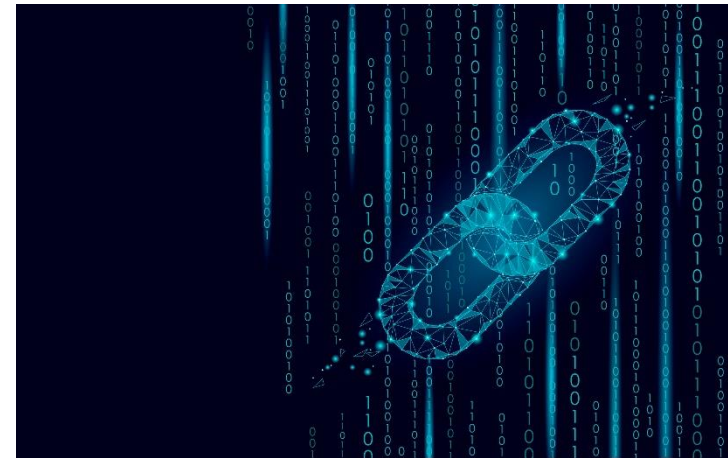




Mission Critical and Decentralized Infrastructure

Nuno Silva, PhD (Product Manager)
William Truong (Business Developer)



70 years of history



January 1975
Acquisition of
Defensor

January 1982
Acquisition of
Plascon
AG, CH

January 2002
Acquisition of
Draabe
Industrie-
technik
GmbH, DE

February 2011
Acquisition of
Anderberg
Fugtstyring
a/s, DK

September 2011
Acquisition of
ML System
a/s, DK

January 2014
Acquisition of
Geveke BV,
NL&BE

June 2017
JV 50/50
Condair
S.A.P.I., MX

July 2018
Acquisition of
Aireven Pty
Ltd, AUS

July 2019
JV 50/50
Condair
Polska Sp. z
o.o., PL

Foundation

1948

1975

1982

1993

2011

2017

2019



January 1982
Acquisition of
**Nortec Ltd.,
CA&USA**

January 1993
Acquisition of
Barth &
Stöcklein
GmbH, DE

October 2009
Acquisition of
Eichler GmbH
AT&HU

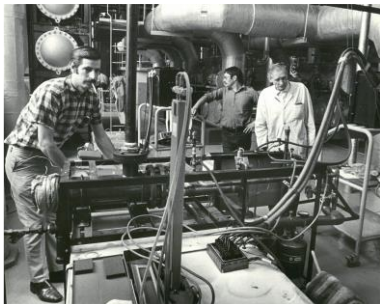
May 2011
Acquisition of
JS Humidifiers
plc., UK

January 2012
Acquisition of
Hanseata
S.A., ES

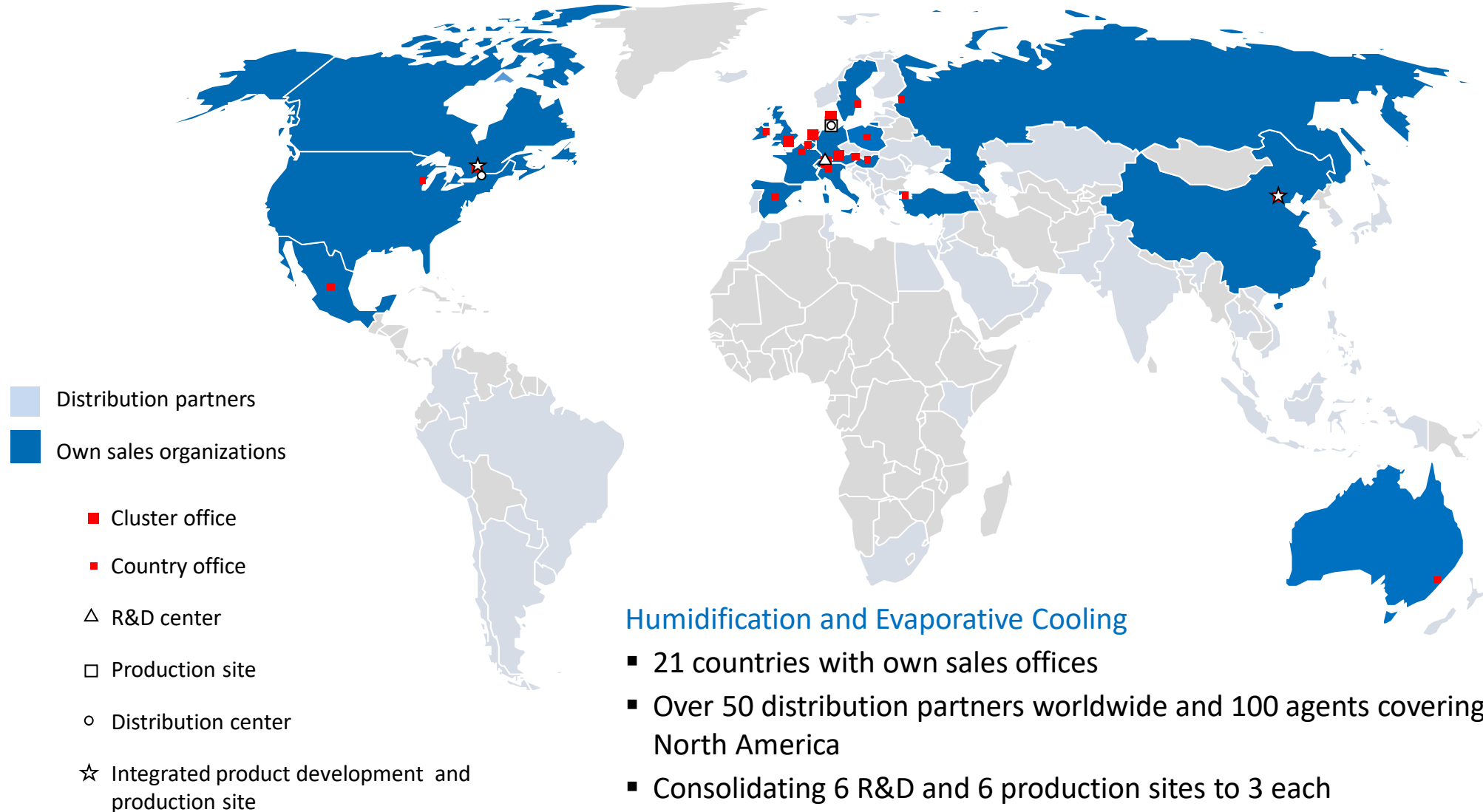
July 2016
Acquisition of
Lufta s.a.r.l.,
IT

