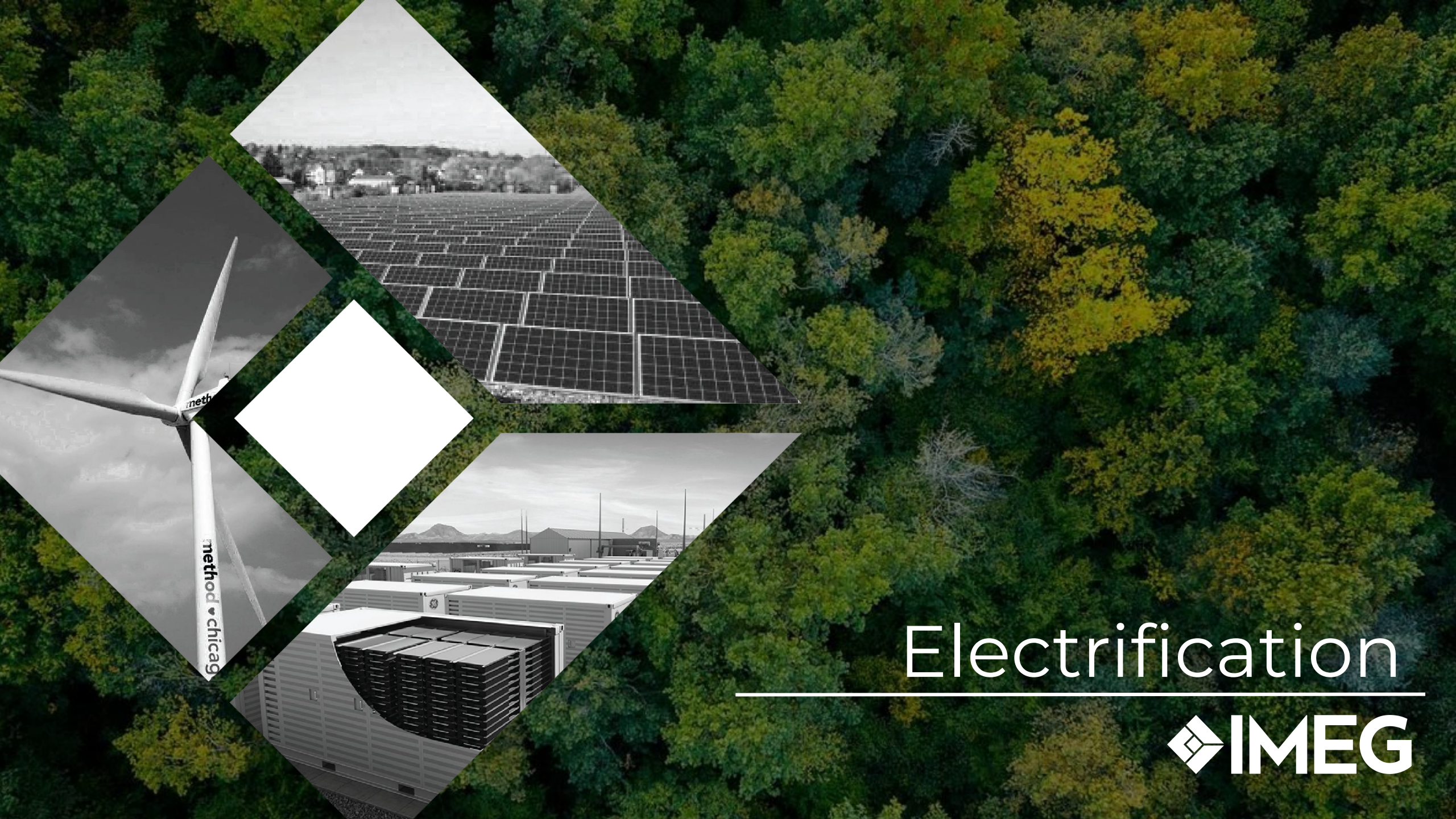


Electrification

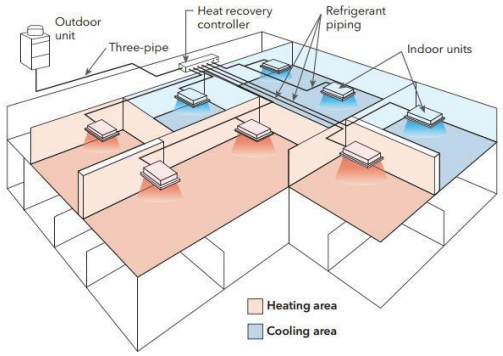
IMEG

Large commercial electrification

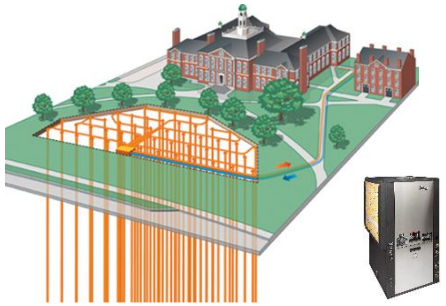
