DISTRICT COOLING

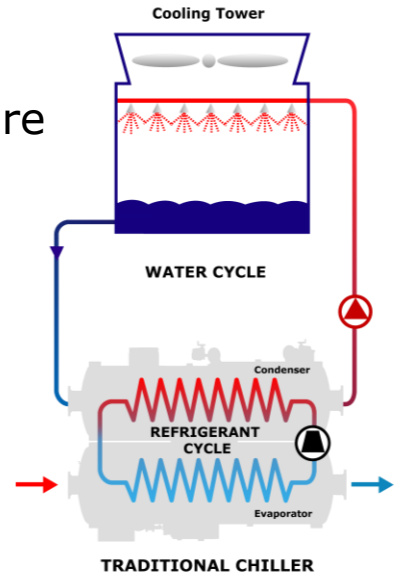
Efficiency Improvement in District Cooling System using Direct Condensation

ARANER

CONDENSER SELECTION

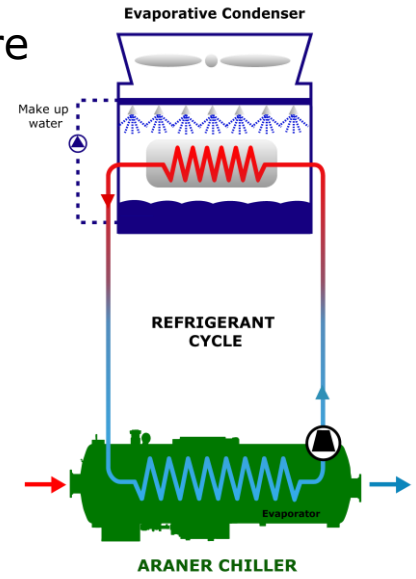
INDIRECT CONDENSATION

- There are two heat transfers:
  - Cooling tower and Condenser
- Water will have a dT
- Big water flow required
- Higher condensing temperature
- Higher electrical consumption
- Needs more equipment
- Needs more maintenance

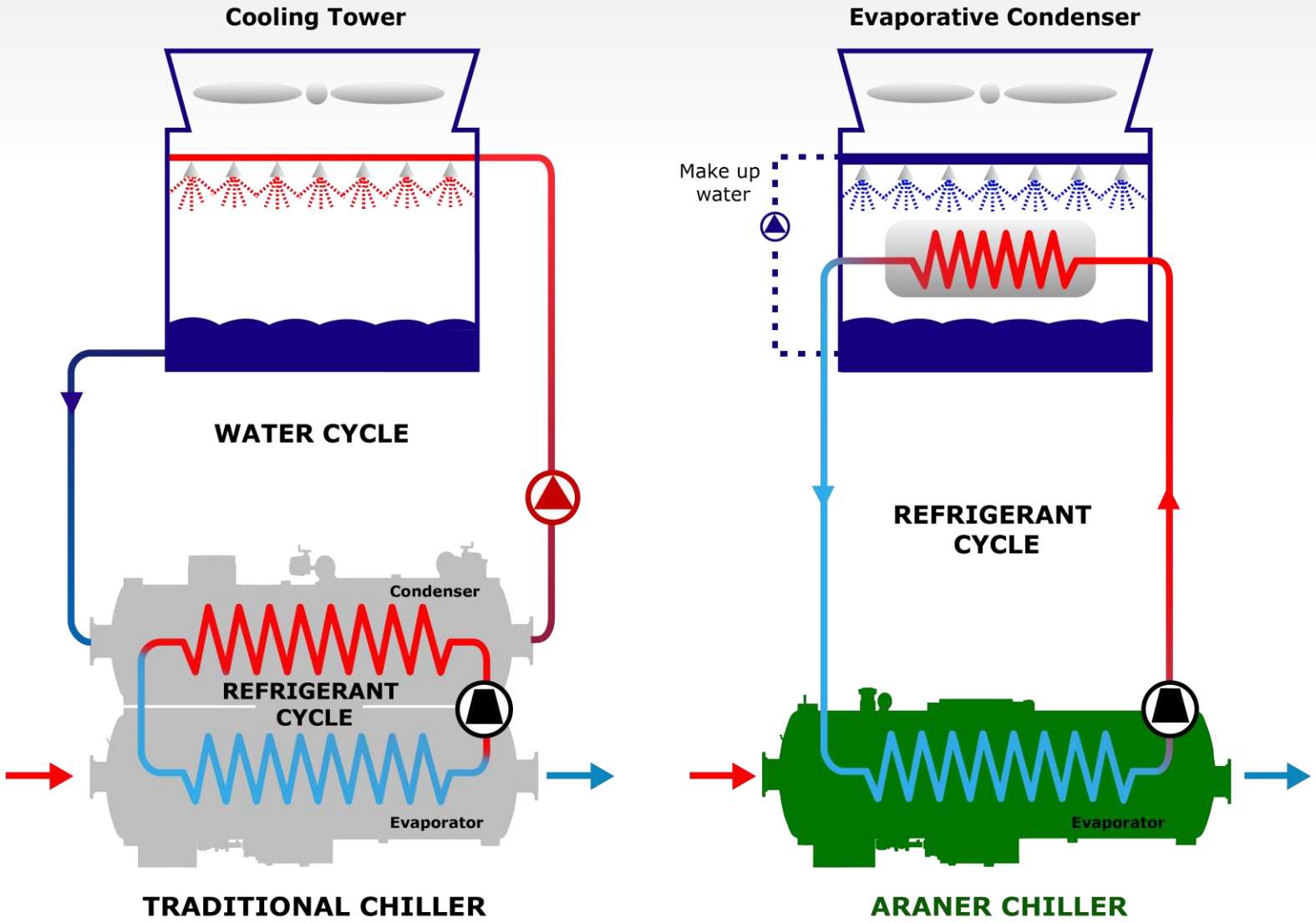


DIRECT CONDENSATION

- There is only one heat transfer:
  - Evaporative condenser
- No water dT
- Lower condensing temperature
- Small water flow required
- Lower electrical consumption
- Needs more refrigerant
- Needs less maintenance
- **Reduction in footprint and**
- **increase in efficiency**



