Example name: Facade-integrated PVT transpired collector

Template completed by:
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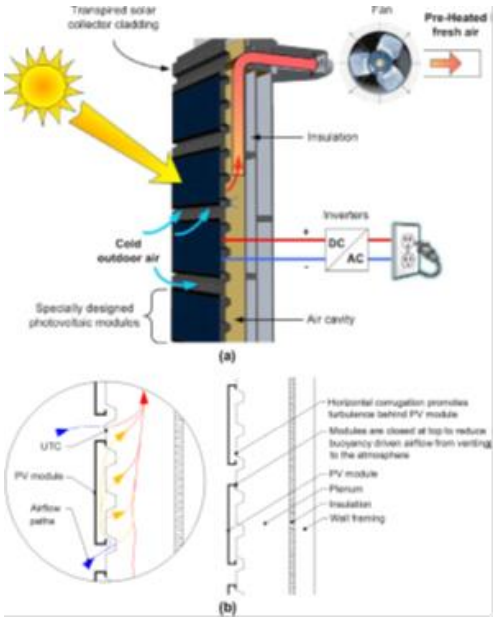


For installations

BISTS Location: Montreal, Canada 45.3N, 73.4W
Level of BISTS integration
Rush level 3 / Reijenga level 3

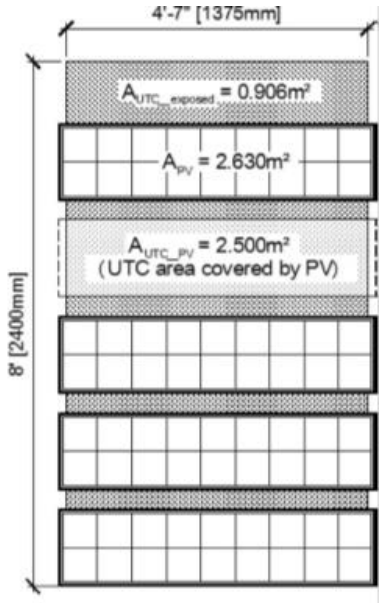
- ~~O~~ New Build
- O Refurbishment
- O Other: ……

Type of BISTS:

~~Active/Passive~~/Hybrid

Function(s):

- ~~O~~ Air heating
- O Water heating
- O Combi-system
- O Cooling/ventilation/shading
- ~~O~~ PV/T
- O linked to another system (e.g., heat pump)
- O Other: ……



Building element:

- ~~O~~ Facade
- O Roof
- O Other

BISTS characteristics:

The BIST is a combination of BIPV/T and UTC (Unglazed Transpired Collector) systems designed for building facades. The full scale prototype unit is constructed with 70% of the UTC area covered with PV modules specially designed to enhance heat recovery. The corrugations in the UTC are horizontal and the black-framed modules are attached to facilitate flow into the UTC plenum. The BIPV/T concept is applied to a south-facing facade on a full scale office building demonstration project in Montreal, Canada.

Stage of Development:		Responsible:
O	Idea/Patent	
⊖	Prototype	Dept. of Building, Civil and Environmental Engineering, Concordia University
⊖	Demonstration	Dept. of Building, Civil and Environmental Engineering, Concordia University
O	Integral building element	……..
O	Commercially available	……..

BISTS description and context

The transpired collector used in the prototype was a black galvanized steel sheet (26 gauge) with a porosity of 0.6%. The plenum depth (distance between UTC and insulation) was 0.15 m. The transpired collector sheets were installed with the corrugations running horizontally to facilitate closing of a gap between the upper frame of the PV panel and the UTC, so as to reduce heat losses by natural convection, while inducing turbulence behind the panels and increasing mixing in comparison to vertically oriented corrugations. Thus, airflow behind the PV modules is possible through the bottom and the sides. Finally, a portion of the UTC was left uncovered at the top to promote buoyancy driven cooling of both the plenum and the modules in summer.

The PV modules had custom designed features to improve the total absorbed solar radiation that can be converted to useful heat. To increase the effective solar absorptance of the PV, a black PV module backsheet was selected along with a black aluminium frame. A long narrow rectangular module was selected to reduce vertical temperature stratification of the air in the cavity between the PV panel and the UTC. This reduces the PV operating temperature and facilitates flow of air from behind the PV into the UTC. A custom designed 70 W polycrystalline module containing two rows of nine solar cells and measuring 1465 mm x 359 mm x 38 mm was used for this application. A vertical spacing of 90 mm between the PV modules was selected.

System viability

Whilst the thermal efficiency of the UTC system is higher than the BIPV/T (combined thermal plus electrical efficiency), the equivalent thermal efficiency of the BIPV/T system (assuming that electricity can be converted to four times as much heat) is 7–17% higher. Connection of air source heat pumps to solar-heated air will enable expanded use of such BIPV/T systems over a wider range of outdoor temperatures for space heating in addition to fresh air preheating.

Modelling and simulation tools developed/used

BISTS Performance data

Based on:
O Estimation
O Detailed simulation
Θ Measurement/testing
O Long-term monitoring

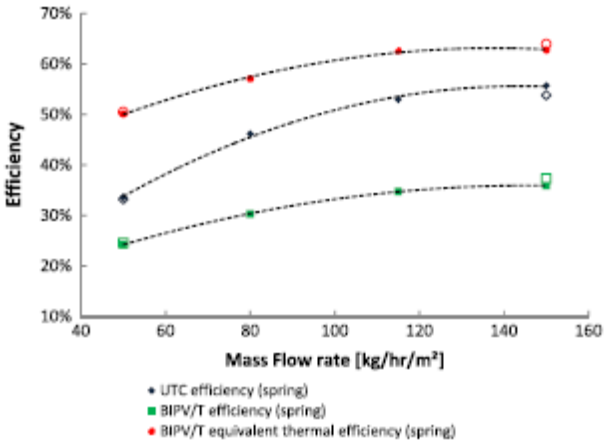
Performance parameters

For integrated systems:
key performance indicators -

For separate collectors:
performance rating coefficients -

Other:

Mass flow rate (kg/h/m^2)	50	80	115	150
Suction velocity (m/s)	0.011	0.019	0.026	0.033
Maximum plenum velocity (m/s)	0.172	0.289	0.409	0.517
Hole heat exchange effectiveness (%)	75.5	64.9	57.6	52.8



Additional information:

Sources and references:

AK Athienitis, J Bambara, B O'Neill, J Faille. A prototype photovoltaic/thermal system integrated with transpired collector. Solar Energy 85 (2011) 139–153