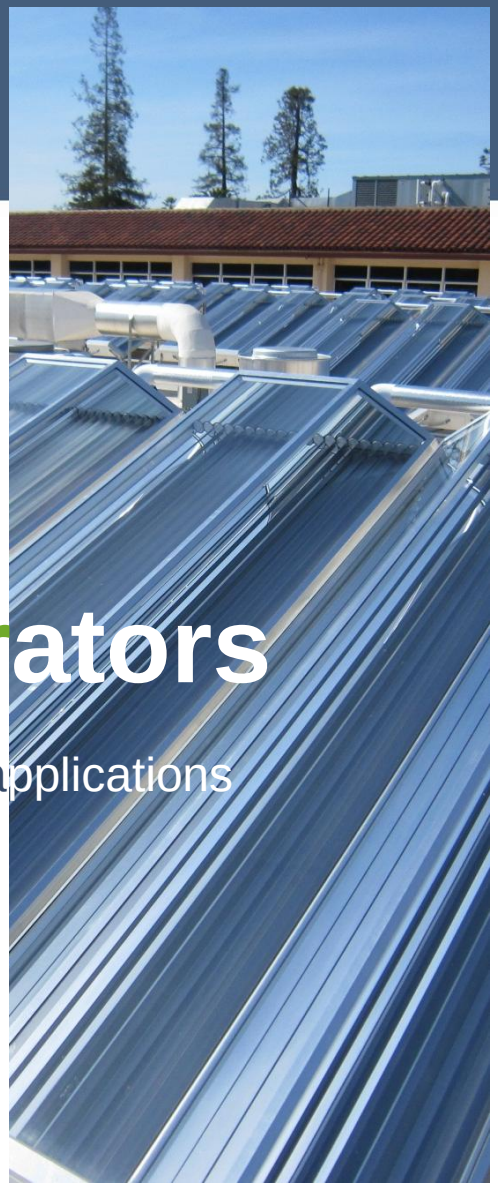
CHROMASUN

Rooftop Micro-Concentrators

A review of a 120kW thermal project in Santa Clara and applications



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Background = Fresnel CSP

- Chromasun's team background is building large Fresnel CSP plants for direct steam generation.
- These systems are 'fixed' to the ground with pressurized receivers that do not move.
- Arguably the lowest cost solution.

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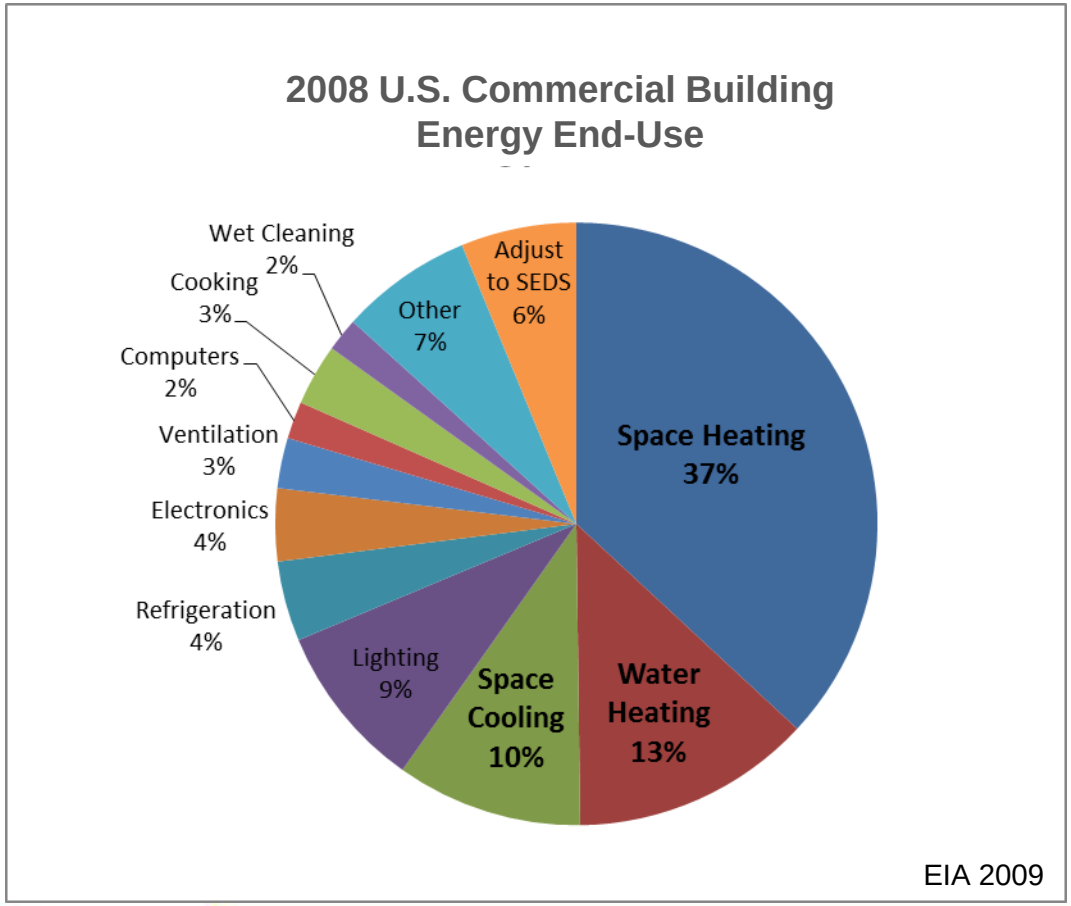
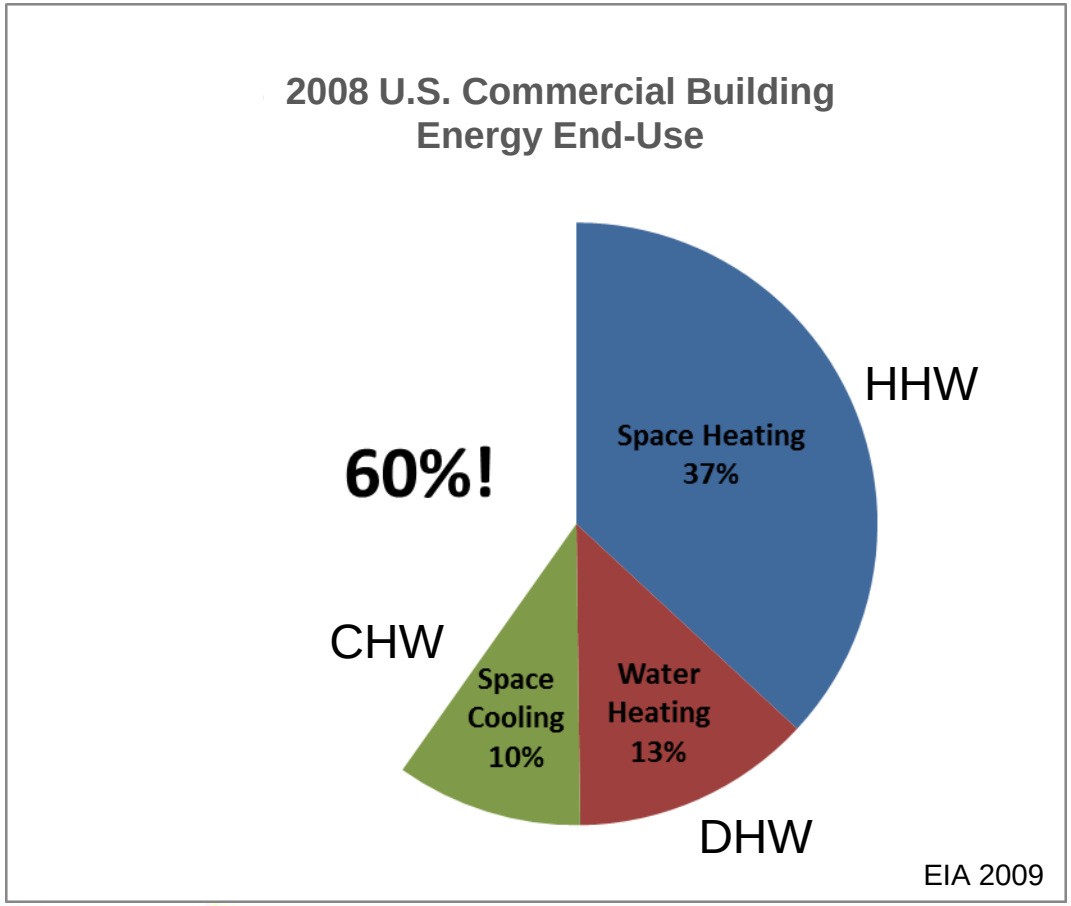
BTU's or kWh's?

