated energy policy that we have suggested.

Broad-based and pilot programs

Although we are in the early stages of market development, several programs are in place to support solar hot water adoption. The federal and Ontario governments currently provide two general types of support: broadly-based programs that provide funding or rebates to purchasers; and pilot programs with builders, utilities and other organizations with an interest in the technology.

This table shows existing broadly-based programs:

Program name	Offered by	Available to	Details
ecoENERGY Retrofit Homes	Federal govt	Homeowners	Requires home energy audit; maximum $500 rebate for solar hot water

Home Energy Savings Program	Ontario	Homeowners	Matches $500 ecoENERGY Retrofit rebate; provides 50% rebate for energy audit (up to $150).
Sales tax rebate	Ontario	Homeowners	Retail sales tax portion of cost
ecoENERGY Renewable Heat Program	Federal govt	Business, municipalities, public institutions	Maximum $80,000; payment based on a rate per square metre of collector area multiplied by a collector-specific performance factor
Ontario Solar Thermal Heating Incentive	Ontario	As above	As above; matches federal funding

Pilot programs

There are a number of solar hot water pilot programs in progress and under development across the province. These include several under a Natural Resources Canada program at the federal level, as well as the provincial PowerHouse program that is discussed later.

The entities we identified as being involved in pilot programs include:

- Bullfrog Power
- City of Hamilton
- City of Toronto – Toronto Solar Neighbourhoods Initiative
- Enbridge
- Ontario Ministry of Energy and Infrastructure – Powerhouse Program
- Peterborough Green-Up
- Reliance Home Comfort
- Sustainable Ottawa/Seventh Generation - Solar H2Ottawa
- Utilities Kingston

The number and type of pilots suggests a need for coordination to make effective use of the results as wider programs are developed.

IV. The industry's potential

Reaching the 100,000-roof target and then moving to sustained growth provides an excellent opportunity for Ontario to create jobs in an innovative, green industry by meeting demand for an environmentally-friendly technology.

Sector will need to grow quickly

Canada's solar hot water industry is small at present, providing the equivalent of an estimated 150 full-time jobs across the country.

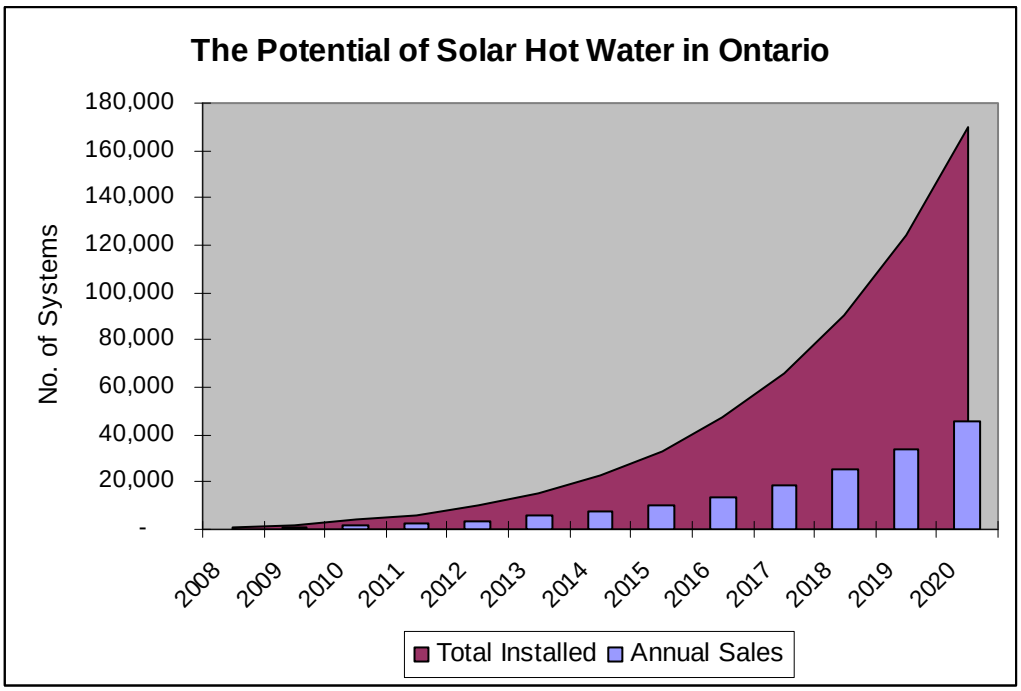
There is no official, accurate source of information on the number of solar domestic water heating systems sold in Ontario. The available information is at best anecdotal, as many systems are installed without building permits. Therefore, estimates range from as low as 60 to more than 100 installations a year.

A number of manufacturers sell their product in Ontario, with the market shared between domestically-manufactured and imported product. Only two Canadian manufacturers are large enough to have international sales, compared to an estimated 50 in the United States. Sales are typically made to customers through solar specialty firms, as well as mechanical contractors, plumbers or other installers. There is a recent trend toward systems being marketed through "big box" home improvement stores, which then sub-contract the installation. Most of the companies specializing in solar installations are small, employing only a few people.

Despite the small size of the industry in Ontario at present, its participants are enthusiastic about the potential for the technology to help Ontario to evolve to a more sustainable energy future.

That evolution would also create jobs as part of a general shift toward employment in the "green" economy. Large-scale adoption of solar hot water systems made in Ontario would create thousands of manufacturing jobs in the province, as well as in raw materials processing and other related activities. Installation and ongoing maintenance of systems represent additional jobs over the long term. Installation typically involves two to four person-days of work; after installation, routine maintenance is required on a regular basis.

As part of our work, we developed a basic model of potential growth scenarios. Using aggressive growth rates similar to those experienced by the solar hot water industry in leading countries around the world, we believe that achieving 100,000 solar roofs can be accomplished within 15 years from the start of significant support from government. We believe that sales can increase from the estimated 60 to 100 a year (in 2007) to more than 45,000 systems a year by 2020.



Building a domestic industry to meet Ontario demand would also present opportunities to expand the export market, as other jurisdictions in North America also begin to adopt the technology on a broader basis.

Ontario's ability to take advantage of this opportunity will require strong and consistent support by government, especially in the next several years as people in Ontario and elsewhere wake up to the benefits of the technology. With major solar hot water manufacturing capacity off-shore, including as many as 10,000 factories in China that are currently meeting its own demand, Ontario will need to move quickly and decisively to ensure that its domestic industry continues and thrives. Government can support the domestic industry in several ways, which we explore in more depth in our roadmap to success.

Capacity building under way

Certification of installers is a way of helping to ensure quality installation. The Canadian Solar Industries Association (CanSIA) currently provides certification training and testing for existing installers. To date it has certified 31 installers across Canada, 15 of them in Ontario. These numbers understate the growing interest among applicants, however, as the organization has so far this year trained more than 200 people who can be expected to go on to write the certification exam.

CanSIA, with the help of Natural Resources Canada, has updated and translated its training materials for solar hot water installers. The government of British Columbia requires that in order to ensure a consistent level of quality installation, any government-supported solar hot water installation must use a CanSIA-certified installer.

Recognizing the need for post-secondary training in this field, Natural Resources Canada is also providing funding at the federal level for the Association of Community Colleges of Canada (ACCC) to develop curriculum for solar hot water courses and solar photovoltaic programs. As well, the federal department is providing funding to the Electricity Sector Council for developing occupational standards for solar hot water installers, which will help to make training and accreditation consistent.

Ensuring quality and safety

Before making a large and long-term investment, consumers need credible evidence that the product will perform and last as long as expected, that any defects will be corrected, and that the system will not present risks to the property.

The industry, building authorities and government bodies are already working to ensure the quality and safety of solar hot water installations. Warranties are a marker of quality, for example, because the longer the term of the warranty, the higher the quality is assumed to be. Warranties on systems are similar to those for other space and water heating equipment.

The most recent version of Ontario's building code, which sets the minimum standards for construction in the province and deals mainly with safety issues, covers solar hot water systems. It includes guidance on both packaged and non-packaged systems, and requires that packaged systems carry the certification of the Canadian Standards Association (CSA), a nationally-recognized body. The code requires that non-packaged systems must be installed "in accordance with good engineering practice."

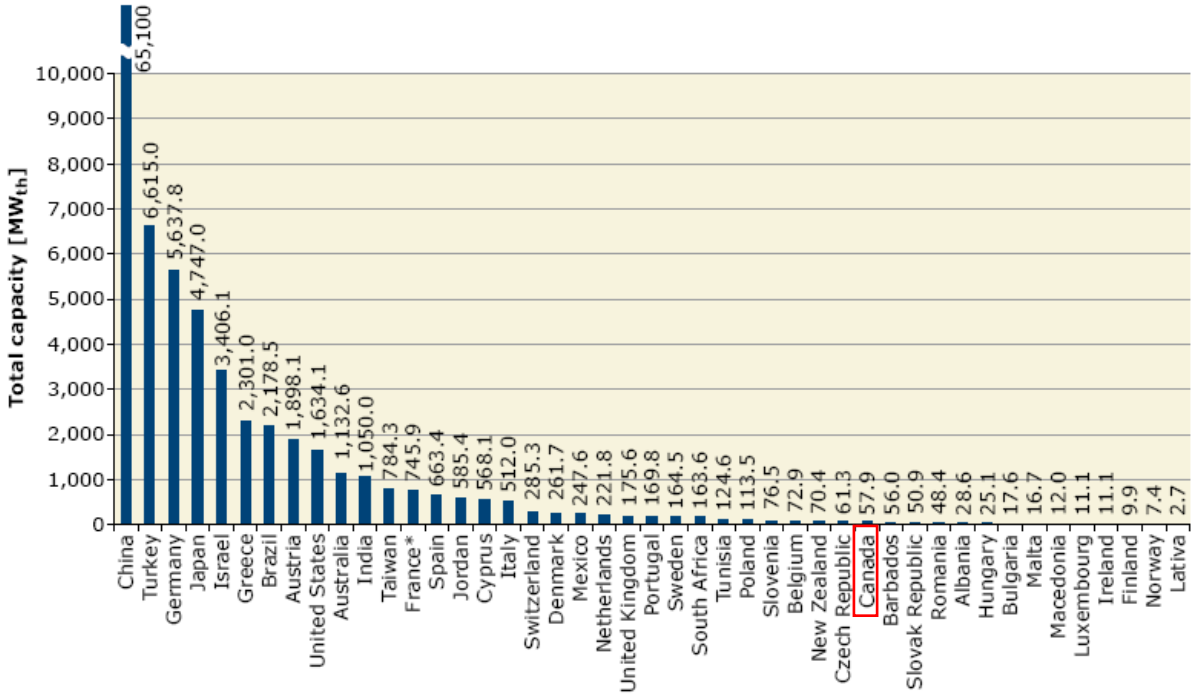
All of these initiatives show that capacity-building in the solar hot water industry is under way, but is not yet providing the sustained growth necessary to make the industry self-supporting. Before looking at the current barriers to wider adoption and how to address them, it is useful to look at the conditions that have driven high rates of installations in other jurisdictions.

