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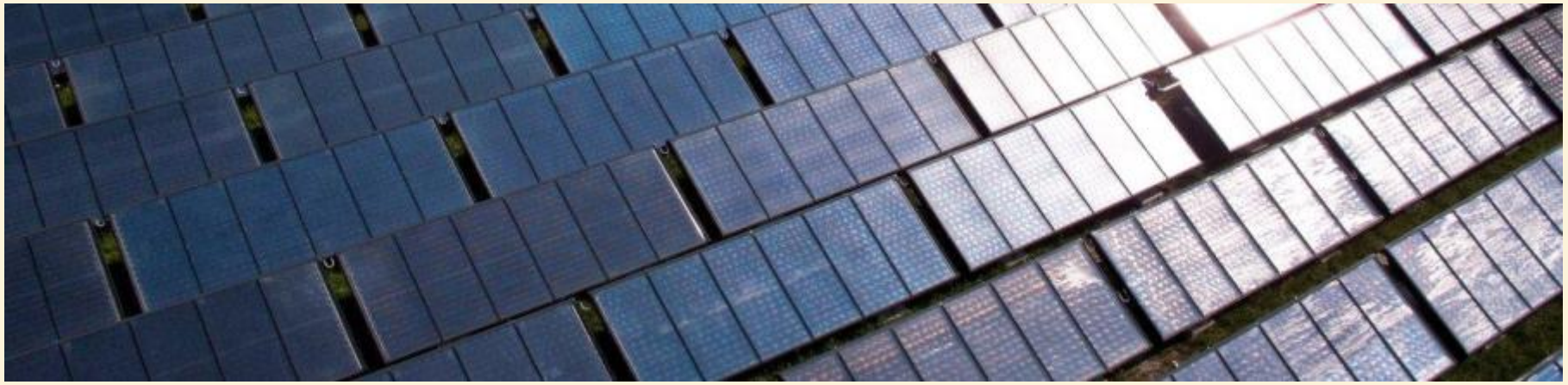
Solid large scale solar thermal cooling

UWCSEA East Tampines Campus
Singapur



S.O.L.I.D. – what we do

Large scale solar thermal heating and cooling plants:

- project development
- engineering
- construction
- operation & maintenance
- finance (ESCo)
- research & development

Solar cooling references

Location/Project	Cooling Machine	Constr.	Cooling Power	Collector Area
EAR Tower, Pristina, Kosovo	LiBr-Chiller	2002/3	90 kW	226 m²
Wine Cooling , Leutschach, Austria	Ammonia	2003	10 kW	100 m²
Graz – office, test Plant	Ammonia	2003	2 kW	8 m²
Stadtwerke, Crailsheim, Austria	LiBr-Chiller	2004	15 kW	500 m²
Renewable Energy House, Brussels, Belgium	LiBr-Chiller	2005/7	35 kW	60 m²
Desert Outdoor Center, Phoenix, USA	LiBr-Chiller	2006	70 kW	126 m²
Olympic Village, Qingdao, China	LiBr-Chiller	2006	512 kW	638 m²
Estellas Restaurant, Tampa, USA	LiBr-Chiller	2007	70 kW	210 m²
CGD Office Building, Lisbon, Portugal	LiBr-Chiller	2008	545 kW	1579 m²
Warehouse, Lanta, Phoenix, USA	LiBr-Chiller	2008	130 kW	504 m²
Office, Graz, Austria	Li Br Chiller	2008	17.5 kW	58 m²
Metro MAN, Istanbul, Turkey	LiBr Chiller	2009	Study	
Sheikh Zayed Desert Learning Center, UAE	LiBr Chiller	2010/12	400 kW	1108 m²
United World College, Singapore	LiBr Chiller	2010/11	1400 kW	3900 m²
Desert Mountain High School, Scottsdale, USA	LiBr Chiller	2011/13	1700 kW	5000 m²
DigiCel, Kingston, Jamaica	LiBr Chiller	2012	600 kW	982 m²

Sheik Zayed Desert Learning Center (UAE/Al Ain)

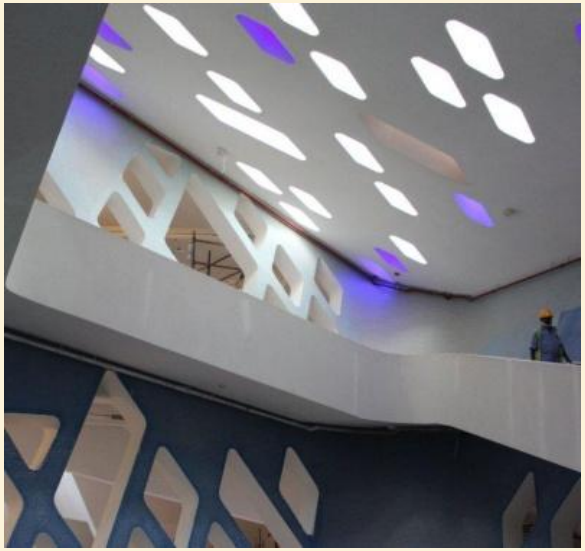
Solar Cooling via concrete core activation of a desert museum (18 /13 return/flow)