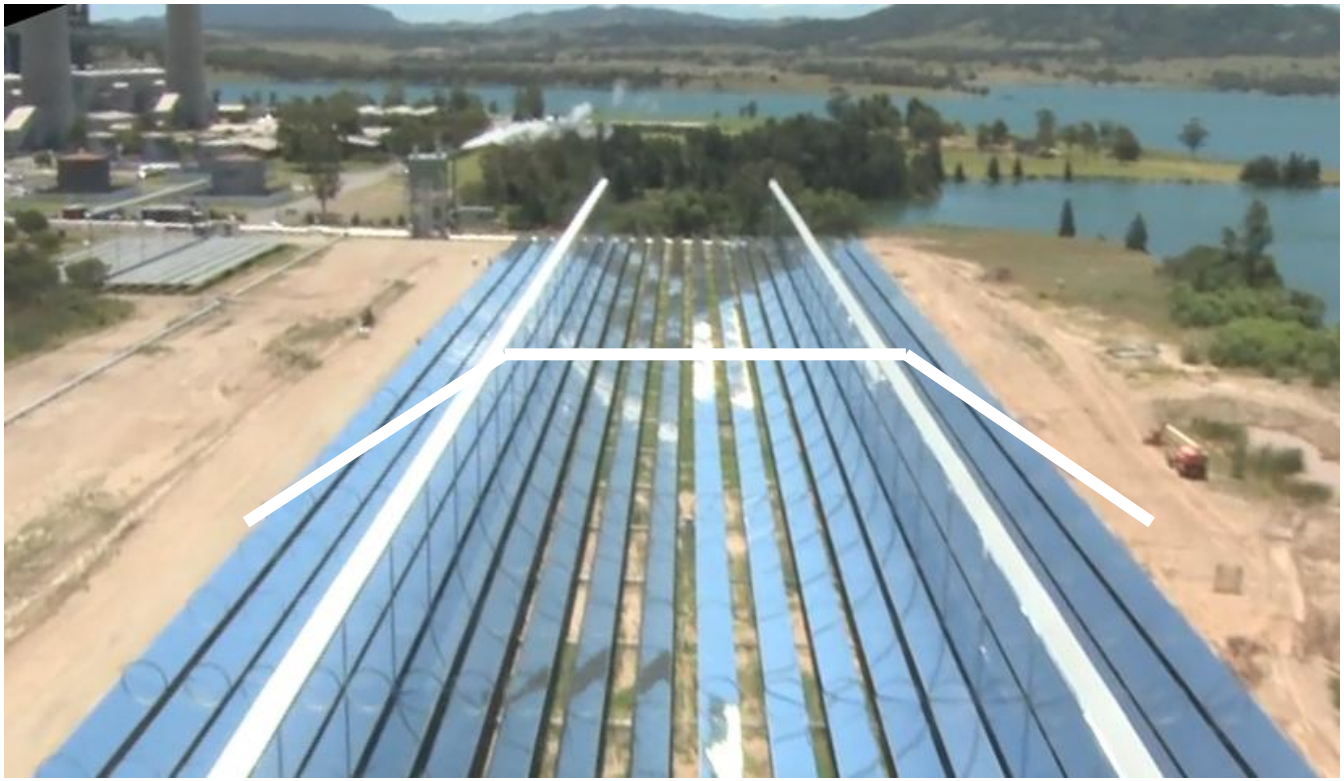


EIA 2009

Heating and Cooling



Bringing CSP to the rooftop?



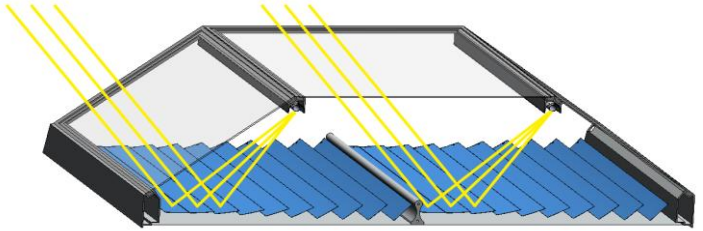
- Most process heat and cooling loads are in urban areas.
- Could Fresnel CSP be made to work on rooftops?.....