V. The experience elsewhere

Despite low awareness of solar hot water technology in North America, much of the rest of the world has embraced the technology. Adoption outside this continent represents millions of rooftop installations, which provides ample opportunity to look at the factors that spur widespread adoption.

Leading adopters not all sun-rich

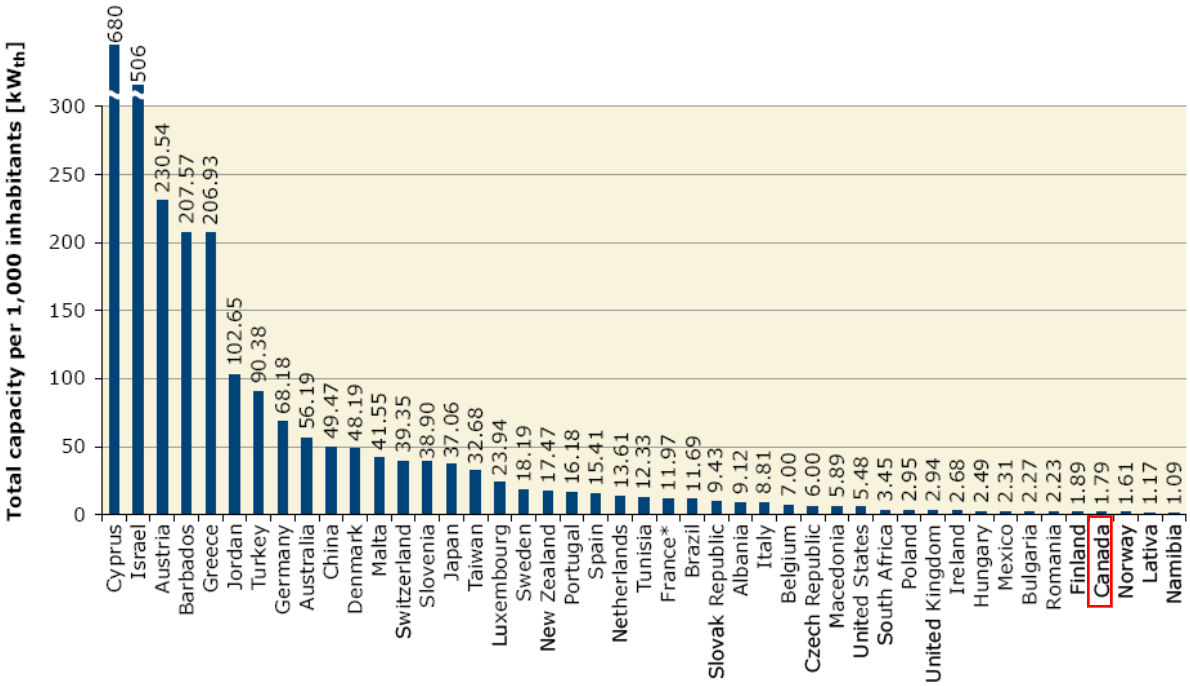
On an absolute basis, China – with its large population and government commitment to the technology – is the world leader in adoption by a factor of ten compared to the next most successful country, Turkey. This graph of countries with significant installed capacity shows that on an absolute basis, Canada is in the bottom third:



Source: International Energy Agency (IEA) Solar Heating and Cooling Program, *Solar Heat Worldwide: Markets and Contribution to the Energy Supply 2000*, Edition 2008

Note: MW_{th} as a unit of measurement refers to megawatts of thermal heat energy

Because countries with high populations tend to dominate the above rankings, it is also useful to look at which countries have had the greatest success on a per-capita basis. By this measure, Cyprus, Israel, Austria, Barbados and Greece are the leaders, while Canada has one of the lowest adoption rates:



Source: International Energy Agency (IEA) Solar Heating and Cooling Program, Solar Heat Worldwide: Markets and Contribution to the Energy Supply 2000, Edition 2008

Note: KWth as a unit of measurement refers to kilowatts of thermal heat energy

What is noteworthy about countries with the highest per-capita adoption of solar hot water technology is that they are not all endowed with ample solar resource and frost-free climates. Among the top 20 countries on the chart above, almost half are located as far, or farther from, the equator than is southern Ontario (which contains roughly 90% of the province's population). In most of these countries, the market cost of a system is similar to that in Ontario, and in some instances actually higher. The major drivers of solar adoption in these countries are generally high energy costs, sustained government support and strong commitment of the population to reducing greenhouse gases.

Comparisons to European adopters

To explore these factors in more depth, the table below compares three European adopters of solar technology to Ontario in terms of energy costs, availability and strength of sunlight, and total daily household consumption. It also shows their installed capacity per 1,000 inhabitants, as well as that of Canada:

	Solar resource vs. Ontario	Energy unit price vs. Ontario	Household hot water consumption vs. Ontario	Solar hot water installed capacity/1,000 residents (kW_{th})
Austria	12% less	+75%	43% less	230.5
Germany	23% less	+200%	51% less	68.2
Netherlands	23% less	+200-300%	43% less	13.6

Canada				1.8

Source: Adapted from the Marbek report

Energy prices are higher in these countries than in Ontario, but this is balanced out by lower hot water consumption. For example, the German unit energy cost is about twice that of Ontario. However, the average German household uses about half the hot water of one in Ontario. In other words, a household in Germany spends about the same total amount as one in Ontario on heating water. This suggests that higher total energy costs were not a critical factor in encouraging people in these European countries to add solar hot water systems. Clearly, other factors are at work.

Comparing Germany to the Netherlands, for example, shows that both countries have similar solar resources and unit costs for energy. Yet Germany has installed about five times as many roofs per capita as the Netherlands. Similarly, Austria has also been far more successful than the Netherlands, with almost 20 times its installed capacity on a per-capita basis – even though its unit energy prices are actually lower than those of the Netherlands

Because of the less-than-perfect correlation between energy prices and adoption in countries with similar solar resources, we looked next to government policies. The following discussion summarizes public information on government policies as well as research carried out by Marbek and appearing as Chapter 3 in their report, available at

http://www.energy.gov.on.ca/index.cfm?fuseaction=conservation.solartaskforce

Austria: 30 years of support

The Austrian Energy Agency sets out the country's energy priorities as "security of supply, environmental compatibility and social acceptability." Reducing greenhouse gases is another important public priority – in 1990, Austria set a goal of reducing national carbon dioxide emissions by 20% by 2005, compared to an international target set two years earlier. Going well beyond that target, many Austrian villages, cities and eight out of its nine provinces have committed to reducing emissions by 50% by 2010.

Given these priorities, it is not surprising that public policies in Austria in support of solar hot water have a long history:

- Solar systems have been subsidized for almost 30 years without a break in some parts of Austria. Upper Austria is notable in this regard: it accounts for more than 25% of installations although it represents less than 17% of Austria's population.

- Solar installations are currently subsidized in all nine provinces. About a hundred municipalities also provide additional funding.

- The average incentive provided by the provinces for solar hot water systems is 20% of total installation costs. If space heating is included in the proposed system, the average incentive level rises to 30%.

- Tax deductions have been available for solar hot water systems since 2001 under the *Housing Creation and Refurbishment Act.*

- A modest energy tax was introduced on both small-scale and industrial users of gas and electricity and is partly used to fund alternative energy programs. This tax was doubled in 2000.

- No building permits are required for installations of less than 20 square metres.

Growth rates in annual installations in Austria appear to track energy prices and taxes on conventional energy:

- Average growth was 30% a year from 1990 to 1996;

- Growth was stagnant up to 2002, when energy prices began a steep rise;

- Annual installations have grown by about 25%to 30% a year since 2003.

The German experience

The central aims of German energy policy, according to the federal Ministry of Economics and Technology, are economic efficiency, security of supply and environmental compatibility. With few domestic sources of clean and climate-friendly energy, and a commitment to phase out nuclear power, Germany's stated goal is to maximize its energy security with a diverse mix of energy sources and suppliers. Reflecting this aim, Germany represented more than half the total European solar thermal market in 2001.

The federal, state and municipal governments in Germany have all put in place policies and programs to support solar hot water systems for a substantial period of time. Measures include:

- Low-interest loans (roughly 2% below market levels) for renewable energy systems from 1990 to the present that allow homeowners to pay monthly.