Cooling power: 400 kW

Collector area: 1108 m^2

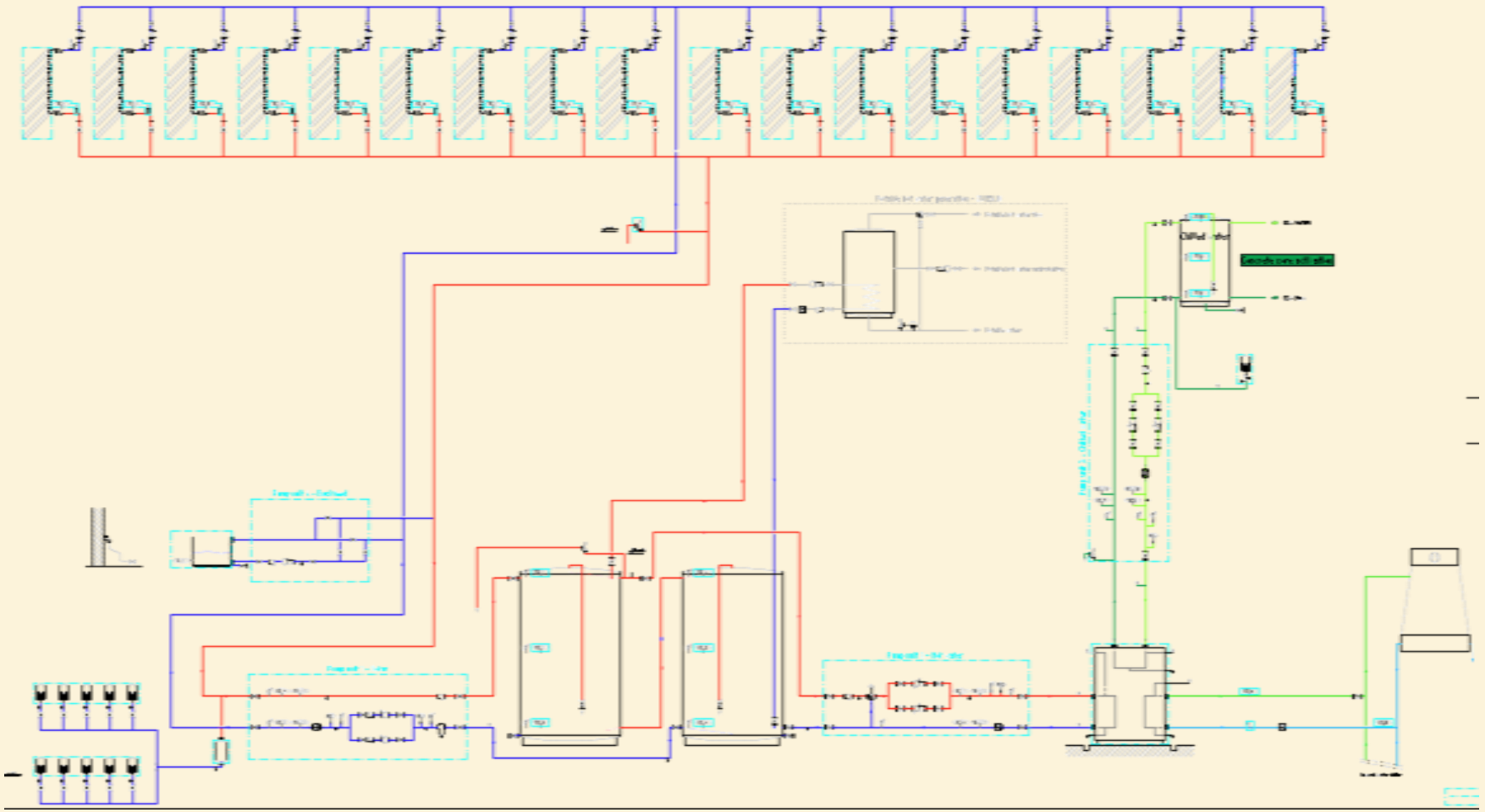
Expected Solar yield: 825 $kWh/m^2/year$

Commissioning: October 2012



Sheik Zayed Desert Learning Center (UAE/Al Ain)