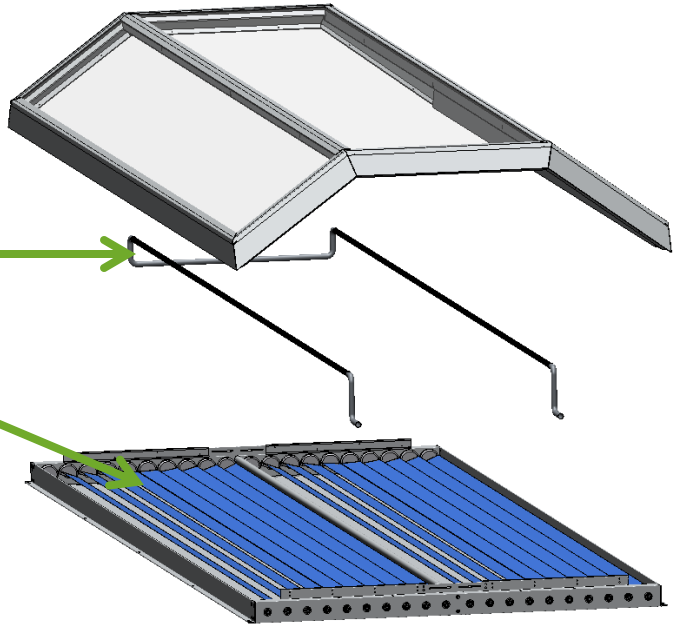
Chromasun MCT Panel

- Flat panel format
- Internal tracking
- High temps
- Turns on and OFF
- No external moving parts
- Easy installation and O&M
- Low wind and roof loadings

How MCT works

Section View





Receiver Pipe
(SS 304 A213 Tube)

Parallel Mirrors

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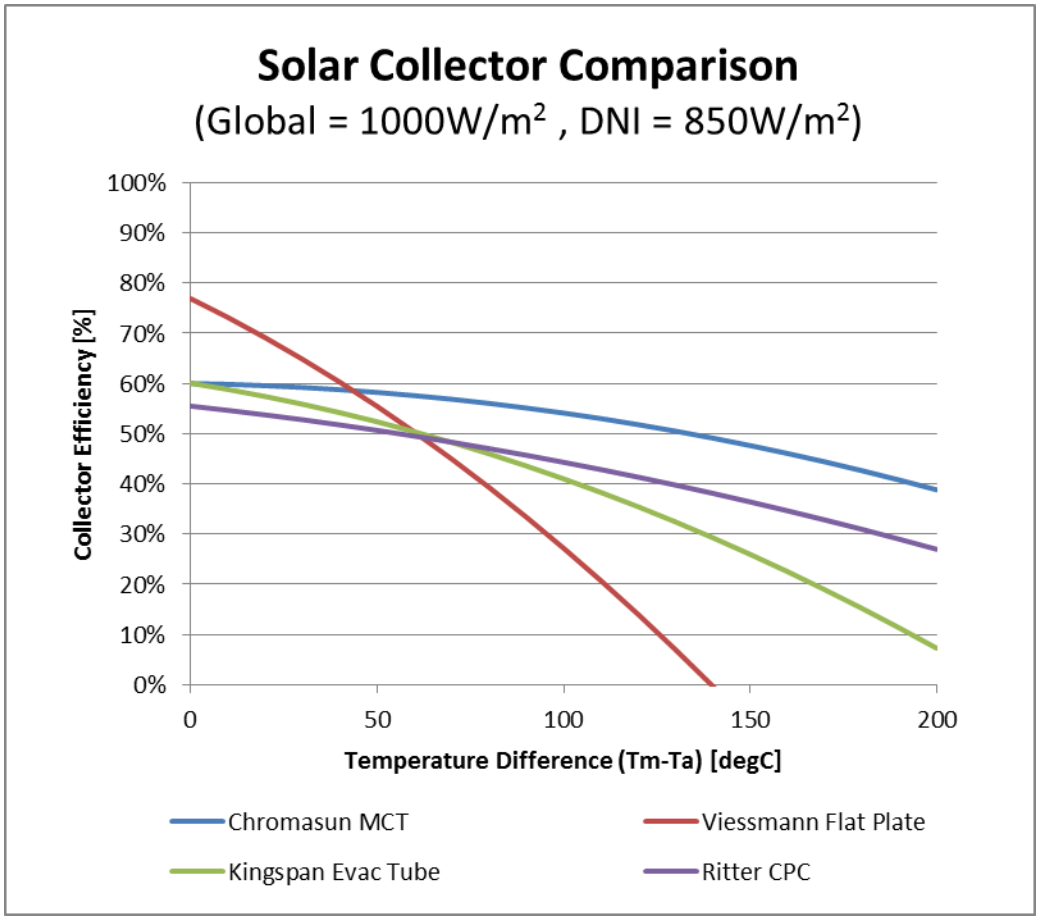
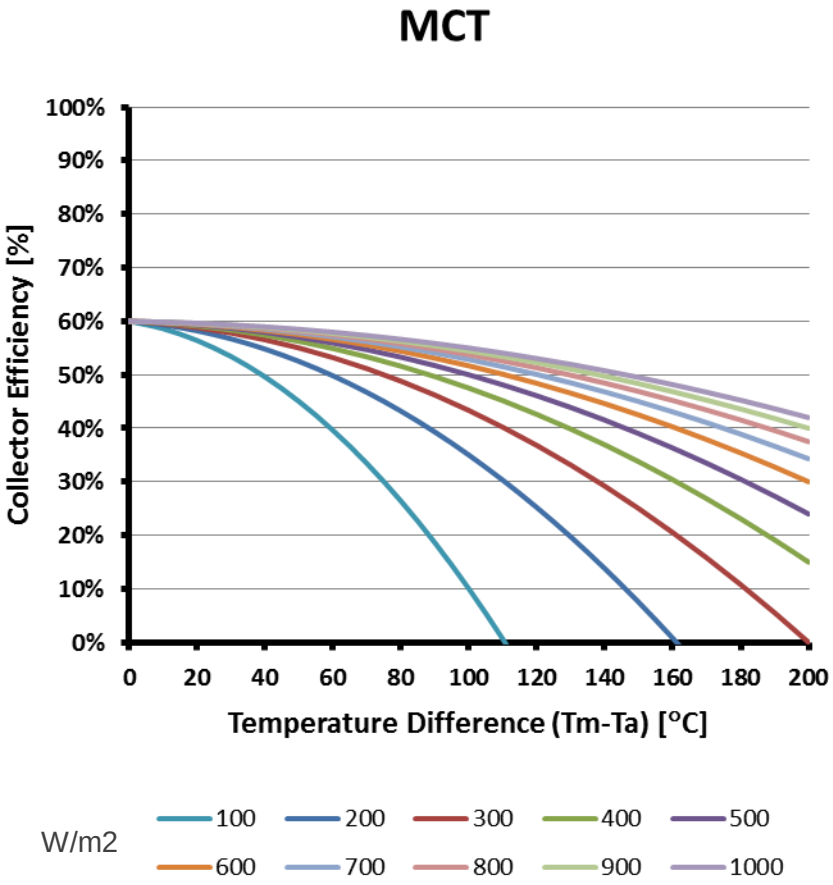
MCT v flat panel