- Home grants for the purchase of solar thermal or heat pump systems from 1995 to 2004.

- Grants and long-term, low-interest loans from 1999 to the present. Initial grants were high but steadily decreased after the program began to receive overwhelming demand in 2001. Subsidies are now at less than 25% of their initial level.

- An additional tax on both electricity and fossil fuels purchases. This tax, expanded in 2003, has been one of the main funding sources for incentives.

- Substantial support from the states (an average of $35M a year between 1991 and 2001) for solar thermal systems since 1985.
- A requirement by the municipality of Vellmar for solar in new developments.
- Municipal coordination of a "guaranteed results for solar collectors" initiative that allows for more precise cost-benefit calculations and has improved consumer confidence with systems.

The German market has grown steadily on average since 1990, paralleling support programs and energy prices to some extent:

- Annual installations grew by about 25% a year from 1994 to 1999 on average
- There was strong growth in 1999-2001 in annual installations but a sharp decline in 2001-2002, when grants and conventional energy prices both declined
- Average yearly increase in annual installations of 27% from 2002 to 2005, and a 58% increase in 2006-2007

Other factors believed to contribute to Germany's success include:

- Participation of the traditional heating industry in the solar thermal market;
- Greater installer acceptance of solar thermal systems;
- Very good education and awareness campaigns; and
- Improved testing facilities, certification for installers, and quality control of products.

In the Netherlands, lower adoption rates

Past energy policies in the Netherlands do not appear to have had as strong a focus on energy security and reduced greenhouse gases as those of Austria and Germany. The country's 2002 Energy Report concluded that no urgent problems around security of supply were expected, although the issue was attracting increasing attention. At that time, the Dutch government was on its way to meeting its target of a more modest 6% reduction in greenhouse gas emissions between 1990 and the 2008-2012 period.

The Netherlands offers economic incentives that cover solar hot water and other technologies:

- Loans for renewable energy systems (including solar hot water) have been made available at 1-2% lower than market rates since 1995.
- Low-interest loans are available for "sustainably built" homes (including ones with solar hot water systems), to cover the cost of environmental extras.

- Since 1997, up to 55% of renewable energy investment costs can be deducted from income taxes (translating into a deduction of up to 19% of investment costs, given Dutch tax rates).

None of these policies, however, appears to target solar hot water specifically. Perhaps as a result, annual growth in solar installations in the Netherlands has never been as high as in Germany or Austria. It averaged 18% a year between 1999 and 2004, for example, before entering a period of decline that extends into the present. Some reasons for decreased recent uptake include:

- Energy saving regulations for new dwellings can be met at a lower cost with alternative solutions.
- Installers give priority to other work.
- There is a lack of education among developers and builders.
- Government support of marketing activities decreased and subsidies are no longer available for property developers.
- Subsidies can now only be claimed after installation, so there is no guarantee.

A municipally-driven approach in Spain

Another noteworthy European comparator for Ontario is Spain, because of its fairly recent efforts to increase adoption – spurred largely at the municipal level – and the high rates of growth these have triggered.

At present, Spain has almost nine times the installed solar capacity of Canada on a per-capita basis. Its solar resource is about 20% greater than that of Ontario and its energy prices are about 70% higher.

Key drivers of adoption appear to have been changes to municipal requirements and the building code:

- The city of Barcelona's solar hot water ordinance, put in place in August 2000, requires that solar thermal energy provide at least 60% of hot water demand in all new buildings or buildings undergoing major renovation.
- As of September 2007, the Spanish building code began requiring that all new buildings and all those undergoing renovation cover 30% to 70% of their hot water demand with solar thermal energy.

- A local government promotion and financial system for solar hot water installations of up to 50 square metres provided subsidies of between 20 and 40% of the total cost. This project ran from 1997 to 2006.

Largely as a result of these policies, Spain has undergone very strong growth in recent years: the number of annual installations grew by roughly 30% a year between 1999 and 2005 and jumped 64% between 2005 and 2006. This has likely been helped by rising electricity prices as well as growing familiarity with the technology since the Barcelona ordinance and the building code requirement.

In the U.S., improved incentives

In the United States, as in Canada, generally lower energy prices and greater reliance on gas, a less expensive fuel in recent years, for water heating have hindered the growth of the solar market compared to other parts of the world. With volatile prices, energy supply worries and concerns about greenhouse gases, however, the technology is gaining greater acceptance. In 2006, for example, installation in the U.S. increased by a factor of four from the previous year.

Although the charts earlier in this chapter show that the United States as a whole is not yet one of the leaders in terms of installed capacity, the federal government introduced an energy act in 2005 to support solar hot water and other renewable technologies. It recently enriched its economic incentives for renewables: a new 2008 energy act removes the earlier legislation's 30% cap on tax breaks for homeowners who invest in home solar-power systems, both solar hot water and photovoltaic, or small wind turbines. It also extends the credit out to 2016.

These new provisions, when combined with incentives already offered in many states, mean that homeowners can get back a sizeable portion of their investment in solar hot water and other renewables from government – as much as half the total cost of the system, and potentially even more.

At the state level, California and Hawaii offer significant additional support that was of particular interest to us.

In California:

- Several utility companies offer rebates, typically valued at up to $1,500, for the purchase and installation of systems.

- A property tax exemption of the full value of a system is in effect until December 31, 2009.

- There is a personal tax deduction for the interest paid on loans used to purchase energy-efficient products or equipment for a residence in California.

- The city of Santa Clara supplies, installs and maintains solar hot water systems for residents and businesses through its water and wastewater utilities department.

- In September 2008 the California city of Berkeley approved a solar loan program for homeowners who install solar systems on their roofs. Loan repayments will be through a small addition to the property taxes of each participating home.

- The *Solar Rights Act* bars restrictions by homeowner associations on the installation of solar energy systems.

- A solar easement act ensures that sunlight cannot be blocked.

- Some municipalities have building permit fee waivers or fast-track permit processing for projects involving solar systems.

Hawaii has also put in place a comprehensive range of incentives and requirements for solar hot water systems:

- All new homes required to have solar water heaters installed starting in 2010 under a new state law.

- Tax credit of 35% of system cost to a maximum of $2,250 for a single family residence.

- Residential customers eligible for a flat $800 rebate for each solar system installed through the Kaua'i Island Utility Cooperative's energy use analysis and screening program.

- The Hawaiian Electric Company, Inc. and its subsidiaries provide a $1,000 rebate.

- The Maui Solar Roofs Initiative Loan Program, offered by an electrical utility, provides interest-free loans and rebates of up to $1,000. Other organizations also provide interest-free loans.

- A "Pay As You Save" program allows residential electric utility customers to pay for the cost of a system over time on their utility bill, as long as the estimated life-cycle electricity savings from the solar hot water system exceed the cost of the system.

- Hawaiian law bans any restrictions on the installation or use of a solar energy system on a residential dwelling or townhouse through what are called "restrictive covenants." Hawaii also requires homeowner associations to adopt rules that provide for the placement of solar energy systems.

The experiences of these two states show the impact of both energy costs and public policies. Of the estimated 9,000 solar systems installed in the United States in 2006, Hawaii accounted for about half, while California – whose population, at 36.6 million, is more than 30 times that of

Hawaii – saw the installation of about 1,000. This means that Hawaii's per-capita adoption rate for the year was more than 100 times that of California.

Hawaii pays the highest electricity costs in the U.S., roughly twice those of California, and has no easy access to natural gas as an alternative. This is likely the biggest factor in Hawaii's leadership in adoption of solar hot water in the United States, and the reason why utilities and the state government offer such strong support. With growth rates of roughly 50% a year on average from 2002 to 2007, Hawaii now has more than 70,000 residential and commercial systems in place. The boost to installations provided by the 2008 legislation is as yet unknown.

Other Canadian jurisdictions

We have already described federal support that is available for solar hot water installations, in Chapter III. Some provinces and territories provide additional incentives:

- **British Columbia** provides a provincial sales tax rebate on alternative energy systems, including solar hot water.

- **Saskatchewan** has extended and enhanced its EnerGuide for Houses retrofit grant program until March 31, 2011. Combined with federal incentives, existing homes which install a solar domestic hot water heating system can receive up to $1,500.

  Saskatchewan residents who built or purchased a newly constructed ENERGY STAR qualified or R-2000 home between April 1, 2007 and March 31, 2008 were eligible to receive up to $2,400 in rebates, including a $1,000 rebate for the installation of a solar domestic hot water heating system.

  Saskatchewan offers a program for new solar hot water systems installed by large, non-residential consumers of hot water that matches the federal incentive program for these consumers.

- A program in the **Northwest Territories** provides rebates to residents for new energy-efficient products purchased through local vendors, including a $500 rebate for the installation of a qualified solar hot water heating system. The program also matches federal grants to provide an additional $500 rebate for installation of a qualified solar hot water heating system in the NWT. As well, domestic solar hot water systems are now eligible under the small renewable energy program, which helps homeowners and commercial businesses that want to use commercially available, clean energy technologies.

- **Nova Scotia** provides a 15 % rebate of the installed cost of a solar hot water system for residential, institutional, industrial or commercial use. The maximum provincial rebate is $20,000.

- The Renewable Energy Loan Program, available to all homeowners in **Prince Edward Island**, provides loans to assist in the installation of renewable energy equipment, including solar domestic hot water systems. It provides loans up to $10,000 at an interest rate of six per cent, and the monthly payment is between $90 and $150 a month regardless of the loan balance. There is also a provincial sales tax exemption on small-scale renewable energy equipment, including solar hot water systems.

