Solar cooling in hot humid climates

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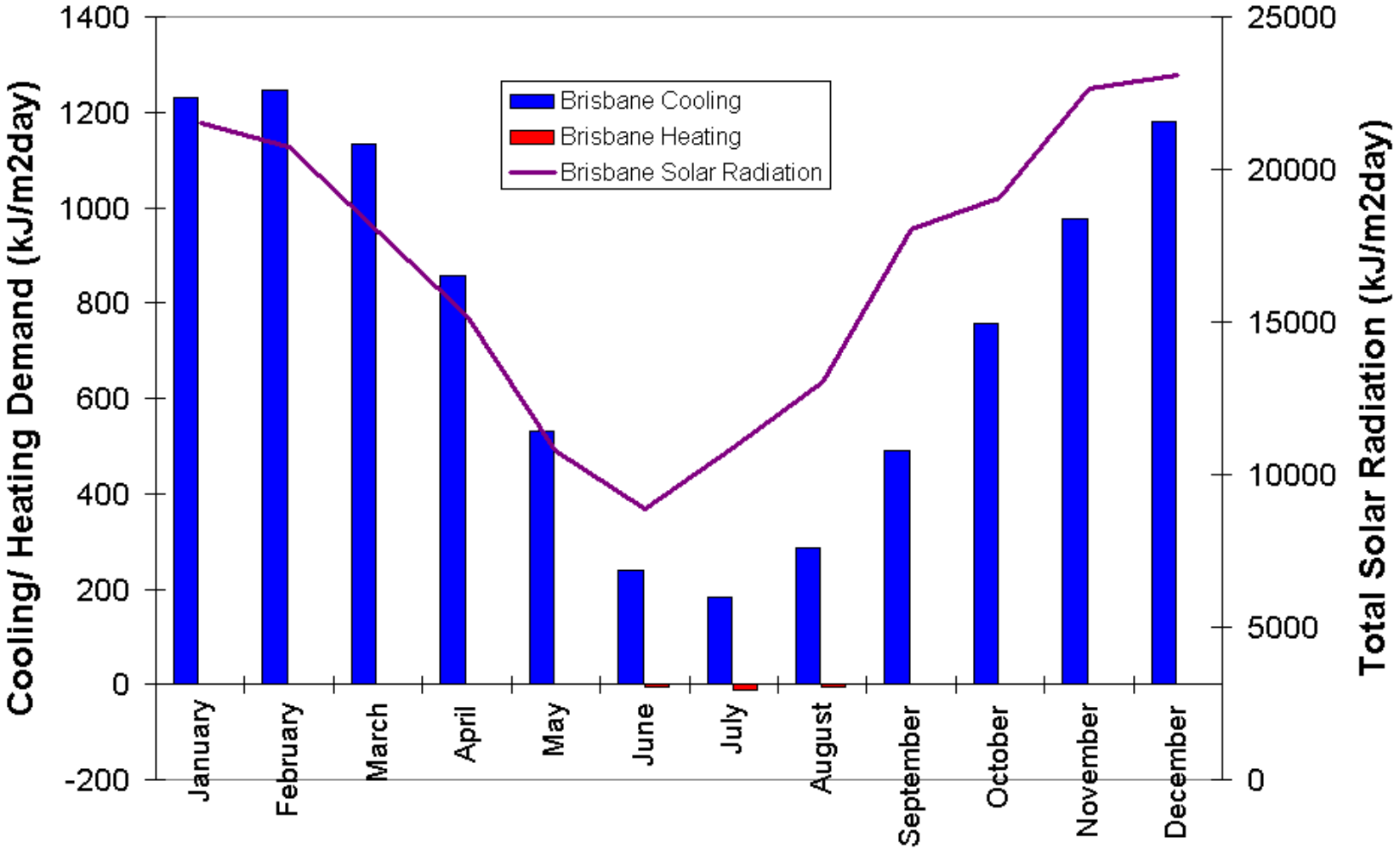
Solar cooling

Using solar radiation to drive a cooling process.

