BIPV-T Perspectives

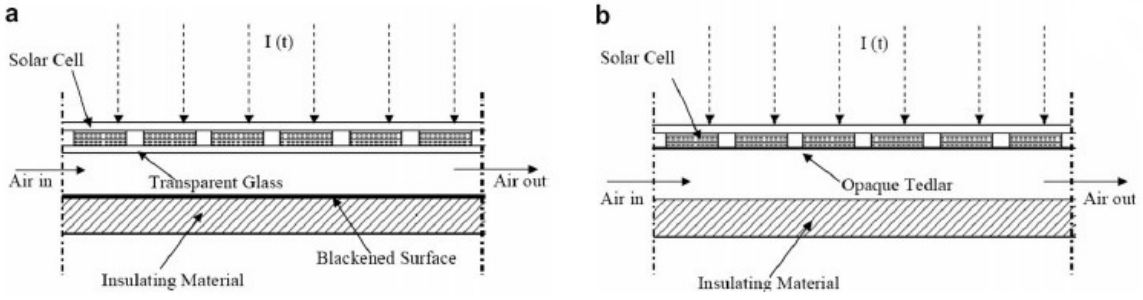

[3]

Typical PV collector efficiencies are roughly 4-7% for amorphous and 14-17% for crystalline. Increase of panel efficiency is the main reason why the idea of PV-T (photovoltaic-thermal) has been considered and further researched this last decade.

PV-T systems make use of the remaining 83-96% of incidental solar energy providing additional thermal energy for water heating. Furthermore PV-Ts can increase PV efficiency by reducing cell temperatures (temperature rise decreases cell eff. ~0.5%/K varying for different cell types).

- **Several air-air systems have been researched:**

  - ✓ glass- glass photovoltaic modules with /without ducts for recovering heat (solar radiaton left is absorbed by blackened surface after the air gap)
  - ✓ glass- tedlar photovoltaic modules with /without ducts for recovering heat (solar radiaton left is absorbed by the opaque tedlar increasing directly cell temperature)



(a) Cut sectional view of glass to glass PV module with duct. (b) Cut sectional view of glass to tedlar PV module with duct.

[2]

Efficiencies of technologies researched are the following:

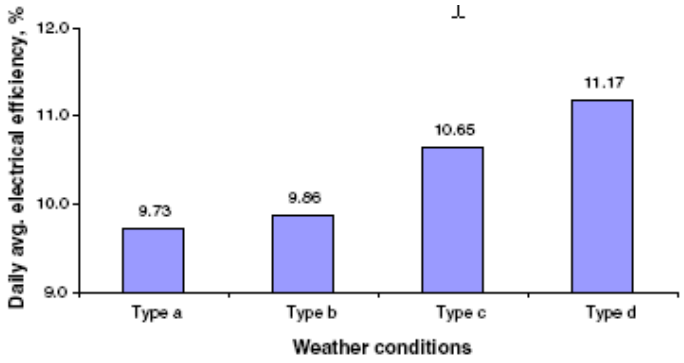
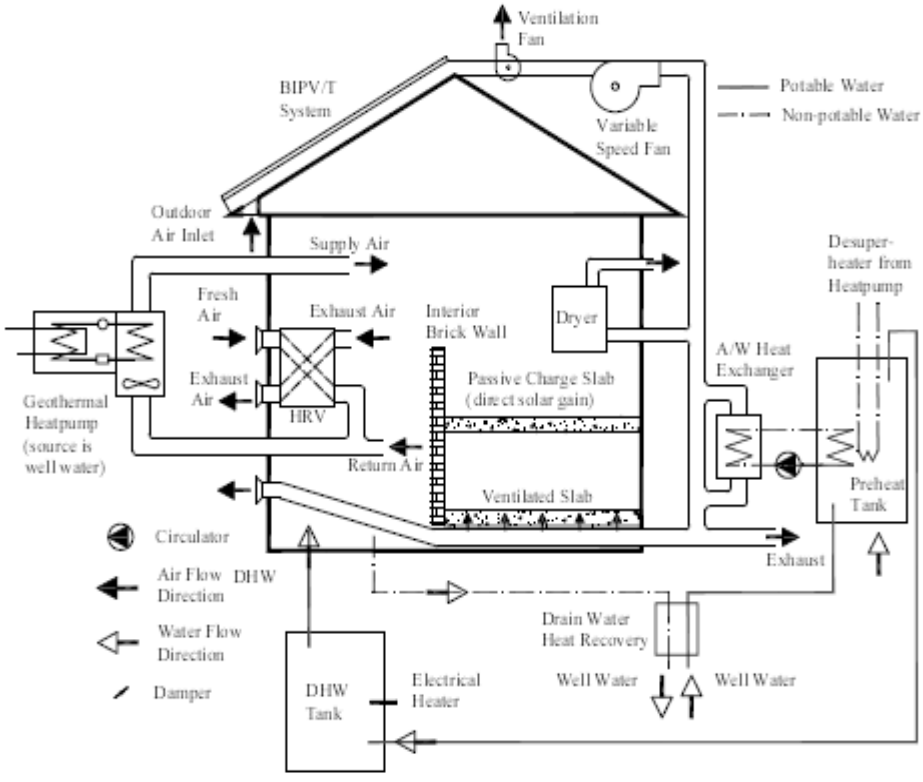


Fig. 7. (a) Hourly variation of electrical efficiency for a, b, c, d type weather conditions considering glass to glass PV module with duct. (b) Daily average of electrical efficiency for a, b, c, d type weather conditions considering glass to glass PV module with duct.