Key policy drivers for solar hot water

These experiences in Europe, the United States and Canada suggest several conclusions:

- Supportive public policies and priorities have a central role in boosting adoption of solar hot water technology;
- The total number of installed systems closely reflects the duration and consistency of government support;
- Public awareness and support from the building industry and trades seem to be key success factors, as does a progressive approach to building code requirements;
- Subsidies and policies that are specific to solar hot water appear to be more successful than general energy-efficiency programs in achieving adoption;
- The involvement of more than one order of government (and of utilities) is beneficial for increasing economic incentives and other forms of support; and
- Support for solar hot water appears stronger where security/scarcity of supply is a major concern, and is further bolstered by a strong commitment to reducing greenhouse gases.

A further conclusion – and a key one for Ontario – is that with the right set of incentives and policies, demand can grow at high rates on a sustained basis. Annual average growth in total capacity was on the order of 20% a year world-wide from 1999 to 2005. Rates are typically even higher in the early stages of market growth.

This chapter has looked at the impacts of many of the most common policies and practices used around the world to support the growth of solar hot water installations for residential use. To create the best all-round program in a particular jurisdiction, the combination of measures depends, above all, on the particular challenges in that jurisdiction. We therefore turn next to the challenges facing Ontario for widespread adoption of solar hot water technology.

VI. Challenges

This chapter sets out a number of challenges to wider adoption of solar hot water systems in Ontario that were outlined to us by industry participants, homeowners, officials and others with an interest in the sector.

Perhaps surprisingly, the Ontario climate is not the greatest of these. Although as Canadians we view our country as too cold and too far north to make harvesting sunlight worthwhile, other countries with less solar resource have achieved widespread use of roof-top panels to help heat water for domestic use. Austria, for example, has achieved a 20% share for solar domestic water heating, even though it is further north than Ontario's most densely-populated regions and its capital is on roughly the same latitude as Timmins.

Challenges arise instead from several sources: economic hurdles, gaps in information, awareness and education, the small capacity of the sector at present, and a range of regulatory and public-policy issues. As the previous chapter shows, other jurisdictions have faced and successfully overcome very similar barriers.

Economic hurdles

Research and our discussions with those interested in this technology pinpointed the economic challenges to capturing a wider market. An individual homeowner typically has a limited budget to put into energy-efficiency investments. The relatively high up-front cost of a water heating system, at $5,000 to $7,000 installed before taxes, is an immediate challenge.

Spreading out a system's costs over the expected life of the equipment, so that the timing of the homeowner's expense better matches the timing of the savings, is key.

But another concern is that at current energy prices, the costs paid by an individual homeowner are likely to be greater than the savings the system achieves even when spread out over time. This is particularly true for householders with low hot water consumption and more efficient conventional hot-water systems.

We believe it would be a mistake to look at the costs and savings just from the perspective of the individual homeowner. More widespread adoption offers huge benefits to society as a whole, by significantly cutting greenhouse gas emissions and reducing dependence on conventional sources of energy. To increase demand, government must take a leadership role by both reducing costs and helping buyers spread them out over time.

Level and type of support

A key question in looking at widening the market is the level at which a householder would consider buying or renting a solar hot water system. Natural Resources Canada carried out a survey along those lines this year, which presented participants with a range of hypothetical prices for a solar hot-water system.

At $1,000, 14% of respondents said they would buy, but this share fell sharply as the price rose, dropping to only 4% for a system costing $8,000 (which is much closer to the actual installed price). Similarly, 10% of respondents expressed an interest in renting a system if the fee were $19 a month, falling to 4% for a monthly fee of $79.

It is likely that most of the 4% who said they would buy or rent at the highest price belong to the committed environmentalist group. Bearing in mind that 4% of Ontario's 2.9 million single-family detached homes amounts to more than 116,000 systems, it is clear that reaching out to these potential buyers needs to be a key element of any plan to achieve the 100,000-roof target. Because the high up-front costs might be a disincentive to even this group, we look first at that barrier, and then at ways of making costs more manageable in general.

Making costs more manageable

There are two basic approaches to spreading out the up-front cost of a system: rentals or loans to finance a purchase.

Ontario consumers are very comfortable with the concept of renting a hot water heating system, as more than nine in ten currently use this arrangement. The hot water heater rental companies have a large existing customer base and portfolio of conventional heaters. Involving them in solar hot water heater rentals might also give them an important role in broadening the market. Getting just 2% of the three million households that rent converted to solar would provide 60,000 systems – moving Ontario 60% of the way to its target.

To use a loan to reduce the up-front cost of buying a system outright, the homeowner needs to have the cost included as part of the value of the house covered in the mortgage, or take out a separate loan. The former course would work well for a new home, while the second is the more likely route where the system is retrofitted in an existing house.

One option for ensuring lower costs and spreading them out over time would be to offer zero-interest loans to homeowners, possibly combined with an up-front rebate on the purchase price. This is the general direction of the PowerHouse Program, funded by the Ministry of Energy and Infrastructure, which applies to several energy-saving technologies.

If government sees solar water systems collectively as a means of generating energy using a renewable resource and of meeting its greenhouse gas reduction targets – and the 100,000-roof target suggests that it does – then there is a role for it to play in helping homeowners get past the economic hurdles. This will be especially helpful in creating a sustainable long-term market.

This table provides an indication of monthly costs to a homeowner under two different scenarios – including a system in a new house and attaching its cost to a 25-year mortgage, and a retrofit involving a zero-interest loan and higher initial rebate that is available at present. For comparison, the last column shows the monthly costs under the current rebate framework:

	New home	Enhanced retrofit	Current retrofit
Cost of system, installed	$6,500	$7,000	$7,000
Rebate on purchase price	-	1,750	1,000

Loan/mortgage amount	6,500	5,250	6,000
Interest rate	7.5%	0%	10%
Term of loan (years)	25	10	10
Monthly payment	$48.03	$43.75	$79.29

It is worth remembering that the Natural Resources survey showed that at $79 a month (roughly the cost of a system under the existing incentives), only 4% of householders are interested in a solar hot water system. But if the monthly cost were $19 a month, 10% of respondents expressed an interest.

These results suggest that for every $10 drop in monthly cost, the number of people who would consider a system increases by one percent of the population. Providing a system at a price of around $45 a month should therefore be attractive to about 7.5% of homeowners. This is a much higher share than the 4% of the population who expressed an interest when prices suggested in the survey were closer to those in the market.

In other words, the pool of potential adopters would almost double if it were possible to include a system in a 25-year mortgage or, for an existing home, receive a zero-interest loan and a further $750 rebate on the purchase price. Another approach that would get similar results would be subsidies to allow a rental price in this range.

Gaps in information, awareness and education

The experience elsewhere shows that education is key to building a market. Getting to widespread adoption of solar hot water in Ontario will call for a concerted campaign to increase awareness not just among potential buyers, but in the building industry as well. Another important way in which consumers can get information about sustainability initiatives is from their children, who learn about them at school.

Building consumer awareness

Consumers are generally aware of the need to make their houses "greener." For example, a poll conducted in 2007 by Ipsos Reid for TD Canada Trust found 73% of Canadian homeowners or those considering buying a home would be willing to pay more for environmentally friendly features.

People are increasingly open to new ideas and technologies that will reduce their exposure to non-renewable energy sources. What's more, many want to make their commitment visible – whether by driving a hybrid or Smart car, buying an Energy-Star certified home, or posting a sign telling passersby that their electricity comes from fully renewable sources.

A solar roof can be another sign of commitment to renewable and local energy solutions. Awareness of solar water heating, however, is low. The 2008 Natural Resources Canada survey found that 40% of Ontario homeowners had never heard of the concept. Roughly half of the survey respondents said they had heard of solar hot water systems but had never seen one. After a description and images of a system were provided, a majority of those surveyed said they found the system appealing and would consider either buying or renting one at a

reasonable price. This research, which is confirmed by findings in other jurisdictions, shows the importance of public education as to what solar water heating is and how households can reap its benefits.

Public education efforts around solar hot water at the provincial level are currently focused on the GO Solar website. The site, which receives an estimated 5,000 to 9,000 visits a month, is managed by the Clean Air Foundation under contract from the Ministry of Energy and Infrastructure. The current contract runs out on March 31, 2009. We believe the GO Solar website is one useful tool that should not be lost, but should not be considered on its own a comprehensive public education campaign and needs to be supplemented.

Educating the building community

Some home builders and subdivision developers understand and are enthusiastic about solar hot water systems, but generally this is driven by a personal or corporate interest in sustainability. To reach the entire new home segment, the industry as a whole needs to be given more and better information. This will help home builders become effective marketers and sales agents for the systems, by understanding which potential purchasers will enjoy the greatest benefits – for example, larger households (especially, a task force member notes, those with teen-aged offspring) – and being able to explain the economics.

The need for information goes beyond just homebuilders. Developers, designers, architects and municipalities (including building inspectors) will have to be educated as to the benefits of solar heating and technical requirements in terms of roof pitch, design and orientation, street layout and placement of trees.

Improving the school curriculum

The education system presents an excellent opportunity to build a culture of conservation in Ontario's young people and move it from there into society as a whole. Environmental sustainability and alternative energy are part of the current public school curriculum, but students would benefit from more information starting in the earliest grades.

At present, sunlight as an energy source is not mentioned in the standard Ontario curriculum until Grade 5, which includes a module on "conservation of energy and resources." The first specific mention of solar technology is in the Grade 6 curriculum, which refers to it only in the context of "the different ways in which electricity is generated in Canada."

It would be more helpful for students to learn right from the start about all the ways in which solar energy can be harvested. Because of the straightforward technology involved, solar heating would lend itself very well to classroom projects.

In secondary schools, guidance counselling should reflect the importance of jobs in the solar hot water industry, whether in manufacturing, installing and maintenance, especially as Ontario achieves significant levels of growth.

