Keeping Things Cool in Hydrogen

Todd May – Global Director, Hydrogen

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BALTIMORE AIRCOIL COMPANY – WHO WE ARE

Amsted INDUSTRIES

A diversified, global manufacturer of industrial components serving primarily the railroad, vehicular, and construction & industrial markets.

Founded in 1902 | Headquarters - Chicago, IL | ESOP 100% Employee-Owned

Railroad Products

Automotive Products

General Industry Products

BALTIMORE AIRCOIL COMPANY – WHO WE ARE

EVAPORATIVE COOLING SOLUTIONS

- HVAC – COMFORT COOLING
- REFRIGERATION
- INDUSTRIAL PROCESS

INNOVATION AND GLOBAL LEADERSHIP FOR SUSTAINABLE SOLUTIONS

34 NEW PRODUCT LAUNCHES IN LAST 5 YEARS

CONTINUOUS IMPROVEMENTS

4.5% less CO_2e Reductions YOY

30% more Energy Efficient

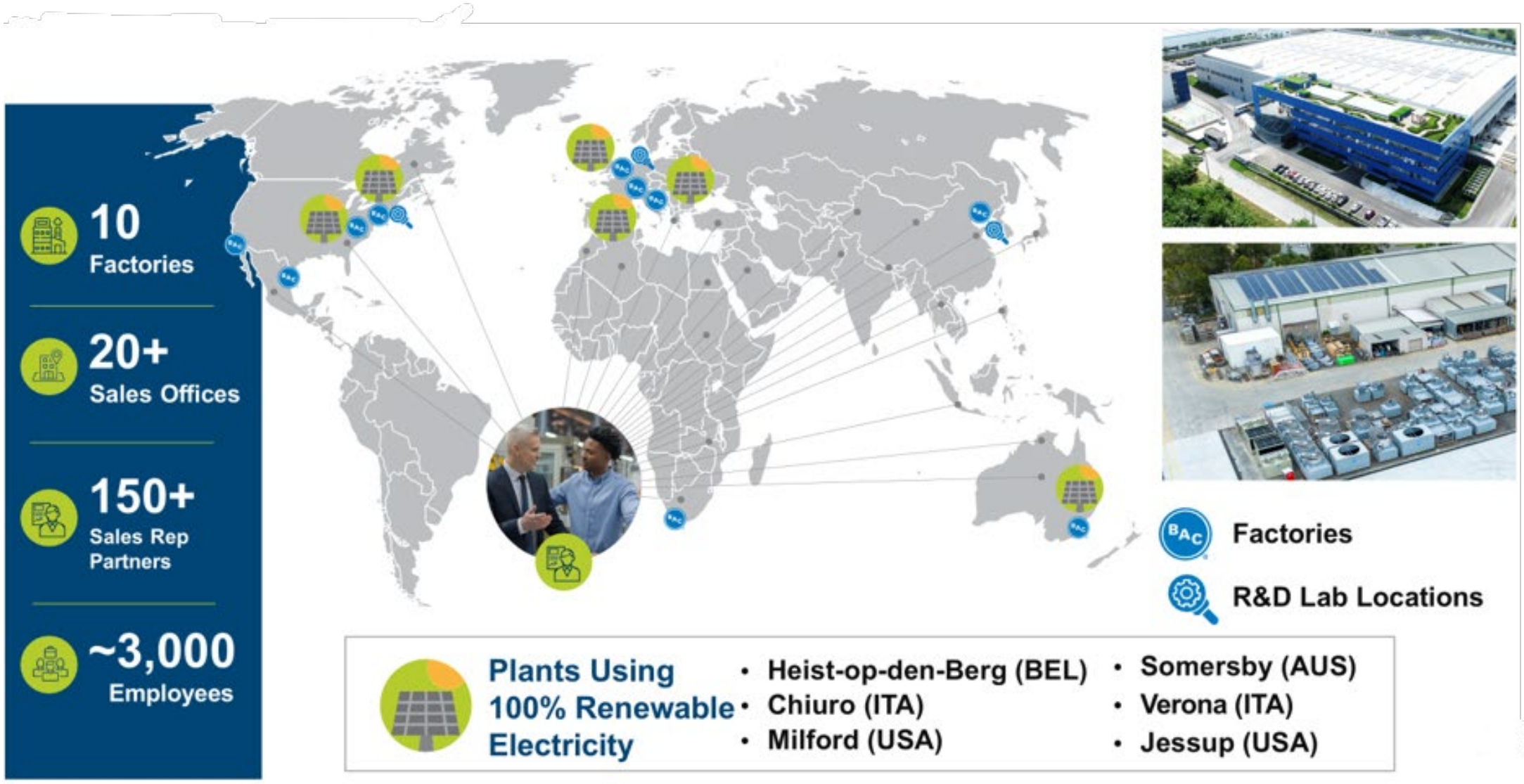
WHERE WE OPERATE

10 Factories

20+ Sales Offices

150+ Sales Rep Partners

~3,000 Employees



BAC Factories

R&D Lab Locations

Plants Using 100% Renewable Electricity

- Heist-op-den-Berg (BEL)
- Chiuro (ITA)
- Milford (USA)
- Somersby (AUS)
- Verona (ITA)
- Jessup (USA)