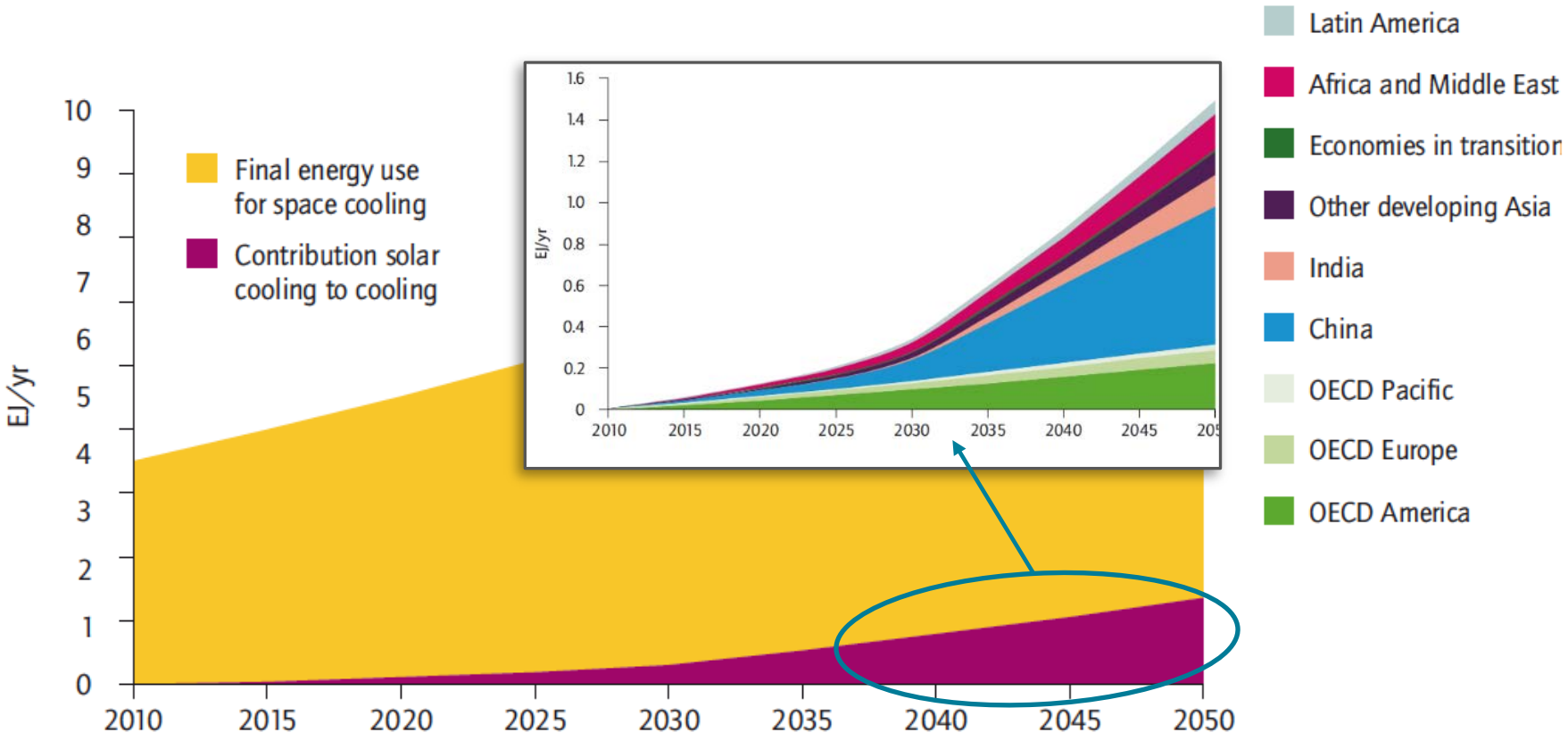
Displacing the use of fossil fuel derived electricity that would otherwise be used in a conventional vapour compression airconditioner**.**

- ✓ Solar thermal heat driving a thermal cooling process
- ✓ Solar photovoltaics driving a conventional vapour compression cooling process

Cooling Demand Matches Solar Availability

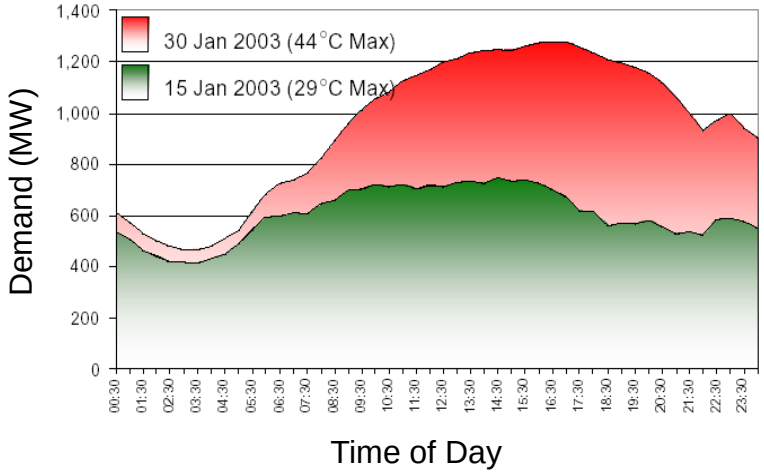


IEA Roadmap vision of solar heating and cooling (2012)



Solar cooling accounts for ~17% of TFE cooling in 2050

Why solar cooling?