Building greater capacity in the industry

Encouraging a sharp increase in sales without ensuring the industry can meet greater demand will cause problems – for example, long waits for installation and concerns about system quality. This need to build capacity extends not just to the solar hot water industry itself, but also to the building and development industry.

Because the existing industry is small, the ramp-up to wider-scale adoption must be orderly to ensure quality installations, especially in the early stages. Ontario is actively investing in retraining workers from its more traditional sectors, and the solar hot water industry presents an excellent opportunity for job creation.

The capacity to handle large numbers of installations is a key consideration, as most consumer problems appear to arise from improper installation of systems. Moving to large-scale adoption will mean ensuring that enough installers, with appropriate training and certification, are available.

New installers could come from among existing trades, such as plumbers and other skilled trades, as well as people who complete specific solar installation programs. While some efforts are under way, as described in Chapter IV, ramping up installations at a substantial rate will require additional attention on training and certification, as well as more resources. The way to ensure quality installations is by requiring that all installers be certified.

The next generation of jobs

Ontario's *Next Generation Jobs Fund*, a $650-million program, is securing the next generation of high-paying jobs for Ontarians by supporting businesses' commercial development, use and sale of clean and green technologies and businesses in Ontario.

Training efforts are already under way through such leading institutions as St. Lawrence College and the Kortright conservation centre. The increased demand generated by a commitment to 100,000 solar installations calls for broader and deeper training. In particular, to meet new demands, more capacity to "train the trainer" is needed. Installers-in-training need opportunities for installation experience in the field, which is part of the certification process. The curriculum for skilled trades adding solar hot water certification should be upgraded and quality control ensured in their training.

A group that warrants particular attention is Ontario's First Nations. Sun and wind have a special place in First Nations' cultures, and applications that make use of these energy sources are also valuable in remote locations that are often highly vulnerable to the volatility of conventional energy prices. The existing First Nations Training Institutes are very interested in training their students in this area. There would be great value in adapting solar hot water training materials to the unique needs and outlooks of First Nations.

The industry's capacity to market its products effectively and ensure quality control is also critical. While Ontario's building code requires CSA approval for packaged systems, to date only one system has received this. Having more CSA-approved packaged systems will help increase adoption, but the industry faces considerable challenges in being able to receive CSA

certification for these. The process is costly and time-consuming, and often requires the manufacturer to make major new investments in their facility. The industry may require provincial help in this area.

CSA certification looks at safety, performance and longevity, but one challenge is that the solar manufacturer is not required to release performance information to the public. Releasing the CSA performance data, in line with what other jurisdictions do, would give consumers a better picture.

As well, more and more consumers look to energy rating labels for help in understanding the relative efficiency of an appliance or system (although not its longevity). Labelling of solar hot water systems by Energy Star, an existing program that provides public information about the products that are "best-in-class performers," will be helpful to consumers and should be promoted. Given the small number of products currently comprising this category at present, there is some confusion about how Energy Star will work for solar hot water systems in Canada. Getting more products certified and tested to create a larger group of comparators would provide more useful Energy Star ratings.

A need for updated policies, programs and approaches

A central aspect of the Ontario government solution to energy needs is harvesting more of our clean, renewable and local sources of energy. The Province recognizes that public policies should help achieve this.

Participants in the solar hot water, building and design industries work in a context of regulation and standard-setting that is designed to protect the public interest. Because it is an emerging technology in Ontario, solar hot water adoption will require some changes in approach to help advance this important initiative more quickly.

Ensuring consistent and workable standards and codes

Consistent and straightforward guidance for municipal building officials and inspectors helps speed and simplify installations in both new build and retrofit situations. At present, permit requirements vary by municipality and present a barrier by confusing both consumers and installers.

A particularly urgent situation is how municipal officials interpret the CSA standard, CSA B64 - Backflow Preventers, which identifies solar hot water (along with other water appliances) as representing a "severe risk" to the water supply. Ontario's *Safe Drinking Water Act, 2002*, places personal liability on water system operators and owners, including municipal councillors, for municipal water quality. This has created a situation of no tolerance to any risks (or perceived risks) to municipal drinking water. As a result, municipal officials have suggested that they will require solar hot water systems to install a commercial type, testable backflow preventer and have it inspected annually. This is despite the numerous measures addressing backflow prevention in a different CSA standard developed specifically for solar hot water systems.

This will increase system costs significantly and result in an ongoing annual inspection cost that will drastically reduce any energy savings. Solar hot water in Ontario will not be an economically viable option for homeowners. Furthermore, the need for a regulated annual safety inspection will instil a climate of fear about solar's safety.

We believe that the Province needs to clarify this situation immediately. Discussion with key agencies is required to ensure that a high standard of water is maintained, but without unnecessarily significantly increasing the cost of a residential system. Further details on this issue can be found in Appendix C.

As well, the current version of Ontario's building code defines a roof-top system of more than five square metres as a designated structure, which means that a professional engineer must design and inspect the installation. This is a particularly onerous condition, because the standard installation is just slightly larger, at just under six square metres. It was not clear to us how the five-square-metre threshold was established.

In addition, the code sets CSA approval as a sufficient condition for packaged systems, but specifies that non-packaged systems must be installed "in accordance with good engineering practice." There is no consistent interpretation of these code conditions among local building officials, which adds time and in many cases costs to approval.

Apart from these specific building code and related issues, general guidance to all municipalities on acceptable design and installation of systems would raise the level of comfort for building officials, especially when encountering the first application for a system in their municipality.

Increasing municipal involvement

As noted elsewhere in this report, municipalities globally have played a crucial role in stimulating the early market for residential solar hot water. Local improvement charges are a unique tool that municipalities can use to support solar hot water adoption. Berkeley, California, and Dawson Creek, B.C., are currently introducing specific solar loan programs using this measure.

Local improvement charges are commonly used to cover costs of infrastructure improvements which benefit a specific neighbourhood. They are a good option for municipalities to finance improvements in energy efficiency and renewable energy installations on private property. City-backed loans for solar installations are repaid through the property tax collection system. Both the loan and the energy savings stay with the property. If a home is sold before the solar loan is repaid, its new owner takes over the loan payments.

There are barriers in Ontario, however, to the use of local improvement charges to finance home solar installations. A regulation under Ontario's *Municipal Act* defines the types of improvements eligible for this type of financing, and energy-efficiency and renewable energy improvements on private property are not included.

Checking on performance information

A body set up at the national or provincial level to develop public information on energy efficiency and other elements of system performance, including its ability to withstand the Ontario climate, would give objective guidance to potential consumers about the merits of various systems. There is an ideal opportunity for Ontario to take the lead in establishing such a body, which would greatly benefit the Ontario industry.

Integrated energy planning not part of the IPSP

Ontario's integrated power supply plan (IPSP), drawn up every three years by the Ontario Power Authority, provides an opportunity to include alternative and renewal energy solutions, as well as conservation goals, in long-term planning. Including solar roof targets in the plan would provide easy-to-track benchmarks for progress and would show clearly their contribution to conservation goals. At present, however, the power authority is concerned mainly with the adequacy of electricity supply and transmission systems, and its mandate is not broad enough to favour solar systems (over natural gas, for example) as an energy solution.

More specifically, the authority has a program that supports electricity conservation and demand management through programs delivered by local electricity distribution companies. Support is based on a calculation of the "total resource cost" (TRC) of potential conservation measures. The current basis for calculating TRC ranks natural gas above solar hot water as an alternative to the standard electrical water heater. The calculation does not fully take into account, however, the environmental cost of that option against solar hot water.

The authority is able to fund other solar hot water initiatives that are not delivered by local distribution companies. But the TRC calculation means that there is a limited role for Ontario's local electricity distribution companies in encouraging the technology. This is unfortunate, because local distribution companies in some areas would benefit from greater uptake of solar systems as a way of relieving electricity supply and infrastructure concerns.

With the right incentives, more utility companies could develop ways of speeding their customers' adoption of solar systems, possibly in partnership with the rental companies or another financial intermediary. The requirements of the power authority's current conservation and demand management program for local distribution companies, however, exclude solar hot water systems from this source of support.

Economic incentives should go further

Economic incentives are a very clear way in which government can signal its support for solar hot water systems. Both Ontario and the federal government have programs in place to reduce the up-front cost of systems by rebating a portion of the purchase price. These are described in Chapter III. There are problems, however, with the relative support provided to homeowners, as well as program design.

The level of incentive available to homeowners is not as high as to businesses and institutions. The federal and provincial programs for business and institutions provide for a rebate to a

maximum of $80,000 each. The maximum payment is calculated on a rate per square meter rather than a percentage but the result is a combined grant of up to 50% of the project cost or $160,000. The $1,000 combined rebate for a homeowner is less than 20% of the cost of a typical residential installation.

We also heard from stakeholders that the process for getting rebates is cumbersome and requires unnecessary steps for solar hot water that act as a barrier.

In particular, a potential buyer must have an energy audit before and after installation. This federal requirement, which must be met to receive matching funds from Ontario, creates a major disincentive. There is no need for an audit, as the building permit process provides the necessary verification of installation. The audit requirement reduces the subsidy for solar by about half. Furthermore, in our opinion, there are not enough independent, arm's-length auditors in this program with adequate knowledge of solar hot water technology to provide proper direction to homeowners.

The grant can only be applied for once, and the homeowner is unable to reapply in the future for support for further energy improvements such as a solar water heater. There is never a bad time to install a solar hot water heater. As interest builds for solar hot water, those homeowners who have taken early action on energy conservation are the very homeowners who will be the early adopters for solar, yet they are excluded from the grant.