PRIMARY MARKETS / APPLICATIONS

HVAC

OFFICE BUILDINGS

HOSPITALS

STADIUMS/ARENAS

DATA CENTERS

REFRIGERATION

SUPERMARKETS

COLD STORAGE

BREWERIES

FOOD PROCESSING

INDUSTRIAL

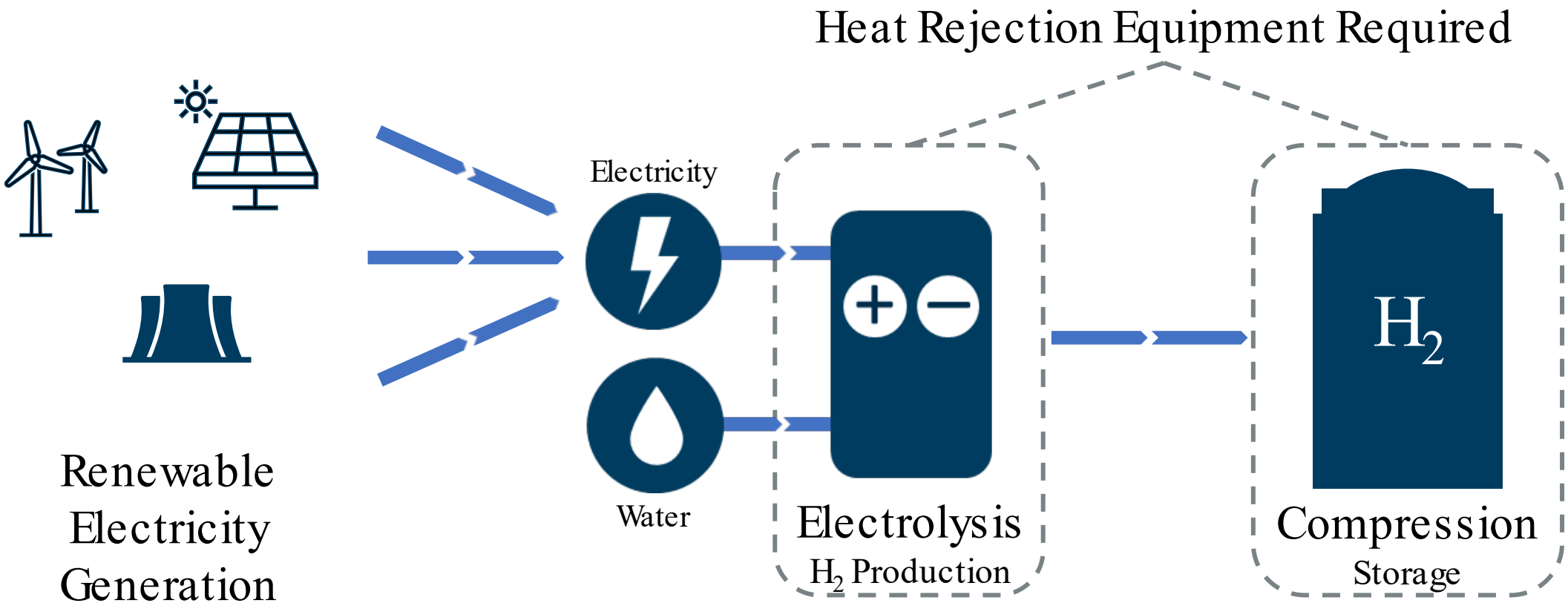
POWER GENERATION

STEEL

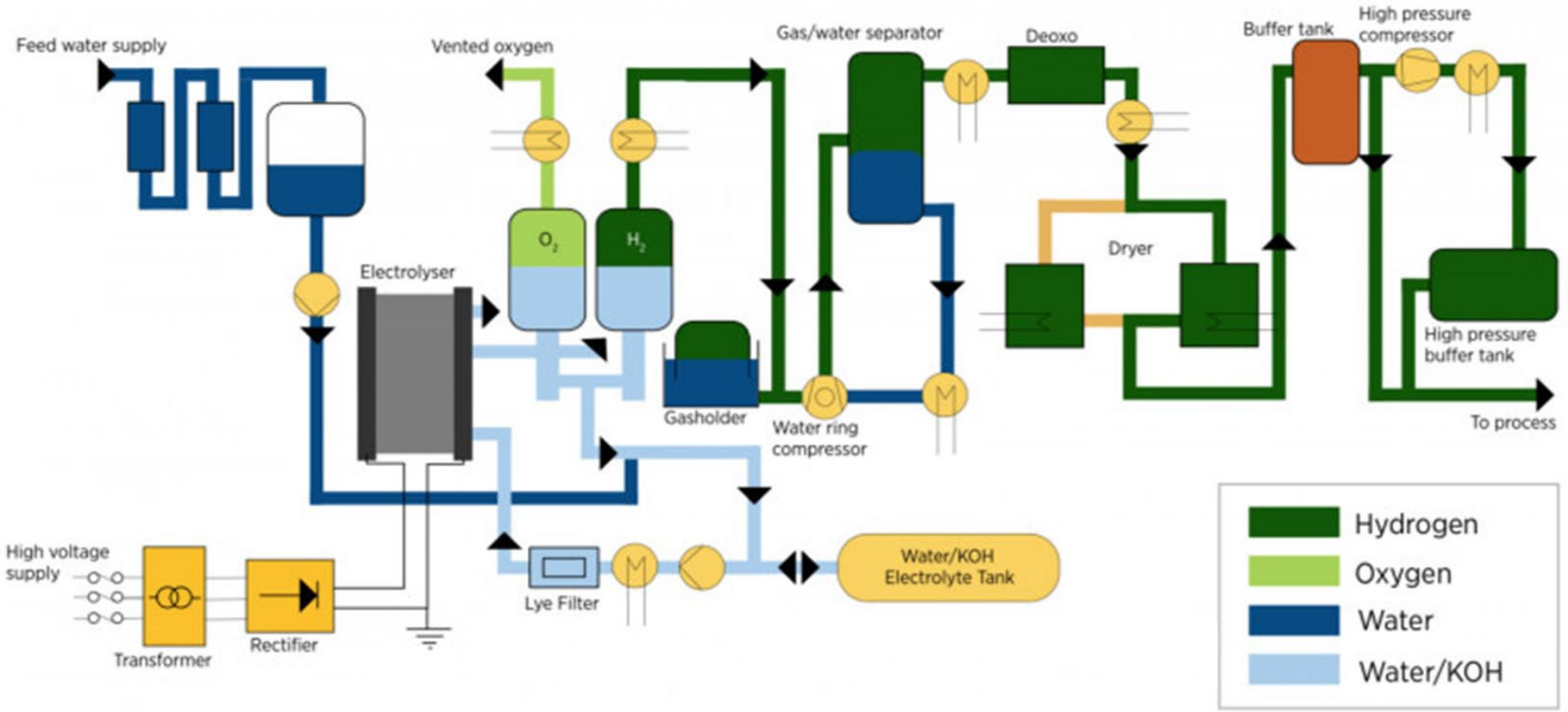
PULP & PAPER

INJECTION MOLDING

Heat Rejection In Hydrogen



Heat Rejection in Alkaline Electrolysis

