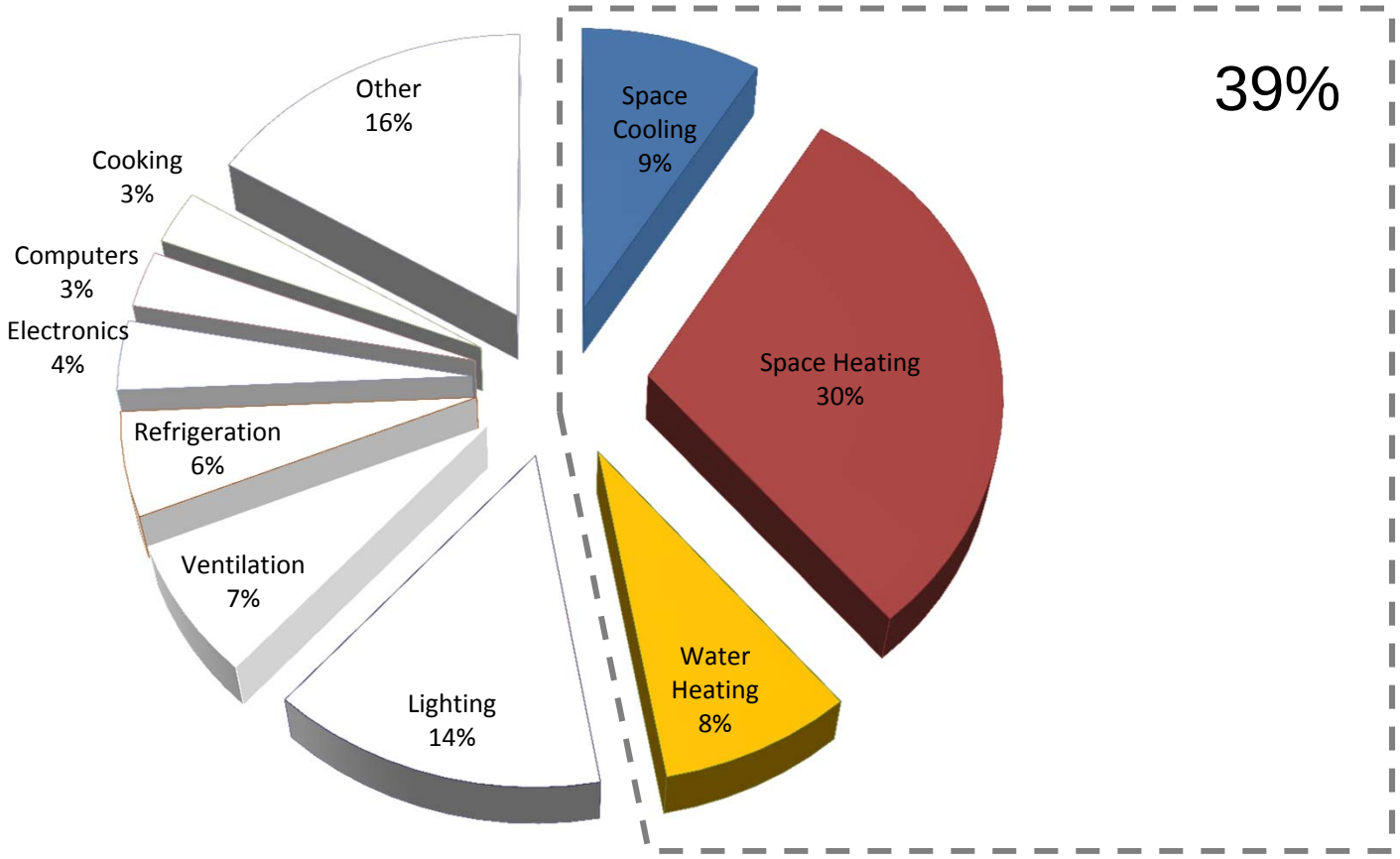
12/17/2011

# Solar Heating and Cooling

## Chromasun Rooftop Applications

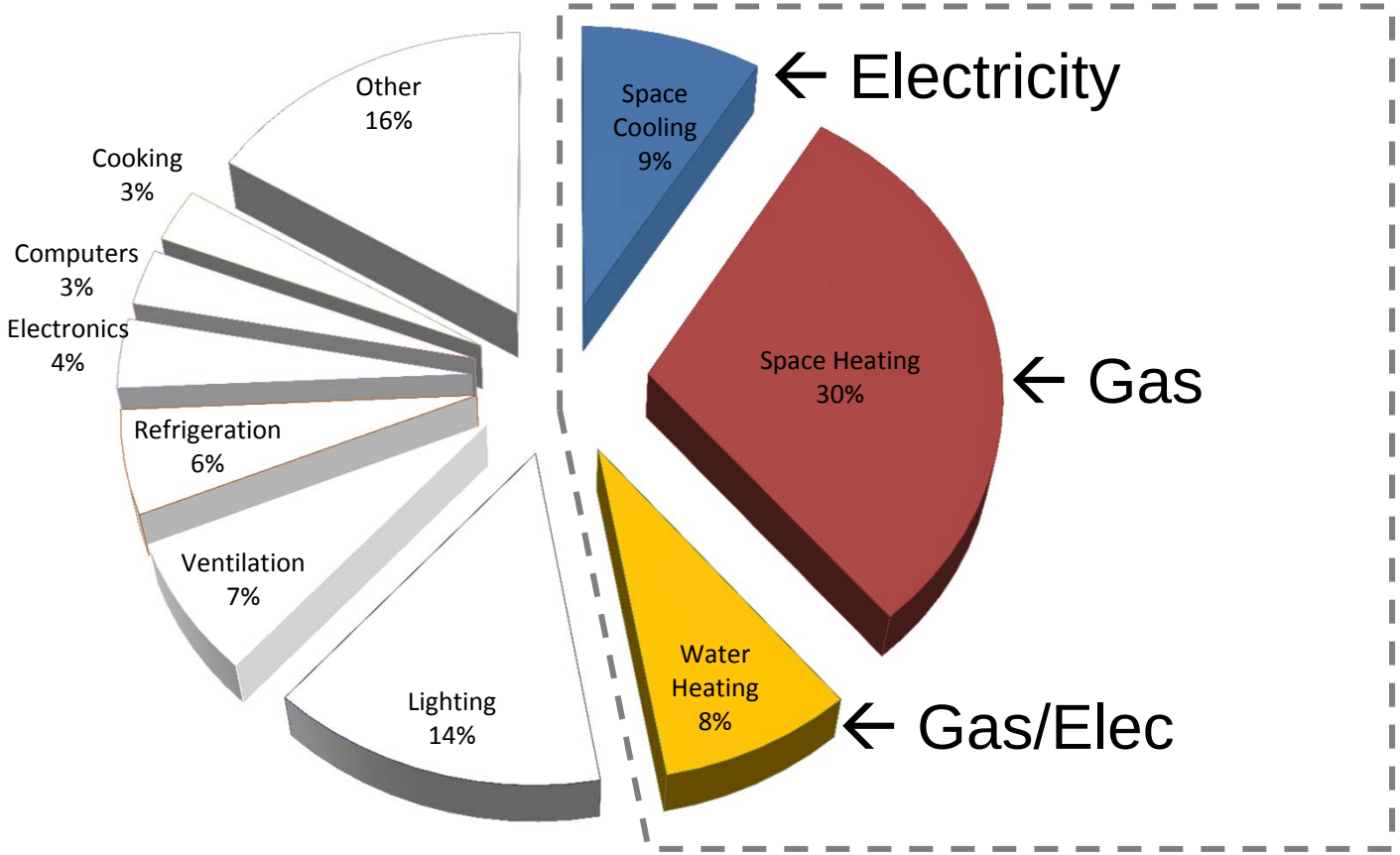
CHROMASUN

# Heating and Cooling



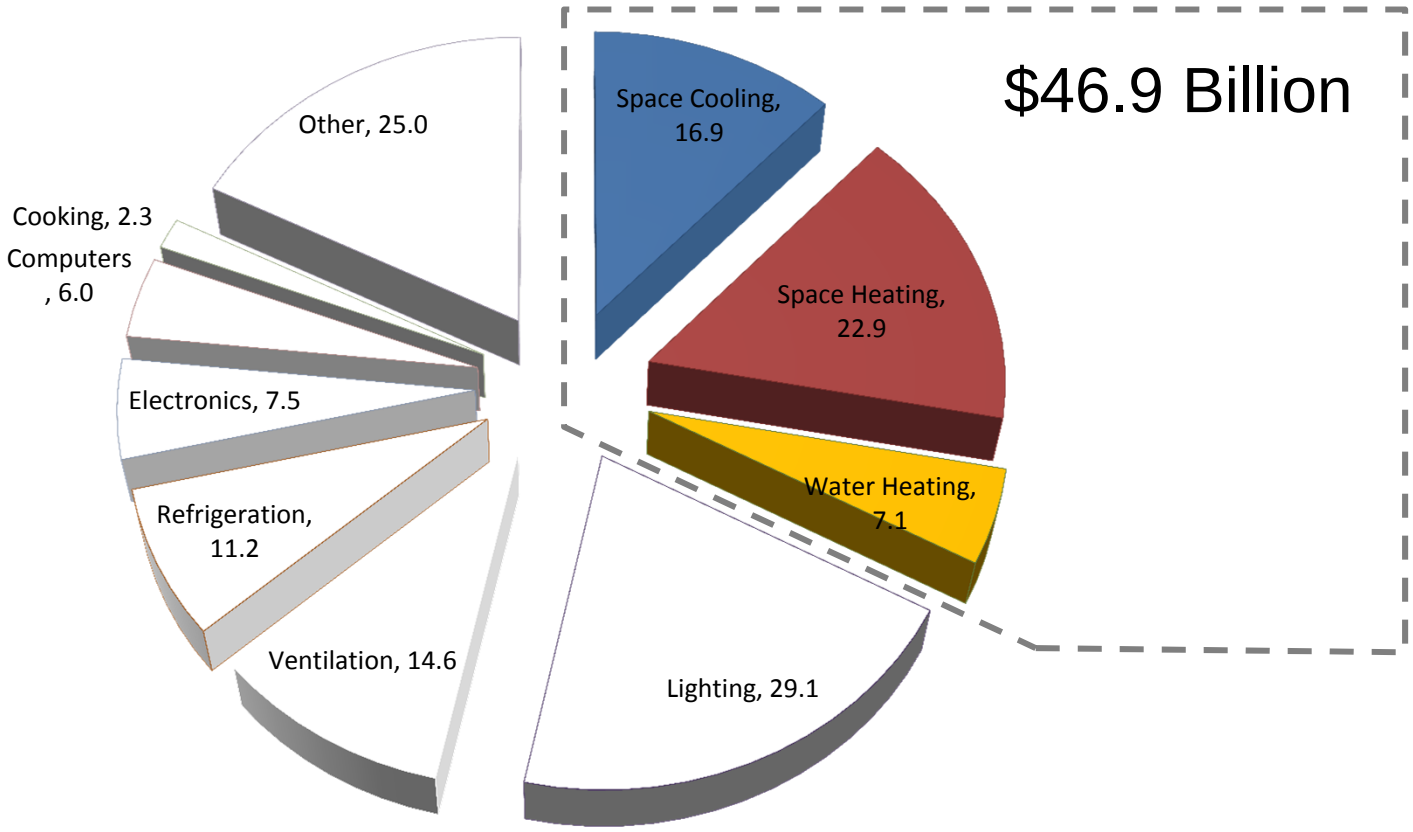