As well, the subsidy is available only for home retrofits and excludes new homes.

In summary, the design of these programs places severe restrictions on homeowner participation.

Another aspect of provincial support is a refund of retail sales tax for solar hot water systems, which gives buyers back 8% of their all-in purchase price. The rebate for residential solar systems was introduced in 2002 for a five-year period. In November 2007, it was extended for a further 25 months to January 1, 2010. We believe that the Ontario government should permanently exempt solar hot water installations from the retail sales tax.

There is a need to assess the benefits of the existing PowerHouse pilot project offering zero-interest loans and rebates. This program will soon expire. To date, the program appears to have attracted more interest in geothermal systems, which are eligible for a higher level of provincial and federal rebates. We feel that any program of this type should level the playing field for solar hot water, and be consistent in design and available across the province.

We believe that government and the industry, working together, can overcome these challenges. Together they can meet Ontario's target through a coordinated and concerted effort over a sustained period of time. This is critical if Ontario is to reach its target and become an exporter of a technology being rapidly adopted around the world.

In the next chapter we set out a phased approach to creating a dynamic solar hot water industry in Ontario for the benefit of people, the economy and the environment.

VII. Roadmap to success

There are valuable opportunities to allow Ontario to harvest more of its solar resource. The challenges identified by homeowners, industry members, regulators and others suggest that a range of measures will be needed to move Ontario to the 100,000-roof target in a timely and coordinated fashion. For that reason, we have set out a series of phased recommendations.

The need to build capacity now

Ontario cannot get from a few hundred to several hundred thousand roofs overnight. Given that solar roofs are certain to offer an increasingly a cost-effective way of helping to meet Ontario's energy needs and greenhouse gas reduction targets, the ramp-up to the 100,000-roof target must start now.

Achieving the goal of 100,000 domestic solar roofs is central to the important priorities of reducing dependence on dwindling fossil fuels and cutting Ontario's greenhouse gas emissions. It also provides a hedge against future uncertainty: the recent volatility in the price of non-renewable fuels has shown that Ontario's homeowners cannot expect any degree of predictability about their heating costs going forward.

The current economics of solar systems suggest that this goal will require expanded government support in the early stages. These initial provincial investments should be targeted, strategic and focused on capacity-building, reducing barriers and expanding pilot projects. As capacity grows, regulatory hurdles are lowered and buyer interest in the technology grows, the need for economic incentives and other government involvement is likely to diminish over time, especially as energy prices move upward.

Three phases in meeting the target

We envision three distinct phases in the evolution of solar roofs in Ontario:

1. **Priming the pump**. In this critical early stage, government and the industry will need to work together in a coordinated fashion to increase awareness of the technology on the one hand and build capacity to meet greater demand on the other. In reaching out to consumers, efforts will focus in particular on the early adopter groups.

2. **Widening the market.** The intermediate phase of this sustained initiative will leverage the gains in public awareness and capacity-building to broaden interest beyond early adopters.

3. **Reaching sustainability.** In the final phase, solar roofs will be widely accepted and understood, and the industry will have the capacity to meet high ongoing demand for both new housing and retrofit installations.

We set out below detailed measures for the pump-priming phase of adoption, as well as for widening the market. Our advice is based on the current outlook for energy prices and planning. We would expect policies, especially those for the third and final phase, to be determined in greater detail as more information becomes available on those fronts.

Phase 1. Priming the pump: 2009-2011

Ontario can reach at least 5,000 installations in the three years and move from 60-100 installations a year to more than 2,000 a year. This will create the experience and the critical mass needed to expand the market broadly across all segments of the home market in Ontario. This would be achieved through the following actions led by the provincial government:

1. Put in place a broad consumer information program.

   The GO Solar website is gaining recognition as the "go-to" portal and information source for solar technology in Ontario. To help meet Ontario's ambitious target of 100,000 solar roofs, however, a web presence needs to be backed by a broader public education and awareness campaign. This would drive potential consumers to the site through the print and electronic media. To meet the much greater interest and demand generated by a broader media program, the site itself needs to be re-thought. The expertise of an advisory board that included the solar and building industries, coupled with the communications-media expertise of the Ontario Media Development Corporation, could create a useful synergy and help meet higher public expectations. There may also be opportunities to find new partners who could assist in the funding.

2. Grow the culture of conservation in the schools.

   Ontario's school curriculum should reflect the economic and social benefits of solar thermal technology from the earliest grades, to help instil a strong culture of conservation in young people and society as a whole. Teachers should be provided with kits to update material on solar and other renewable technologies.

   Going beyond the classroom, installing systems on schools gives students, parents and educators a chance to see the technology in action. Technical institutes with a focus on First Nations education are another natural place to showcase solar hot water technology. Some school boards are already installing solar hot water systems, and provincial support is available through the Ontario Solar Thermal Heating Incentive, which matches funds from the federal Renewable Energy Heat Program. Simplifying the application process and possibly increasing the level of support would help to get more schools involved.

   Many more students have the opportunity to see energy-efficiency initiatives in action during school visits to conservation areas and green technology demonstration sites. A small number of these micro renewable energy demonstrations have been funded throughout the province through the Community Conservation Initiative (CCI). While some of these, such as the Kortright Centre north of Toronto and Energy House at St. Lawrence College in Kingston, make use of solar hot water technology, the Province should ensure that the technology is as widely demonstrated as possible.

3. Work to make all new homes solar ready.

   "Solar ready" homes have the conduit from the roof to the mechanical room already in place. In our view, the plumbing lines and wiring through the conduit should also be installed, because adding these later is complex and fairly costly. The only requirement from a siting perspective is that each house must have a rooftop area of at least 6 square meters that faces south – which should be easily accomplished with current "hipped" roof designs. Including the basic requirements for later solar hot water installation is relatively inexpensive for builders and provides strong encouragement for potential buyers to upgrade to a full system. Solar-ready homes can be put in place either as a requirement in the building code or by providing economic incentives to new home builders. In our view, this would happen more quickly and easily through the use of incentives, at least initially, but in the longer term the Province could change the building code to make solar-readiness a requirement for newly built houses.

4. Place more solar systems into subdivision model homes and sales centres.

   Each year, model homes are built for new Ontario subdivisions to showcase features for potential buyers. Covering the costs of a solar hot water system for at least one model home in each new development would show thousands of consumers the technology in place in an actual home, remove financial risk for builders, and – because model homes are ultimately sold – directly increase the number of in-service solar systems. Each subdivision should be provided with at least one system for model home demonstration purposes.

   The Province should also leverage the relatively new phenomenon of the centralized sales centre, similar to a showroom, where potential new home can see all the possible options for a new house. The Province should work with builders and developers to determine how to get solar hot water systems into these centres and make them attractive as an energy-saving option.

5. Increase residential rebates to the level provided to businesses and institutions

   The Ontario's current residential rebate program, the Home Energy Savings Program, presents problems where solar hot water systems are concerned.

   We estimate that the current $1,000 available through the program ($500 from the Province and $500 from the federal government through its ecoENERGY retrofit program) provides only an 8-10% level of support for an average residential solar hot water system when including the cost of required audits, while federal/provincial support for industrial, commercial and institutional systems can reach 50%.

   We believe that, based on international experience, a 25% level of support which is easily accessible, combined with a zero interest loan, will begin to stimulate the market for residential solar hot water in Ontario.

As well, the rebate program should be designed so as to encourage the rental companies to offer solar hot water systems in their portfolios. As noted, even 2% of the current rental portfolio would add about 60,000 solar roofs. Because of economies of scale and established marketing channels, these companies are particularly well positioned to help adoption among new home buyers.

6. Work with federal officials to develop ways of compensating solar hot water system buyers for the cost of the current audit requirement and to make the rebate available to all homeowners.

   The federal ecoENERGY program (which Ontario matches through the Home Energy Savings Program) creates the requirement for an energy audit. Although the ideal would be to remove solar hot water from the audit requirement – and this should be the ultimate goal – this broader combination of provincial and federal programs involves other energy improvements where this requirement may be appropriate. (Because solar hot water requires a building permit, this rather than an audit could verify that a system was installed.) We would hope that Ontario would enter into discussions with federal officials about ways of removing solar hot water from the audit requirement, possibly through a specific program. Until then, the recommendation above would compensate purchasers for the additional cost.

   Furthermore, the programs for supporting solar hot water sales need apply to a wider variety of different ownership models to include new homes and the hot water heater rental market as well as retrofits. This, too, is an area for provincial-federal discussion.

7. Provide a zero-interest loan program across the province

   The Province should provide a zero-interest loan program based on the one currently being offered in several areas through utilities and financial intermediaries as a pilot. Before the wider roll-out, however, it should first redesign the program to make it as attractive as possible for solar hot water systems. It should also ensure that the same program is used in all areas to avoid confusion and allow streamlined processes.

8. Exempt solar hot water systems from retail sales tax

   The current rebate is in place only to January 1, 2010. We urge that these systems be permanently exempted from retail sales tax.

9. Allow consumers to benefit from all available programs

   Where additional local or other support is available for solar hot water systems, the Province should allow the consumer to enjoy the maximum benefit of all programs.

10. Support increased training as an element of the industry's expansion.

    The Province and the industry need to work with Ontario's community colleges on specific programs to train and license installers of solar systems. Where an existing tradesperson, for example a plumber, wants to add solar installation accreditation, the industry, unions and government need to ensure that training is designed and delivered using best practices. The Province should also support the adaptation of training materials for First Nations Training Institutes.

    The Province should use retraining funds available through the Ministry of Economic Development and Trade for both training and "training the trainers" for solar hot water. This is a natural fit for workers moving from automotive and other manufacturing sectors, and supports growth in innovative, green jobs. This is an important step in increasing the industry's capacity and is a natural first step toward a "green energy" act.