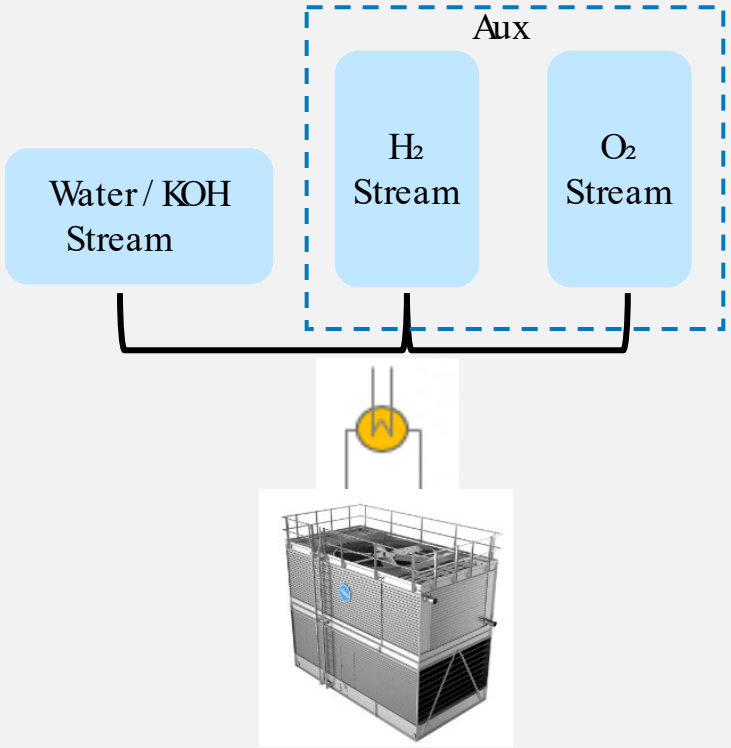


Water / KOH Stream (70%)
Electrolyser Lye Cooling

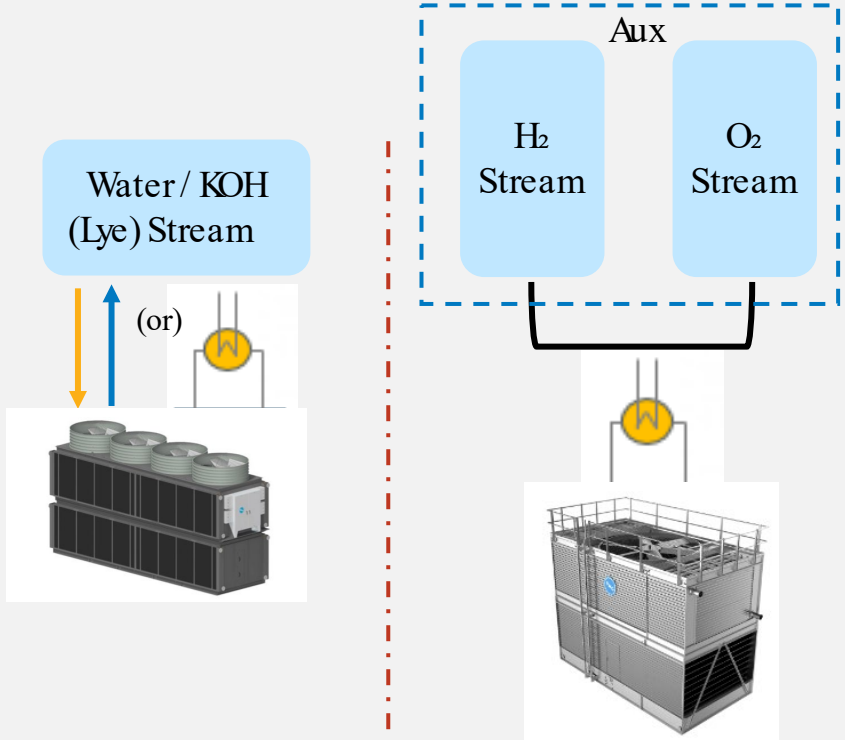
Hydrogen Stream (25%)
Gas Purification
Gas Compression

Oxygen Stream (5%)
Separation

Heat Rejection in Alkaline Electrolysis: Combined vs Split Stream

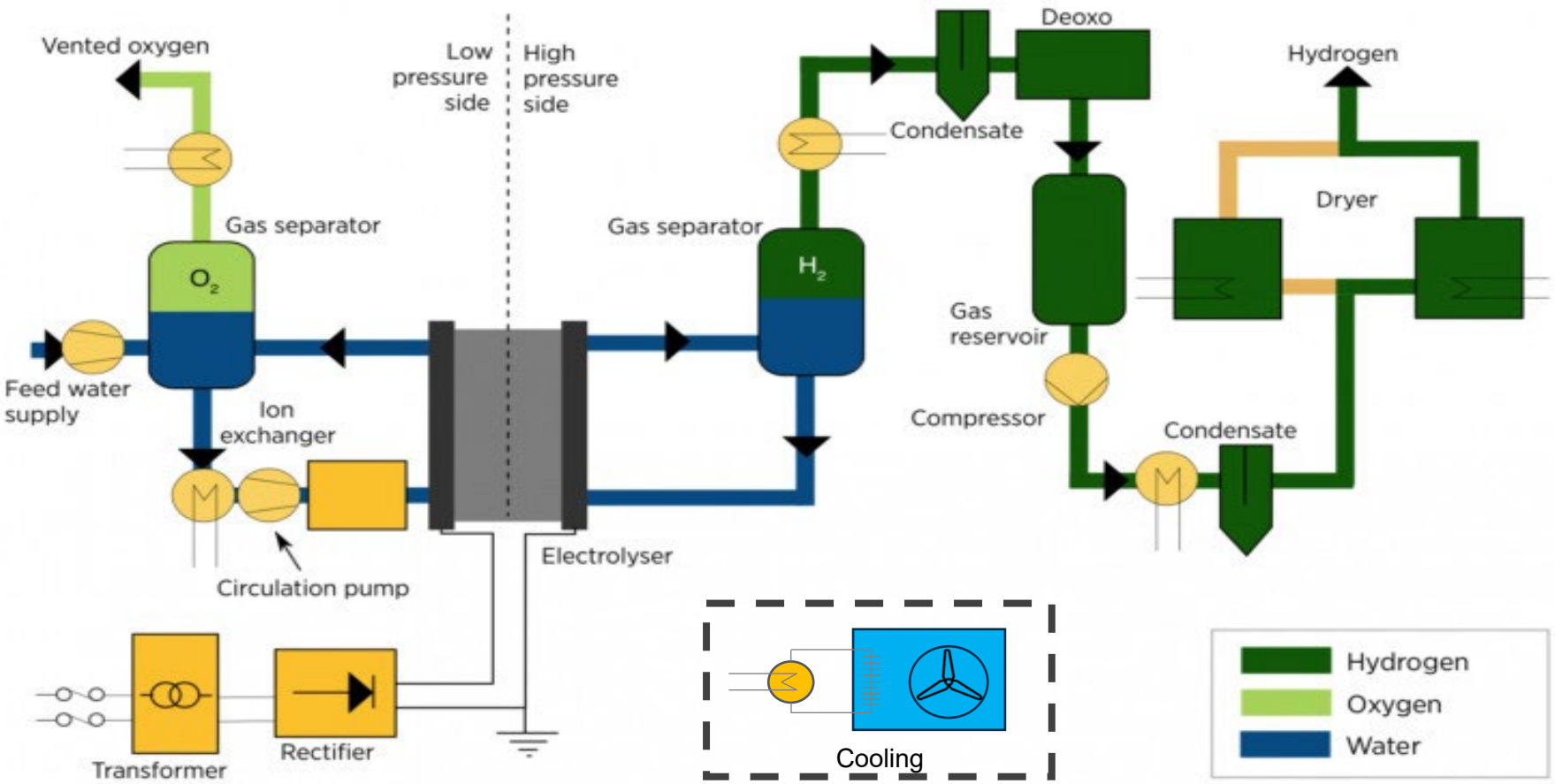


- Combined Fluid in / out : 42/32°C
- Small approach temperature requires larger installation.



