



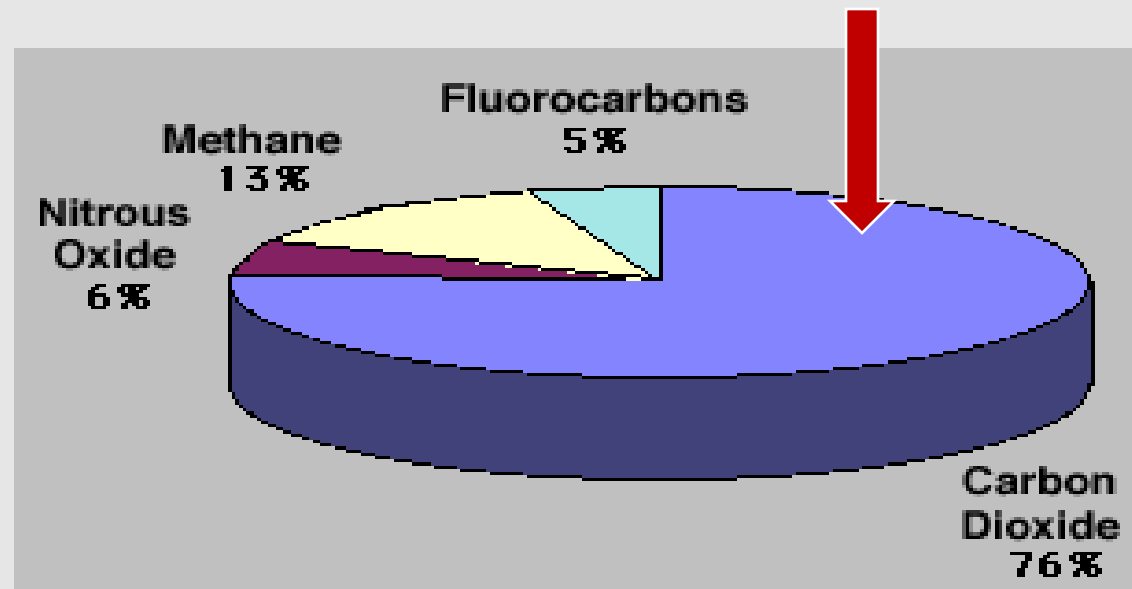
SOLAR AIR- CONDITIONING

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INTANGIBLES BENEFITS

GREEN INITIATIVES- USING SOLAR ENERGY

REDUCED GREENHOUSE GAS (GHG) EMISSION



WHY SOLAR ENERGY?

- **Abundance of sunlight** - *89,000 terawatts from the sun VS 15 terawatts needed entire world.*
- **Pollution free**
- **Can be used from anywhere** - *Installed on building/remote areas*
- **Depleting Renewable energy**
 - *Cruel Oil reserve : 19years*
 - *Natural Gas reserve: 33years*
- **Viable to harness via Evacuated tube solar collector technologies**
 - *92% of efficiency*
 - *High temperature of hot water*
 - *Zero maintenance*
 - *Long operation lifespan*



THE MOST CRUCIAL REASON FOR USING SOLAR

IS.....

**THE SURVIVAL OF MANKIND
WE HAVE TO GO FOR GREEN AND
SUSTAINABLE TECHNOLOGY**



A 50,000m² building



Electric chiller



Replaced by



Non-electric chiller







33,000 trees

Replacing an electric chiller with a non-electric one equals planting 33,000 trees.

Why Solar Air Conditioning?