11. Act immediately on the risk assessment of solar hot water to the water supply

    The provincial government must provide immediate and unequivocal direction on what water risks should be prioritized by municipal water departments and provide an independent assessment of what the contamination and health risks are for various water appliances and the appropriate measures that should be enforced to mitigate these risks. Further details on this issue can be found in Appendix C.

12. Review building code treatment of solar hot water collectors

    Several measures need to be taken to ensure the Ontario building code better supports solar hot water systems. For example:

    The threshold of five square meters used to define panels as a designated structure needs to be reviewed and a suitable methodology developed. This would save the time and expense needed to get engineering approval for the structural element of the building permit, without any impact on building safety.

    Under the current building code, every component of a solar system must be CSA certified, but the entire system may not be acceptable because it is not certified as a package. Building departments should be encouraged to interpret the building code in a way that makes non-packaged systems acceptable as long as all the components are CSA certified.

    When combined systems for hot water and space heating started appearing in the market, there were similar barriers and no one body to resolve them. The Air-Conditioning, Heating and Refrigeration Institute (AHRI) created guidelines that were used in the interim until the existing codes and standards were able to catch up to this new development.

These guidelines took into account the unique features of combination systems, including the need to have everything "potable approved."

We suggest that AHRI could go through a similar process for non-packaged solar hot water systems. This might even be seen as an extension of the work the organization already carried out on combined water and space heating. This interim document would provide guidance to municipal building officials on non-packaged systems.

The Toronto Area Chief Building Officials Council is creating guidelines for standard designs of solar systems that comply with the building code. Once finalized, these should be rolled out across the province.

Both of these steps would promote consistency and increase local officials' comfort with the technology.

Because of confusion and uncertainty about solar hot water systems, and the likelihood that more barriers at the municipal level will emerge with wider adoption of the technology, the Ministry of Municipal Affairs and Housing needs a renewable energy champion. This person would work within the ministry and with municipalities and the industry to lower the barriers to achieving the Province's renewable energy ambitions.

13. Allow municipalities to use local improvement charges for supporting renewable and energy efficiency improvements on private property

    Including solar hot water systems on private property in the list of measures that can be funded through these charges would allow municipalities to use loans collected through the property tax to finance systems on residential rooftops. This would help to eliminate high up-front costs to consumers and keep the costs of a system attached to the property enjoying the benefits. The Province should provide direction and guidance to the Ontario Municipal Board and Ontario municipalities on the implementation of such programs, which are used successfully elsewhere.

14. Get municipalities involved in pilot and more broadly-based programs.

    The Province, through the Ministry of Energy and Infrastructure and/or the Ministry of Municipal Affairs and Housing, can help to build additional capacity at the municipal level on several fronts:

    One approach would be to provide a pool of pilot-project funding for which municipalities would compete, based on how many retrofits they could deliver. The municipalities involved would then provide public results and "lessons learned" reports.

In light of the *Energy Conservation Leadership Act*, many municipalities are now developing sustainability plans. As these are drawn up, the Province and municipalities should consider recognizing the infrastructure benefits of solar systems. One way to do this would be through reducing development charges for green subdivisions that use solar hot water and other energy-saving technologies. This would also help to develop local expertise and address local pricing barriers.

15. Expand the mandate of the Ontario Power Authority to explicitly include energy sustainability.

    Under its current mandate, which focuses on electricity supply only, the authority and its long-term supply plan and programs have limited ability to provide solar hot water incentives. By adding energy sustainability to its mandate, the authority would begin to include in its planning the environmental costs of available energy sources. Its incentive programs could then fully reflect the value of solar hot water systems in reducing the environmental costs, including greenhouse gas emissions, of conventional energy.

16. Take a lead in developing a national performance database for solar hot water systems.

    Ontario should recommend to the Canadian Council of Energy Ministers the development of a publicly available database on the performance of solar hot water systems. It should then require that any system eligible for provincial government subsidy or support be included in it.

    Having this information would improve public awareness and help consumers make better choices. There are already existing organizations that maintain performance databases on appliances. The Air-Conditioning, Heating and Refrigeration Institute's Gama database, in particular, covers many existing space and water heating appliances.

17. Provide provincial support for certification, testing and facility upgrades.

    The pipeline for certification and testing of Ontario-manufactured systems appears to be far too narrow. To help make more approved products available to buyers, the Province should provide financial help for these steps and for upgrading facilities to meet CSA standards, all of which can be very costly for small companies. Any company benefiting from this help would be required to make performance and other relevant data publicly available through the database recommended above.

18. Support development of better information on the solar hot water industry and its products.

The Province should invest in collecting and analyzing better information on the payback and life cycle costs of solar hot water systems, sales numbers and industry size and characteristics.

19. Move to enact "right to light" legislation as an element of a "green energy" act.

    The Province and municipalities should begin discussion as soon as possible of "right to light" issues. These will be especially important to clarify the requirements for new subdivisions, but are likely to be very contentious where retrofitted systems are concerned. The timeline would be to introduce provincial legislation in Phase 2, covering right to light as part of a broader act to support green energy initiatives through building requirements, as other jurisdictions have done.

Phase 2. Broadening the market: 2012 - 2017

By the end of Phase 1, Ontario will have installed at least 5,000 roofs. While that may seem like a low number, it represents a five-fold increase from the current level. Even more important, reaching this level will put in place the infrastructure for significant sustained growth.

As a result, in this second phase, as many as 60,000 solar roofs could be added. With strong demand, there will be important investment and job-creation opportunities. This phase will focus on broadening public education efforts and expanding the concept of systems in model homes to "model subdivisions" in which all homes come equipped with solar systems.

Detailed recommendations for this phase will suggest themselves as the market for solar hot water and conventional energy evolves. We suggest the following actions at a high level:

1. Introduce "right to light" provisions as part of a "green energy" act.

2. Ramp up public education programs

3. Build capacity in the solar hot water manufacturing sector in Ontario through tax incentives and other mechanisms.

4. Evolve the adoption of solar hot water from model homes to model suburbs.

   This could be achieved by reductions to development charges that would provide an economic incentive for builders.

   As part of this effort, the Province should encourage the next evolution: Integrated design and net zero energy homes:

   - These approaches take a holistic view of housing developments to find the most harmonious and integrated ways of reducing energy needs and environmental impacts.

- This could mean using solar technology for space as well as water heating, possibly with a linkage to geothermal systems. As technologies evolve, there may be opportunities to use solar overcapacity from summer to heat during the winter. Another potential technology now in its very early stages is the use of solar hot water to reducing central air conditioning loads.

Phase 3. Reaching sustainability: 2018+

In Phase 3, going beyond 2017, energy prices are likely to be such that consumer subsidies will not be as necessary and may be reduced. With sustained support, Ontario would start to have world-level installation numbers. The focus of government efforts could be more on industrial expansion, turning Ontario into an international export powerhouse, benefiting from the groundwork laid in the first two phases.

Conclusion

Solar technologies hold out promise as a responsible, long-term solution not just to Ontario's energy needs and environmental challenges but as a key component of its shift to a "green" economic base. Our review of the many jurisdictions around the world where solar heating has become a widely-adopted element of energy supply have confirmed that this is a viable technology for Ontario and a positive strategy for growing jobs and companies in this province.

Moreover, we have concluded that the ramp-up to the Province's ambitious target of 100,000 solar roofs needs to start immediately. In a world of economic, environmental and energy uncertainty, harvesting the energy of sunlight offers a powerful means of making a real and positive difference to individuals and society as a whole. Our major trading partners already recognize this fact, and Ontario must not delay if it wishes to be in the forefront of this rapidly growing sector.

We have set out here a number of detailed recommendations for making this happen. These specific measures will both create higher demand for solar hot water heating in the homes of Ontario families and increase the capacity of the solar industry to meet it. We envision a future for Ontario as not just a leading adopter of all solar technologies but as an exporter as well, benefiting from our strong manufacturing base and dedicated workforce.

We have also considered the place of solar hot water and other renewable technologies in a fully integrated energy strategy that takes into account all the costs, including environmental impacts, of our energy choices. We believe that the solar hot water initiative represents the start of developing such a strategy, which would be led by the Ministry of Energy and Infrastructure and inform policy across a range of ministries. With solar hot water and other renewable technologies at the forefront, this strategy would be given life through a comprehensive legislative framework. This step would signal Ontario's commitment to sustained support for renewables. It would create the conditions for the growth of green jobs, green households and green communities to benefit Ontario today and generations to come.

Appendix A. Biographies

Elizabeth McDonald - Chair

Elizabeth McDonald has been Executive Director of the Canadian Solar Industries Association (CanSIA) since May 2007.

As executive director of the solar industry's national trade association, McDonald has worked to increase the profile of the solar industry in Canada and abroad. Under her direction, the annual CanSIA conference was moved from Ottawa to Toronto, which more than doubled the size of the conference and its exhibition. As interest in renewable energy sources continues to increase, McDonald and the CanSIA board are working to ensure they are ready to respond as the industry grows. McDonald is also reviewing CanSIA's training and certification activities to respond to increased demand in this area.

Before she joined CanSIA, McDonald worked with three trade associations in various senior positions. She has served on a number of public and private boards and has extensive experience developing effective public-private partnerships. McDonald has also worked as an independent consultant and has extensive project management experience.

Brian Rosborough

Brian Rosborough is Director of Policy with the Association of Municipalities of Ontario. Rosborough has twice worked for the association; first during local services realignment discussions from 1995 to 1997 and again since early 2004.