- Lye Fluid + CT: In/Out : 90/70°C
- Large approach temp, fewer units, dry cooling feasible.
- Lye Fluid + Hex, fluid in/out : 60/45°C
- $H_2 + O_2$: In/Out : 42/32°C :

HEAT REJECTION IN PEM ELECTROLYSIS

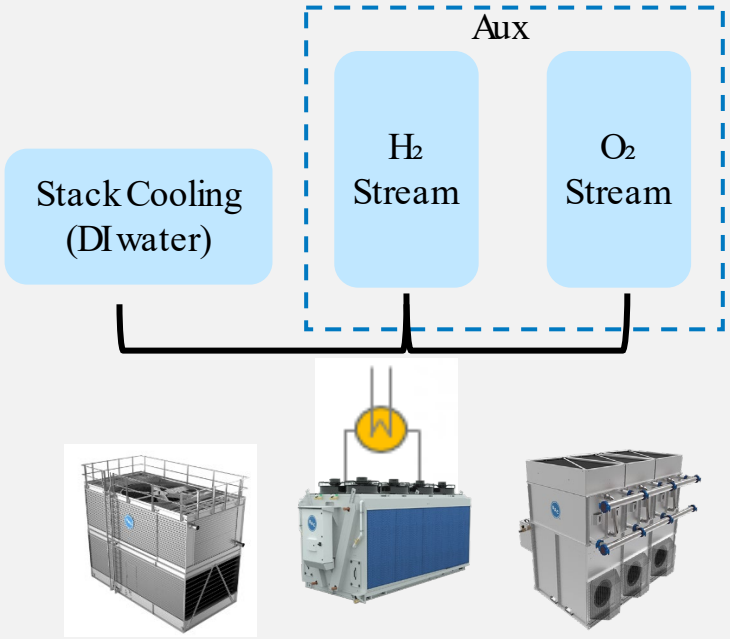


Stack Cooling (70%)
DI Water Loop

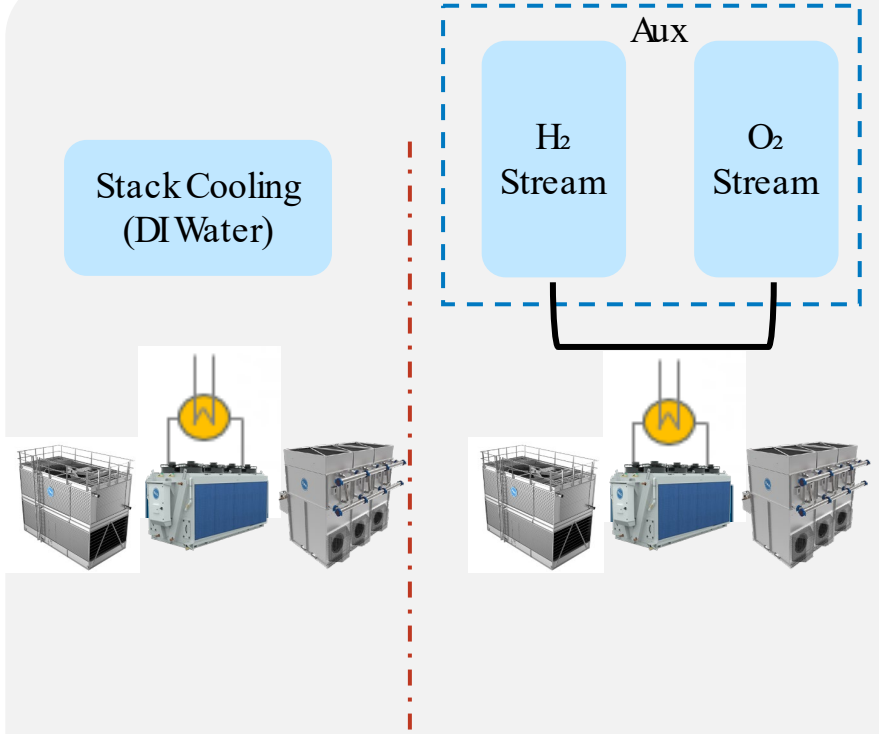
Hydrogen Stream (25%)
Gas Purification
Gas Compression

Oxygen Stream (5%)
Separation

HEAT REJECTION IN PEM ELECTROLYSIS: COMBINED VS SPLIT STREAM



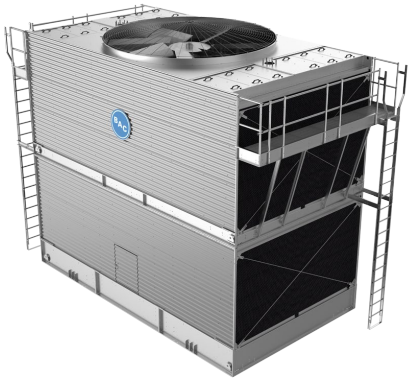
- Stack loop must stay below 70°C
- Auxiliaries can tolerate high / low temperatures, typically 30-45°C
- Combined fluid in / out : 45/35°C
- Small approach temperatures requires larger installation.