November 2017
JV 50/50
Condair
Nemlendirm
e A.S., TR

January 2019
Foundation of
Condair AB, SE



The Condair Group, a world leader in humidification solutions, is the result of many acquisitions made over the last 50 years by Meier Capital (Walter Meier Group)

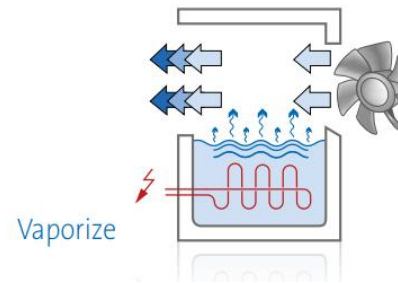
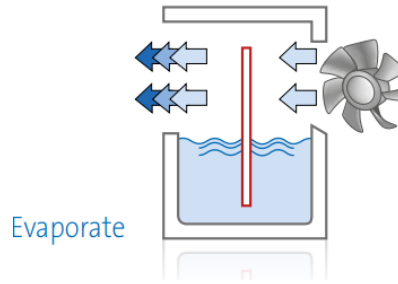
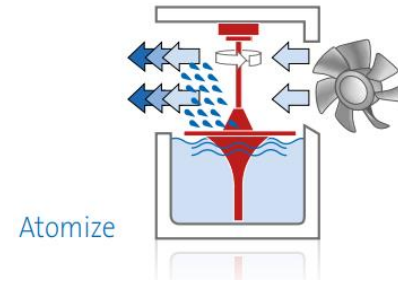


Humidification and Evaporative Cooling

- 21 countries with own sales offices
- Over 50 distribution partners worldwide and 100 agents covering North America
- Consolidating 6 R&D and 6 production sites to 3 each
- Formerly known as Nortec in North America



Methods of air humidification



Adiabatic

Energy comes from the air

Isothermal



The adiabatic humidification process involves direct evaporation of water in the air without addition of energy from outside. The water is atomized in order to maximize the heat exchange surface and then introduced into the environment as microscopic water droplets by evaporation, water spray or combination of both.

The energy required for absorption is taken by the air mass and not supplied by external sources. This causes, a cool down of the humidified air mass.

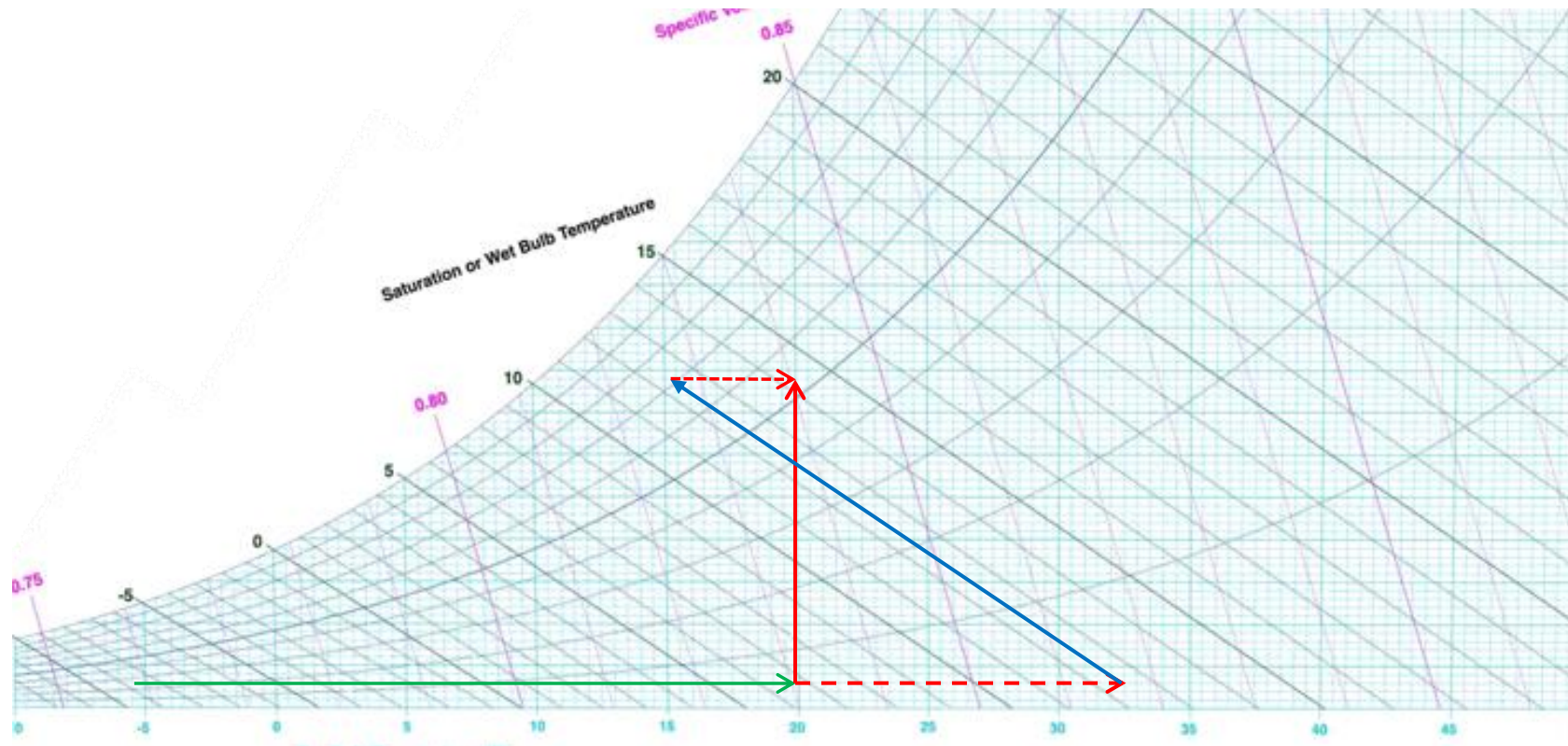
Power consumed by the mechanical action of adiabatic coolers is quite low.