DIRECT CONDENSATION SYSTEM – WATER COOLED



FUNDAMENTALS OF THE IMPROVEMENT

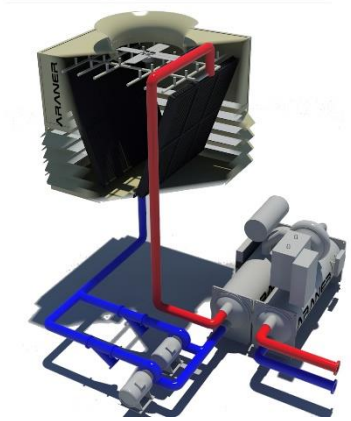
- For equal refrigeration capacity and equal chilled water temperature, the Chiller electrical consumption is higher for higher condensing temperatures
- In a tradition plant with cooling tower, the condensing temperature equals:

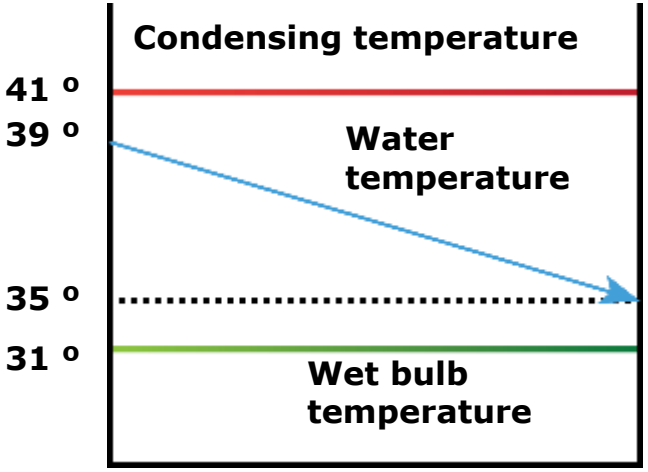
➡ The wet bulb temperature	(31 ºC)
+ the cooling tower approach	(4 ºC)
+ the water temperature difference	(4 ºC)
+ the condenser approach	(2 ºC)
➡ **Final condensing temperature:**	**41 ºC**

- If we manage to make direct condensation under the web bulb temperature we will avoid, at least, the water temperature difference

Eliminating intermediate process will reduce the chiller electrical consumption

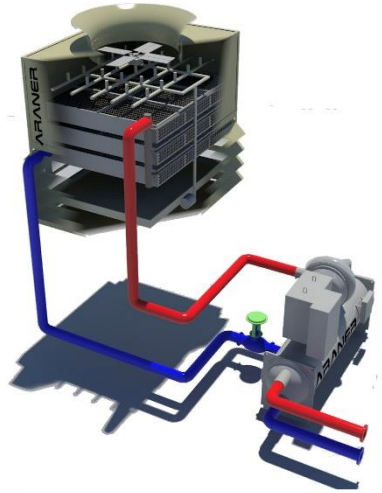
INDIRECT CONDENSATION
Traditional solution