DOE US 2010 Commercial Energy End-Use Splits, by Fuel Type

# Heating and Cooling (at the same time)



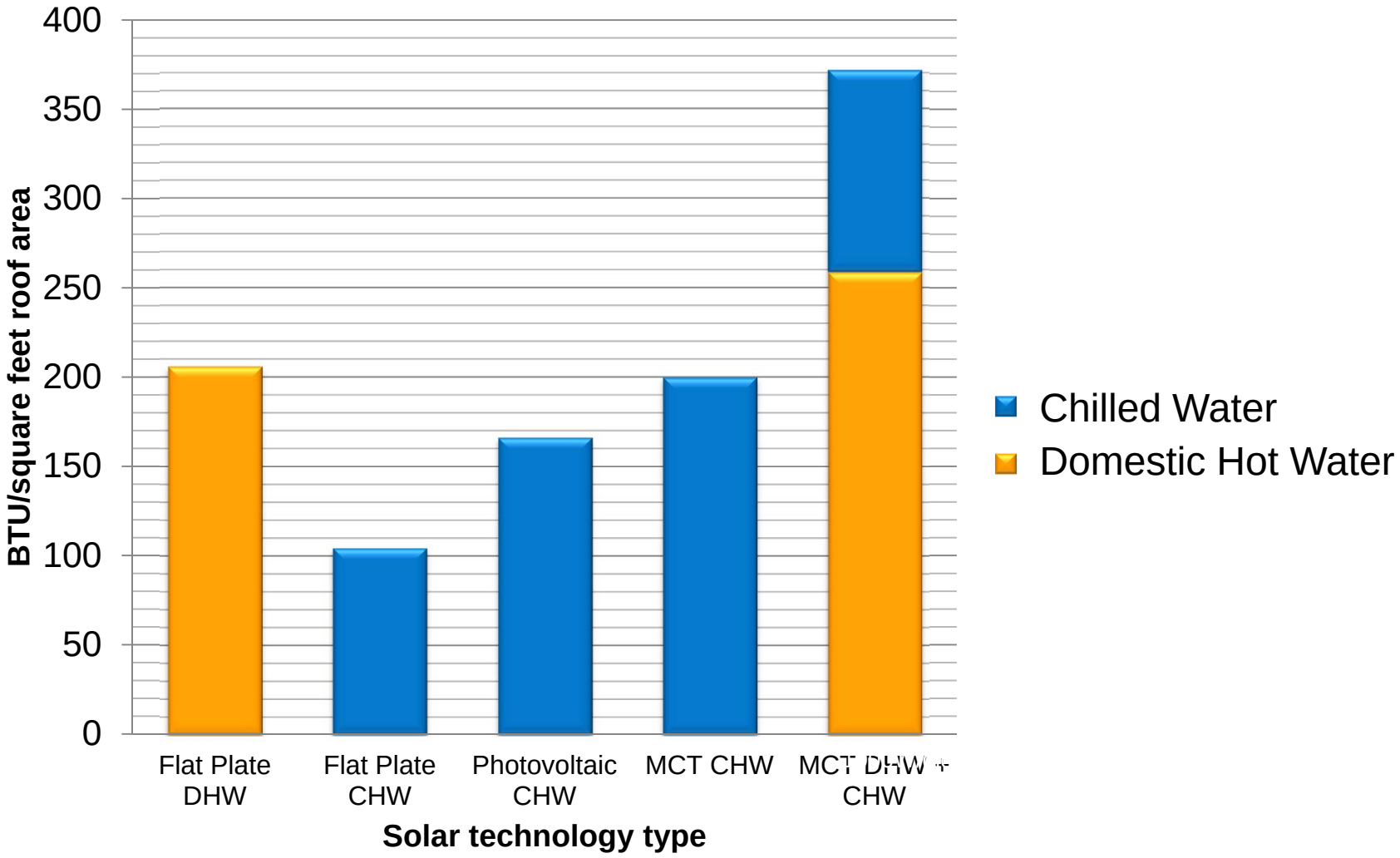

DOE US 2010 Commercial Energy End-Use Splits, by Fuel Type

# Heating and Cooling $$




US 2010 