Heat of Evaporation:
970 – 1075 BTU/lb
2257 - 2500 kJ/kg



- Vapor pressure differential governs evaporation rate
- Evaporation slows as it approaches saturation
- Constant Enthalpy process
- Arid = Rapid Evaporation
- Damp = Slow Evaporation





Example:

System CFM = 20,000 cfm

Humidity load = 200 lbs/hr

*Heat is removed at a rate of roughly 1063 BTU's/lb of water evaporated

Formula:

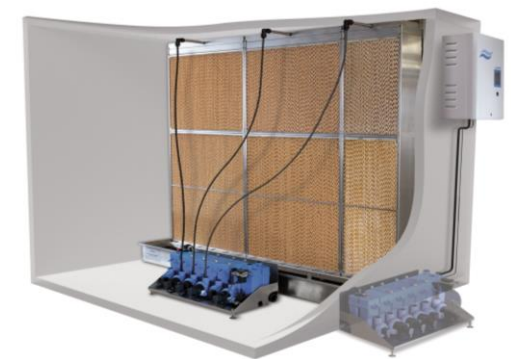
$$\Delta T = \frac{\text{BTU}}{\text{CFM} \times 1.10 \text{ (Constant)}}$$

$$\Delta T = \frac{200 \times 1063 \text{ BTU}}{20,000 \text{ CFM} \times 1.10}$$

$$\Delta T = 9.7^\circ\text{F}$$



Electrode Boiler - 74.8 kW



Evaporative Media – <0.3 kW (up to 2,200 lbs/hr)



Adiabatic Portfolio – Modular Solutions



Atomization/Evaporation

Same IC & Touch Display →



HVAC (duct application)

Direct Systems (direct room application)

Evaporators

ME Series

High pressure nozzle systems

HP Series

Hybrid (low pressure & evaporation)

DL Series

High pressure nozzle systems

Draabe ML System

Compressed air nozzle systems

JetSpray

Rotary disk atomizers

ABS

Ultrasonic nebulizers

US Series

Mobile evaporators

B500

Ceiling humidifier

TE

Water Treatment Systems (reverse osmosis)

RO-A



ML System



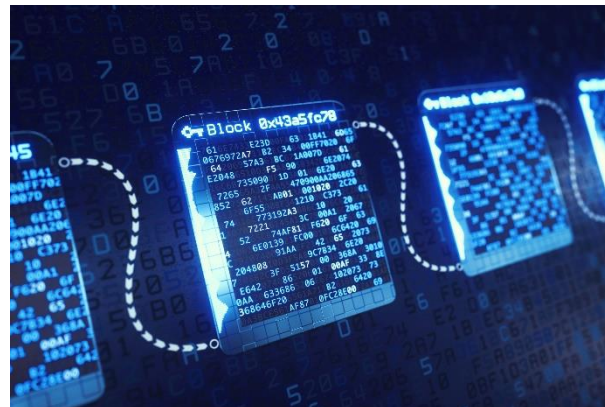
Draabe box (rental)



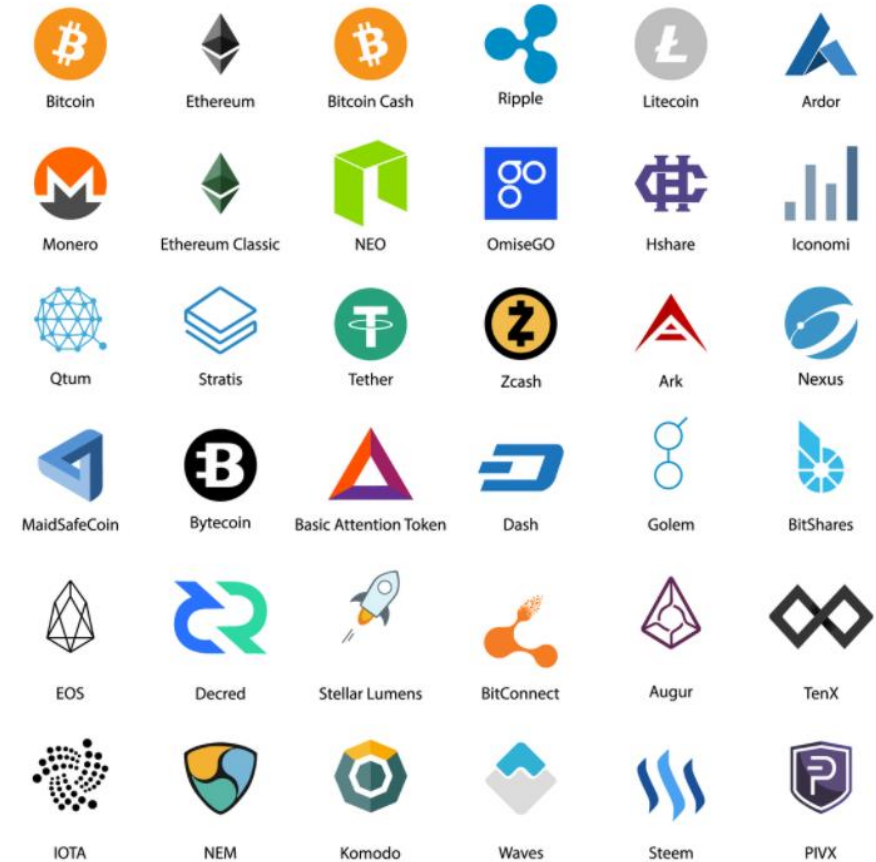
Blockchain is a distributed digital ledger system – Public or Private. All transactions (currencies, supply chain, trades, etc) are stored chronological on the form of blocks on the chain and copies saved on all the network nodes (public) or in private chains, eliminating daunting search and traditional authentication methods (e.g. banks, cloud databases, etc)

Some of the applications included instant validation for transactions (e.g. insurance premiums) or supply chain records (e.g. supermarket chains)

The bigger the chain and nodes grow, more computational power will be need. If digital currencies are adopted, a massive building of infrastructures is expected if PoW is used.