[2]

Such systems can be applied on inclined roofs reducing significantly the heating demand in colder seasons. BIPV-Ts are capable of pre heating ambient air and work together with ventilated concrete slabs (thermal mass) in order to store heat. This heat absorbed by thermal mass avoids overheating issues releasing heat gradually in evening hours.



[4]

- **Water systems seem to be preferred (fluids improve heat recovery rates).**

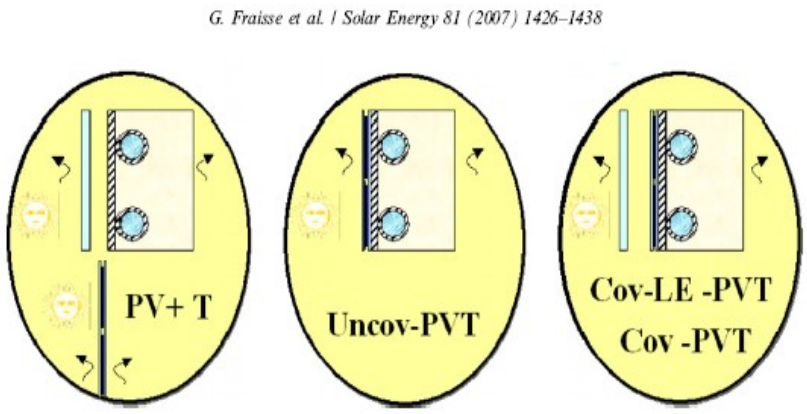


Fig The four different studied configurations. [1]

- **Main advantages-disadvantages of PV-T systems**

  - ✓ Less material in relation to pv and thermal collector systems added up
  - ✓ Roof material reduction when fully integrated on the roof
  - ✓ Significant increase of energy generated per m^2 as thermal is added to electrical

However, PV-T thermal efficiency is lower compared to conventional solar collectors due to:

  - ✓ part of the absorbed energy converted to electricity
  - ✓ absorption coefficient being smaller
  - ✓ thermal losses becoming higher

If a glazed cover is attached to the structure, which would increase thermal efficiency but would reduce electricity generation due to higher cell temperatures and optical losses. Furthermore:

  - Reliability due to increased temperatures approaching stagnation levels remains an issue
  - Decrease of cell efficiency occurs especially when higher water temperatures are required when connected to house DHW systems

- **Managing temperature inputs-outputs**

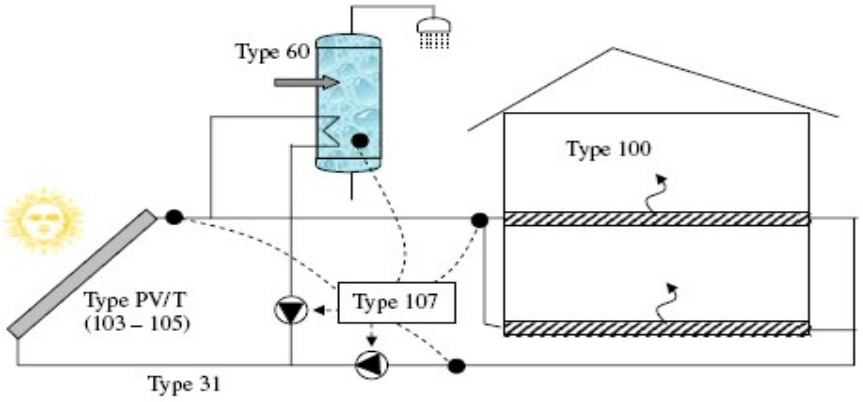
The cooling effectiveness of water circulating and exchanging heat with pv cells is strongly related to its temperature. Systems operating in lower temperatures provide higher electricity outputs.

When considering conventional systems i.e. radiators there needs to be a golden section drawn between optimal operating PV and water output temperature levels. In this case a glazed PV-T is more appropriate including amorphous cells as their efficiencies are less temperature sensitive.

An interesting alternative regarding heat-electrical energy generation is BIPV-Ts connected to a Direct Solar Floor. This is a combined system ideal for optimum electrical generation as it operates at low temperatures (35ºC). Controls function similarly as in conventional solar collector systems. Circulation is switched on or off according to temperatures of the collector output, floor loop return and domestic water tank.

In the case of a combi system a hybrid collector is utilised for domestic hot water as well as for directly heating the floor mass (meaning no extra tank is required).

BIPV-T systems considered could be uncovered cells, covered with conventional glass or low-e glass. Refrigerant liquids reduce temperature of the panels. However only the uncovered have a higher efficiency (~10%) when compared to conventional systems with covered ones efficiency significantly reduced.



[1]

References

[1] Energy performance of water hybrid PV/T collectors applied
to combisystems of Direct Solar Floor type, G. Fraisse, C. Me´ne´zo, K. Johannes a, www.Elsevier.com

[2] Dubey S et al., Analytical expression for electrical efficiency of PV/T hybrid air collector, Appl Energ
(2008), doi:10.1016/j.apenergy.2008.09.003

[3] Optimizing the energy and exergy of building integrated photovoltaic thermal
(BIPVT) systems under cold climatic conditions
Basant Agrawal *, G.N. Tiwari
Centre for Energy Studies, Indian Institute of Technology Delhi, Hauz Khas, New Delhi 110 016, India, www.Elsevier.com

[4] http://www.springerlink.com/content/n30m34rm24001630/fulltext.pdf