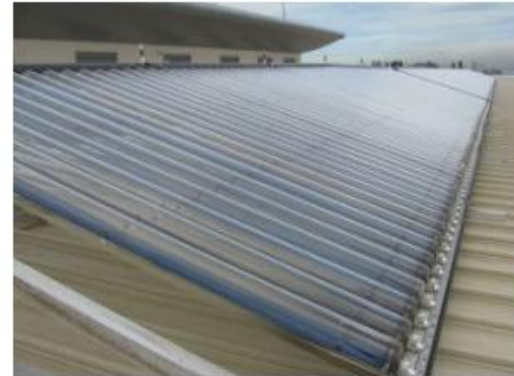
	Solar Chiller	R134A Electric Chiller
Power source	<ul style="list-style-type: none"> •Steam, Natural gas, diesel, hot water and waste heat 	<ul style="list-style-type: none"> •Huge capacity of electricity
	<ul style="list-style-type: none"> •Cooling cap. 350RT •Power consumption: 5.5 kW 	<ul style="list-style-type: none"> •Cooling cap. 350RT •Power consumption: 227.5 kW
Working media	<ul style="list-style-type: none"> •Refrigerant: water •Absorbent: e.g Lithium Bromide •Harmless to environment 	<ul style="list-style-type: none"> •Refrigerant: Chlorofluorocarbon CFC(R22,R123,R134A..) •Ozone depletion, global warming
Working principle	<ul style="list-style-type: none"> •Using absorber to maintain vacuum condition at evaporator 	<ul style="list-style-type: none"> •Using compressor to transfer the refrigerant from evaporator and maintain lower sat. pressure
Maintenance	<ul style="list-style-type: none"> •Less moving part •Less noise and vibration •Easier for maintenance 	<ul style="list-style-type: none"> •High speed rotation •High pitch sound and vibration •More wear & tear

Examples of Solar aB/aD sorption Chiller

Refrigerant cycle	Closed refrigerant cycle		Refrigerant (water) is in contact with the atmosphere	
Principle	Chilled water		Dehumidification of air and evaporative cooling	
Phase of sorbent	solid	liquid	solid	liquid
				
Typical material pairs	water - silica gel	water - lithium bromide ammonia - water	water - silica gel, water - lithium chloride	water - calcium chloride, water - lithium chloride
Market available technology	Adsorption chiller	Absorption chiller	Desiccant cooling	Close to market introduction
Typical cooling capacity (kW cold)	50 – 430 kW	15 kW – 5 MW	20 kW – 350 kW (per module)	
Typical COP	0.5 – 0.7	0.6 – 0.75 (single effect)	0.5 – >1	> 1
Driving temperature	60 – 90 °C	80 – 110 °C	45 – 95 °C	45 – 70 °C
Solar collectors	Vacuum tubes, flat plate collectors	Vacuum tubes	Flat plate collectors, solar air collectors	Flat plate collectors, solar air collectors

Solar Air-Conditioning Projects In Malaysia

Ikhasas office building , Puchong
Winner of ASEAN Energy Award 2009:
1st Centralized Solar Cooling System in Malaysia