- New digital ecosystem.
- Energy consumption is the current flashpoint between adopters and critics of digital currencies.
- While digital currencies infrastructure is still very energy intensive, as with any disruptive industry, a positive change from within is possible in the next years (e.g. equipment, PoS vs PoW, etc)
- **Improve renewables integration with efficient cooling strategies is possible.**

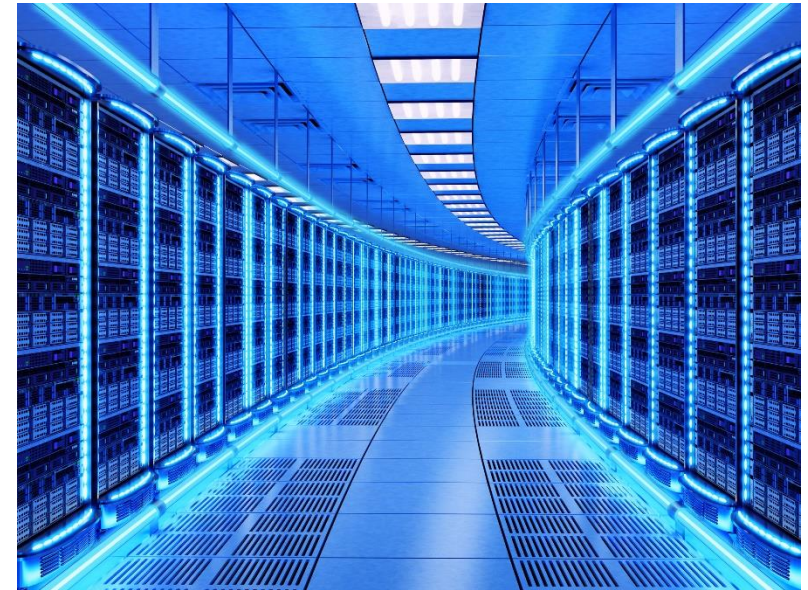


Source: <https://blog.malwarebytes.com>

BITMAIN - Antminer S19



MicroBT – Whatsminer M40s



Description	Requirement
Operating Temperature	23° – 104°F
Operating Humidity	10 – 90% (non-condensing)
Storage Temperature	-4° – 158°F
Storage Humidity	5% - 95% RH (non-condensing)
Altitude	<2000m

Source: <https://support.bitmain.com/hc/en-us/articles/360021472873-Environmental-Requirements-for-Antminers->

Why the energy demand in digital currencies (e.g. bitcoin)?

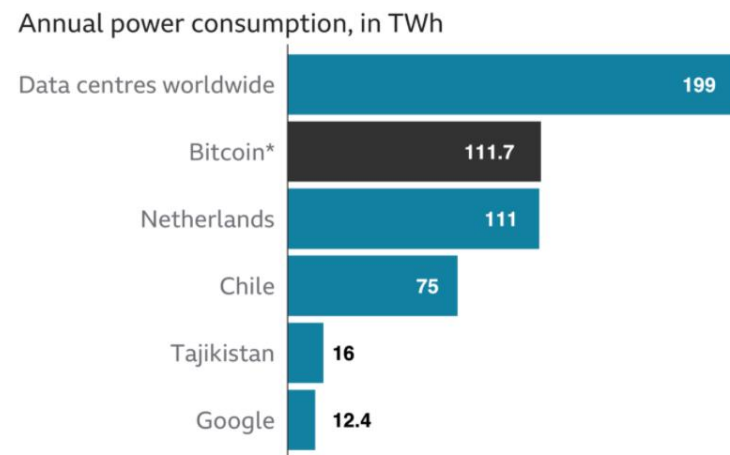


Consensus mechanisms - Authentication (double spending problem) – Validate transactions on the network, without the need of an institutional body.

Proof-of-work (Intensive and exponential over-time)

Miners compete between them to solve a mathematical problem to valid transitions, being reward in bitcoins. Overtime the problems will get more complex and more computational power will be required to have a chance to validate transactions, which will also increase the resilience of the network.

Bitcoin rewards also are halted over time, and there is a finite number of 21 million that will be achieved by 2140



*All figures 2019 except Bitcoin, which is annualised middle estimate for bitcoin electricity consumption in January 2021

Source: Forbes, IEA, EIA, Cambridge Centre for Alternative Finance





Data Centers



HYPERSCALE:

- Largest of the large
- Cloud Based
- Own the servers / applications
- Run servers to their limits: 85°-95°
- Downtime of any site is not as critical
- 1% efficiency gain = Big \$\$ savings
- High use of evaporative cooling technologies

COLOCATION:

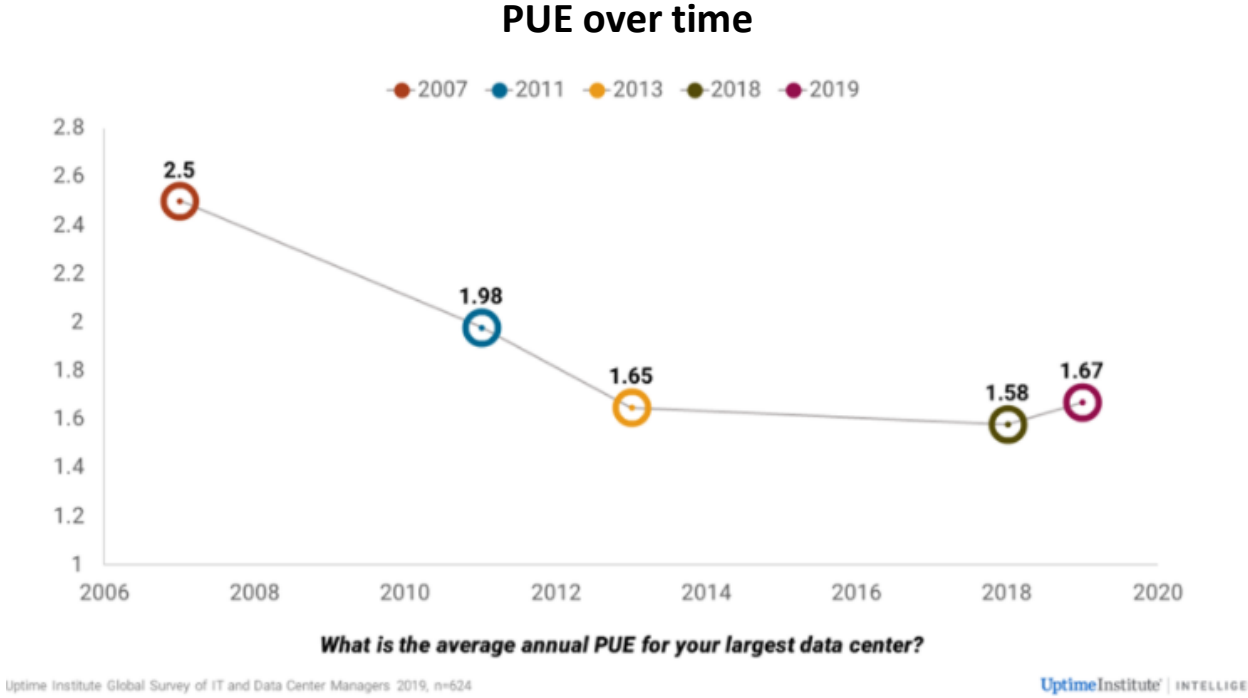
- Large Scale sites
- Colo company rents Rack, Cage space (owner supplies racks) or *Cloud based processing (colo owns servers)
- Humidity and temperature control is critical
- Limited use of Evaporative Cooling today

EDGE:

- Located at the edge of the network
- Small rooms/Closets
- Remote sites
- Typically containing network switching
- Only small in-space Evaporative cooling applicable

Power Usage Efficiency is in the center of operating Data Centers

- Power Usage Effectiveness
 - PUE: $\frac{\text{Total facility energy used(kWh)}}{\text{Total IT energy used(kWh)}}$
- Water Usage Effectiveness
 - WUE: $\frac{\text{Total water used per year(L)}}{\text{Total IT energy used(kWh)}}$
- State of the art data centers have PUE as low as 1.05