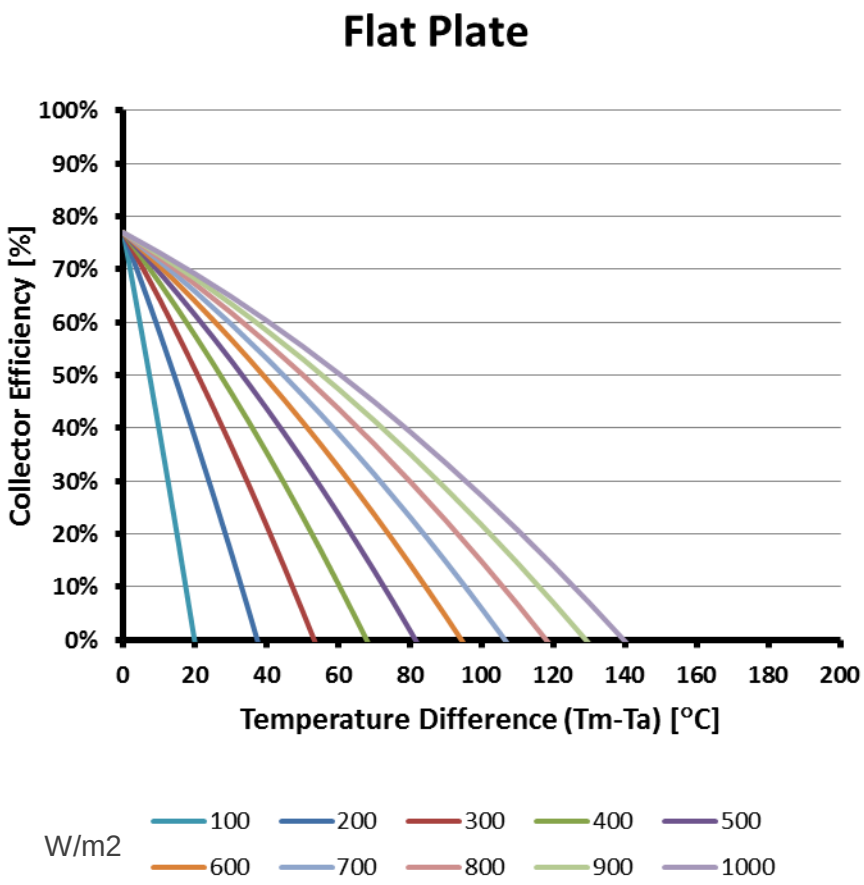


Flat Plate Collector

Evacuated Tube Collector

Efficiency at full and partial sun





Testing program

Santa Clara University, California

SoCalGas - Los Angeles

SRCC – Menlo Park, California

GE Global Research – Bangalore, India

Australian National University

GE Global Research - Munich, Germany

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Process Heat Applications

- Steam
- Boiler Feedwater Pre-heat
- Hydronic Heating
- Domestic Hot Water

Benson Commercial Showcase

Santa Clara University Benson Building

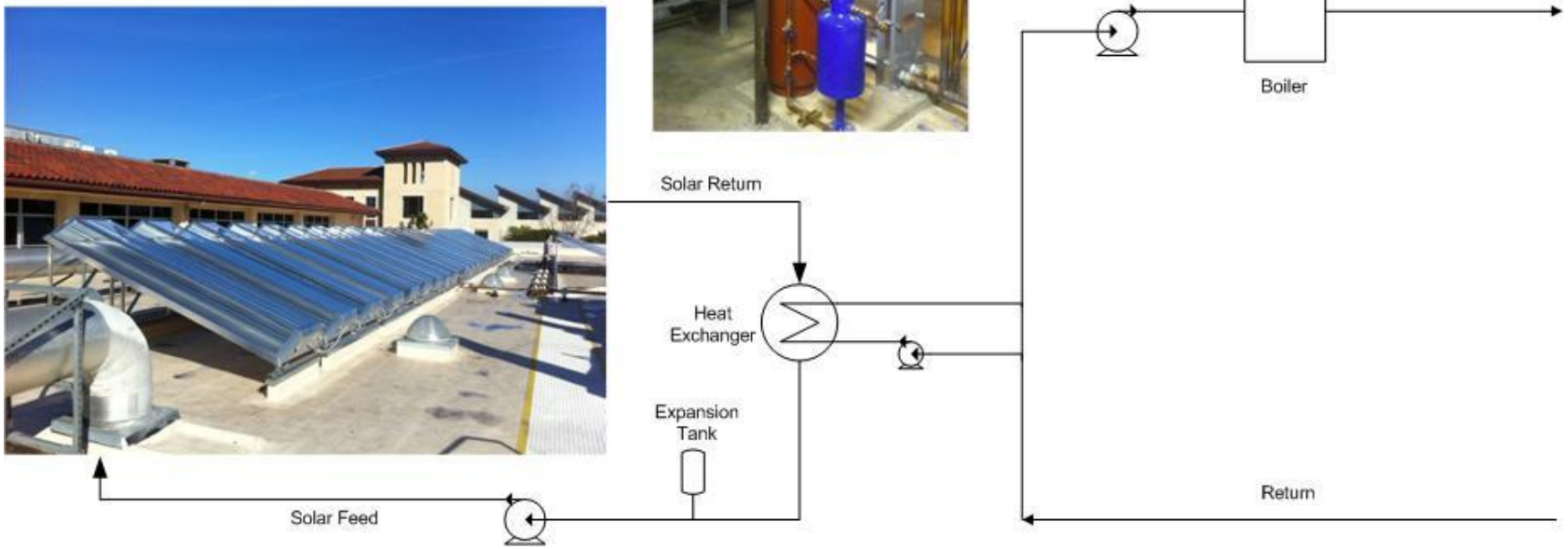
- 60 MCT panels
- 2,682 square feet
- 120KWt peak
- 410 Mbtu/h
- 6,727 therms PA