Cooling power: 400 kW, Collector area: 1108 m^2



Digicel, Kingston, Jamaica

Office space: 13,685 m²

Solar Panels:
982 m²

Single stage LiBr chiller:
600 kW

Hot storage: 2 x 5.5 m³

492 MWh cooling energy per year

In operation since Nov. 2012

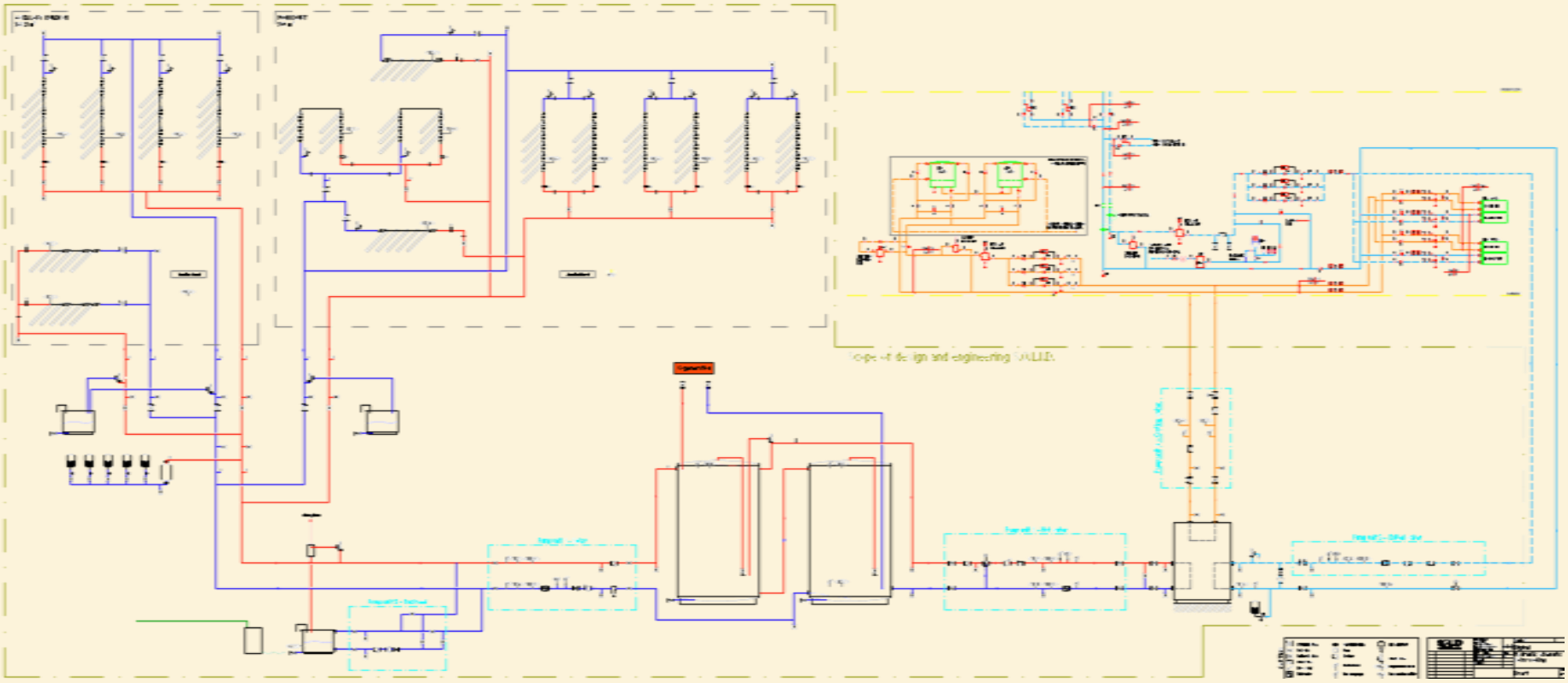
Realised in partnership with RED, Jamaica

From first call to start up in 16 months!