- Stack loop must stay below 70°C
- Auxiliaries in / out : 45 / 35°C

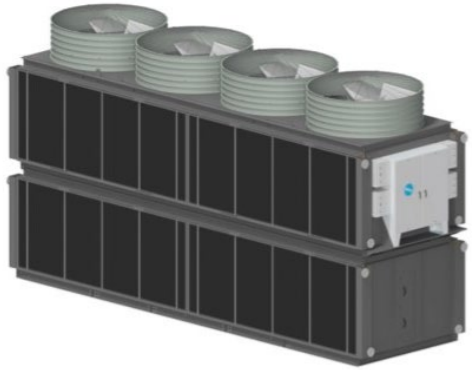
KEY PRODUCT CATEGORIES

Open Cooling Towers



Closed Circuit Cooling Towers

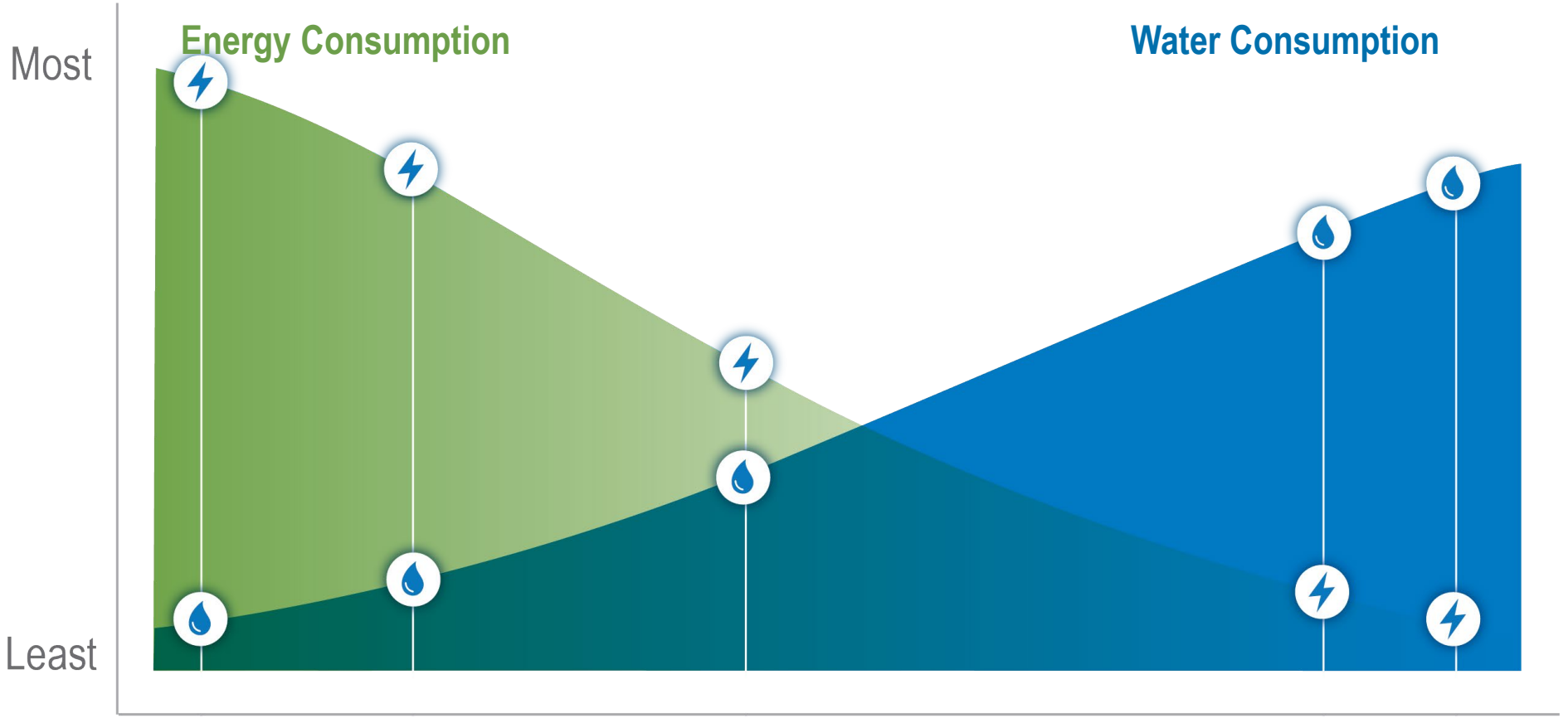
Large Dry Coolers



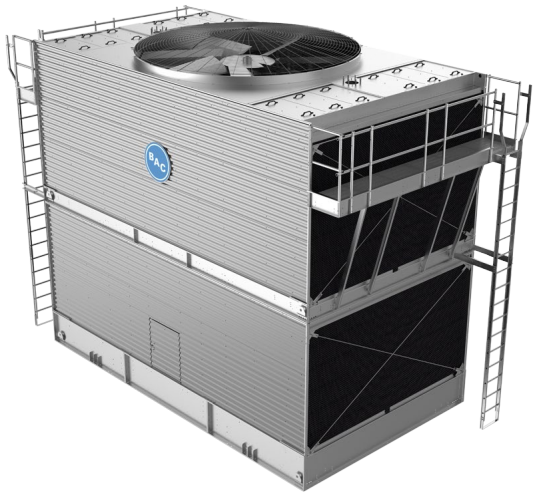
Adiabatic Products

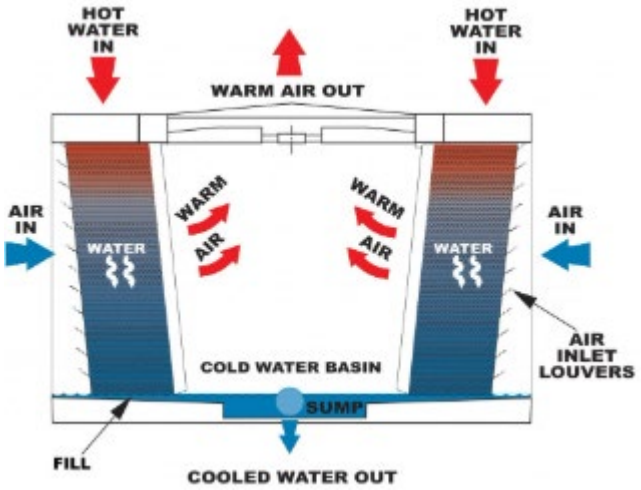
Hybrid Cooling Towers

TECHNOLOGY RANGE