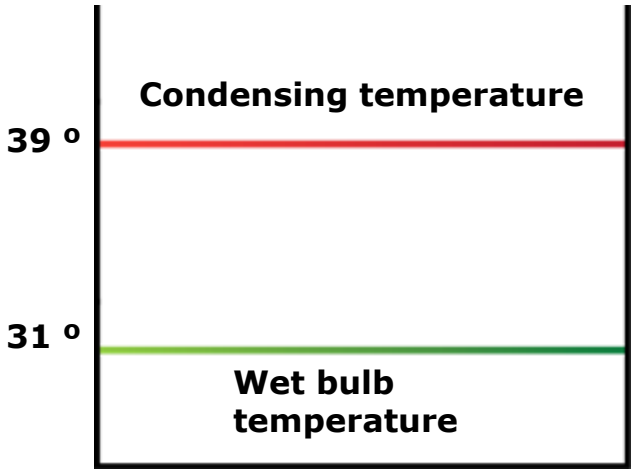




Total approach: 10 ºC

DIRECT CONDENSATION
Improved solution

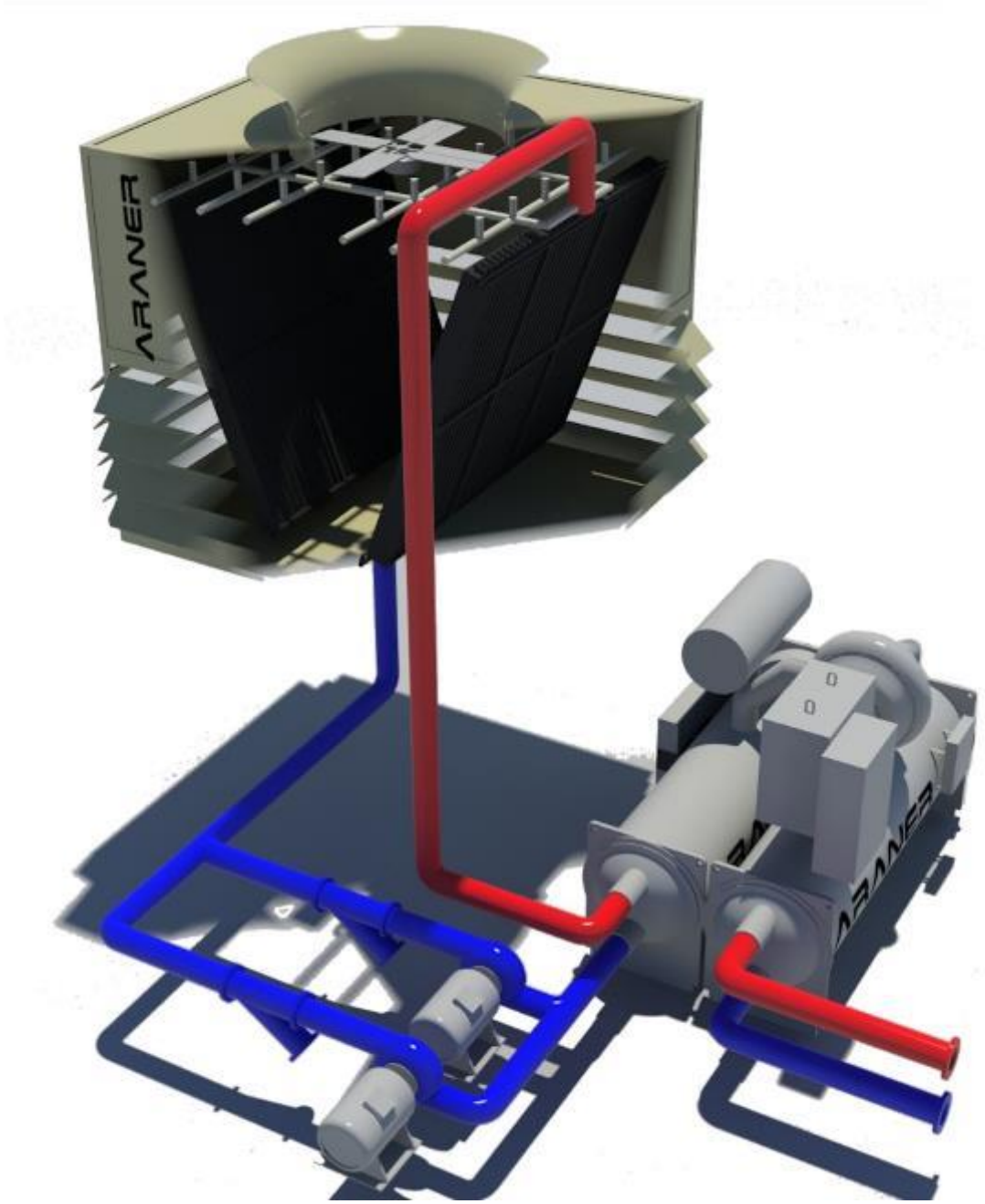




Total approach: 8 ºC

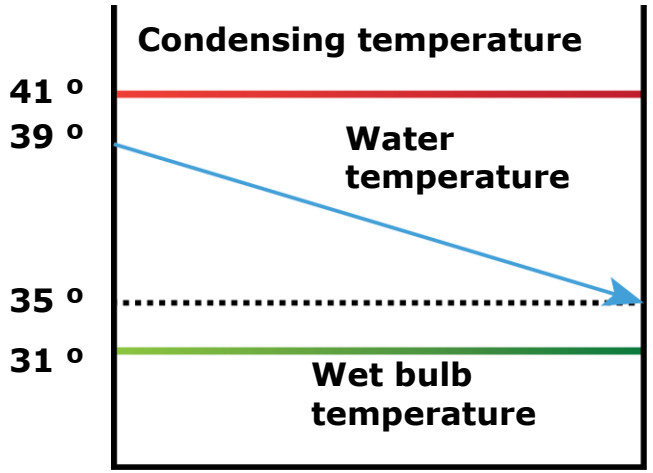
This can reduce the chiller consumption by 6% + eliminate the water pumps consumption!