Buildings Energy End-Use Expenditure Splits, by Fuel Type ($2009 Billion)

# Thermal solar energy yields per square foot of roof.



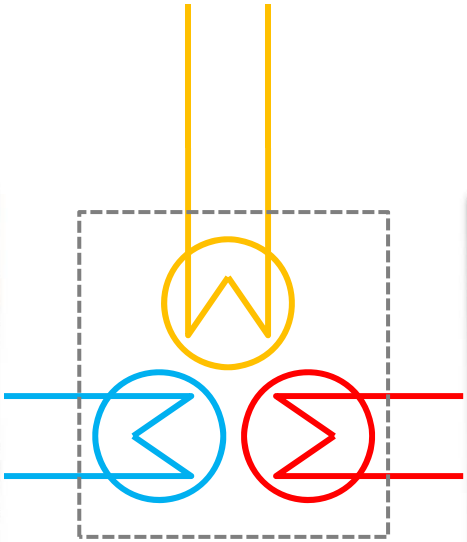
# Heat Pump 101

Heat pumps ‘remove’ heat and provide cooling

Heat can be reused as hot water or hydronic heat

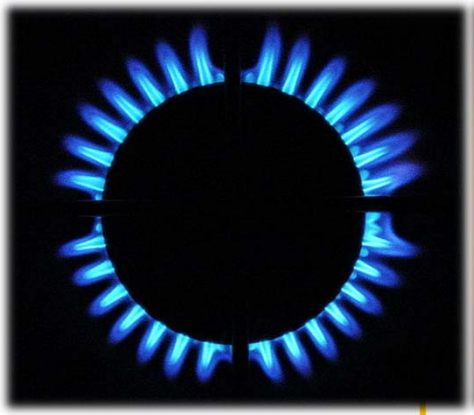
# Heat Pump 101

A thermal heat pump drives the system

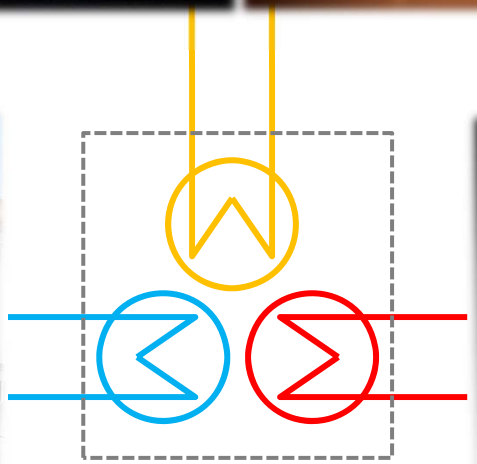


# Heat Pump 101

Gas can drive the heat pump..