Generating hot air

Electric resistance

Air to Air Heat Pump



VRF



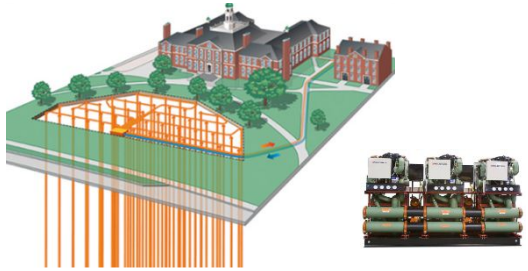
Geothermal with WSHP

Generating HWS

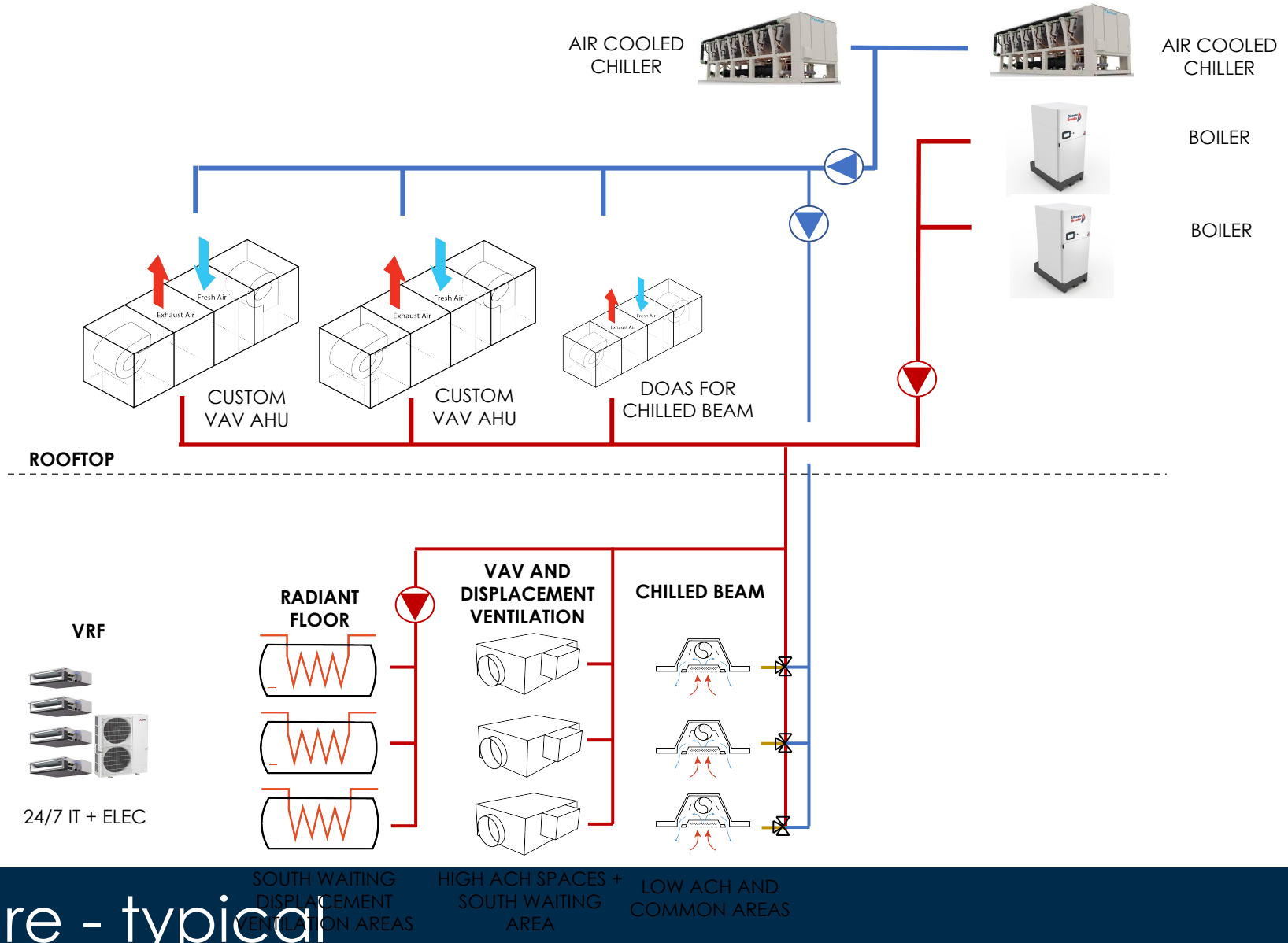
Electric resistance

Air Source Heat Pump

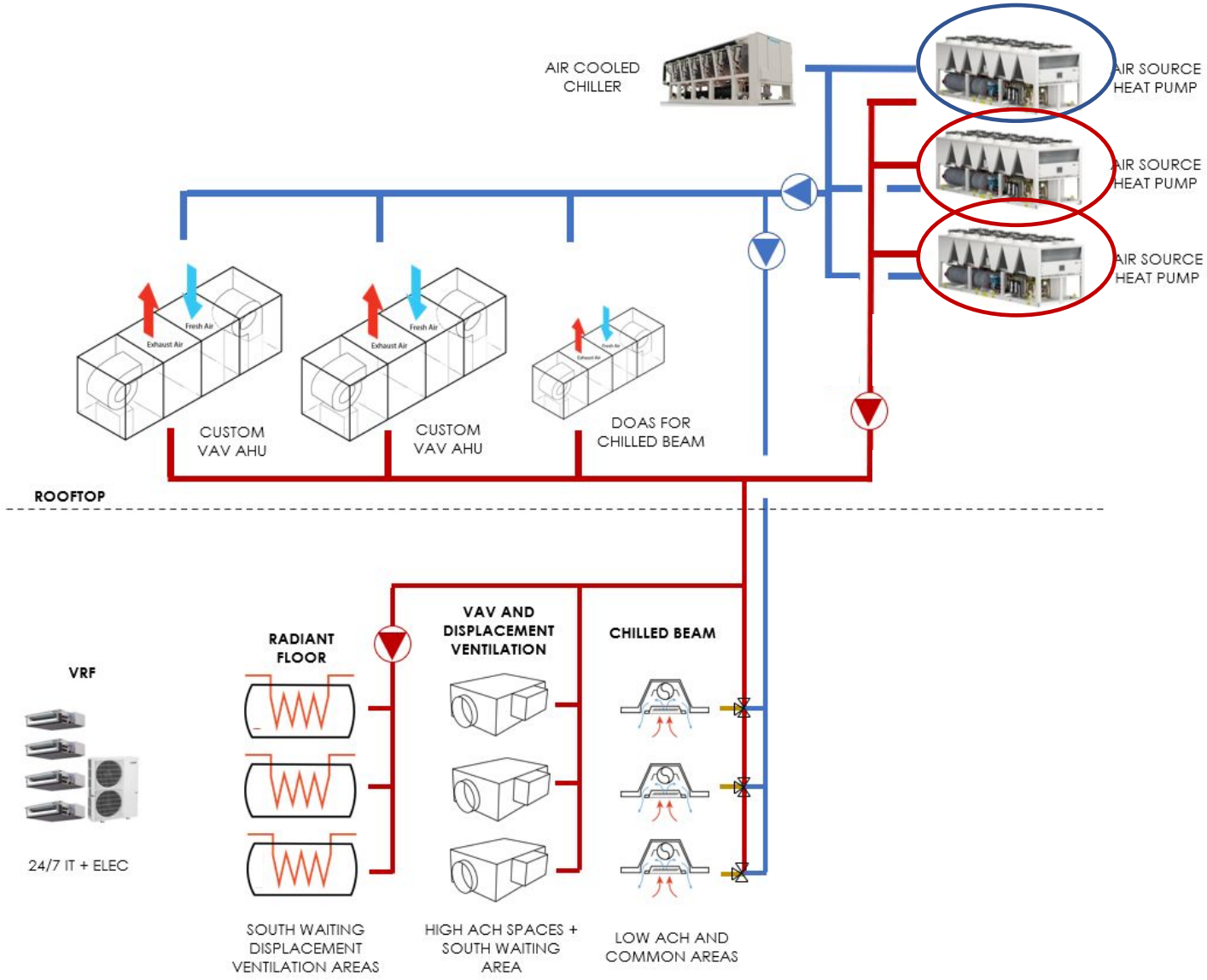
Heat recovery chiller



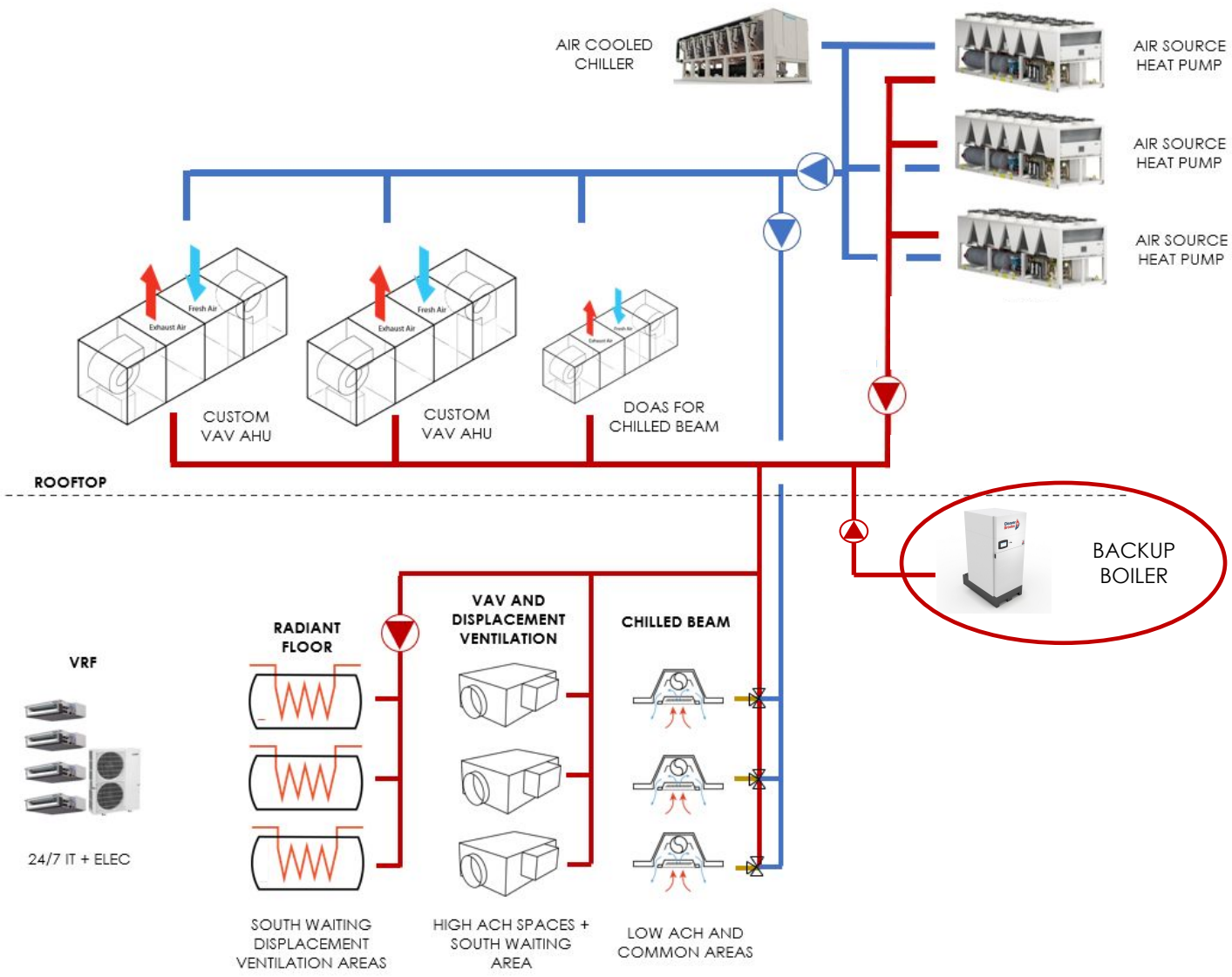