TOTAL 14% savings in electrical consumption



INDIRECT CONDENSATION

Traditional solution



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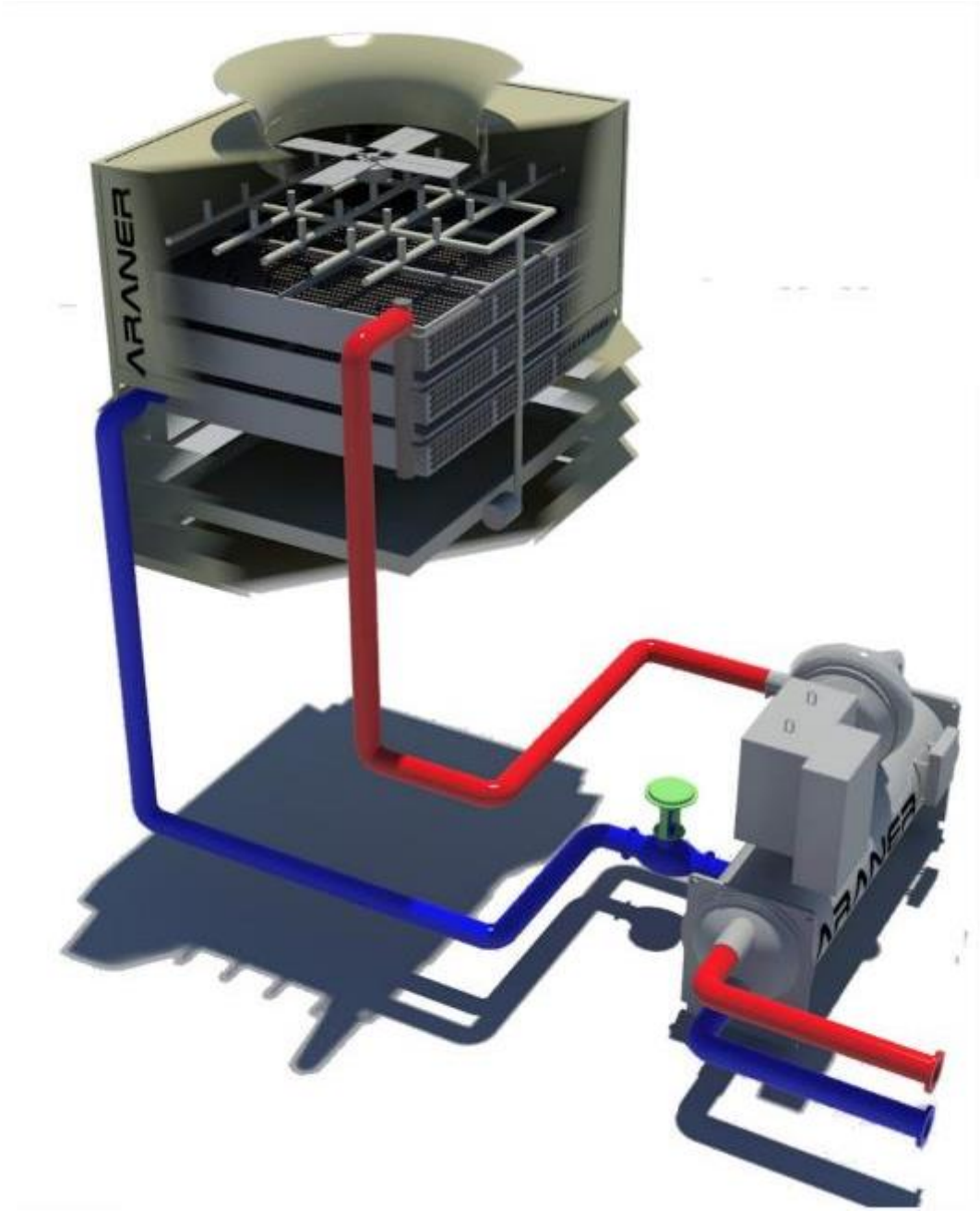
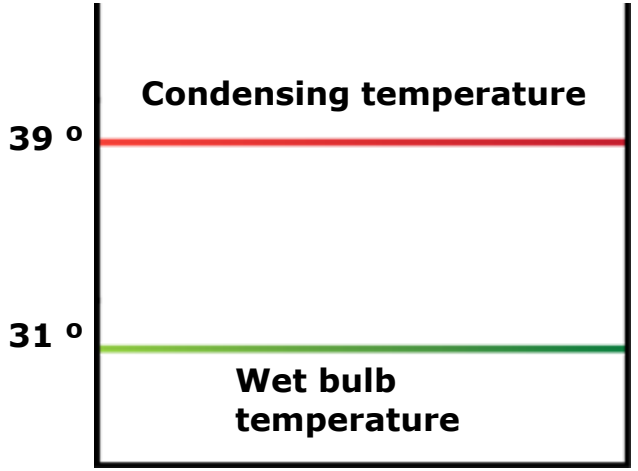