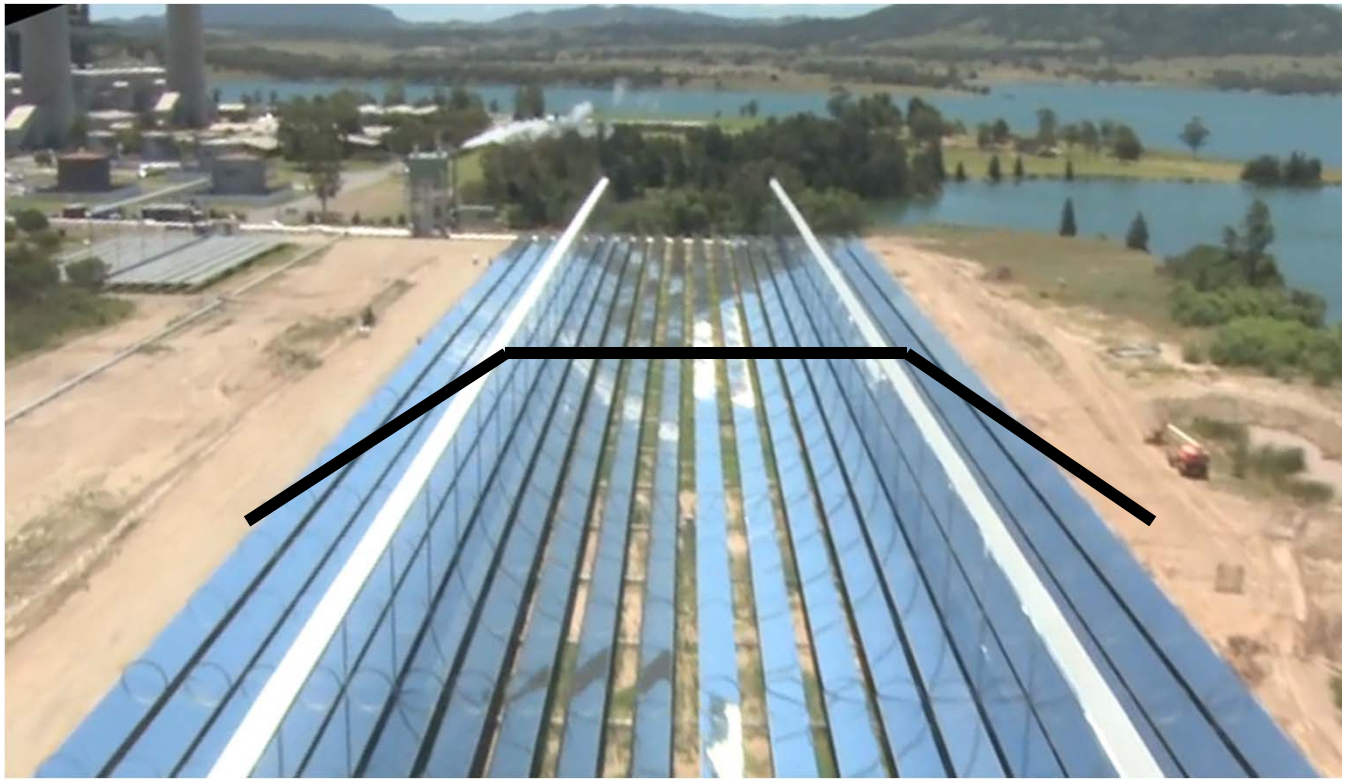
..or solar energy or both!



# MCT Product 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.

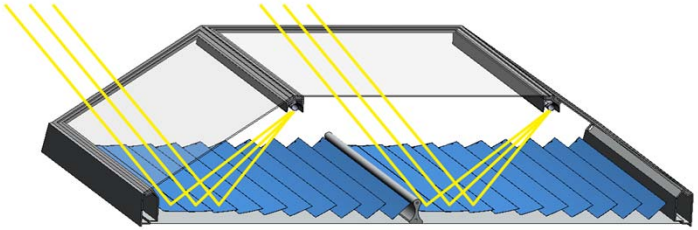
# Bringing advanced solar thermal to the rooftop?

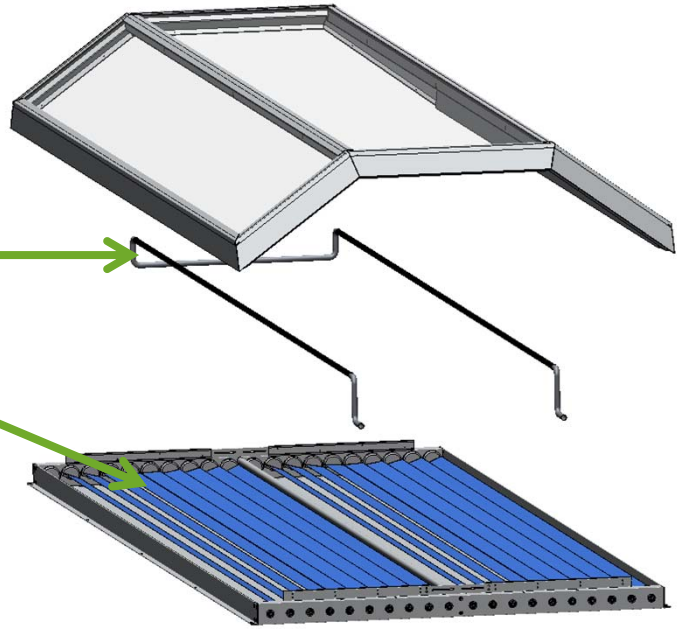


- CSP wastes 2/3 of energy as heat
- Most process heat and cooling loads are in urban areas.
- Could Fresnel CSP be made to work on rooftops?.....