Geothermal WTW HP



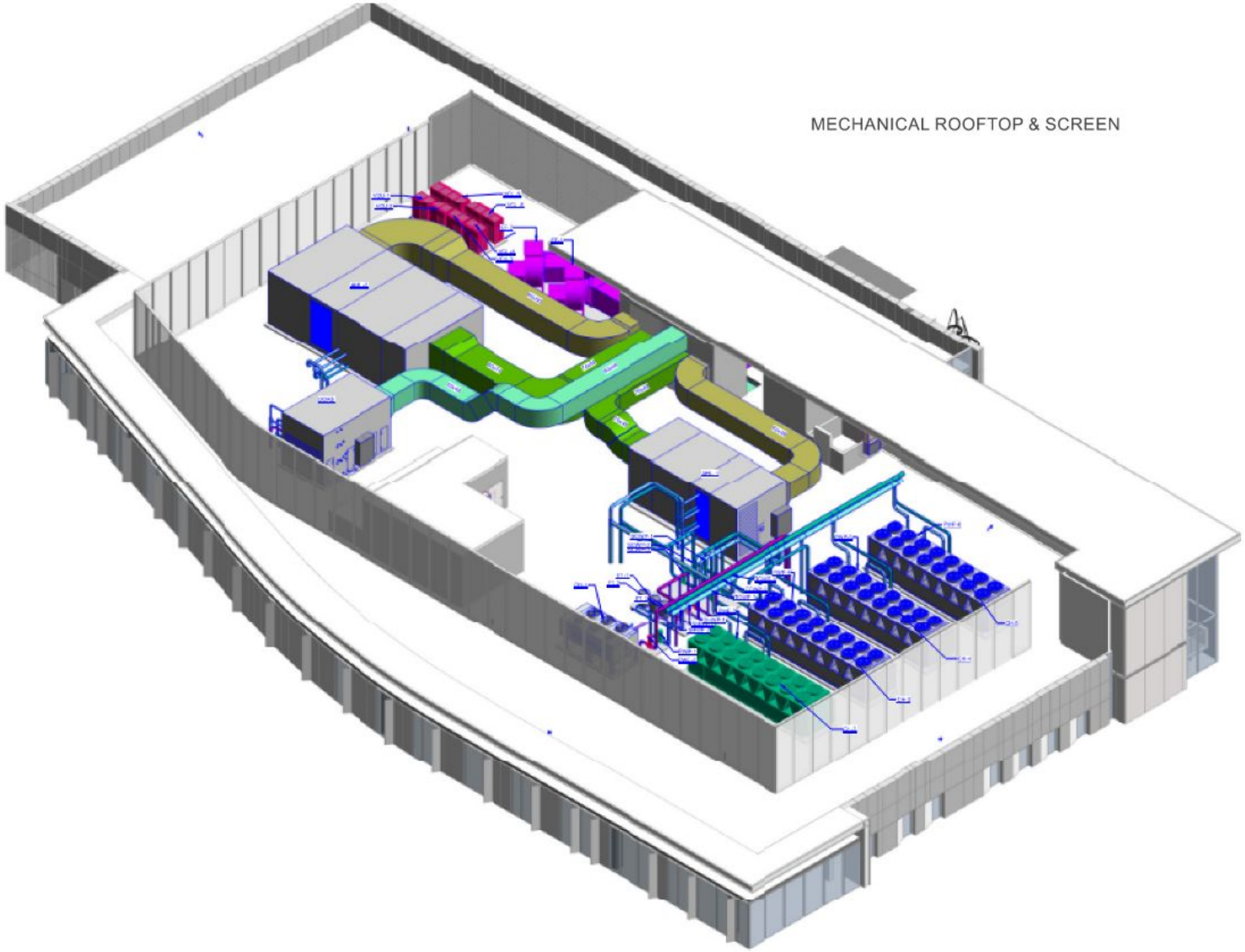
Healthcare - typical



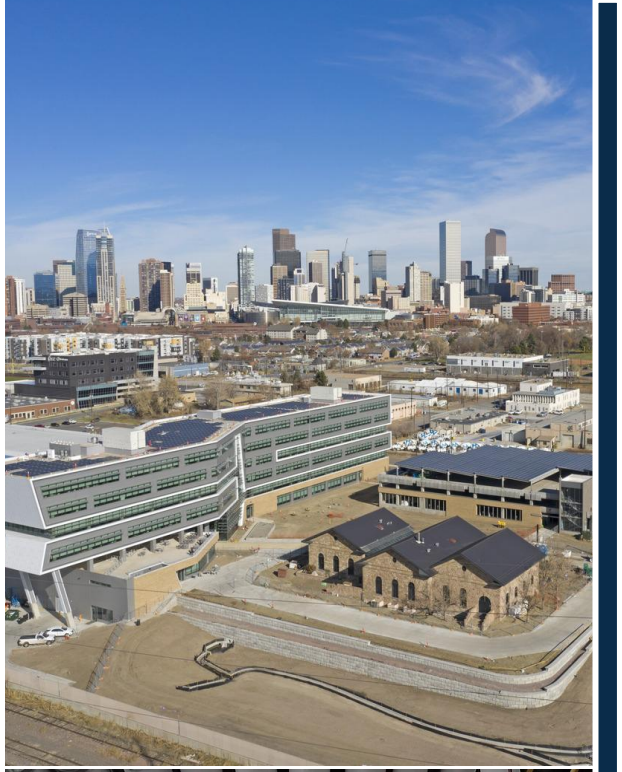
Healthcare – all electric

