Solar Air Heating is an Ontario-success story, as it is currently the only renewable energy technology used around the world with its origins in Ontario. Solar Air Heating is a mature technology that has been successfully applied in thousands of projects across Canada and the United States, with especially strong uptake in Ontario. There are about 5 million square feet of solar air heating systems in operation in North America alone, representing about 250 MW of thermal energy and 100,000 tonnes of GHG displacement each year.

Currently, Solar Air Heating is incentivized in Ontario under the custom programs offered by the gas utilities. The amount of incentive offered by Union Gas and Enbridge amounts to less than 1¢ per m3 of natural gas saved over the lifecycle of a Solar Air Heating system. As such, the incentives are not impactful and are not sufficient to encourage adoption of the technology. There are some exceptions, such as an adder for social housing facilities in the Union Gas territory that awards a higher incentive, but the sporadic and limited nature of these "adders" do not have a pronounced effect on uptake of the technology in Ontario.

The table below will outline the Enbridge and Union Gas, as well as some other North American State programs in which Solar Air Heating systems are incentivized. In the United States, Solar Air Heating systems are awarded a federal tax grant of 30% of the project cost (including installation and balance of system). This is reflected in the "Federal Adder" category and based off a typical installed cost of $52/ft2 of Solar Air Heating collector. Below is a comparison of the different incentive programs, with the last row showing how the proposed Ontario incentive (based on the November 11, 2016 CanSIA document "*Making Solar Air Heating Mainstream*") will compare when converted to cubic metre of natural gas displaced.

Jurisdiction	**Rebate Structure**	**Incentive (per generated m3 of natural gas)**	**Federal Adder (per generated m3 of natural gas)**	**Total Incentive (per generated m3 of natural gas)**	**Total Incentive (per offset m3 of natural gas, based on 80% Seasonal Efficiency)**
Enbridge	Tiered $0.10-$0.30/year 1 m3	$0.0084 (average)	$0	$0.0084 (average)	$0.0067 (average)
Union Gas	$0.20/year 1 m3	$0.0084	$0	$0.0084	$0.0067
California	$10.10/offset therm for 2 years	$0.2379	$0.1063	$0.3442	$0.2754
Massachusetts	$11.76/year 1 therm	$0.1385	$0.1063	$0.2448	$0.1958
Minnesota	25% of project cost	$0.0886	$0.1063	$0.1949	$0.1559
New Ontario Incentive	**Prescriptive**	**$0.2477**	**$0**	**$0.2477**	**$0.1982**

Ontario Program Structure

1. The proposed new incentive is to be a prescriptive, monetary incentive awarded on a per square foot (or per square metre) basis for eligible solar air heating collectors. To account for differing performance across Solar Air Heating systems, it is recommended that the incentive amount be determined by incorporating the SRCC OG-100 collector performance into the incentive amount for each system. This is fundamentally identical to the OSTHI system that was so successful from 2007-2010, the only difference being that the CSA Performance Factor used under OSTHI has been discontinued and replaced by the more comprehensive and accurate SRCC OG-100 standard. The incentive level is arrived at via a simple equation that references the performance value from the SRCC OG-100 test certificate:

$$\boldsymbol{Incentive\ Amount = SRCC\ OG100\ \eta\ rating \times ft^2 of\ Solar\ Collector \times \$51}$$

A detailed explanation of this equation and the proposed program structure is explained in Appendix A of this document.

The list of SRCC OG-100 certified transpired Solar Air Heating Collectors is included as Appendix B of this document.

The application forms used successfully for the OSTHI program are included as Appendix C of this document, and provide a good example of the simplicity of the application process necessary to enact the new program. The OSTHI program was staffed by 2 individuals and their efforts were supported by technical expertise at Natural Resources Canada via the ecoENERGY for Renewable Heat program which included part-time efforts of approximately 4 individuals (Note here that the staff at the ecoENERGY programs administered programs for solar air and solar water heating across Canada, not just in Ontario). It is estimated that the new incentive program under consideration be administered by one (1) senior program manager and one or two (1-2) program administrators.

2. It is recommended that ALL commercial, industrial, institutional, and agricultural buildings (any building that is not single family residential) shall be eligible. The OSTHI program had an identical incentive level for retrofit or new build, and this is recommended for the new program for the sake of ease of implementation and to encourage adoption of the technology among the design community.

3. The end user will receive an acceptance letter from the program, and be given a time period in which to complete the project. It is recommended that the time period be 12 months from the issuance of the acceptance letter.