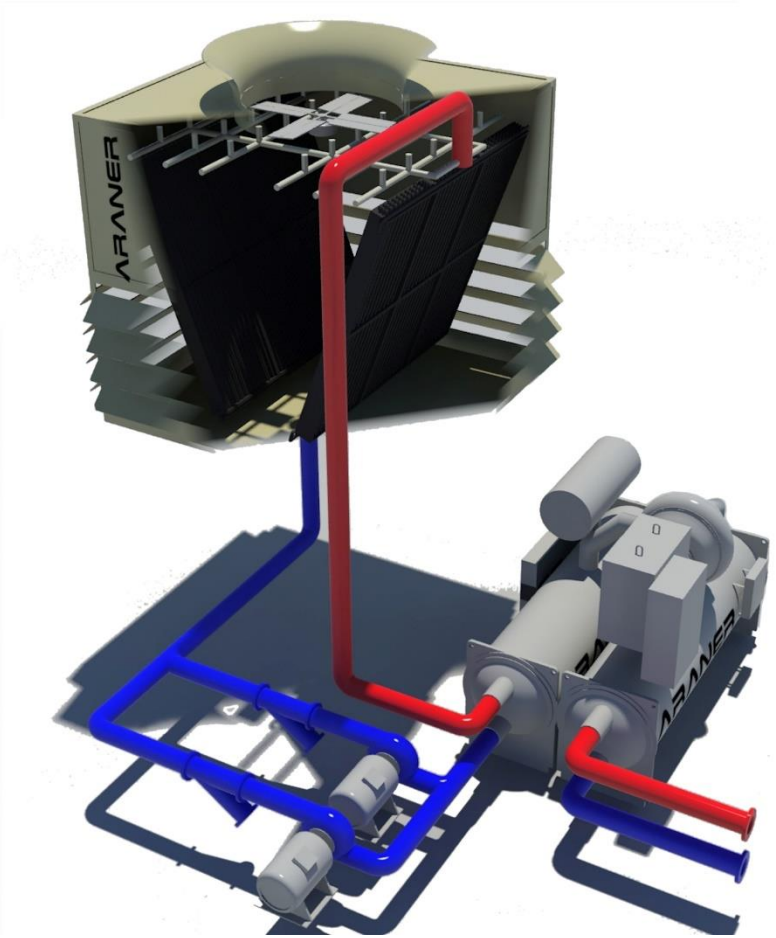
DIRECT CONDENSATION

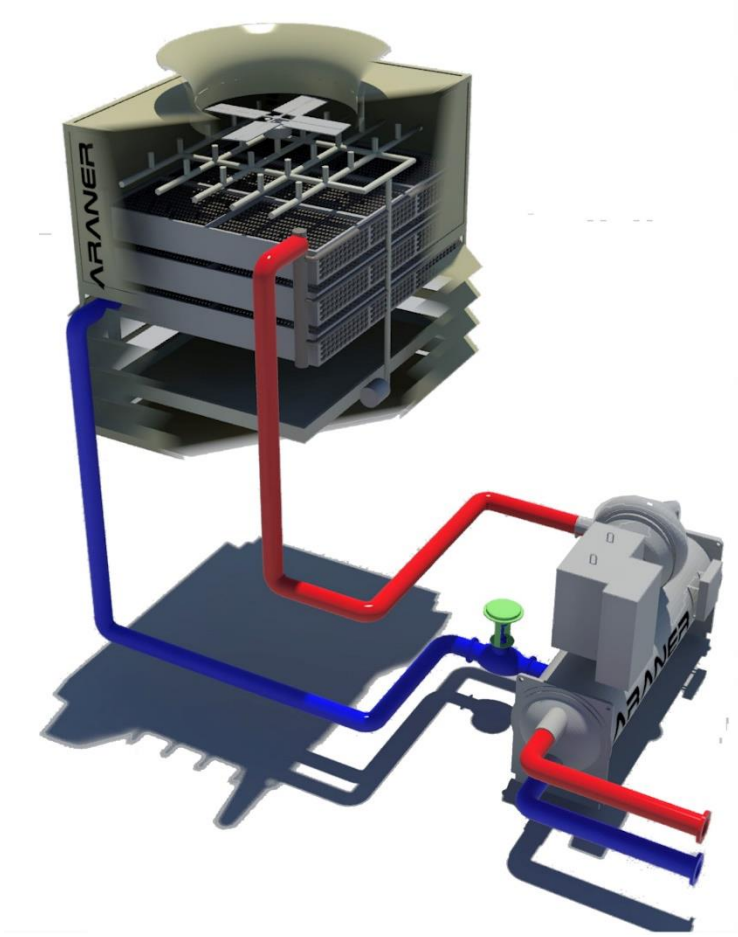
Improved solution



Total approach: 8 ºC

REPLACEMENT OF CONDENSER + COOLER TOWER WITH EVAPORATIVE CONDENSER





ELIMINATION OF BIG WATER PUMPS + OTHER ACCESSORIES!

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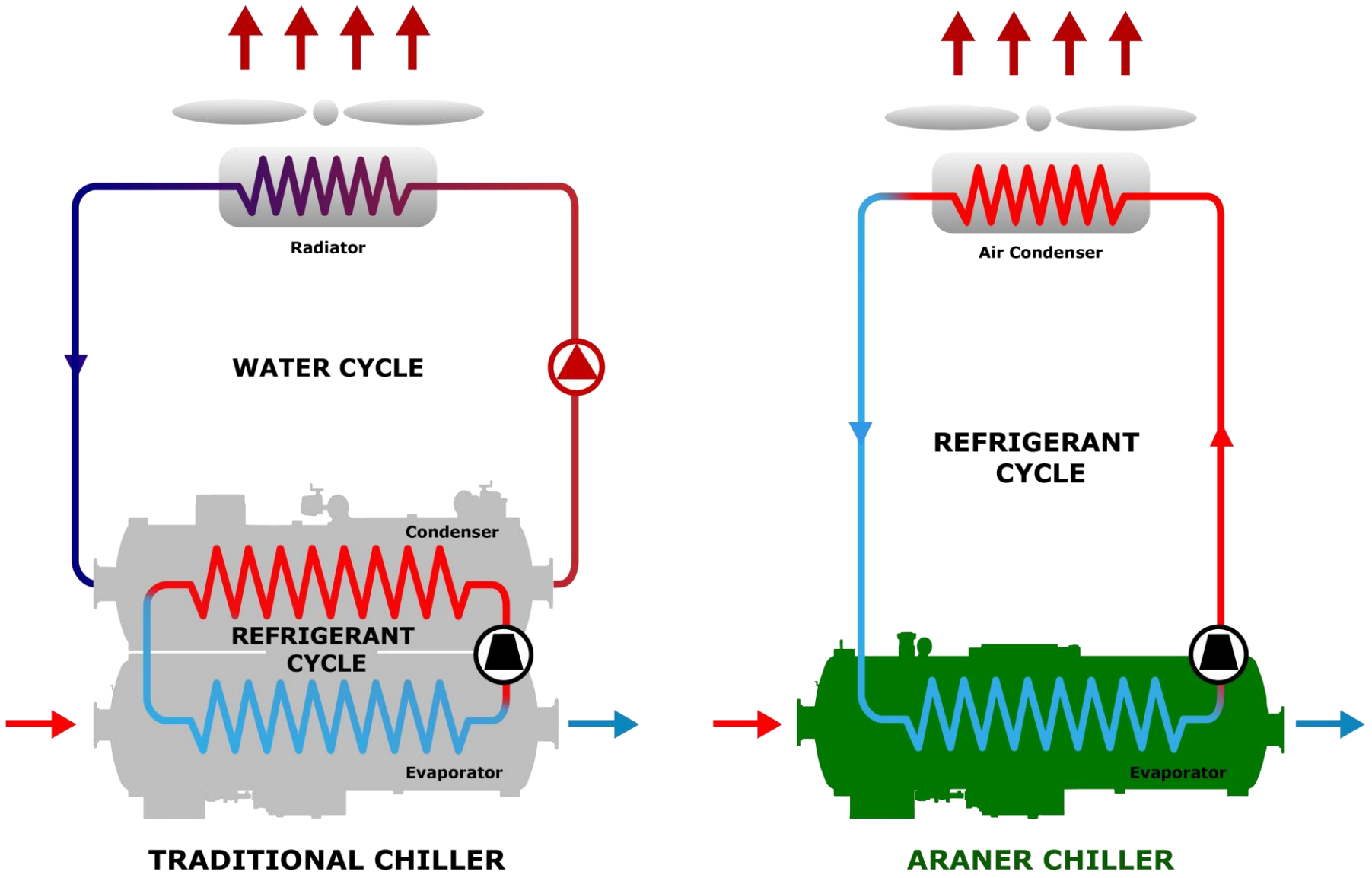
DIRECT CONDENSATION SYSTEM – AIR COOLED