Boiler feedwater preheat application

- HHW and DHW (2,880 GPD) for main cafeteria

Installed 2010

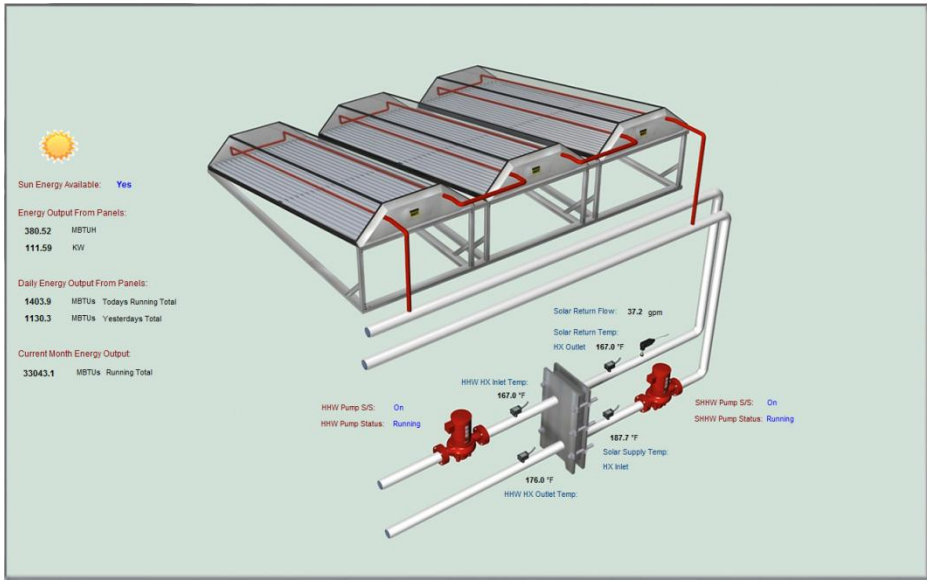
Benson System Schematic



Performance Monitoring

Solar Monitoring Equipment

Thermal/BTU Metering



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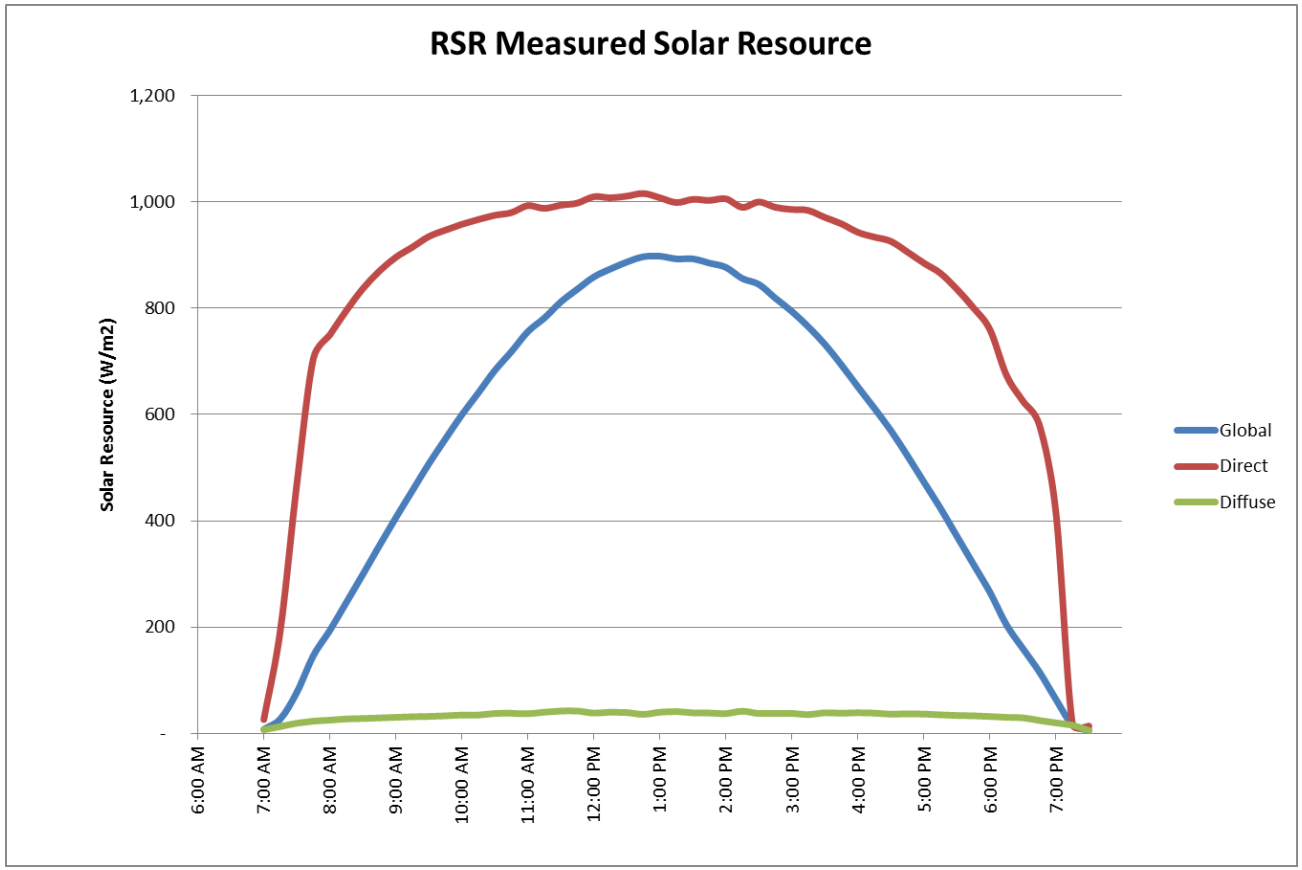
Measured Performance