4. It is strongly recommended to include the option of making the funds, via a Letter of Assignment, payable to a 3rd party. This will allow the finance community to more readily engage with the program and encourage large scale adoption through the creation of 3rd party lease structures and other financial instruments. Making the funds assignable also allows manufacturers and installers to offer the systems at a reduced rate, eliminating the perceived risk to the consumer of the incentive funds being paid.

5. Each project must be commissioned, with close out documents including a certification from the end user that the system had been installed and all associated costs had been paid. A commissioning report must be completed by a P.Eng. licensed in Ontario verifying the installation and showing the area in square footage (or m^2) of the Solar Air Heating collector in order to calculate the final incentive that would be paid to the end user. As a component of the project commissioning a Testing Adjusting and Balance (TAB) report must be included that shows the system air flow per ft2 (or m^2) of Solar Air Heating collector. This measure is used to determine the SRCC OG-100 efficiency value which will be used to determine the final incentive amount that is ultimately provided to the project owner (or 3rd party via letter of assignment).

Appendix A

Development of a Solar Air Heating System Incentive based on the SRCC OG-100 Standard

CanSIA recommends the structure for the new prescriptive Solar Air Heating program to be as follows:

$$\boldsymbol{Incentive\ Amount = SRCC\ OG100\ \eta\ rating \times ft^2 of\ Solar\ Collector \times \$51}$$

$$(\boldsymbol{metric\ units}):\ \boldsymbol{Incentive\ Amount = SRCC\ OG100\ \eta\ rating \times m^2 of\ Solar\ Collector \times \$549}$$

The performance rating of an SRCC OG-100 Solar Air Heating System provides an efficiency of the air heating collector at various air flow rates. This rated efficiency can be used to calculate an incentive value in m3 of natural gas that is based off of the SRCC-certified Solar Air Heating system's performance. In using this approach with the incentive amount modulated by the SRCC OG-100 rating of any given Solar Air Heating system, it is assured that the incentive program distributes an identical amount per m3 of natural gas generated, no matter which type (or brand) of SRCC-certified transpired solar air heating collector is used.

A brief explanation of the calculations behind the funding amount is as follows:

Using the assumptions of an average radiation on a vertical sun-facing surface in Ontario being 800 kWh/m^2 for a season of use of 243 days per year (September 15 - May 15), the total daily amount of solar energy striking a Solar Air Heating system's surface will be:

$$\frac{800 kWh/m^2}{243\ days} = 3.292\ kWh\ /\ m^2\ /\ day$$

As one unit (1 m^3_{NG}) of natural gas is equivalent to 10.83 kWh, it follows that average solar radiation during the heating season will be equivalent to 0.303987 m3 of natural gas per m^2/day.

It then follows that, the Annual Generation (in m3 of natural gas) of an SRCC-Certified Solar Air Heating system will be:

$$0.303987 \frac{m^3_{NG}}{m^2 \cdot day} \times 243\ Days\ \times\ SRCC\ OG100\ \eta\ \text{rating}\ =\ Annual\ Generation$$

Which is equivalent to:

$$73.869 \frac{m^3_{NG}}{m^2} \times SRCC\ OG100\ \eta\ \text{rating}\ =\ Annual\ Generation$$

Factoring in the 30/year lifecycle of a Solar Air Heating system, the Lifecycle production (in m3 of natural gas) of any SRCC-Certified Solar Air Heating system is:

$$2216\ m^3_{NG}\ /\ m^2\ \times SRCC\ OG100\ \text{ŋ rating}\ =\ Lifecycle\ Generation$$

The SRCC OG-100 efficiency value (ŋ rating) can be used to determine the lifecycle production (in m3 of natural gas) per m2 of Solar Air Heating Collector in the following manner:

Using as an example the SRCC Certificate of the Ontario-made Conserval SolarWall product:

COLLECTOR THERMAL EFFICIENCY and TEMPERATURE RISE (K at 756 W/m²) (based on aperture area)								
Wind Speed / Air Flow Rate	0.0 m/s (0.0 mph)		1.0 m/s (2.2 mph)		1.8 m/s (4.0 mph)		3.3 m/s (7.4 mph)	
	η	ΔT	η	ΔT	η	ΔT	η	ΔT
0.6 scmm/m² (2.0 scfm/ft²)			0.40	24.16	0.34	20.95	0.28	16.92
1.2 scmm/m² (4.0 scfm/ft²)			0.56	17.30	0.51	15.83	0.44	13.45
2.1 scmm/m² (7.0 scfm/ft²)			0.68	12.12	0.64	11.33	0.56	9.98