TES TANK COMBINED WITH FLOATING CONDENSING TEMPERATURE

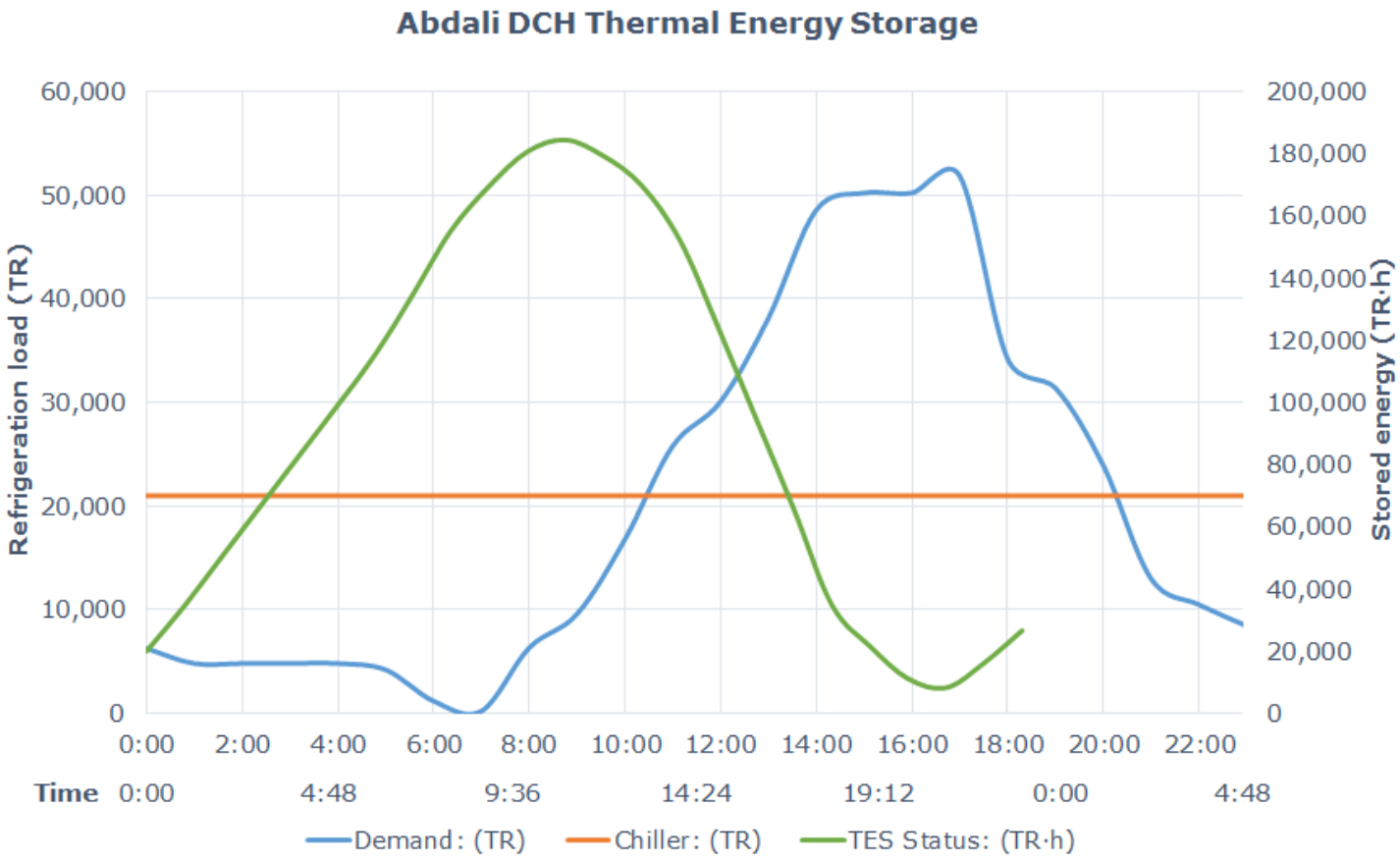
THERMAL ENERGY STORAGE

Criteria

- Daily load profile
- Available plant foot print / height
- The chillers will operate mainly at night with lower ambient temperature
- Chillers have a floating condensing temperature