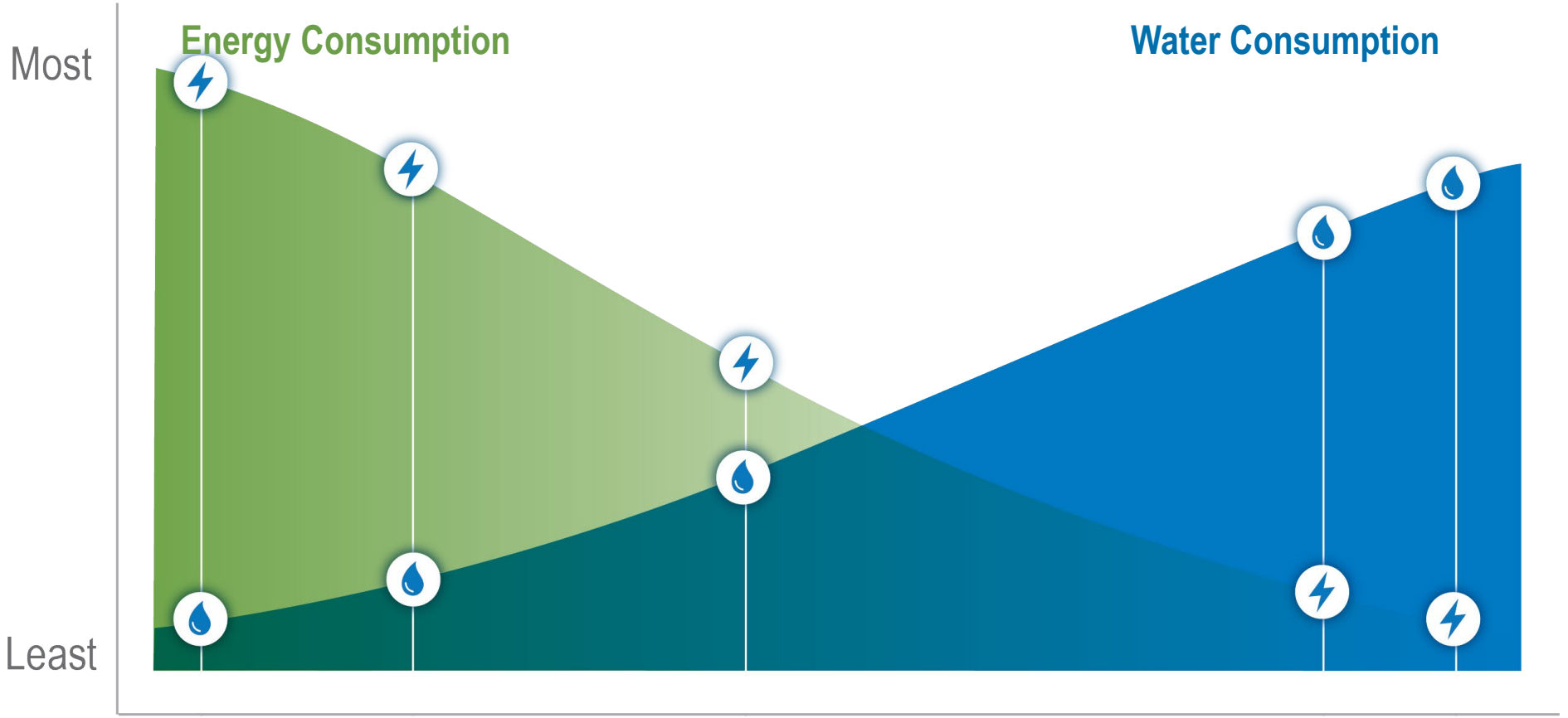


Evaporative Cooling (Water-Cooled) – Open Towers

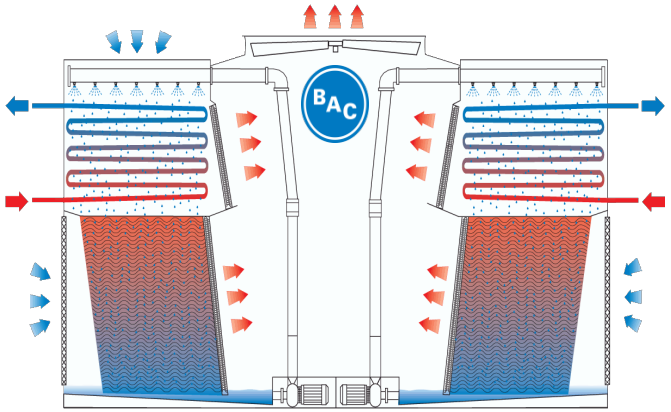




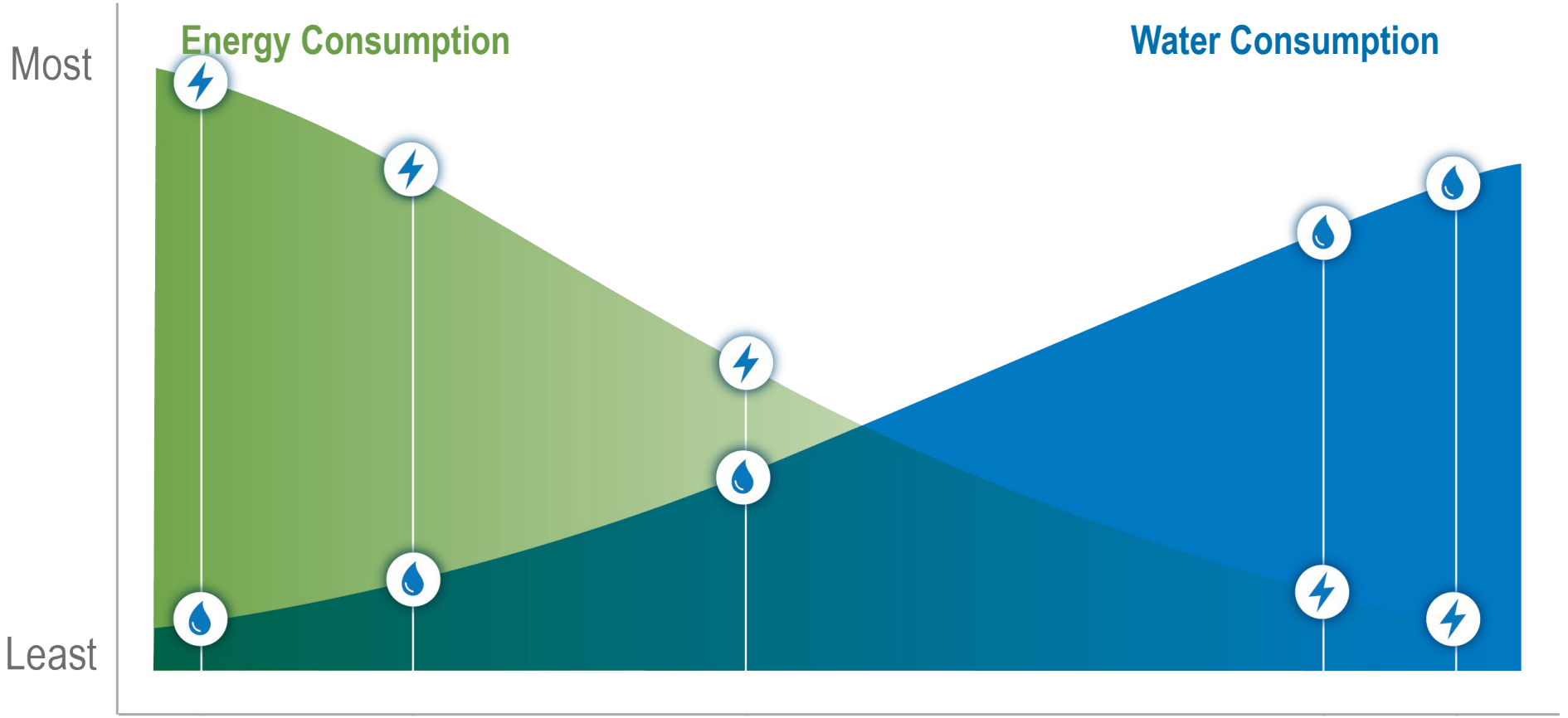
TECHNOLOGY RANGE



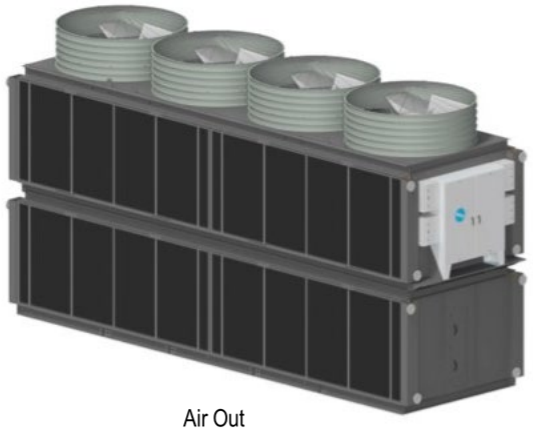
Evaporative Cooling (Water-Cooled) – Closed Towers

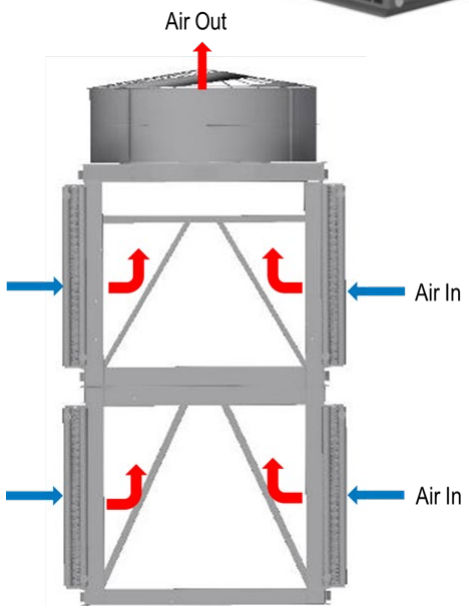


TECHNOLOGY RANGE



Dry Cooling (Air-Cooled)