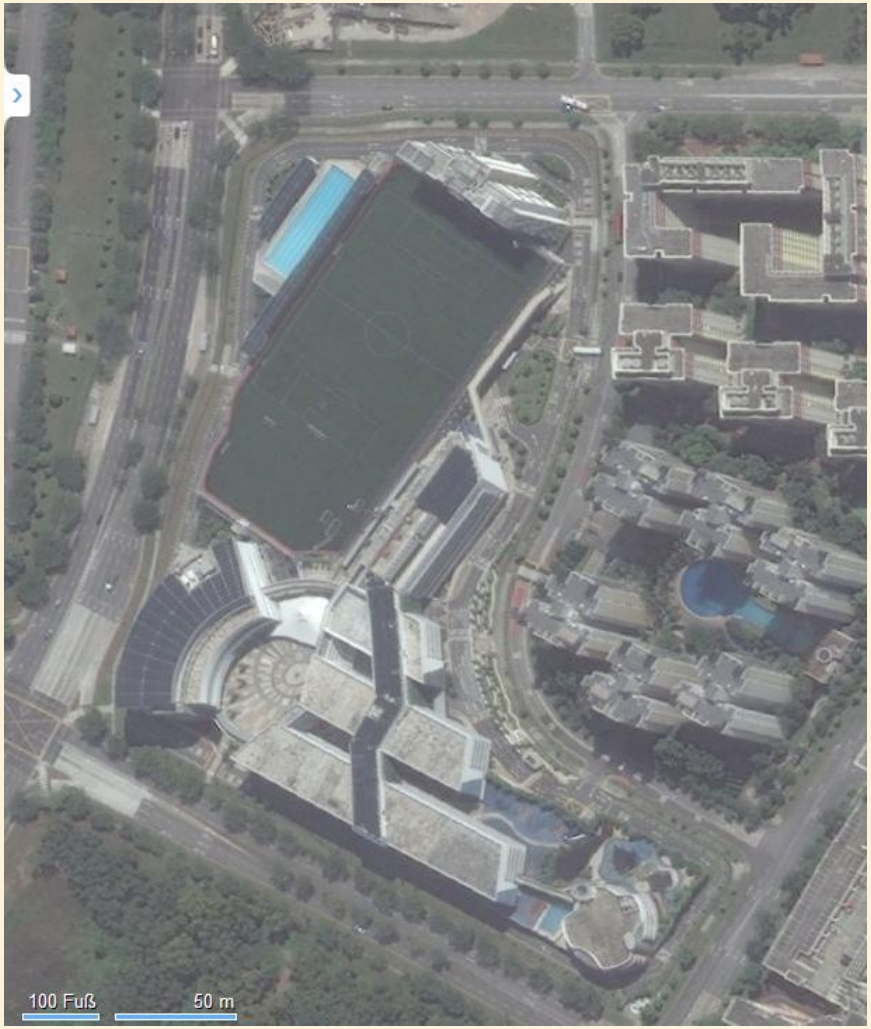
Digicel, Kingston, Jamaica

Solar Panels: 982 m²; Single stage LiBr chiller: 600 kW

Hot storage: 2 x 5.5 m³



UWCSEA-EAST Tampines, Singapore



Solar Cooling & Hot Water for University Campus

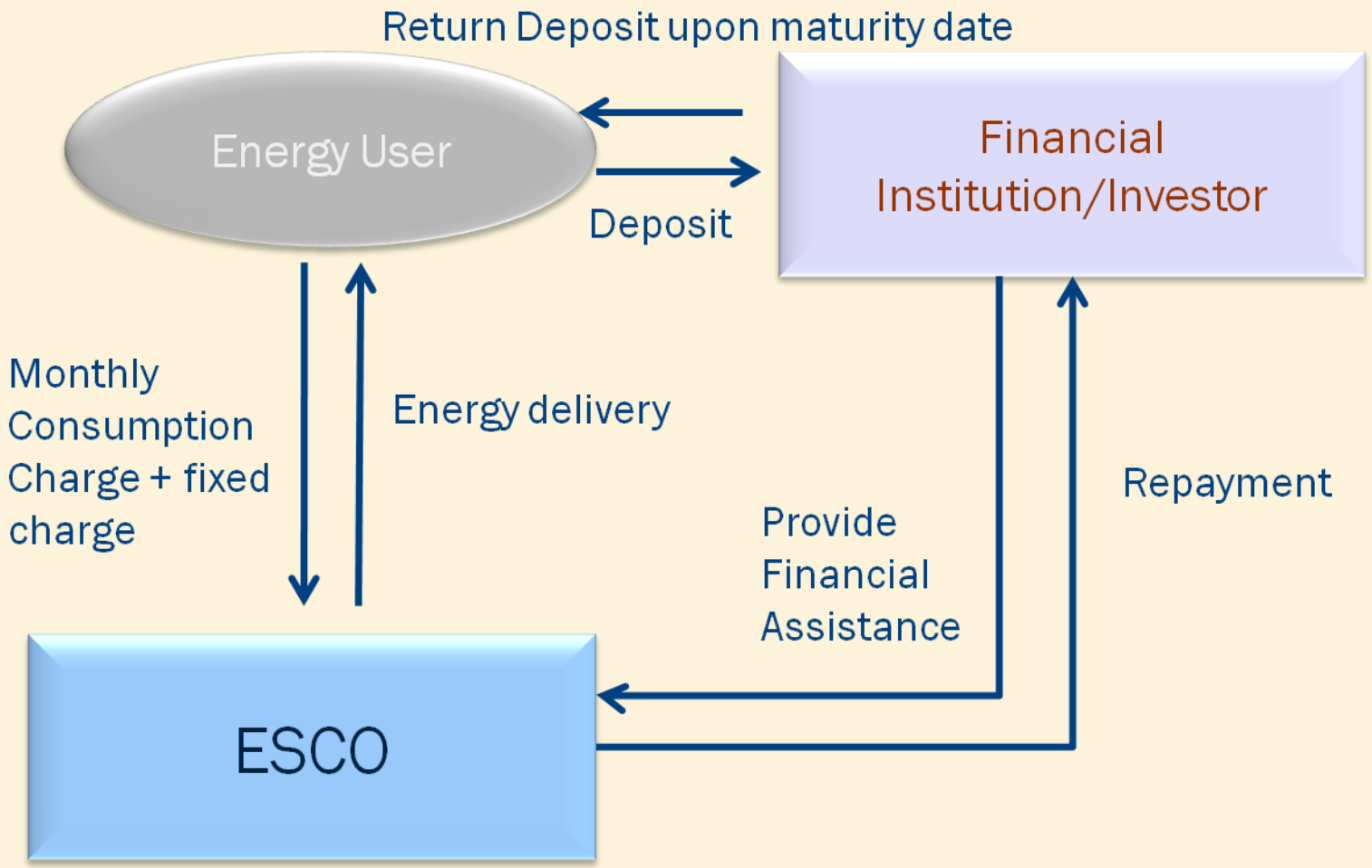
Solar Panels:
3870 m² / 2.7 MW

ESCo

In operation since 2011; first DHW, then cooling from october

World‘s largest Solar Cooling System

Finance scheme



Pictures I/II

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Pictures II/II

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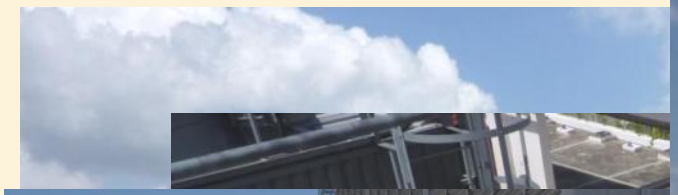
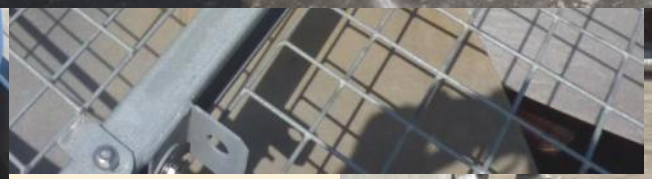
Pictures II/II





Pictures II/II

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Desing, dimensioning of SC plant

- hydraulic was dimensioned for low Delta-T, low pump electricity, high COP_{el}

→ large pipes, large volumes of water inside pipes (solar heat grid stretching over whole campus)

General

- DHW for boarding school, sports facilities: 100% solar; gas boiler in hot water room, but not connected to gas grid
- solar pumps for DHW cooling can run monovalently each or in parallel