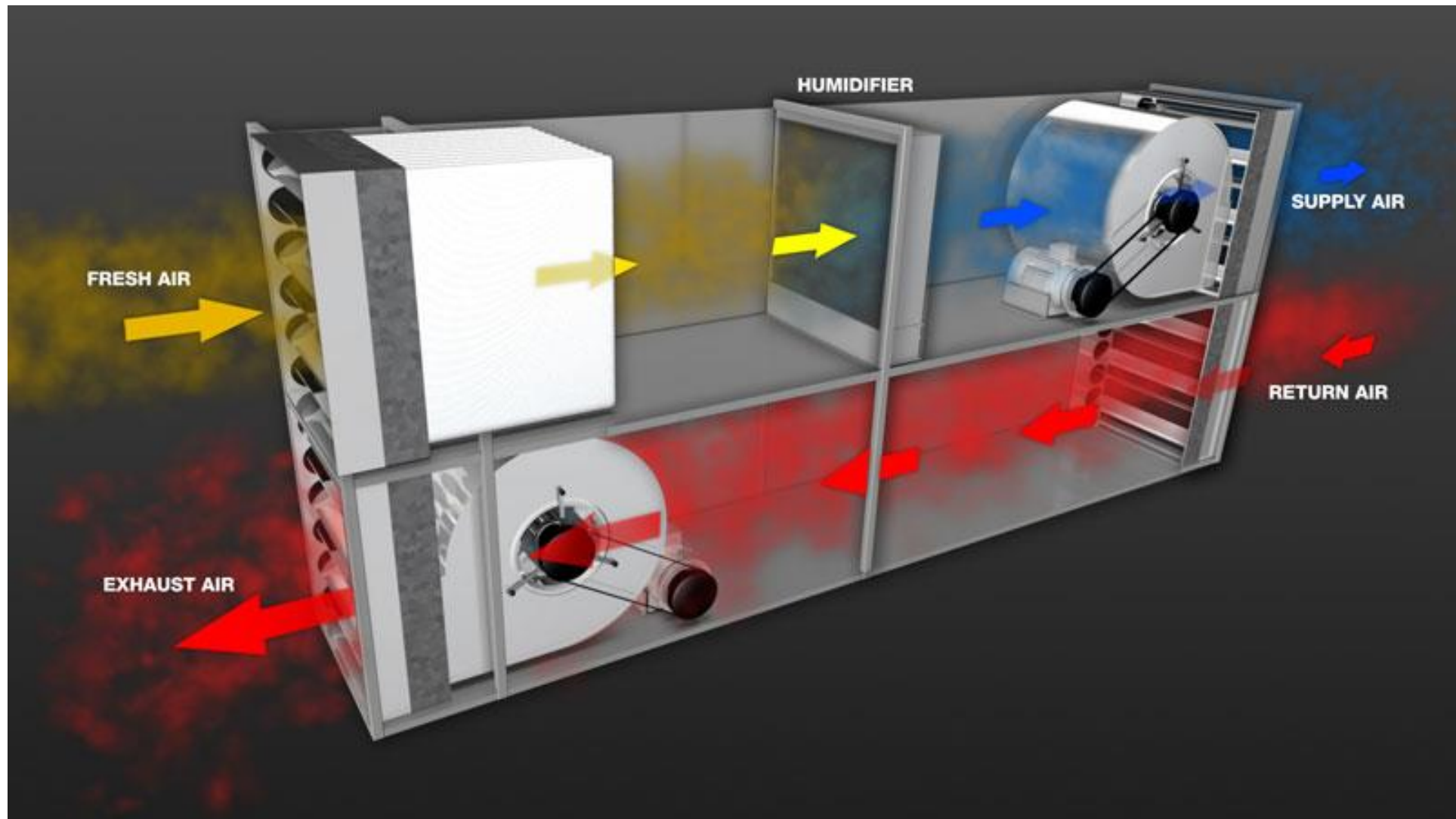
Source: Uptime institute 2019



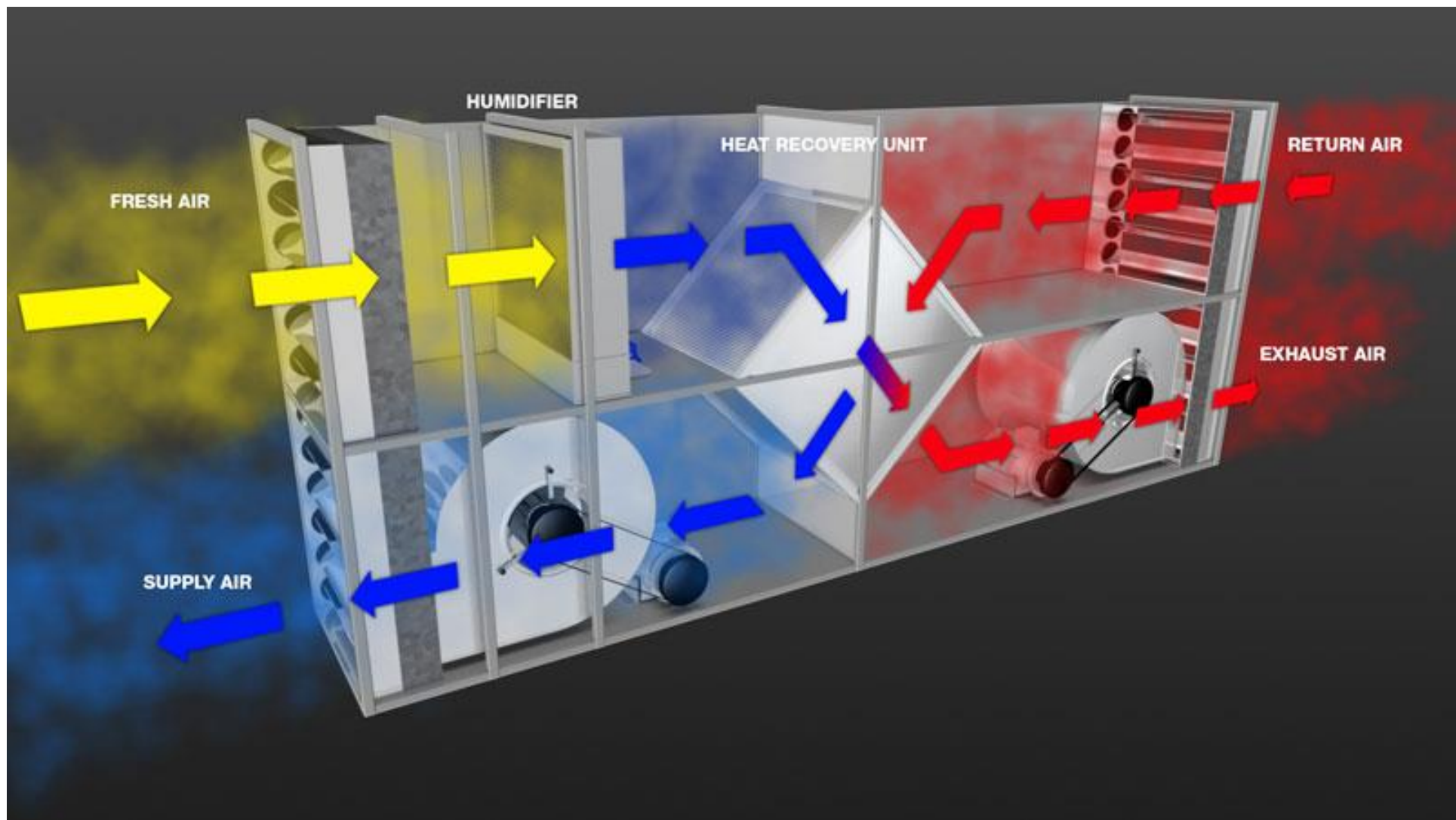
ME series – Custom Evaporative Solutions