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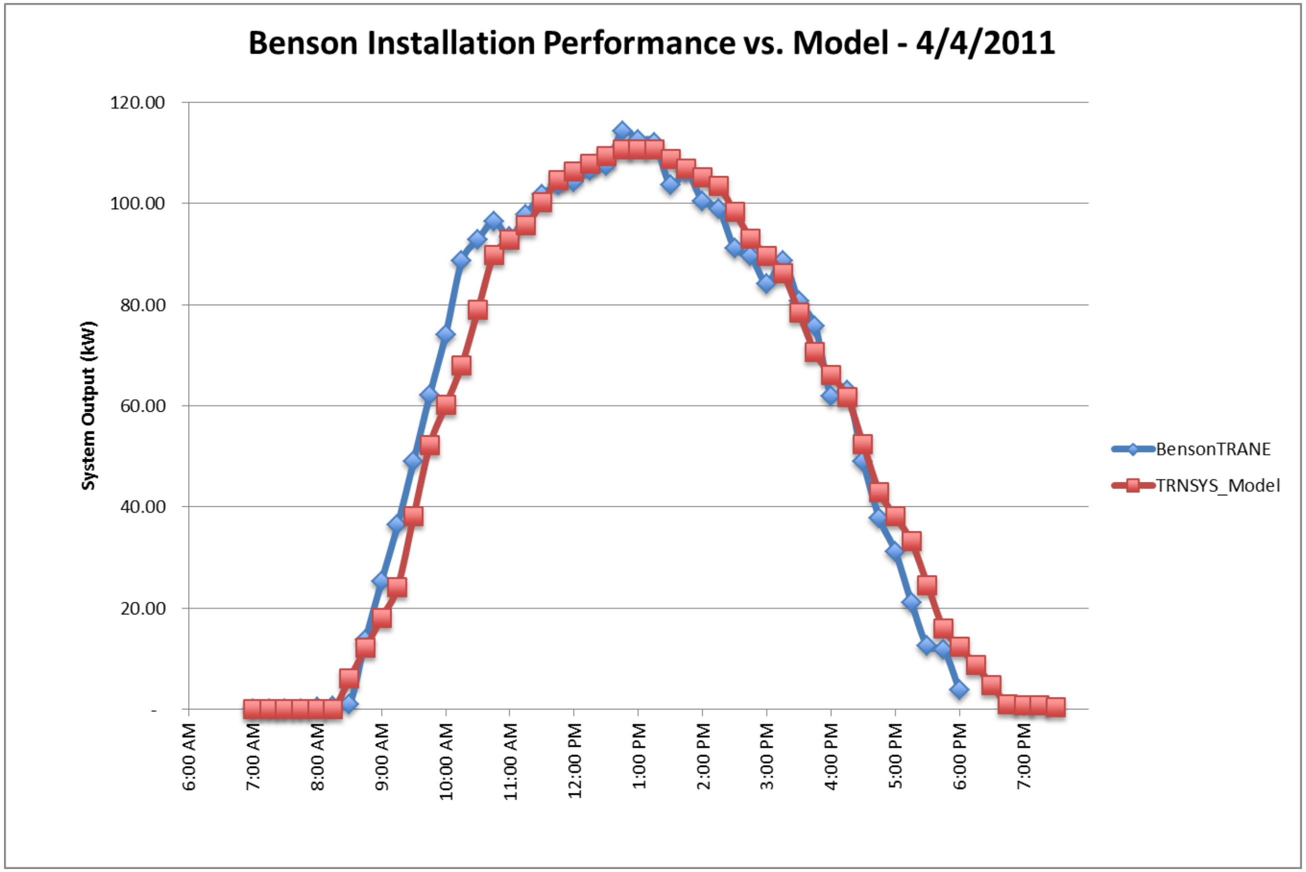
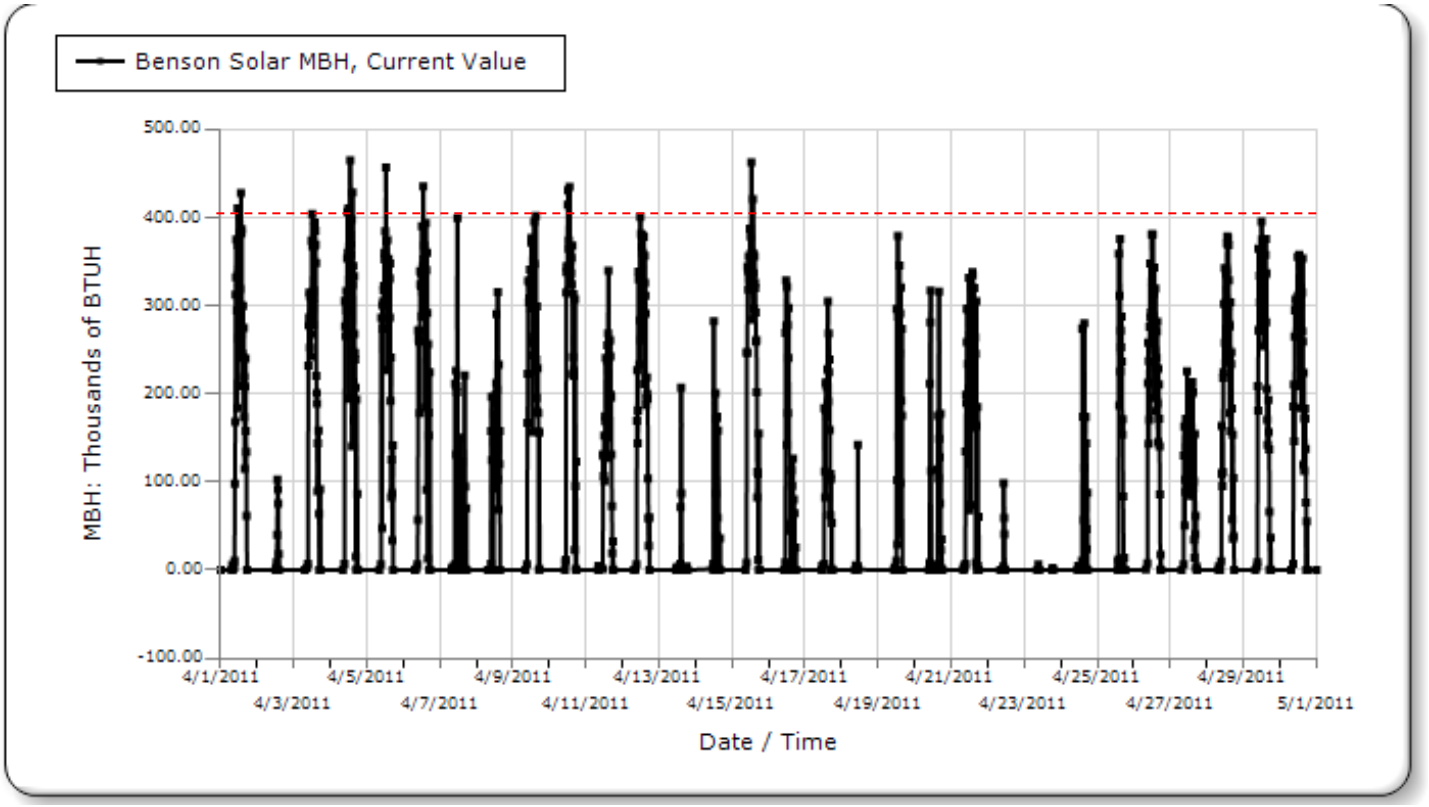
Measured Performance



Measured Performance



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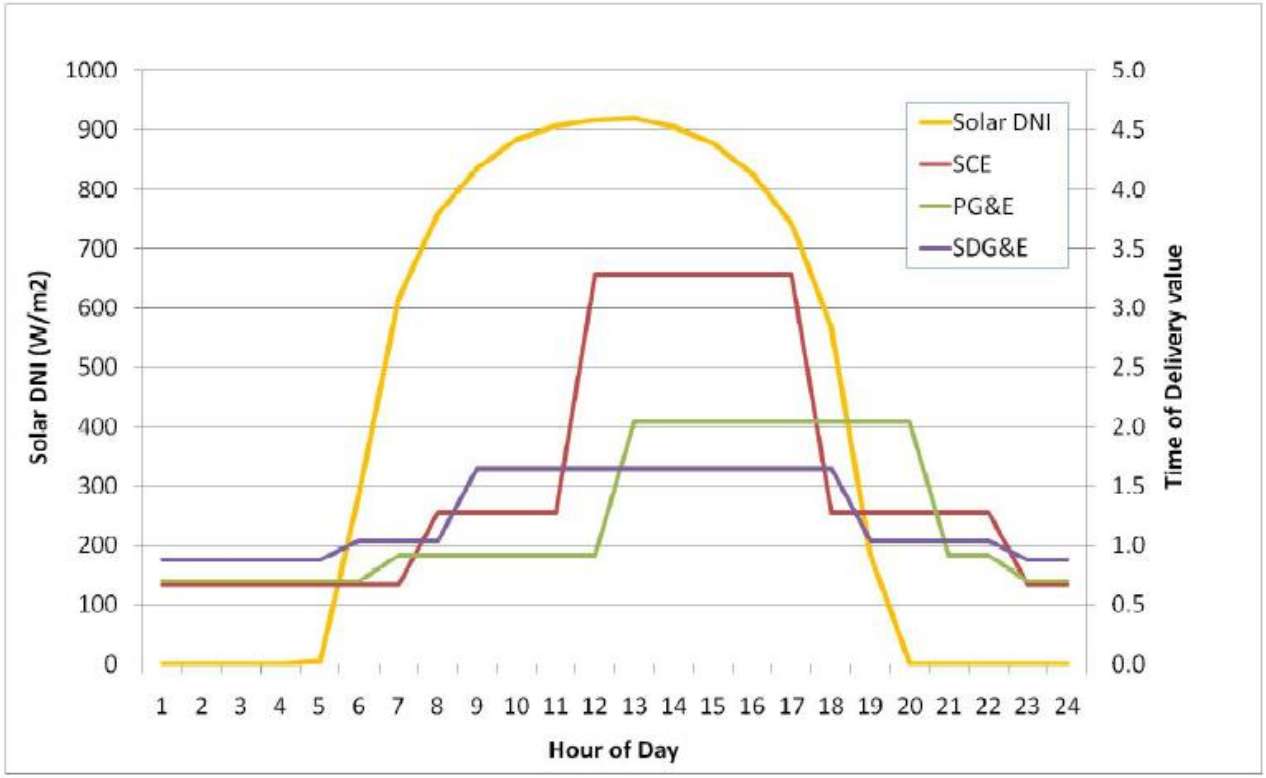
Solar Cooling Applications