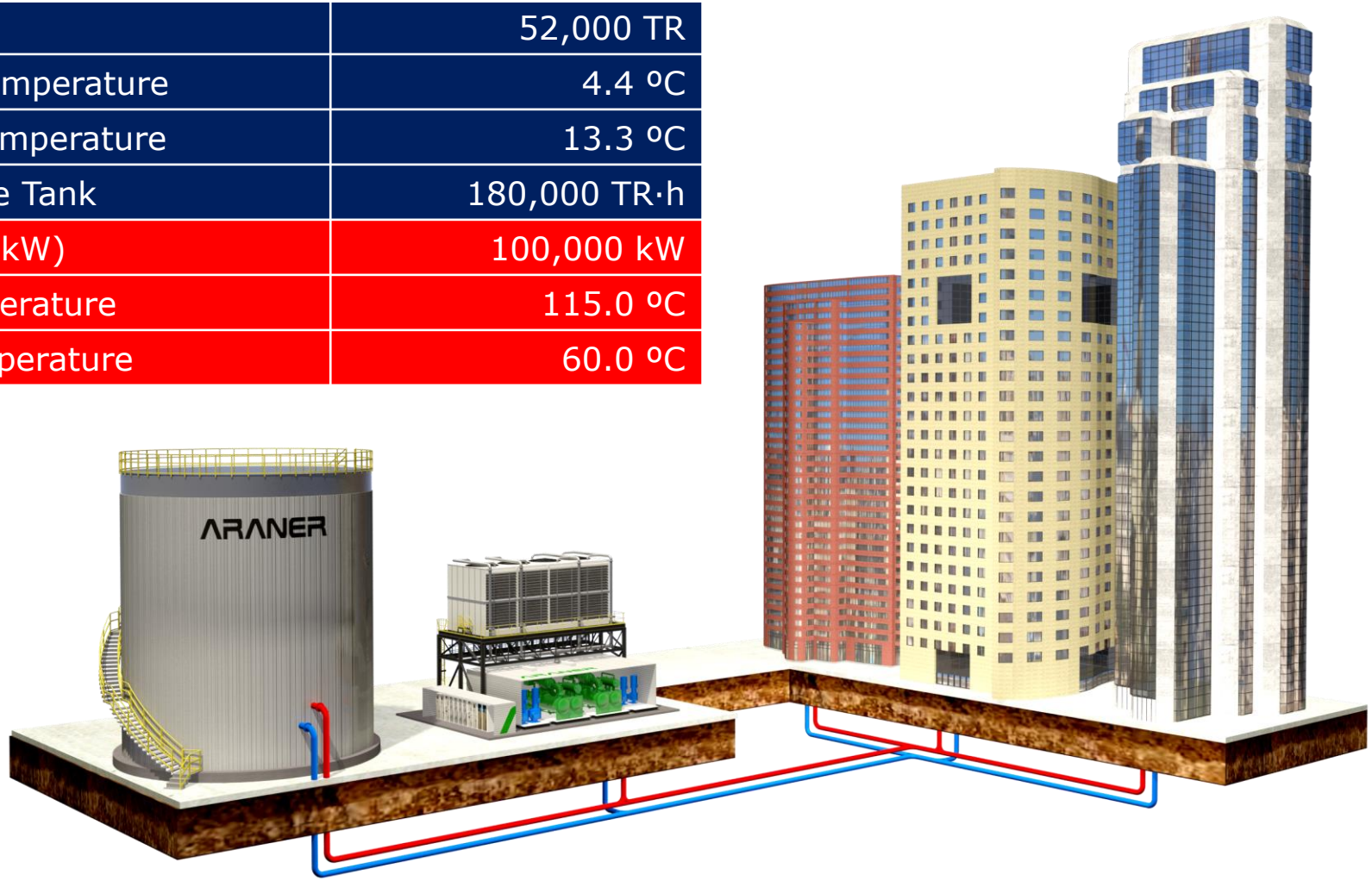
Benefits

- Increase yearly efficiency
- Reduce nº of chillers and auxiliary equipment
- Reduce operating cost
- Increased operating flexibility
- Provide back-up capacity

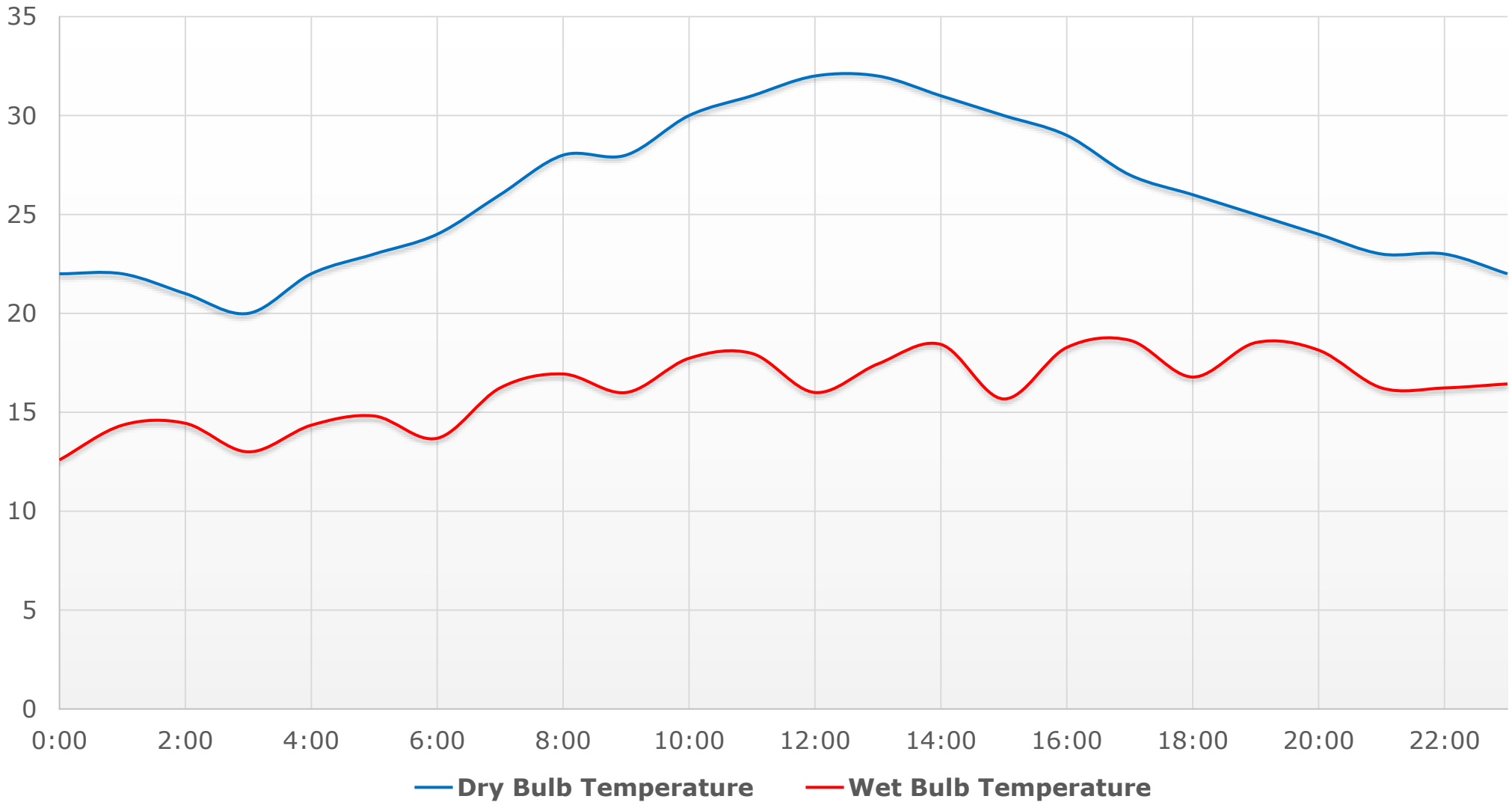


JDE CASE

	DESIGN CRITERIA	
COOLING SYSTEM	Peak Cooling Demand	52,000 TR
	Chilled Water Supply Temperature	4.4 ºC
	Chilled Water Return Temperature	13.3 ºC
	Thermal Energy Storage Tank	180,000 TR·h
HEATING SYSTEM	Peak Heating Demand (kW)	100,000 kW
	Hot Water Supply Temperature	115.0 ºC
	Hot Water Reeturn Temperature	60.0 ºC