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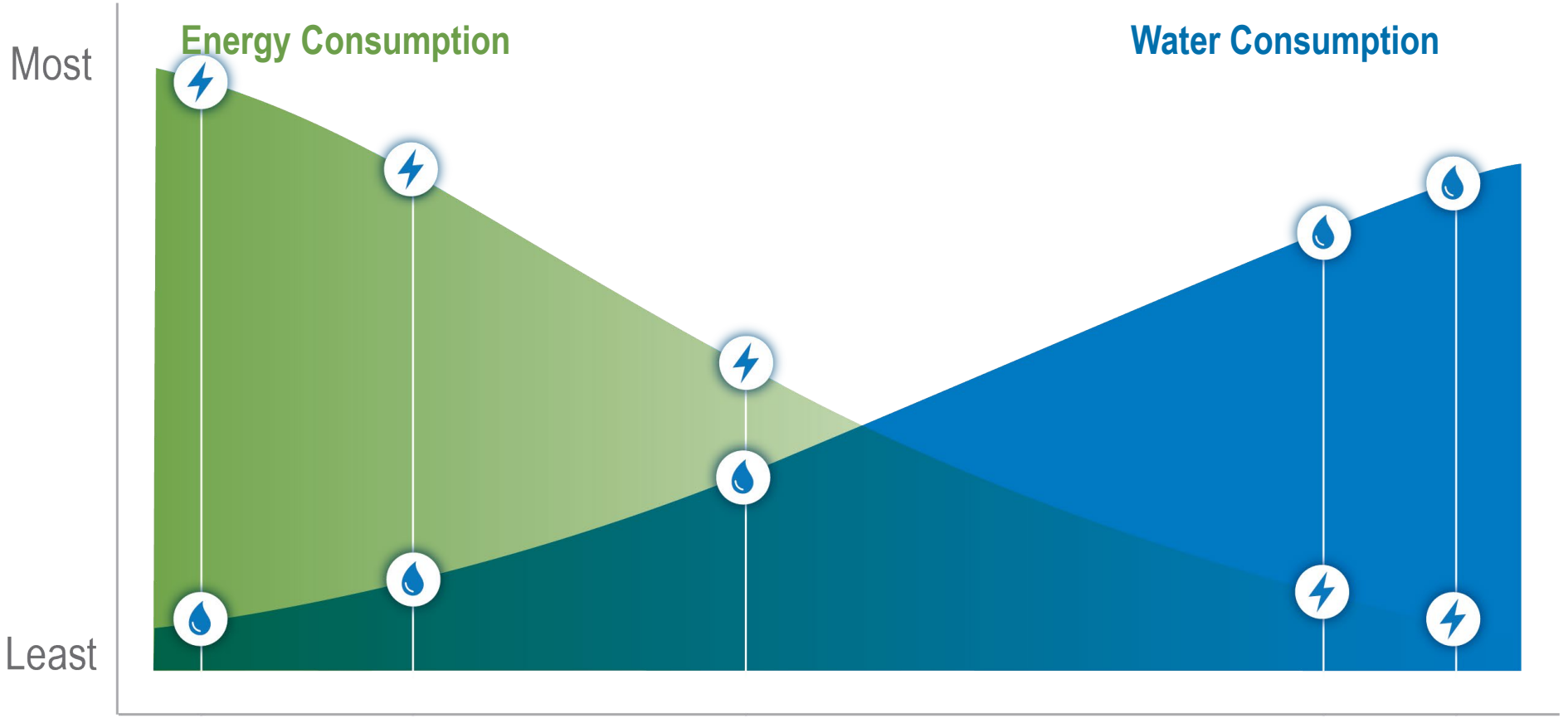
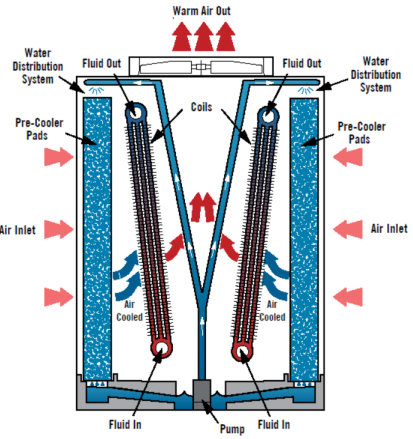
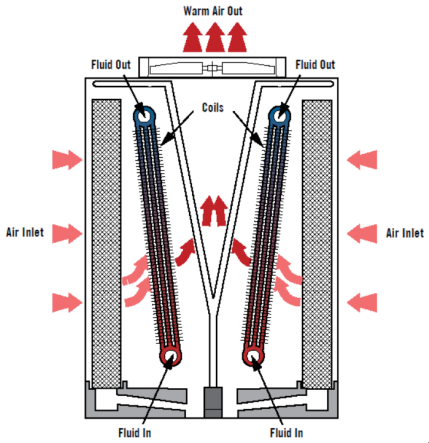