Direct Evaporative Cooling

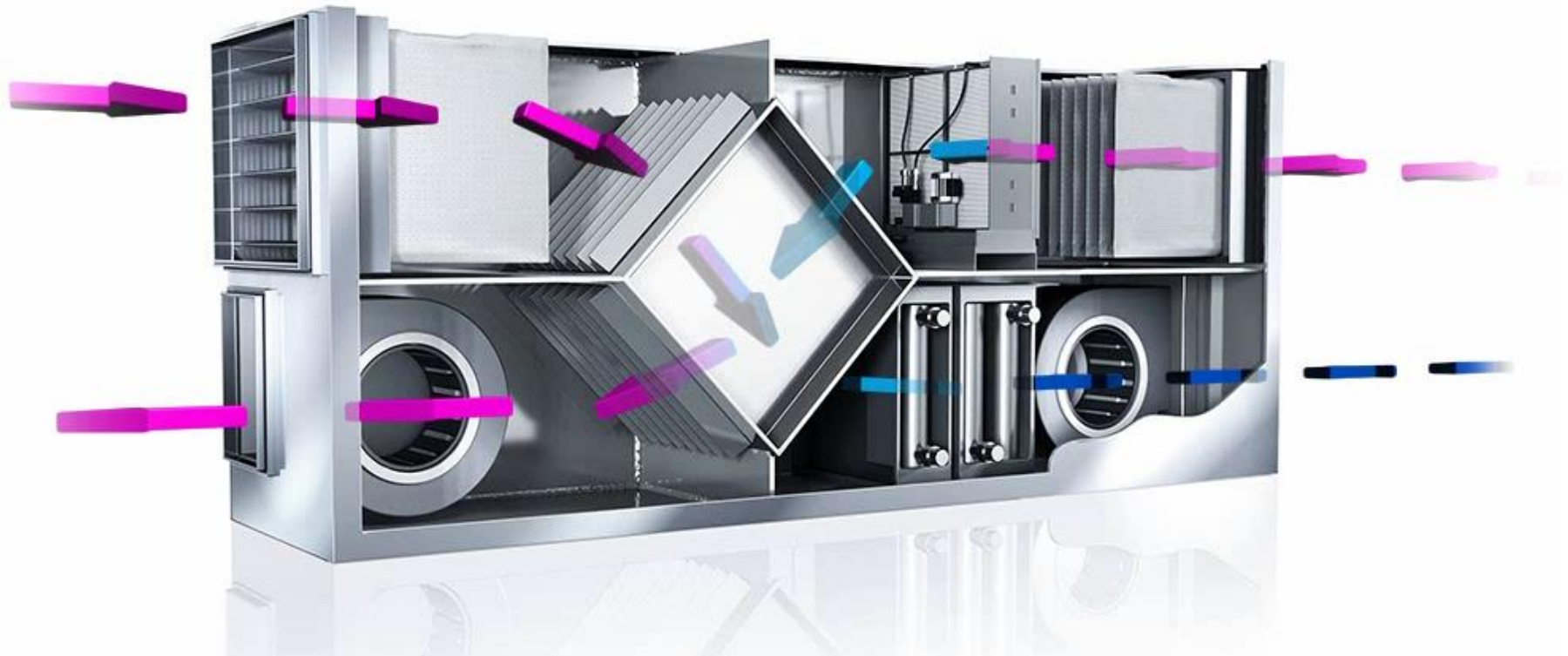


Indirect Evaporative Cooling



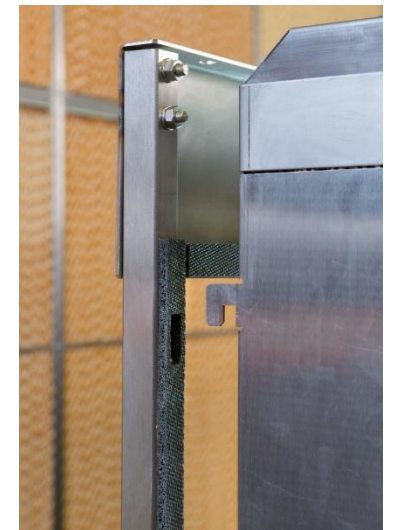


Exhaust Cooling



ME Overview

	ME control	ME Direct Feed
Evaporative Module		
Hydraulic Module		 (Stage control option available)
Control Module		 (Available as an option)

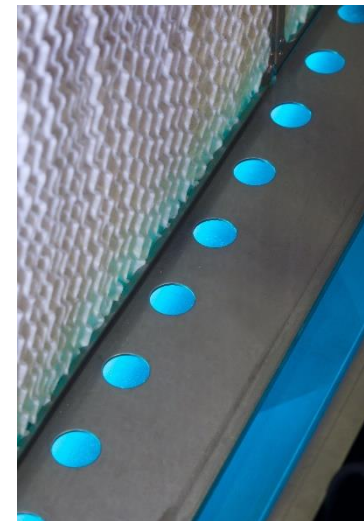
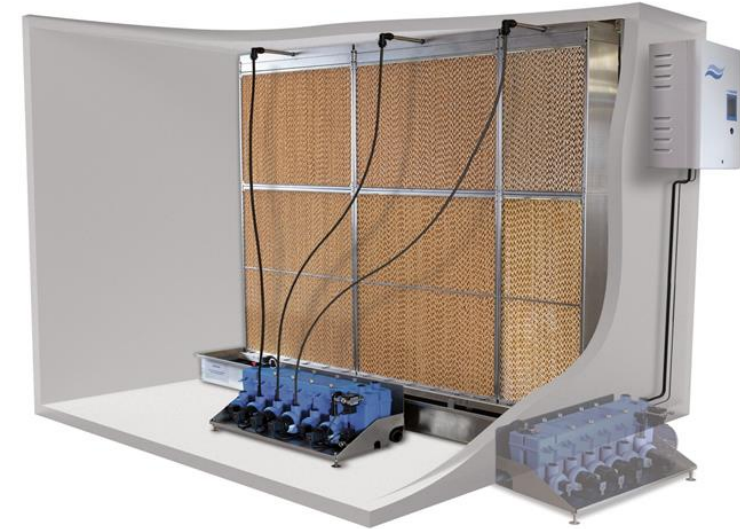


Media types to suit all applications

- Media types to suit humidification or cooling applications available, combining high efficiency and low pressure drop
- Excellent flammability properties
- Modular, individually removable cassettes for ease of servicing and maintenance, with easy fit hook design
- Stainless steel 304 construction for strength and durability
- Low energy consumption (85-278W)

Advanced software interface

- Hygiene control functionalities
- No need for mechanical adjustments
- Fault logging and BMS control integration provided as standard