First months

- heat losses over night; long heat up phase over night of large volumina inside pipes for high temperatures

→ACM heat supply temperatures were reduced – shorter heat up time in the morning and longer operation hours in the evening

Further optimizations

- in Oct 2012 motor valves were installed in the connection pipes of the 3 solar collector arrays were installed

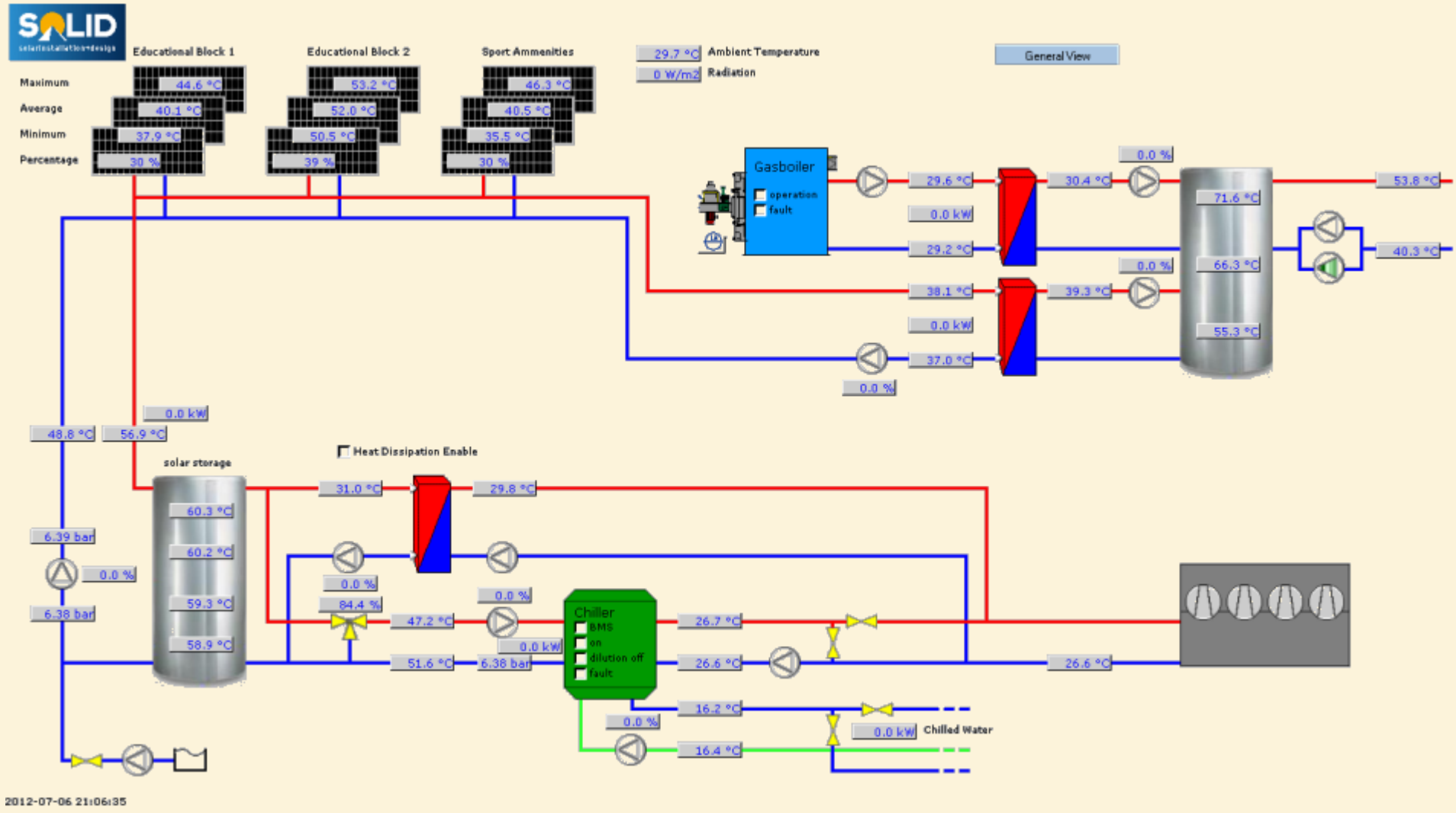
→reduced heat losses over night;

possibility of solar DHW preparation at night

Experiences of UWC operation

- Climate variations: NTU measured significantly lower solar irradiation in 2012 than in previous years
- el. COP 6-13; but optimization was for maximum cold supply
- el. COP to be further optimized(pump speed control, heat rejection)
- Chiller can work at supply temp as low as 60°C
- heat losses are important issue (natural circulation, valves, expansions)

UWCSEA-EAST Tampines, Singapore



Experiences of UWC construction

- core supply by Solid‘s experienced partners
- local supply of piping, steel works, tanksBezug
- solar thermal standards vs. local habits (piping)
- construction site management by Solid

UWC – Collector areas

3900 m² gluatmugl HT
on 4 buildings

LiBr absorption chiller
1575 kW

CGD Bank Headquarter, Portugal

Bank building including hospital, theater, restaurants, 100,000 m^2 offices, 17 floors