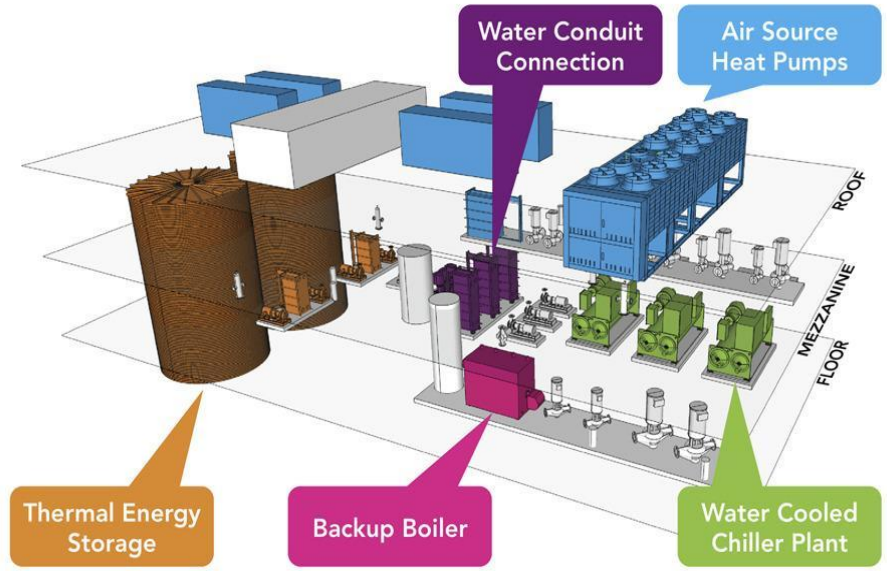


Healthcare – all electric (cold climate)

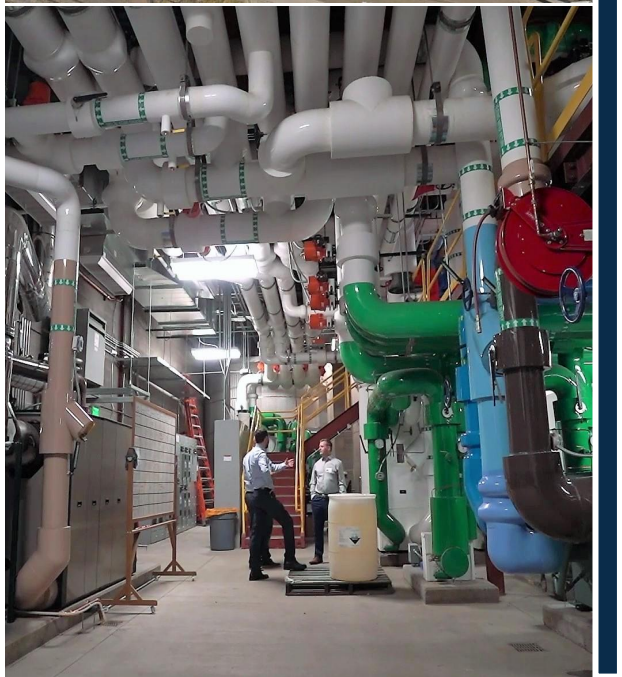


Rooftop layout





Central Utility Plant



DENVER WATER OPERATION COMPLEX

Denver, Colorado

Objective:

With construction of a new office building, the owner wanted to pursue net zero, all-electric energy for the campus.