Adiabatic Cooling

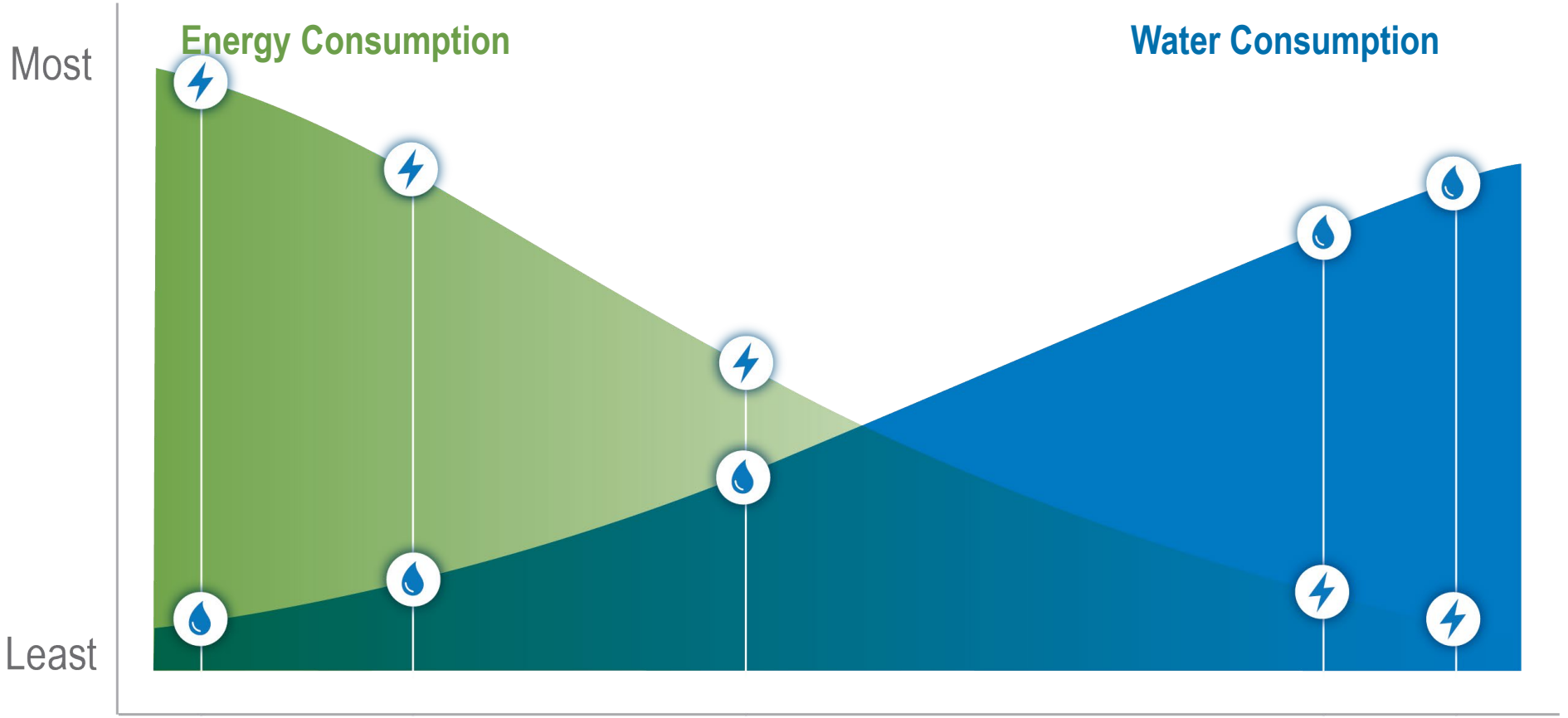


Wet mode

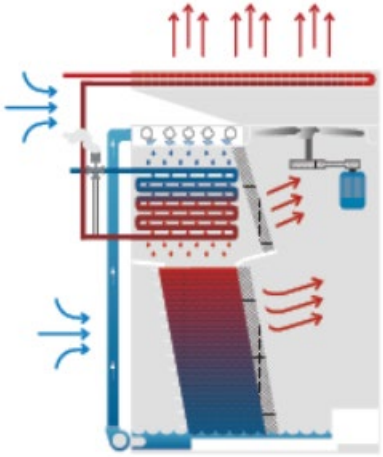


Dry mode

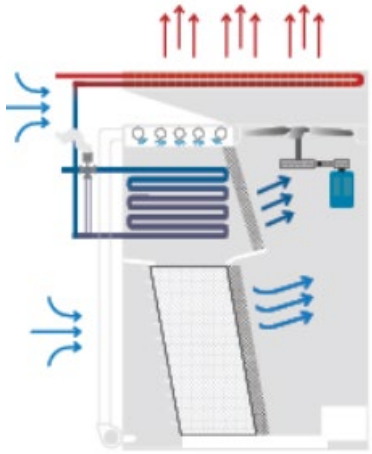
TECHNOLOGY RANGE



HYBRID COOLING

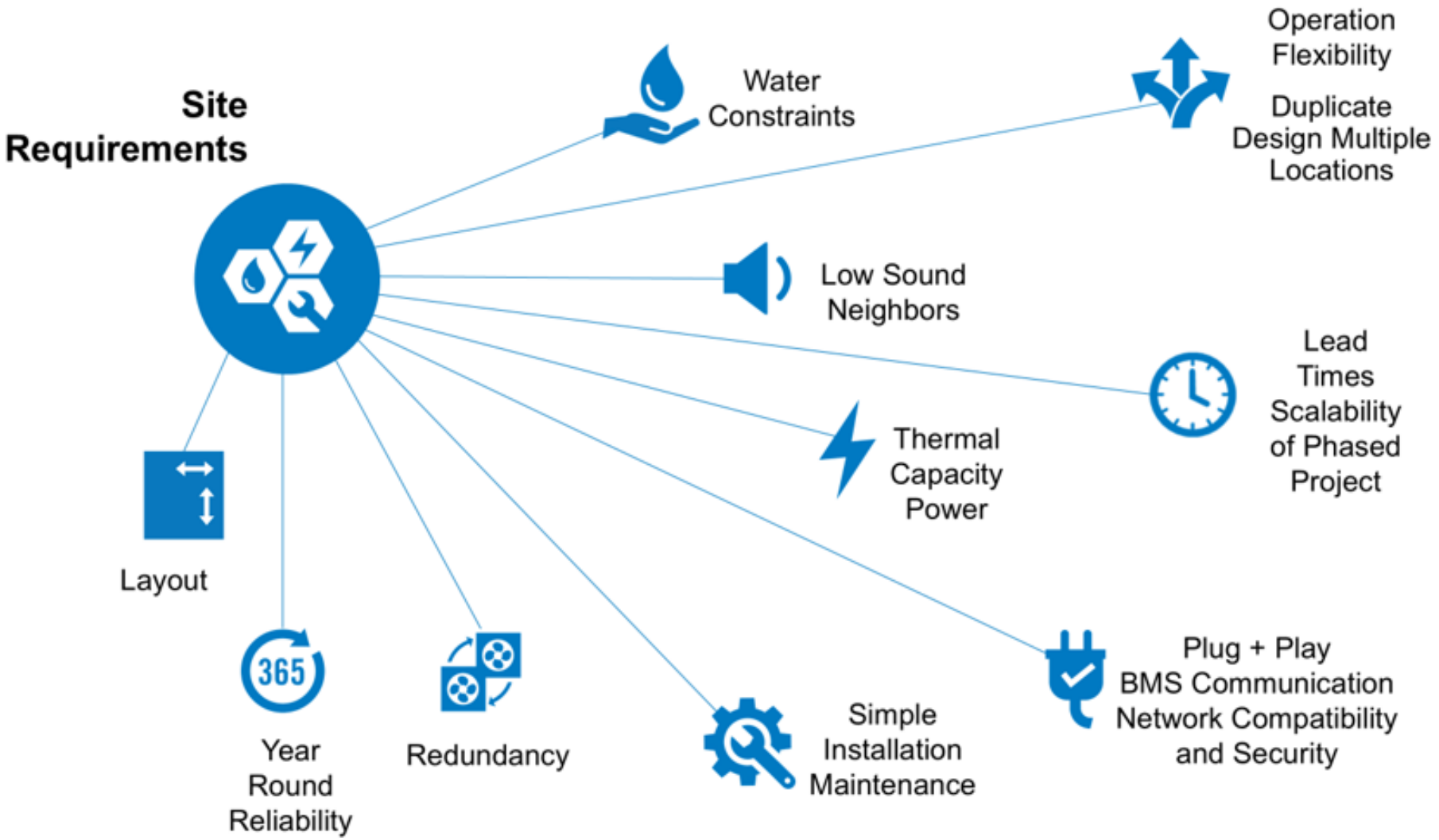


Wet mode



Dry mode

Conclusion



Thank You

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