- DX Unit Pre-cooling to return air
- Chilled Water production (to loop or fancoil)
- Domestic Hot Water
- Reject Heat
- Nominal 135% efficiency
- Some configurations up to 370%.

Solar cooling is a good idea.



- Cooling loads drive peak grid demand.
- There is strong correlation between summer peak electricity costs and solar resource.

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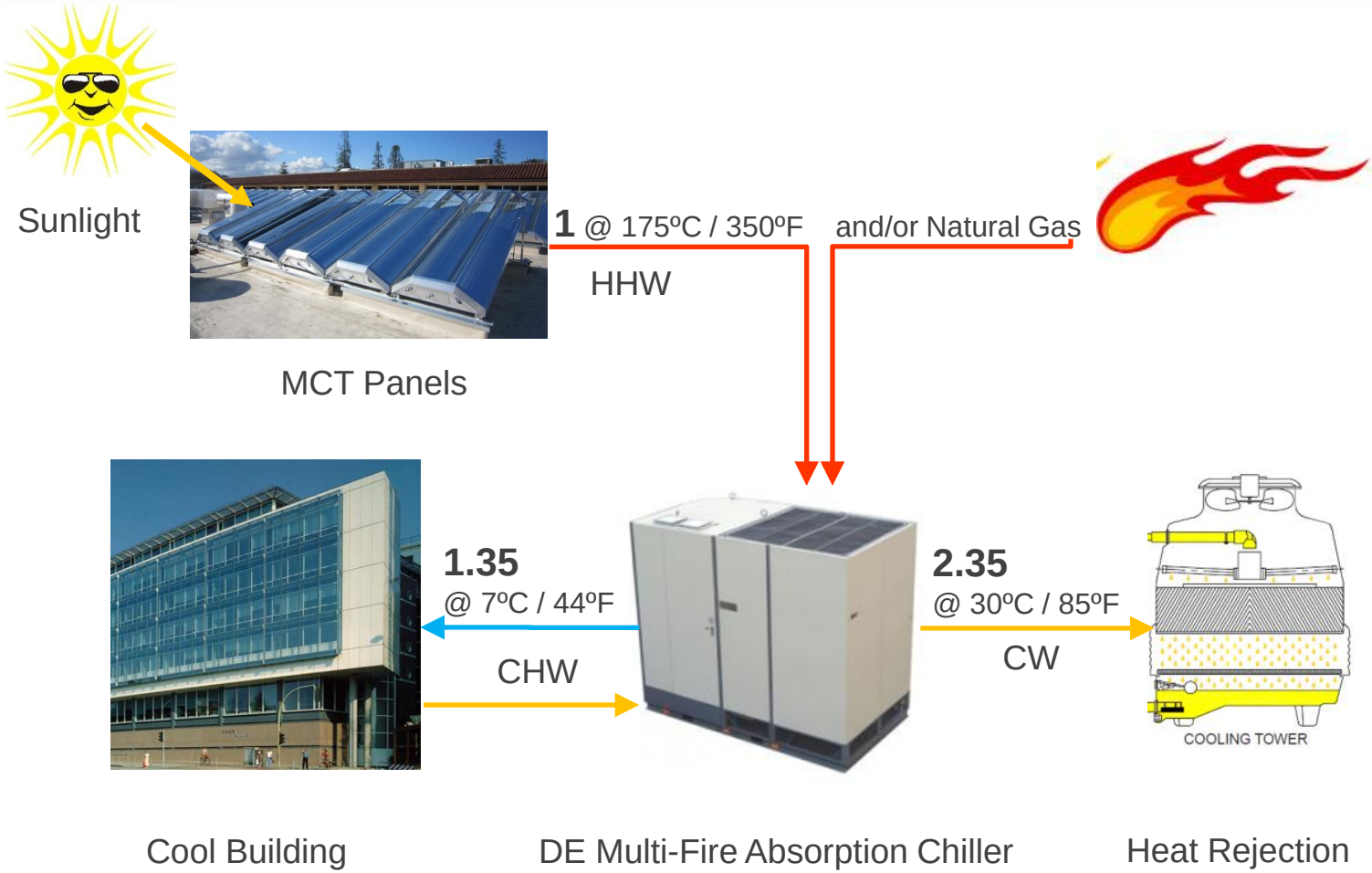
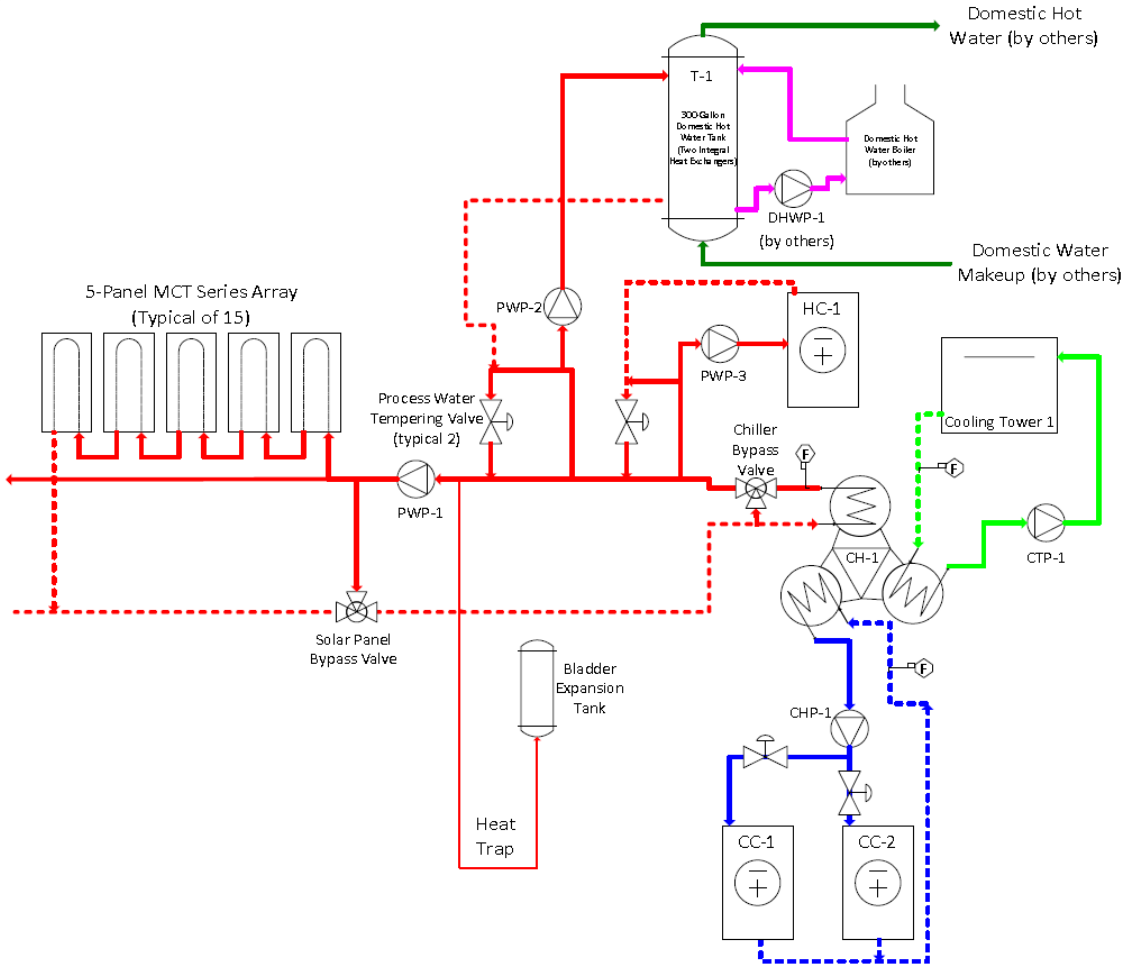
1 MCT = 1.35 CHW and 2.35 CW



