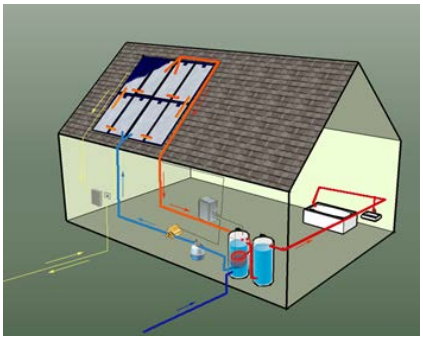
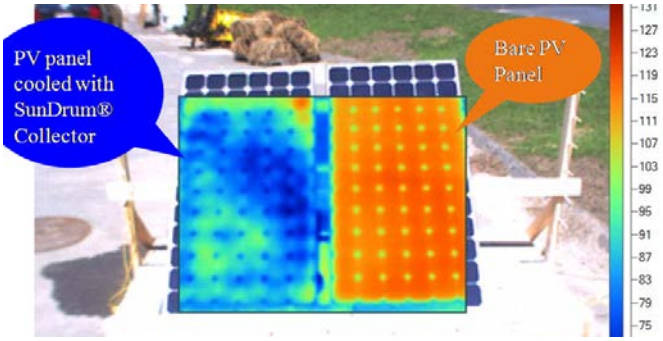
Consideration of Energy Capture in Hybrid Photovoltaic and Hot Water Systems – 2012

From Solar Cell Design and Processing Class ©2012 Dunbar P. Birnie, III





Selected images from www.sundrum.com – others shot at the Solar Decathlon in 2011





Further analysis based on standard module construction thermal characteristics as discussed by Lee et alia, in 2008 (eXpressPolymerLetters) as excerpted here:

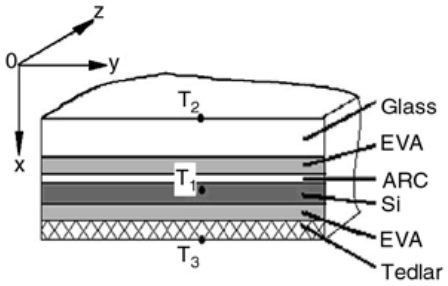


Table 1. The sizes and properties of each layer in encapsulated Si solar cells

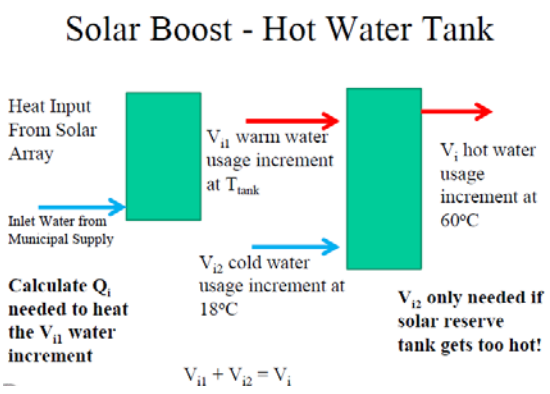
No.	Layer	Thickness δ [mm]	Thermal conductivity k [W·m⁻¹K⁻¹]
1	Glass	3.0	0.98*
2	EVA	0.5	0.23*
3	ARC	(0.06–0.1)·10⁻³	1.38
4	Si	0.25–0.4	148
5	EVA	0.5	0.23*
6	Tedlar	0.1	0.36*

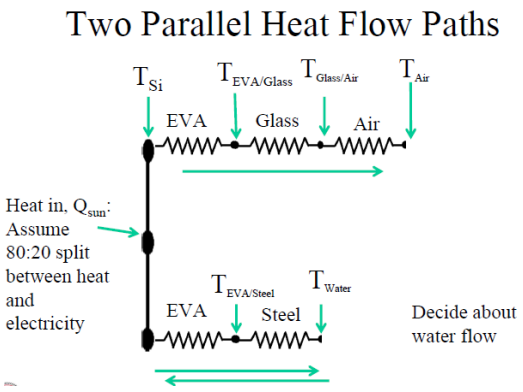
*measured value

Then extrapolate from the standard module design to include steel encased fluid flow zone with these dimensions:

Glass	3 mm	
EVA	0.5 mm	
Silicon Solar Cell	0.3 mm	Assume Constant Temp. Both Sides
EVA	0.5 mm	
Steel Sheet Metal	0.5 mm	
Antifreeze	fix at inlet temperature	
Steel Sheet Metal	container layer – no heat loss	
Insulated Backing	(no heat loss)	

And, further, applying sensible energy balances as discussed here, then we looked at total sunlight arriving and being captured over time.





Final story depended substantially on the hot water usage pattern for the building. One output (for a residential usage pattern) – these are reserve water tank temperature on an hourly basis through an entire typical year. Similar data collection for continuous usage rate showed that sometimes twice as much energy was available for thermal capture compared with the electrical energy!