*Evacuated Tube Solar Collectors



*Absorption Chiller

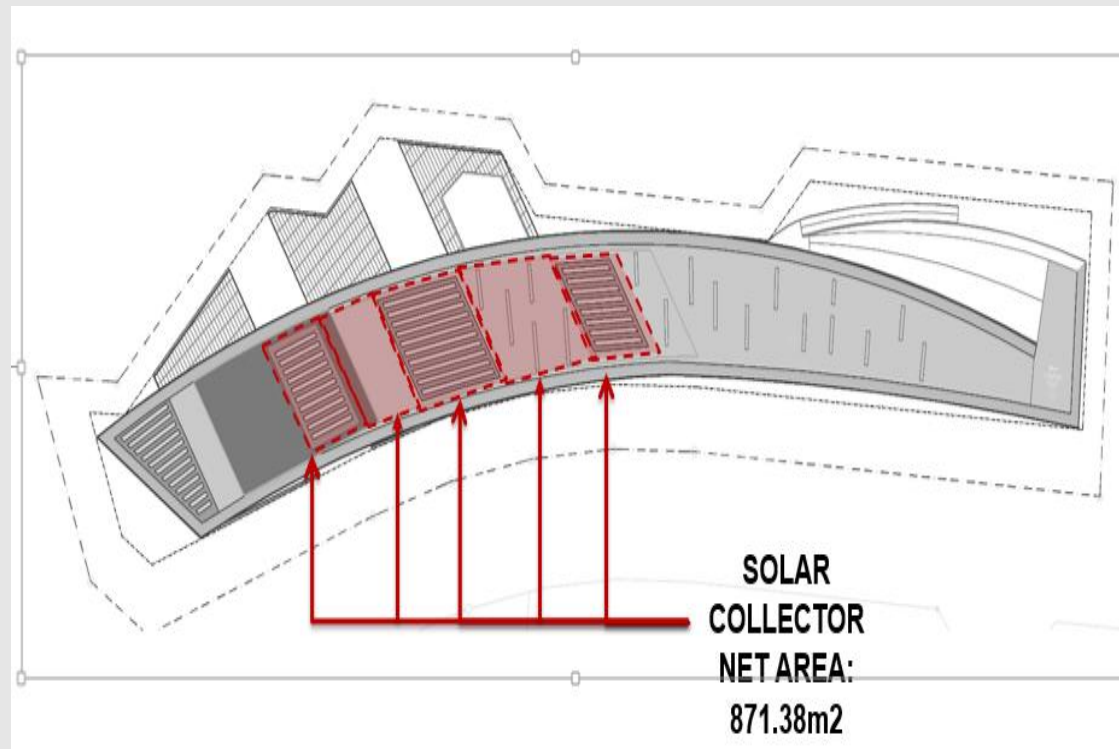


*Hot water Pump



*Cooling Tower

PKNS HQ SHAH ALAM



DESCRIPTION	NOS	CAPACITY	REMARKS
ELECTRIC CHILLERS	3 NOS (2 DUTY & 1 STANDBY)	400RT	-
ABSORPTION CHILLER	1 NO	75RT	~ 9.4% OF TOTAL

Shaftsbury Square, Cyberjaya

Project Shaftsbury Square, Cyberjaya



Day Views of Evacuated Tube collectors at Shaftsbury Square



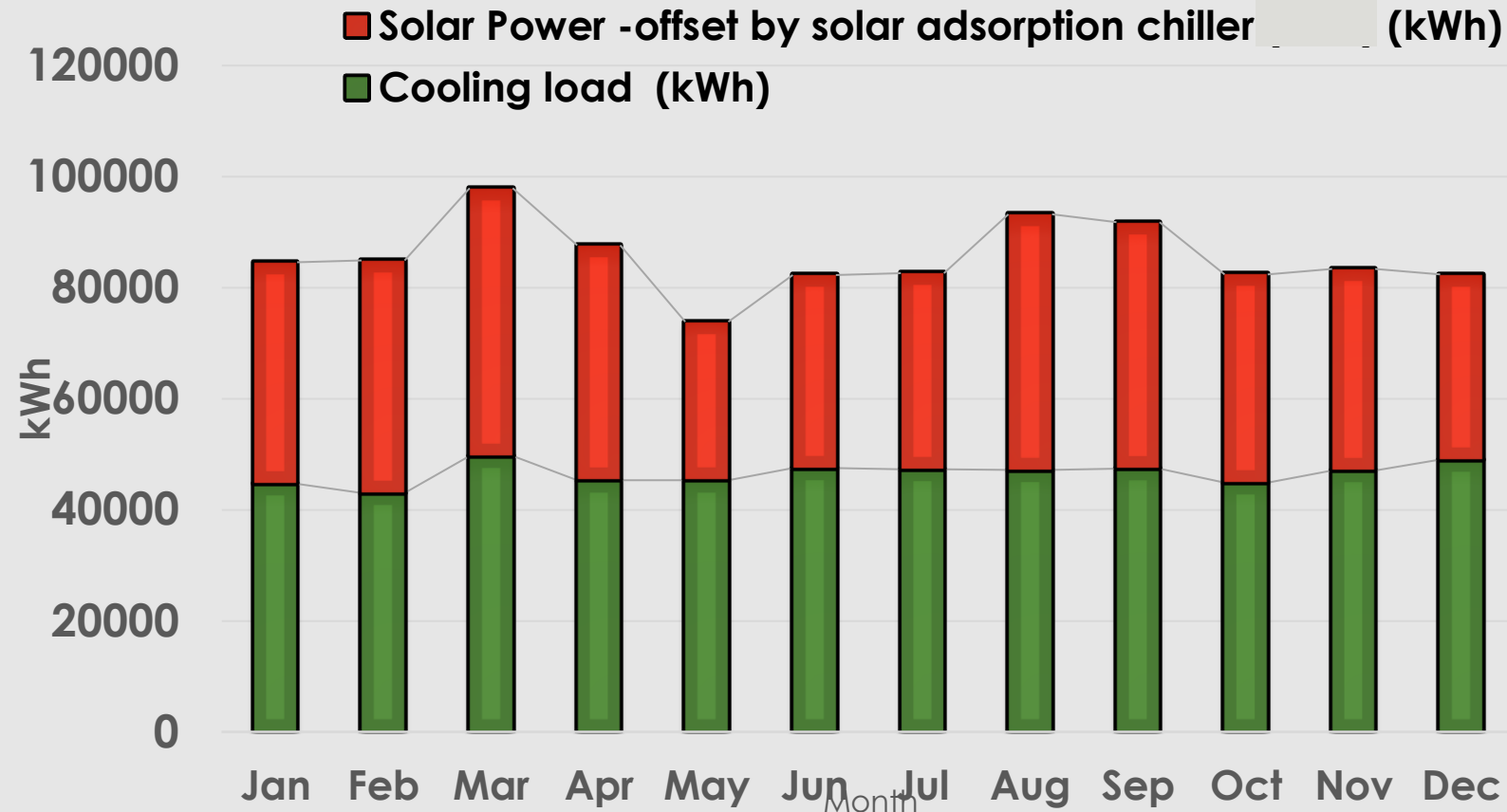
Night Views of Evacuated Tube collectors at Shaftsbury Square