Solar Cooling System Schematic

Crow
Canyon
Medical Center
Danville



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Heat Pump Applications

- Hydronic Boiler supplementation
  - Domestic Hot Water
  - Hydronic Heating Water
- Simultaneous Chilled Water production
- Nominal efficiencies up to 220%

1 MCT = 0.6 CHW + 1.6 DHW = 220%

Sunlight

MCT Panels

1 @ 115ºC / 240ºF

HHW

and/or

Natural Gas

Cool Building

0.6 @ 7ºC /44ºF

CHW

NH3 Multi-Fire Absorption Chiller

1.6 @ 54ºC /130ºF

DHW

Hot Water

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1 MCT = 0.6 CHW + 1.6 HHW = 220%

Sunlight

MCT Panels

1 @ 150ºC / 300ºF

and/or

Natural Gas

Cool Building

0.6 @ 10ºC /50ºF

CHW

NH3 Multi-Fire Absorption Chiller

1.6 @ 74ºC /165ºF

HHW

Hydronic Heating Water

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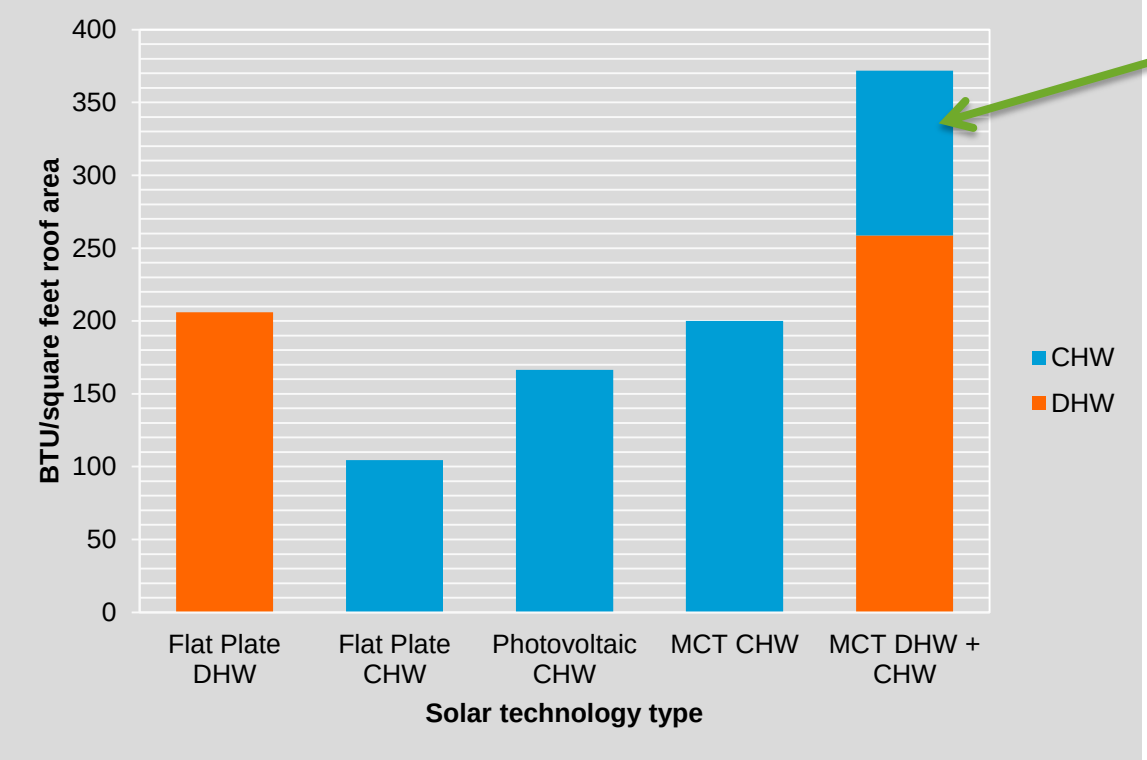
Rooftop solar energy yields



Best building energy outcome!

1000W/global, 850W/DNI solar resource

Summary

- Heating and cooling loads are dominant building loads
- CSP devices like Chromasun MCT can offset these loads
- Subsequent best rooftop energy outcomes are from solar thermal collectors like MCT and not PV.

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CHROMASUN

THANK YOU

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