# How MCT works

Section View





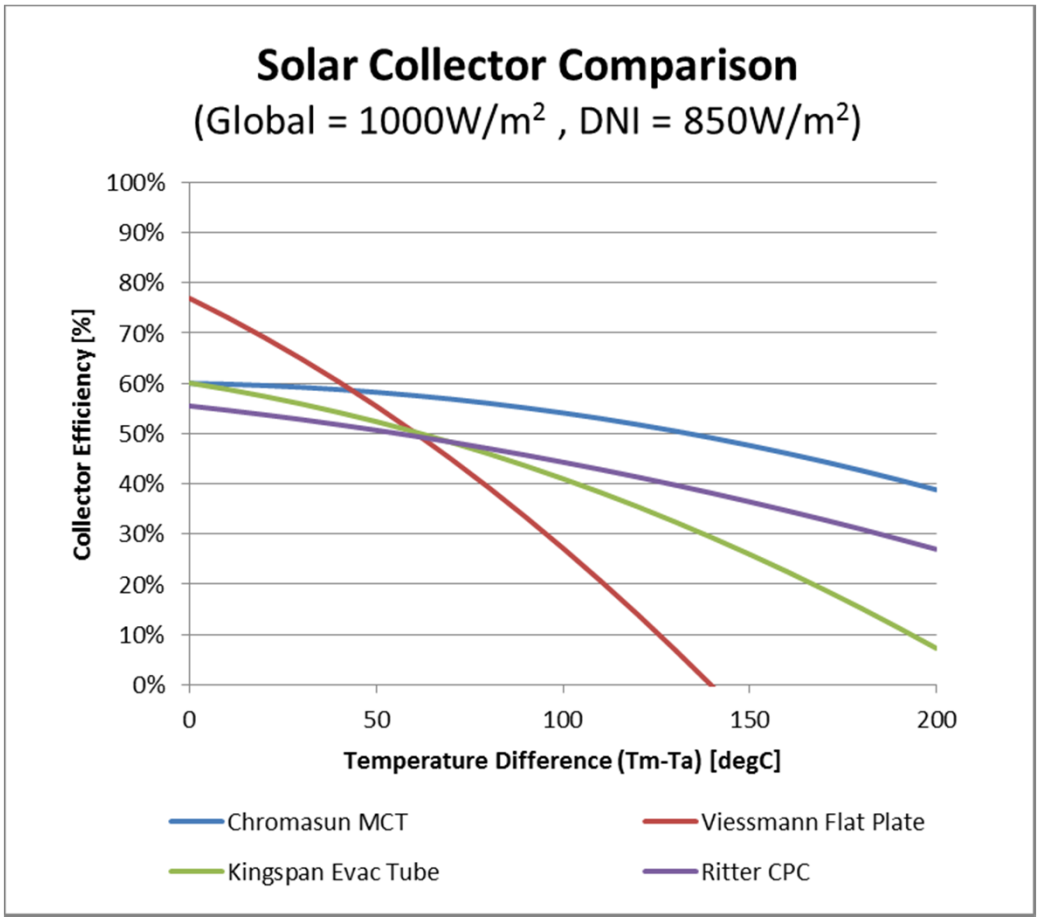
Receiver Pipe
(SS 304 A213 Tube)

Parallel Mirrors

# Chromasun MCT Panel

- Flat panel format
- High temps < 200ºC
- Turns on and OFF
- No external moving parts
- Easy installation and O&M
- Low wind and roof loadings
- SRCC Certified