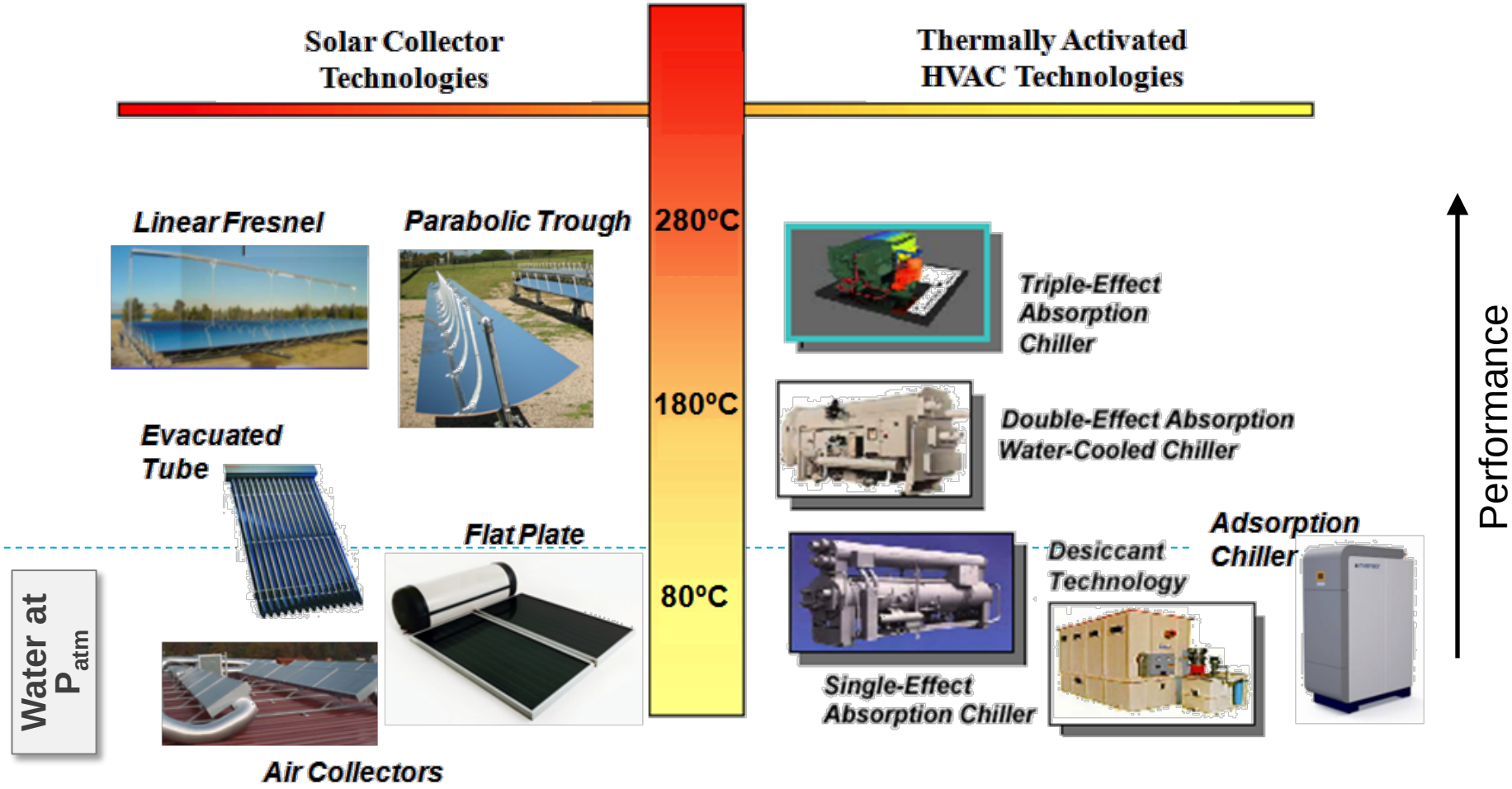
Policy perspective

- Reduce greenhouse gas emissions
- Lower energy costs
- Benefit the electricity system (higher load factor/ lower tariffs)

Building owner perspective

- Asset value
- Reduce energy costs
- Government mechanism (compliance or incentive)

Solar thermal technology options
(By heat source temperature)



