Hybrid photovoltaic/thermal technology

Photovoltaic-thermal (PV/T) systems refer to the integration of photovoltaic and solar thermal technologies into one single system, in that both useful heat energy and electricity are produced. A typical arrangement is the direct attachment of PV modules on to a solar thermal collector surface. For a given collector surface area, the overall system energy performance is expected higher than the conventional “side-by-side” PV and solar thermal systems. Its applications can be in a wide range of building types, in particular for the domestic buildings. The rationale behind the hybrid concept is that a solar cell converts only 6-15% of the incoming solar radiation into electricity. More than 85% of the solar energy is either reflected or converted into heat. This subsequently may bring about a substantial increase in cell operating temperature. By cooling the solar cells with a fluid stream like air or water, the electrical output can be improved.

Study of air-cooled PV panel wall installed at a subtropical hotel building
In the warm or hot climatic regions, the direct production of service hot water has a higher market value than generating warm air for space heating. The higher year round ambient air temperature makes the PV/T option more attractive than the plain PV application. One basic design is the insertion of the PV module inside a conventional sheet-and-tube type solar thermal collector.

Front view of a PV/T collector with single glazing.
Fin performance of the thermal absorber has been identified as one crucial factor that affects much the overall energy performance of the hybrid collector. Accordingly, an aluminum-alloy flat-box PV/T collector prototype was constructed and tested. With a simple and handy design, this new design is very suitable for domestic application.

Related publications:

Chow TT. Performance analysis of photovoltaic-thermal collector by explicit dynamic model. Solar Energy, 75(2), 2003, 143-152