# Current MCT v flat panel (SRCC Data)




Flat Plate Collector

Evacuated Tube Collector

# MCT = Simple *and* Efficient

- Flat PV
- Flat plate T
- Hybrid PVT

Simple + Inefficient

Simple + Efficient

- MCT CST
- MCT CPVT

Complex + Inefficent

Complex + Efficient

- BIPV

Dish CPV/CST
Tower CPV/CST
Trough CPV/CST

# Heat pumps for hot water (and some air conditioning)

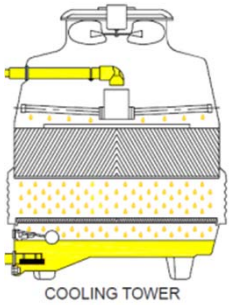
MCT Panels

**1 BTU** @ 175ºC / 350ºF

Solar and/or Natural Gas

**1.35 BTU**
@ 7ºC /44ºF
CHW

**2.35 BTU**
@ 30ºC/85ºF
CW




Cool Building

DE Multi-Fire Absorption Chiller

Heat Rejection/
Pool Heating

# Heat pumps for hot water (and some air conditioning)

MCT Panels

**1 BTU** @ 150ºC / 300ºF

Solar and/or Natural Gas

**0.6 BTU**
@ 10ºC /50ºF
CHW

**1.6 BTU**
@ 74ºC/165ºF
DHW/HHW

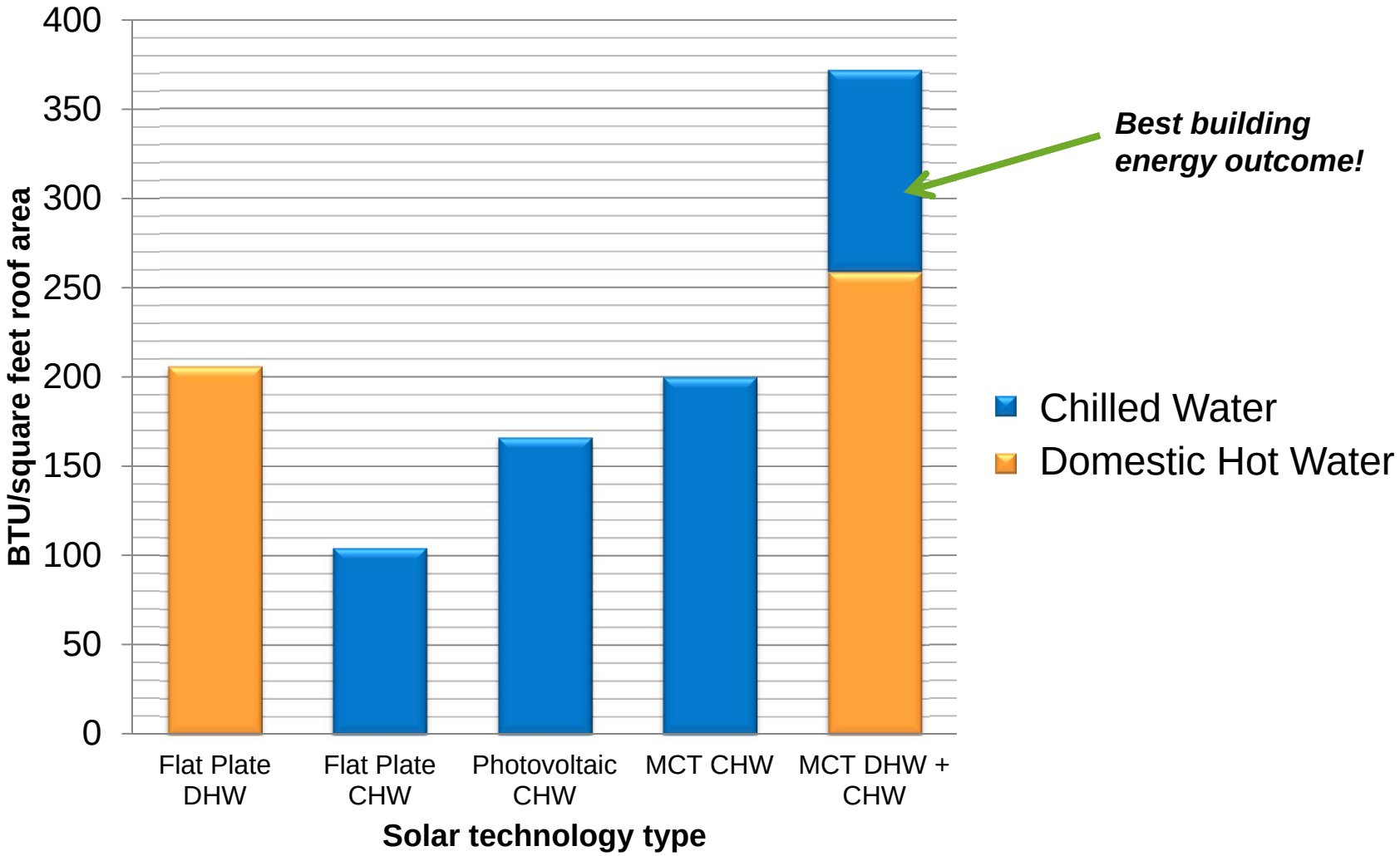
Cool Building

NH3 Multi-Fire Absorption Chiller

Hydronic Heating Water

Hot Water

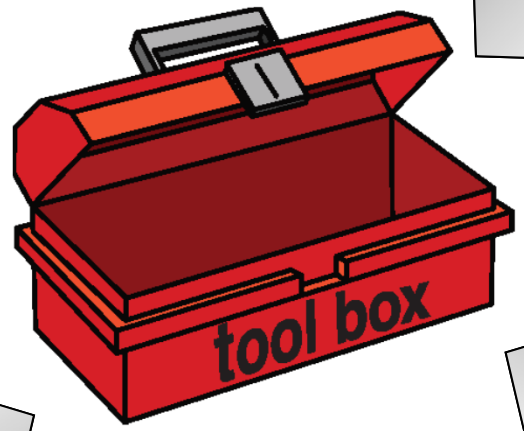
# Thermal solar energy yields per square foot of roof.