Rosborough has worked in public policy in Ontario’s provincial and municipal sectors for the past 17 years. He has been a social and fiscal policy adviser and a policy manager in the Ministry of Community and Social Services. He was also Manager of Integrated Policy in the strategic policy branch of the Ontario Ministry of the Environment.

Rosborough was also an independent public policy consultant for five years for a variety of provincial, municipal and federal government clients.

Rob McMonagle

Rob McMonagle has been active in the solar industry since 1978 when, while at the University of Toronto, he built a solar collector to heat his parents’ swimming pool in Toronto.

He was hired by the City of Toronto in 2007 as a senior energy consultant and was responsible for developing Toronto's Sustainable Energy Plan, which was approved by city council in June 2007.

From 2002 to 2006, McMonagle was Executive Director of the Canadian Solar Industries Association (CanSIA).

Prior to that, he founded Prometheus Energy, one of the pioneer firms in renewable energy in Canada. Prometheus' solar installations included Canada's first residential grid-connected solar

system, a weather station in the Russian Arctic, eco-resorts in Costa Rica, Belize and Guyana, medical clinics in Mexico and Zimbabwe, and research stations in the Amazon. Prometheus Energy was sold to Kitchener's ARISE Technologies in 2001.

McMonagle has served on the board of the Solar Energy Society of Canada, the Canadian Solar Industries Association and the Energy Action Council of Toronto. He has extensive experience working on renewable energy committees and advisory boards, including time on the Ontario government's Council on Renewable Energy. He received CanSIA's Solar Leader Award in 2007.

Larry Brydon

Larry Brydon is a Senior Account Representative with Reliance Home Comfort, where he supports new product development projects within their builder markets group. As an energy and sustainability expert, Brydon represents Reliance's interests through industry advocacy and association participation.

He holds several board and executive positions within the residential construction and green building sectors including: co-chair of the Toronto chapter, Canada Green Building Council; Executive and Director of Communications for Sustainable Buildings Canada; and Board Director for the Building Industry and Land Development Associations.

Volunteer roles include serving as chair of the energy subcommittee for the Canadian LEED for Neighborhood Development green building standard, co-chair of Building Industry and Land Development's Green Committee, and the policy and procedures and technical committees for the Ontario Energy Star and Energuide for Houses program.

Brydon is a regular stakeholder representative for many provincial and crown corporation organizations including Natural Resources Canada, Industry Canada, Canada Mortgage and Housing Corporation and the Ontario Power Authority.

He is a LEED Accredited Professional and a certified energy evaluator.

Appendix B. The technology of solar domestic water heating

Most people are familiar with the concept of using sunlight to produce electricity through a photovoltaic cell. Such “PV” panels are used, for example, to power temporary road signs in construction zones.

What is not so well-known is that direct sunlight can be used very effectively to generate heat for domestic use. In fact, this technology – called solar thermal or ST – is actually more energy-efficient than generating electricity with photovoltaic cells. That is, for the same area exposed to the sun, a solar thermal panel will produce more usable energy than a photovoltaic cell and at a lower all-in cost. Interest in solar thermal technology has grown over the past several decades with rises in energy costs. At present, ST systems are used in many commercial applications for heating water.

The design of a solar domestic water heating system is fairly straightforward. A shallow panel covered in glass is flush-mounted on a south-facing roof-top. A typical domestic system for hot water, for example to serve a family of four, consists of two panels, each measuring two metres by three metres. The interior of each panel is painted black, with tubing running through it.

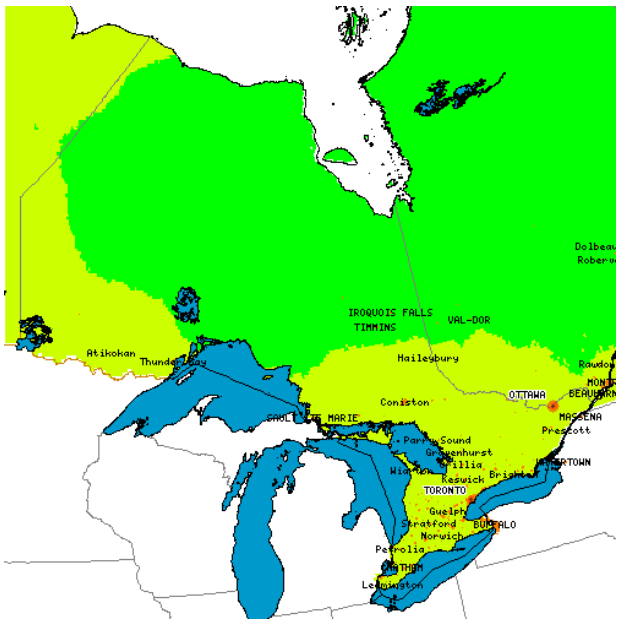
Domestic water-heating systems are generally used year-round. In Canada, most of these tend to be what are called “closed-loop antifreeze systems.” Well-designed, installed and maintained systems of this type can perform well and last for a long time. The tubing contains a mix of water and a compound called glycol, which has a lower freezing point than water. This is a major difference between solar domestic water-heating systems and those used for heating outdoor swimming pools, which circulate the water directly to solar collector panels because freezing is not a concern.

The heat of the sun, trapped by the glass cover and absorbed by the black lining of the panel, heats the fluid in the tubes to a very high temperature. From the roof-mounted panel, the heated fluid is pumped to the mechanical room of the house, generally in the basement. There, it passes through a heat exchanger that transfers the thermal energy to water from the house’s plumbing system. The heated water goes into a hot water tank. The pump moves the cooled antifreeze solution back up to the roof panel to be re-heated.

Ontario’s solar resource

The amount of solar energy available for heating water depends on the strength and duration of the sunlight striking the panels. Depending on the time of year and the area, Ontario’s solar resource varies considerably as these maps from the Natural Resources Canada website show:

Ontario solar resource – June



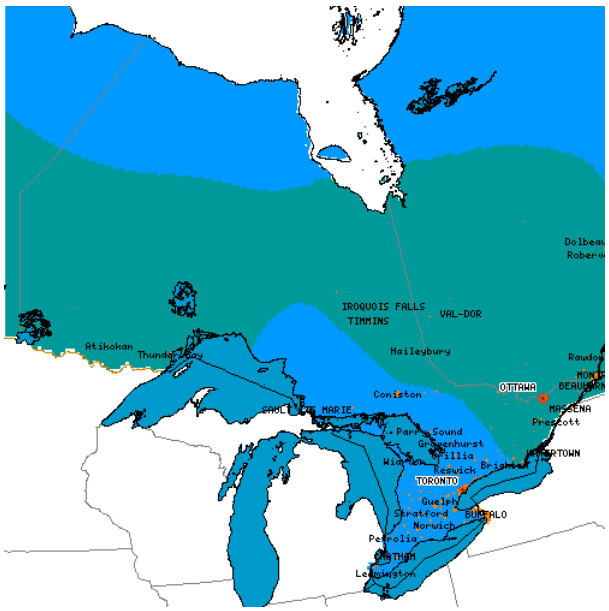
Mean daily global insolation

Red dots indicate built-up areas

4.2-5.0 kWh/square metre

5.0-5.8 kWh/square metre

Ontario solar resource – December



Mean daily global insolation

Red dots indicate built-up areas

1.7-2.5 kWh/square metre

2.5-3.3 kWh/square metre

The amount of energy available also depends on how panels are oriented. The information in the maps above is based on the assumption that a panel would be facing south and would be tilted at an angle to capture the greatest possible energy from the sun. Because Ontario is roughly half-way between the equator and the north pole, this angle is around 45 degrees – less in the southernmost parts of the province and more in the north.

A further climate-related factor that has an impact on the effectiveness of solar hot water is the starting temperature of the water being heated. Most of Ontario's water supply comes from surface water (that is, lakes and rivers). This can result in a large temperature differential

between source and heated water, especially in winter. While this differential increases the efficiency of systems, it also means more energy is needed to heat the water to a usable level.

Appendix C: The need to clarify solar hot water standards

The CSA standard, CSA B64 - Backflow Preventers, identifies solar hot water as representing a "severe risk" to the water supply (other water appliances such as bidets and flex-neck kitchen faucets are in the same risk category). Solar may have been assigned to this category before CSA F379.1, which is specific to solar hot water, was developed.

CSA F379.1: Packaged Solar Hot Water Systems addresses potable water contamination issues extensively and requires multiple fail-safe mechanisms to prevent cross contamination between the solar heat transfer loop and the potable water system. This includes the use of a CSA B64 listed backflow preventer.

However, as a result of the "no tolerance of risk" environment associated with *Ontario's Safe Drinking Water Act, 2002,* it was suggested at a meeting of municipal water safety officials in October 2008 that they would require a reduced pressure (RP), testable backflow preventer along with an annual inspection of it for all solar hot water systems (residential and commercial).

It is important to understand that this is an issue that impacts a number of provincial ministries, including Environment, Municipal Affairs and Housing, Health, and Energy and Infrastructure. Municipally, it impacts Water, Building and Sustainability (Energy/Environment) departments.

It is also important to note that as regulatory barriers are being reduced in Ontario, the solar hot water industry is beginning to work with regulators and to obtain building permits for installations. Requiring costly additional protection against contamination to get a building code for a solar hot water system would drive the solar industry back "underground" and set the industry back years.

We have looked at the potential risk that a solar hot water system might contaminate the water supply. It is our understanding that the probability of contamination is extremely low if a system complies with CSA F379.1. Even if it were to happen, the heat transfer fluid in a solar hot water system consists of a mixture of distilled water and food-grade propylene glycol that is considered practically non-toxic and is a permitted food additive (used in cake mixes, fat-free ice cream, and other products).