Solar Panels:
1.580 m^2

Cooling capacity:
545 kW

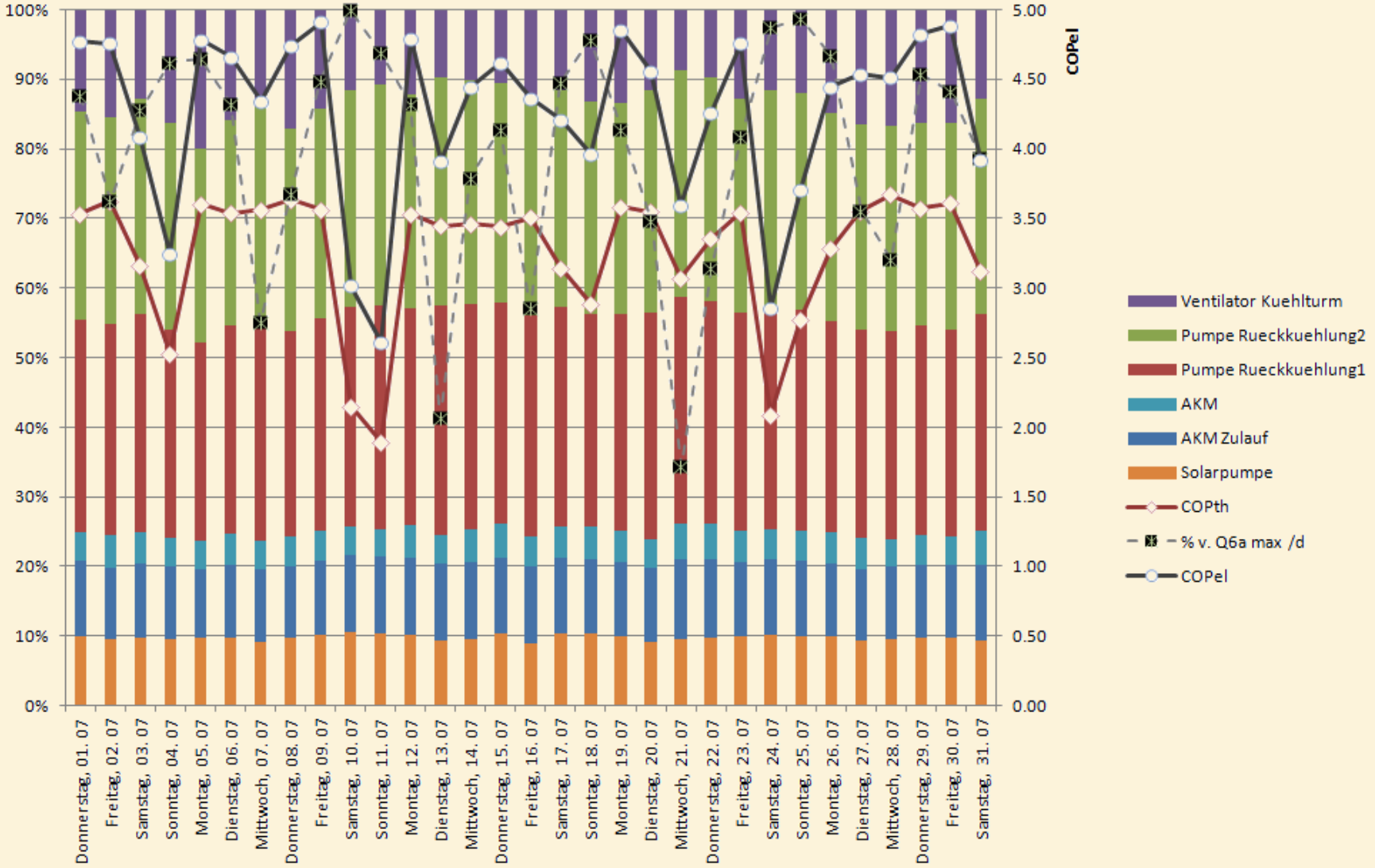
1100 kW Reheating, Heating, DHW

Operating since Feb. 2008

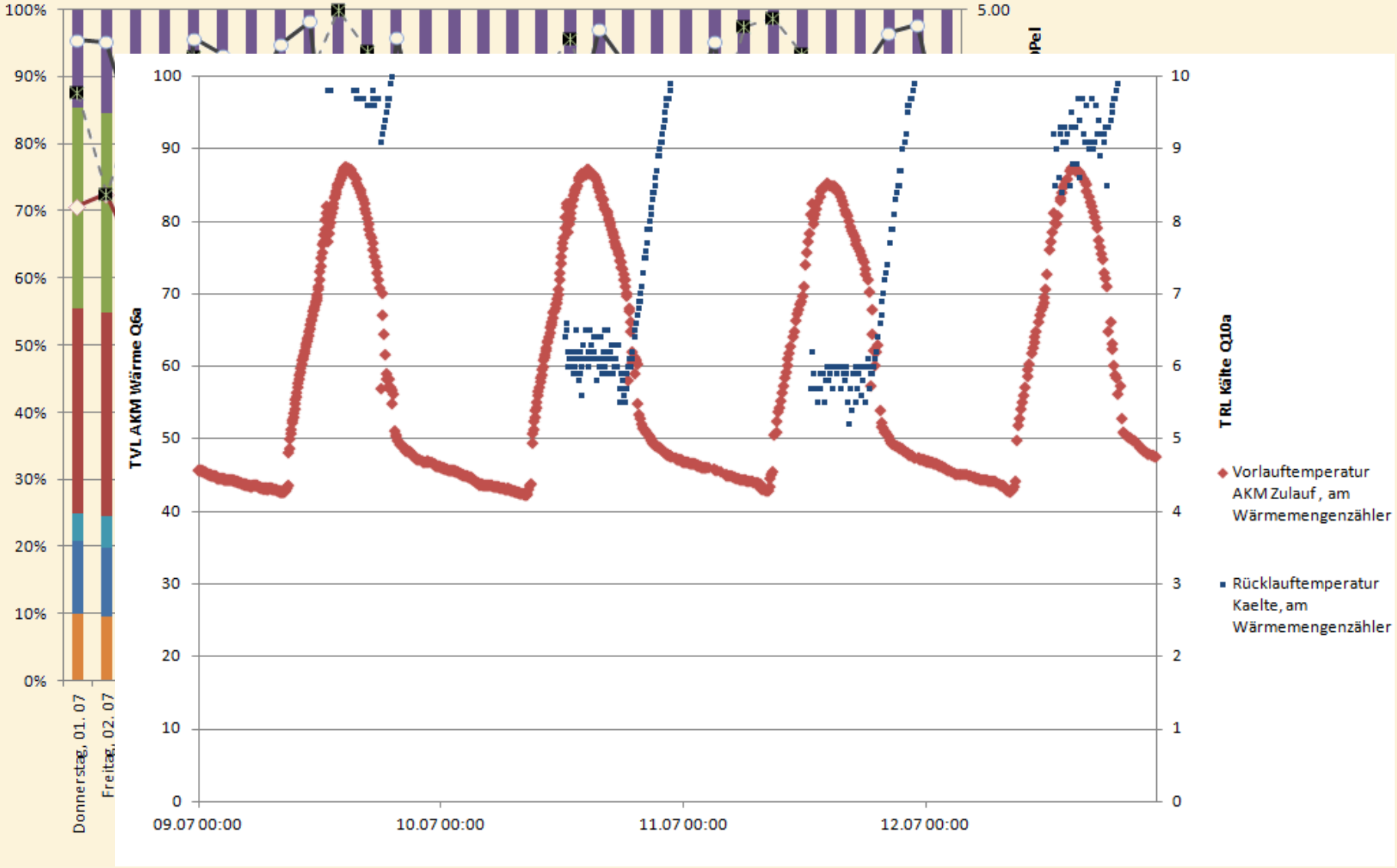
CGD –Solar Details

- Solar Panels: 1580 m^2
- gluatmugl HT
- roof integrated (W-SW, O-SO, 25°)
- Storage: 2 x 5,5 m^3
- 15% freezing protection
- Heat exchanger on user side (DHW, heating, SC)
- 545 kW Bingshan LiBr chiller
- Wet cooling tower