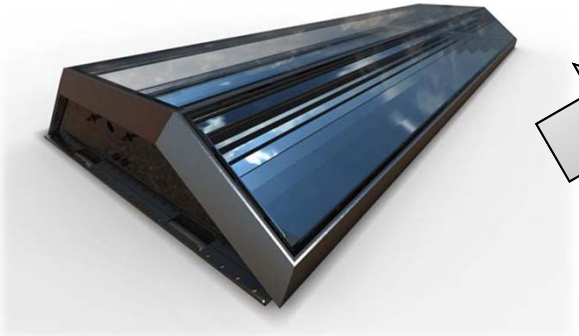

1000W/global, 850W/DNI solar resource

# So what's in the Chromasun toolbox?

**Experienced team**
*engineering and solar experience*




**HVAC and Heat Pump makers**
*a reliable gas/solar alternative to electric.*



**Efficient Chromasun MCT-HT**
*the only flat panel suitable for double effect heat pumps*

**Solar Installers**

# Process Heat Showcase

## Santa Clara University Showcase

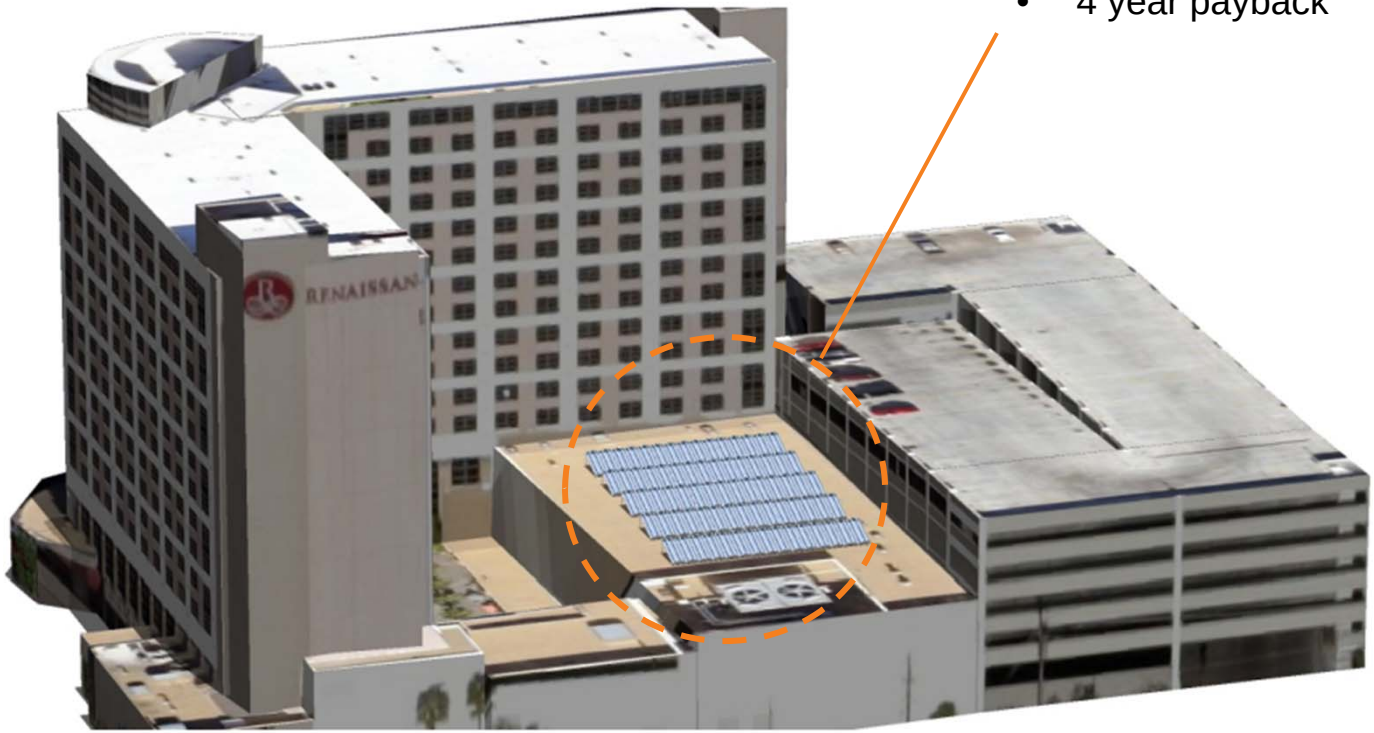
- *San Jose, California*

- 100% peak boiler offset for cafeteria operations
- *1/3 the gas consumption for hot water and HHW*
- Highest rooftop energy density of any renewable
- Net-zero contribution and blackout capability.
- Proof of operation

# Heat Pump Application

*Las Vegas*

- 25 RT gas/solar heat pump solution
- *Halves the total gas consumption*
- Annual Electricity offset : 164 MWh* ($19,210)
- Annual Gas Offset: 59,258 therms** ($50,370)
- 4 year payback




* *PV = 59 MWh*
** *PV = NIL*

# Benefits for customers

*Maui, Hawaii*

- 50 RT gas/solar heat pump solution
- Half the gas consumption
- Annual Electricity offset : 270 MWh* ($98,546)
- Propane Offset: 83,427** therms ($269,673)
- 1.23 year payback

** PV = 126 MWh*
*** PV = NIL*

# Process Heat Proposal

*San Diego, CA*

- Boiler Feedwater Pre-Heat
- 200 MCT Panels
- Annual Gas Offset: 25,434 therms
- PPA Offtake
- 10% reduction in gas price.
- 4.2 year payback

# Summary

## *MCT Advanced Solar Thermal*

- MCT = Highest temp. certified SRCC panel
- Most roof efficient solution
- Simple installation and  O&M
- High temps = new engineering possibilities

## *Benefits*

- Boiler Feedwater pre-heat
- Heat Pump Applications (CHW & DHW/HHW)
- Up to 370% more energy from the rooftop
- Projects payback from 1.2 to 5 years.

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# THANK YOU

CHROMASUN

PETER LE LIÈVRE
+1 650 521 6872
PETER@CHROMASUN.COM