Problem:

The campus is located in a cold climate with a diverse set of campus buildings. Solution would require combination of water main as cooling/heating sink, air source heat pumps, radiant slabs and heating water storage tanks to allow electrification of the heating system.

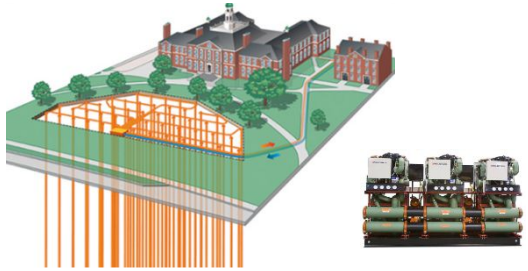
Outcome:

The all-electric design and solar PV added to other areas of the campus provided a fully decarbonized, zero carbon campus.

1 2 3 4

ASSESS / OPTIMIZE / ELECTRIFICATION / RENEWABLES

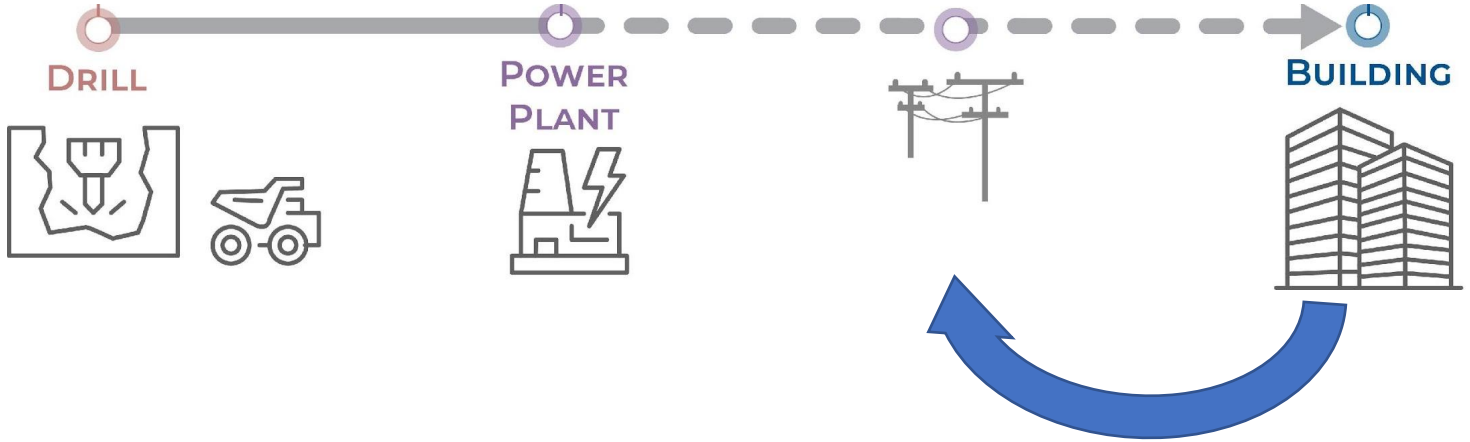
Generating HWS



	Electric resistance	Air Source Heat Pump	Heat recovery chiller	Geothermal WTW HP
Minimum OA operating temp.	NA	0 - 15 F	NA	NA
Heating COP	1.0	2.0 - 3.5	3.5 - 7.0	4.0 – 5.5
Key Benefit	Lowest first cost	Energy cost on par with gas when OA >30F	High COP at any OA temp	Ground heat exchange, not air
Key Limitation	High energy cost 3x+	Minimum OA temp Low HWS temp Capacity falls off as OA drops	Only handles simultaneous load Maintenance and min. load	Well field size and cost
Max HWS temp	Same as gas	125 - 130 F	130 – 140 F	130 – 140 F

Electrification equipment considerations

- Low temperature operation/cut-out
- Electrical load and BOH space
- Utility power needs
- Backup generation capacity
- Utility cost impacts
- Demand cost impacts



Barriers and limitations

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Contact

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