CGD Bank Headquarter, Portugal



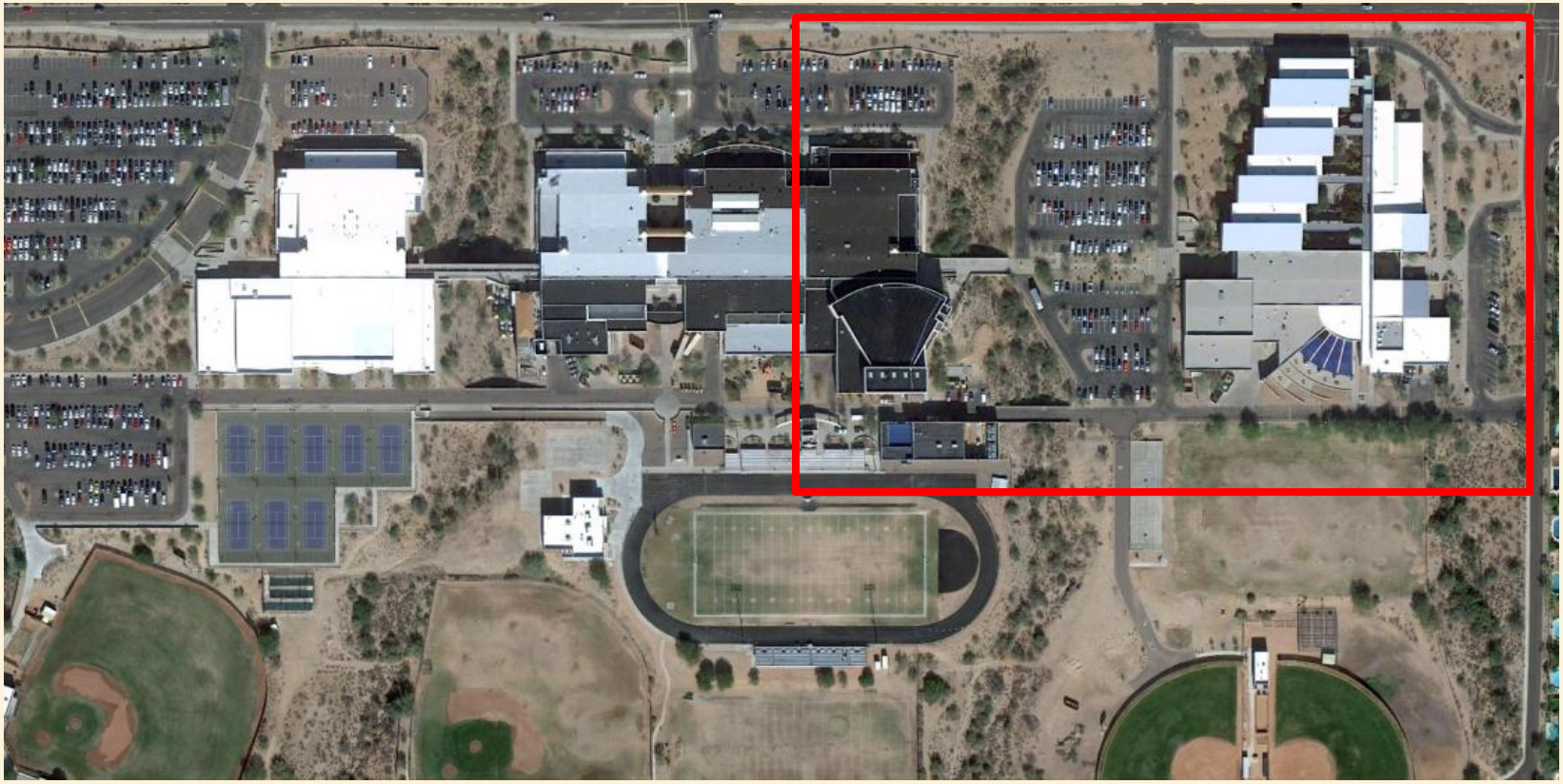
CGD Bank Headquarter, Portugal



Project
under construction

Desert Mountain High School, USA

Scottsdale, Arizona, USA
Cooling, Heating and DHW for Middle School and High school
500 tons /1750 kW_{th} of Cooling, 50,000 ft^2 collector area
10% larger than SOLID's Singapore project



DMHS Hydraulics

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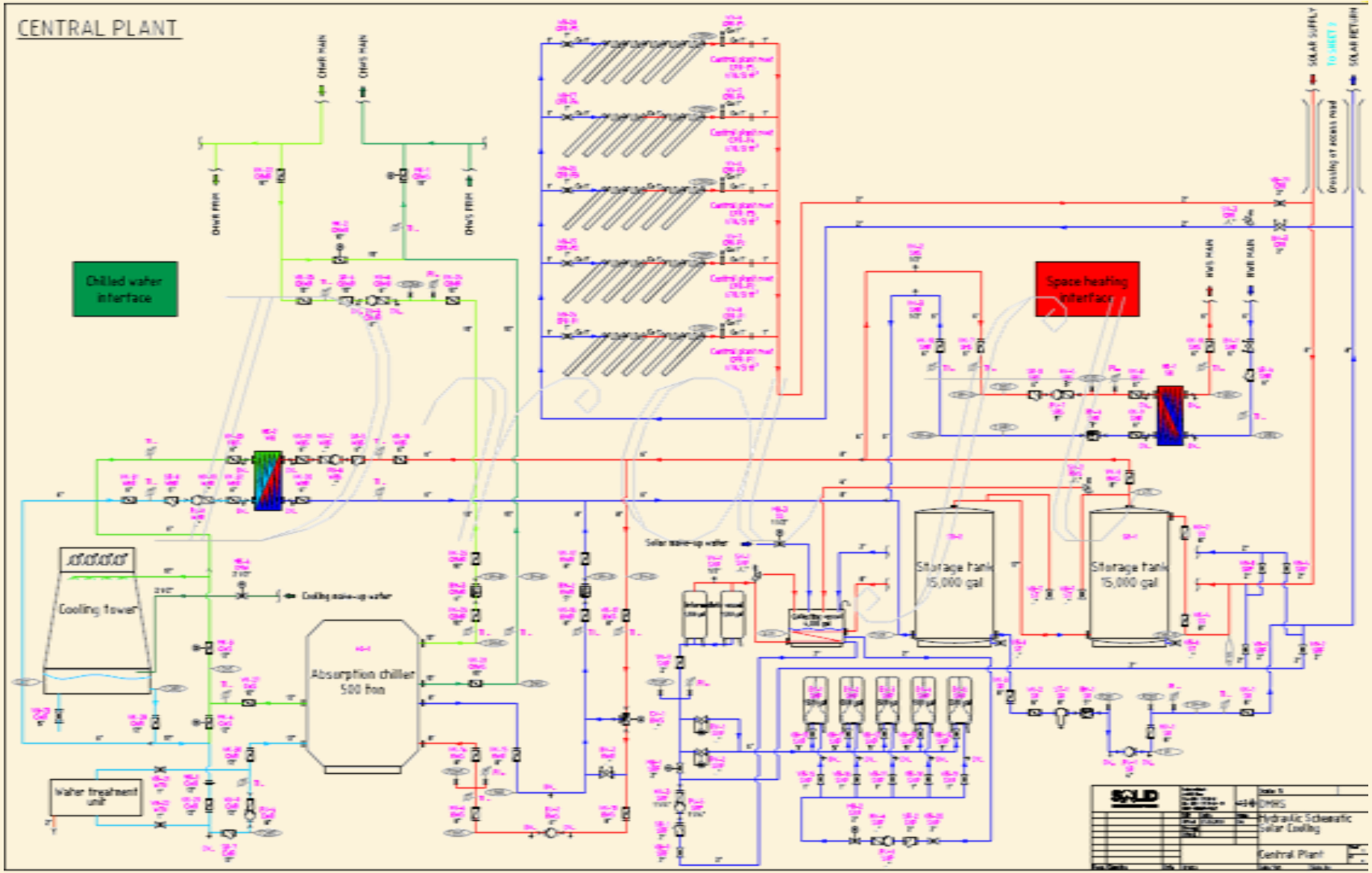

DMHS –Covered Parking

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Thank you!

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