Assuming the system is functioning at the medium wind speed rating column of the SRCC certificate (CanSIA recommends this as the default value) and in this instance, an air flow rate of 4.0 scfm/ft2 (a common mid-range flow efficiency), the SRCC OG-100 ŋ rating will be 0.51. Therefore, by multiplying the total lifecycle amount of solar energy ($2216 m^3_{NG}$) striking the Solar Air collector (in this case, the above-mentioned Conserval SolarWall product operating at a 4.0cfm air flow rate) by the SRCC OG-100 ŋ rating (in this case the corresponding 0.51), the lifecycle production (reflected in m3 of natural gas) will be 1130.16 $m^3_{NG}\ /\ m^2$ of solar collector. This is explained by the equation below:

$$2216\ m^3_{NG}\ /\ m^2\ \times SRCC\ OG100\ \text{ŋ rating}\ =\ Lifecycle\ Generation$$

$$2216\ m^3_{NG}\ /\ m^2\ \times 0.51\ =\ 1130.16\ m^3_{NG}\ /\ m^2$$

Based on CanSIA's recommendation that the structure of the rebate be the following:

$$\boldsymbol{Incentive\ Amount = SRCC\ OG100\ \text{ŋ rating}\ \times\ ft^2 of\ Solar\ Collector \times \$51}$$

$$(\boldsymbol{metric\ units}):\ \boldsymbol{Incentive\ Amount = SRCC\ OG100\ \text{ŋ rating}\ \times\ m^2 of\ Solar\ Collector \times \$549}$$

the incentive amount provided by the Province of Ontario **per m3 of natural gas** that a Solar Air Heating system will generate will be: **$0.2477 per m3.** Assuming an average measure of a facility's heating system having a base efficiency of 80%, **the incentive value provided** by the Province of Ontario **for the offset amount of natural gas** will be **$0.1981 per m3 of natural gas saved by the program.** This amount of $0.1981 per m3 of offset natural gas will be the same for all SRCC OG-100 certified Solar Air Heating Collectors. This level of incentive will encourage large-scale uptake of Solar Air Heating systems throughout the province and achieve

the levels of adoption set out in the November 11, 2016 CanSIA document "*Making Solar Air Heating Mainstream*".

NOTE: If Solar Water Heating systems are to be considered for funding under the proposed incentive program, then the same logic will hold true, utilizing the SRCC OG-100 test certificate for Solar Water heating systems. To arrive at a generated per m3 of natural gas generation amount of $0.2477 and $0.1981 of offset natural gas for solar water heating systems (based on SRCC OG-100 Collector Thermal Performance Rating, in kWh per panel per day, for medium radiation, Category D), the determining equation for solar water heating systems will be:

$$\boldsymbol{Incentive\ Amount} = \boldsymbol{SRCC\ OG}\mathbf{100\ Performance\ Rating} \times \#\ \boldsymbol{of\ Collector\ Panels} \times \$\mathbf{167}$$

Appendix B

The SRCC OG-100 Standard

Originating in Ontario in the mid-late 1980s, Solar Air Heating is a long-standing, robust technology boasting several manufacturers, most with more than a decade of experience. The list of SRCC-Certified manufacturers is below:

SRCC Number	Manufacturer	Brand Name	Model Number	Absorber Coating	Request Type
2011124A	Matrix Energy Inc.	MatrixAir	TR	Non-selective	Unglazed Flat Plate
2011123A	Matrix Energy Inc.	MatrixAir	DT	Non-selective	Unglazed Flat Plate
10002049	Trigo Energies Inc.	Trigo	Calento	Non-selective	Unglazed Flat Plate
10001971	Conserval Systems, Inc.	SolarWall	SW 1-Stage	Non-selective	Unglazed Flat Plate
10001914	ATAS International	InSpire	BWS390	Non-selective	Unglazed Flat Plate
10001798	Aeronergie, Inc.	Enerconcept	Luba GL	Non-selective	Glazed Flat Plate
10001797	Aeronergie, Inc.	Enerconcept	UnitAir	Non-selective	Unglazed Flat Plate
10001796	Aeronergie, Inc.	Enerconcept	Lubi	Non-selective	Glazed Flat Plate
10001759	Conserval Systems, Inc.	SolarWall	SW 2-Stage	Selective	Glazed Flat Plate

A complete listing including the individual SRCC OG-100 Certificates of each SRCC-Certified company is available via the link below:

https://secure.solar-rating.org/Account/CompanySearch.aspx?ctype=Manufacturer