Desert Mountain High School, USA

SOLID
solarinstallation+design

Solar Panels: 5,000 m² → 3.5 MW

Cooling load: 500 tons /1750 kW

In operation since 2014

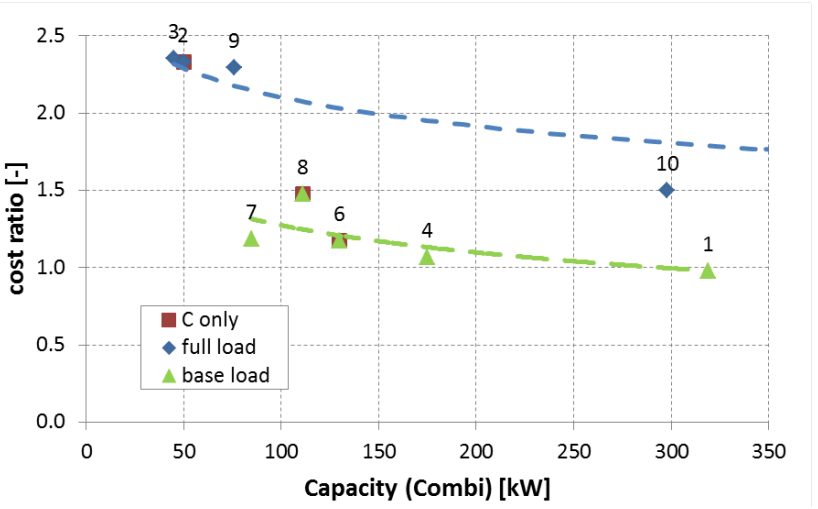
Results after 15 months of operation:

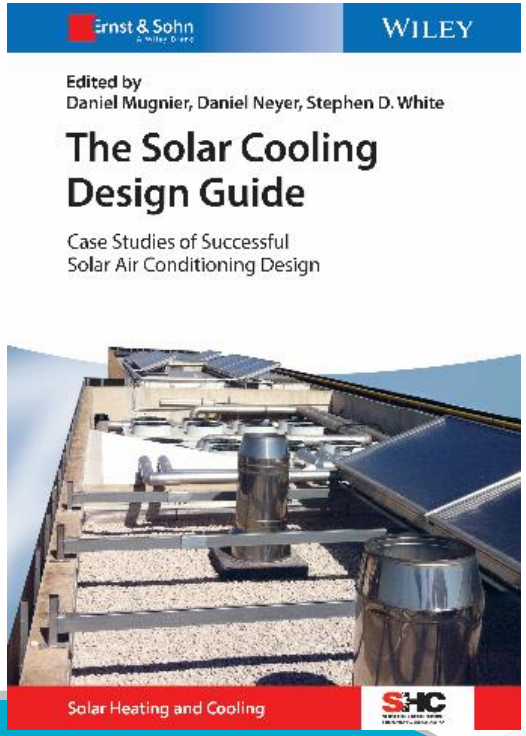
- Chiller $COP_{thermal}$ 0,7 – 0,75
- Peak Hour up to $COP_{electric}$ 42 (kW/kW)/ C
- Full day up to $COPs_{electric}$ 25-30 (kW/KW)/

(on days when full load has been used)