DRY AND WET BULB TEMPERATURE DISTRIBUTION



JDE SOLUTION OVERVIEW

THE DISTRICT COOLING PLANT WITH

There is no water consumption

Air Cooled Chillers are considered with ZERO water consumption

TES Tank configuration

TES Tank reduces the cooling installed capacity and the electrical consumption

Floating Condensation Temperature

Benefit of higher efficiency at lower temperatures

R717 refrigerant

R717 high efficiency natural refrigerant and zero environmental impact

Global average COP

4.51 (0.78 kW/TR)

Taylor made integrated control system

SCADA system of the central plant fully integrated with ETS PLCs

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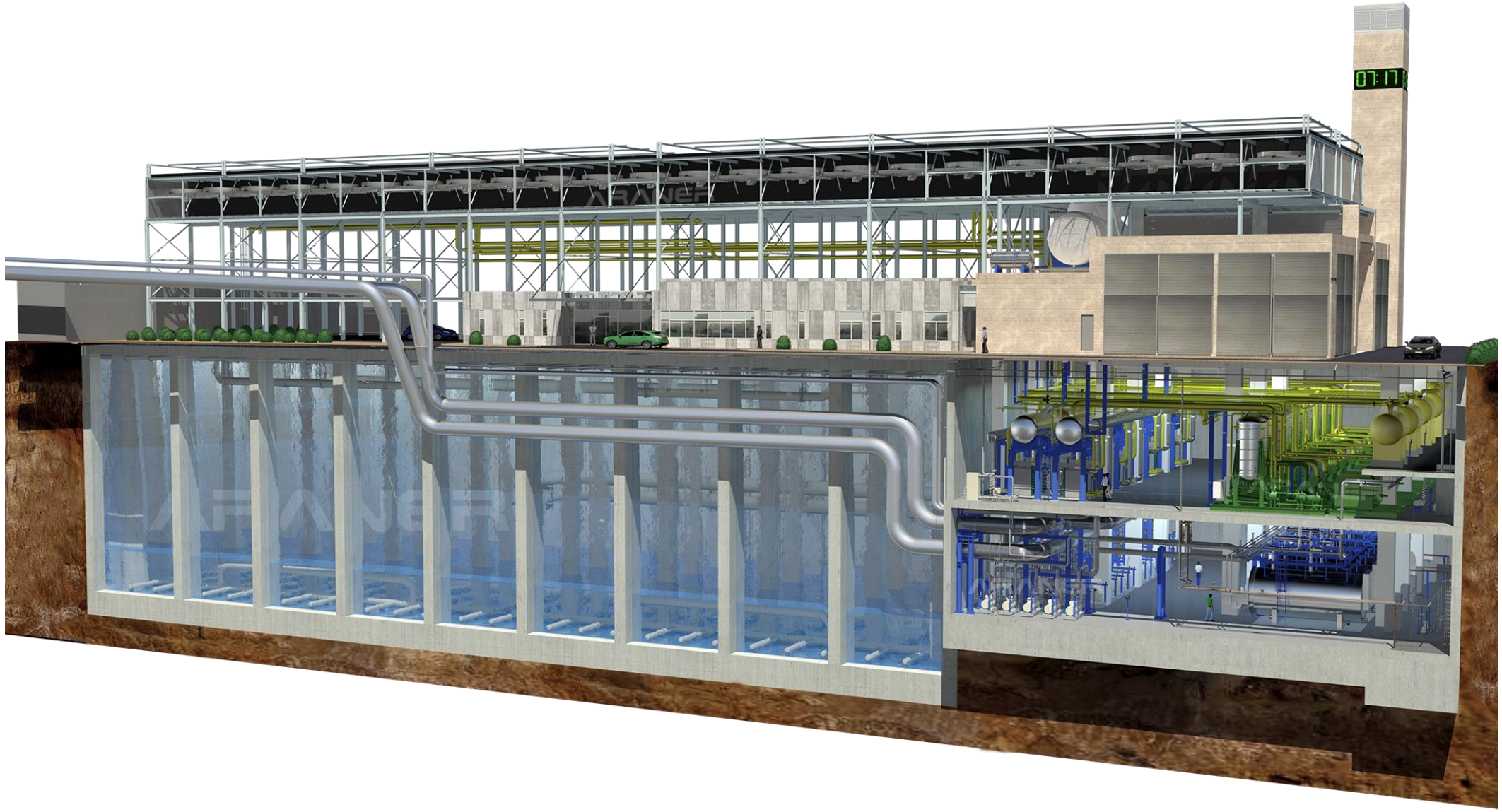
JDE SOLUTION OVERVIEW



JDE RESULTS

CHARACTERISTICS	TRADITIONAL SOLUTION (Cooling Towers)	SOLUTION WITH ARANER's PRODUCTS (Air Cooled)
Peak Cooling Demand	52,000 TR	52,000 TR
Chillers Capacity (Installed Capacity)	52,000 TR	21,000 TR
Energy Storage	No	Long-term Thermal Energy Storage Tank with 80,000 m3
Electrical Peak Demand	62,000 kW	24,000 kW
Condensation	Cooling Towers	Dry Condensers
Refrigerant	R134 a	R717
Water Consumption	500 m3/h	No water consumption
Special requirements	Sewage Treatment Plant	-
Yearly Energy Consumption	30,978,219 kW·h	31,520,536 kW·h
Yearly Average Chiller Efficiency	0.62 kW/TR	0.63 kW/TR
Water Consumption	497,204 m3	ZERO
ADVANTAGES	✓ Standard solution	✓ No Water Consumption ✓ Environmentally Friendly ✓ Low Operation Cost ✓ Low Maintenance Cost ✓ Visual Integration in Urban Areas

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