Shaftsbury Square uses Solar Thermal (Hot Water) System for 2 Blocks of Service Apartment.

http://sdc.my/upload/20151105_210636_PROJECT_2Shaftsbury%20Square.pdf

Solar Air Conditioning System Simulation



Reduce by nearly 50% cooling load from the conventional electrical chiller in the building.

CONCLUSION

- **Solar Air- conditioning Technology**
 - ✓ State of Art Building with **evacuated solar tubes roof**.
 - ✓ Design cooling load can be reduced by more than **50%**.
 - ✓ Environmentally friendly
 - ✓ Sustainable Technology

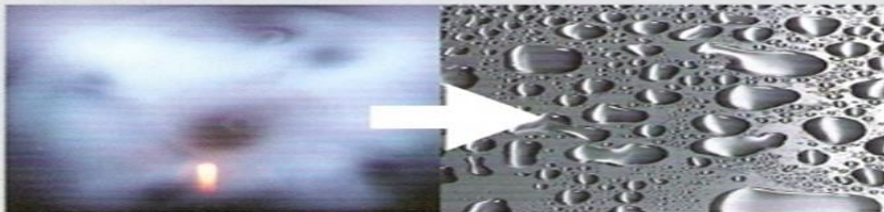
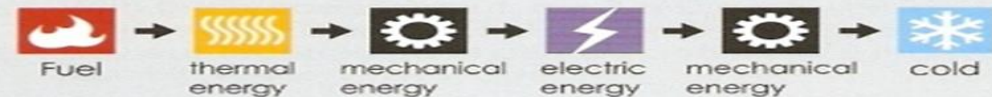
WHY NON-ELECTRIC CHILLERS ARE MORE ENERGY EFFICIENT?

The second law of thermodynamics has taught us that there is some loss in every energy conversion (converted to low quality energy that cannot be further used).



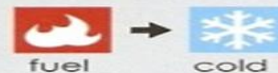
Electric chillers

The overall energy efficiency is about 83% after 5 conversions (7-9 conversions if 2-4 times of voltage transformation to be applied).



Non-electric chillers

The overall energy efficiency is about 153% with only one energy conversion.



(the energy efficiency is even higher if waste heat is used)

Note: The above-mentioned calculation on savings is based upon a 3,500kW (1,000Rt) chiller with 3,000 annual operating hours. A tree adsorbs 18.3kg CO₂ emissions yearly.