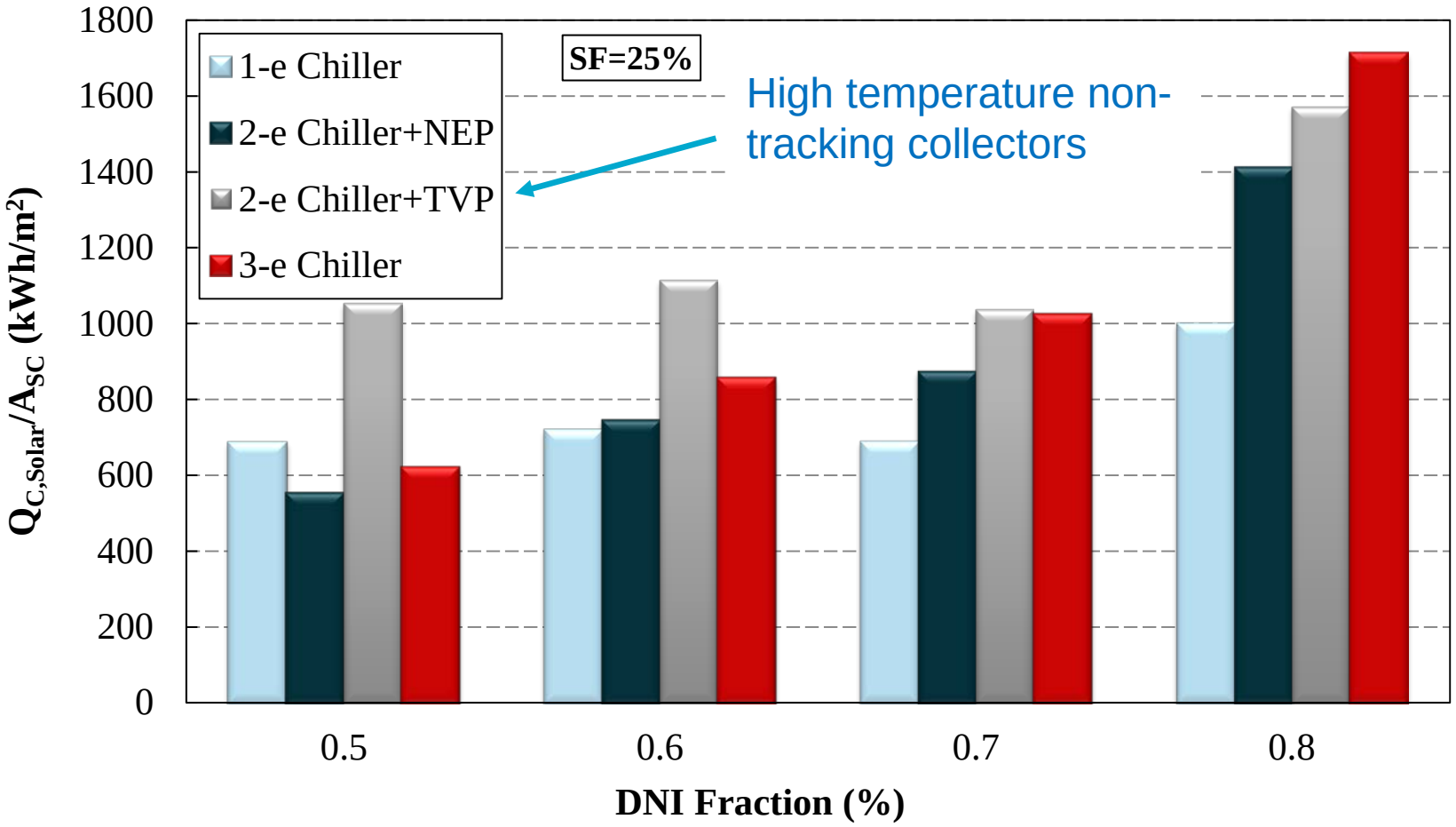
Ten Key Principles

- Good applications have year round load (integrated systems) and don't try to do 100% of building cooling demand
- Careful design is required to minimise heat loss and parasitic electricity, and ensure robust operation at part load





New Research?

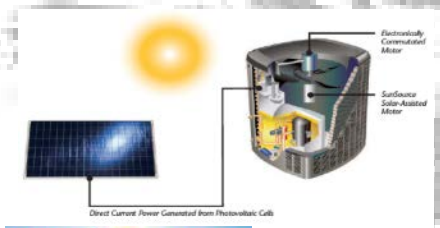


Separate PV and AC (grid acting as buffer)

vs **Connected PV and AC** (off-grid/ self consumption)?

Is this “Solar Airconditioning” **or** ”Solar AND Airconditioning” ?

Systems emerging on the market



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SOLAR AIR
COOLING HEATING

Potential benefits (beyond simple energy savings)

	Electricity system benefit	Consumer benefit	Disadvantages

100% off grid solar PV/AC with separate AC backup	• Reduced peak demand
	• No reverse power flow
	  • Safety
	  • Voltage
	• Slow ramp rates
		Residential:
		• leave it permanently on = guilt free luxury
		Commercial
		• Solar cooling efficiency increase at part load
		I don't need to inform my electricity utility
			• Wasted electricity if airconditioning is not required
			• Needs batteries to manage fluctuations

100% Solar PV self consumption with grid backup	• Reduced peak demand • No reverse power flow	I don't need to inform my electricity utility	Wasted electricity if airconditioning is not required
Solar PV self consumption with grid export/import	Reduced peak demand	Get full value for electricity	Lack of advantages

Conclusions

- Solar cooling makes intuitive supply/demand sense and *should reduce electricity peak demand*
- Significant experience in solar *thermal* cooling has demonstrated technical potential and marginal commercial viability. In the absence of "plug and play" potential, prefer
  - Large systems
  - Integrated heating and cooling systems
- Solar *PV electricity* systems are emerging on the market but products need to be tailored to electricity utility needs

Thank you

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Generic flow-sheet for matching an intermittent heat source and a variable demand for cooling