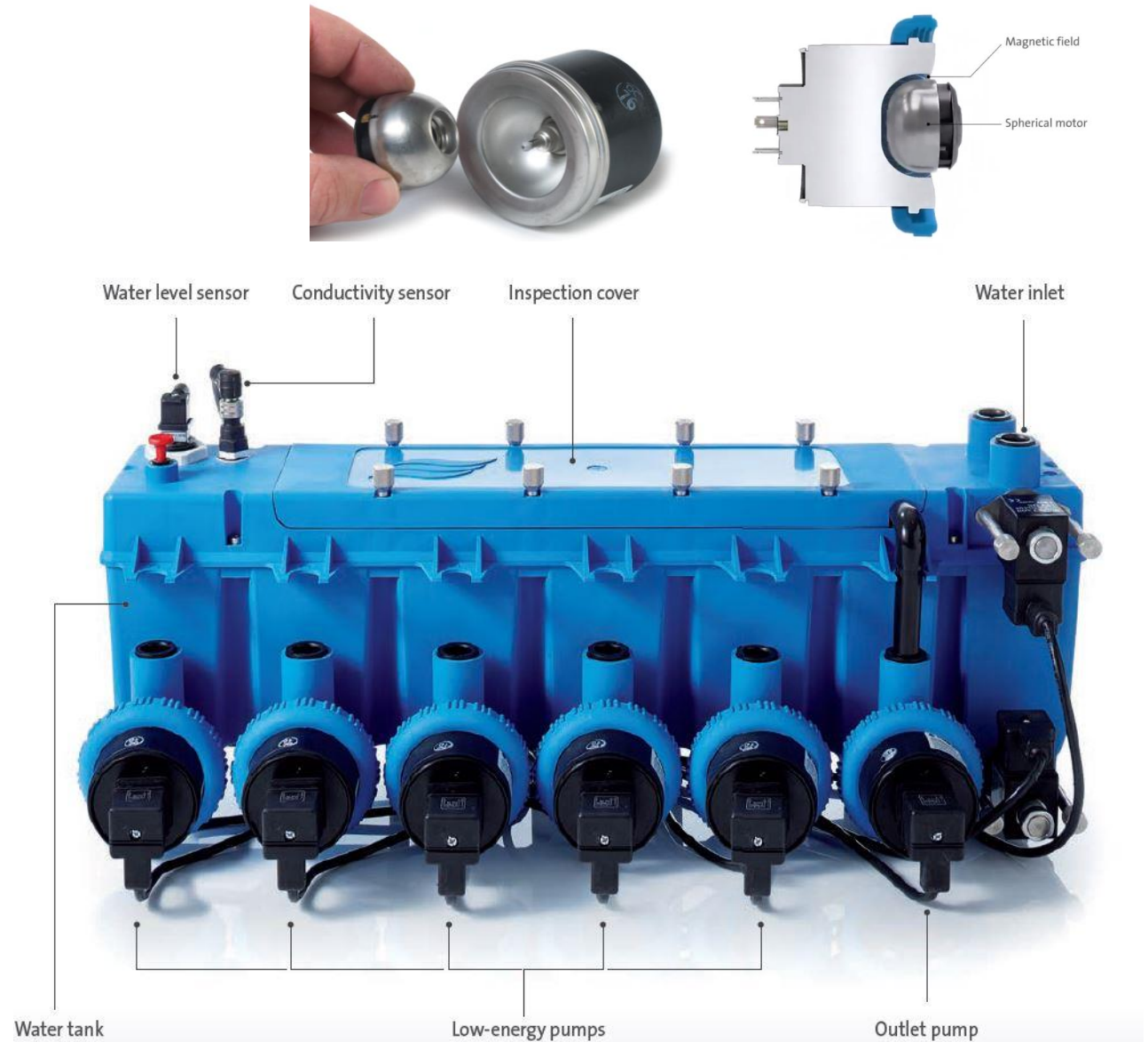
- Operable on types of water, potable and RO.
- Innovated hydraulic unit allows for up to 5 stages of control with individual pumps
- Customization possible

- Adiabatic media humidifier
 - Low energy consumption
 - Adiabatic free cooling
 - Delivers up to 2200 lb/hr of humidification
- Sizes
 - Standard unit sizes available up to 13.7 ft wide x 13.1 ft high



Patented hydraulic moulding design

- Self contained design facilitates installation inside or outside the AHU to suit site requirements
- 24Vdc design is safe and extremely energy efficient, requiring as little as 86W.
- Individual electronically controlled stage control pumps offer close control via a touch screen or BMS interface
- Long life components and redundancy from multiple stage control pumps including assisted drain pump





	Glass Fiber
Material	Fiber Glass
Certification	UL900
Depths	4", 6", 8"
Effectiveness	75%, 85%, 95%
Benefits	Lower pressure drop >Effectiveness vs. competition impregnated with Silver Ions

Fibre (high efficiency)	Cooling (Fibre)
<ul style="list-style-type: none"> •30 / 30 flute •Composite glass fibre media •Fully bonded •Non-combustible according to Euro Class A2-S1 d0 based on EN ISO 1182 and 1323 •UL900 certified 	<ul style="list-style-type: none"> •45 / 15 flute •Composite glass fibre media •Fully bonded •Non-combustible according to Euro Class A2-S1 d0 based on EN ISO 1182 and 1323 •UL900 certified

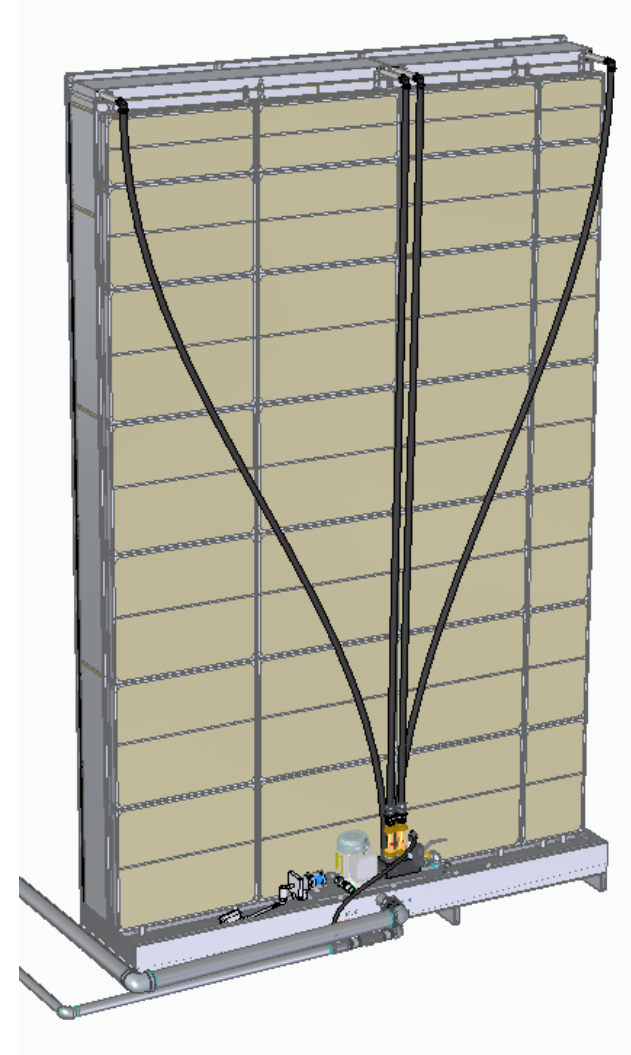


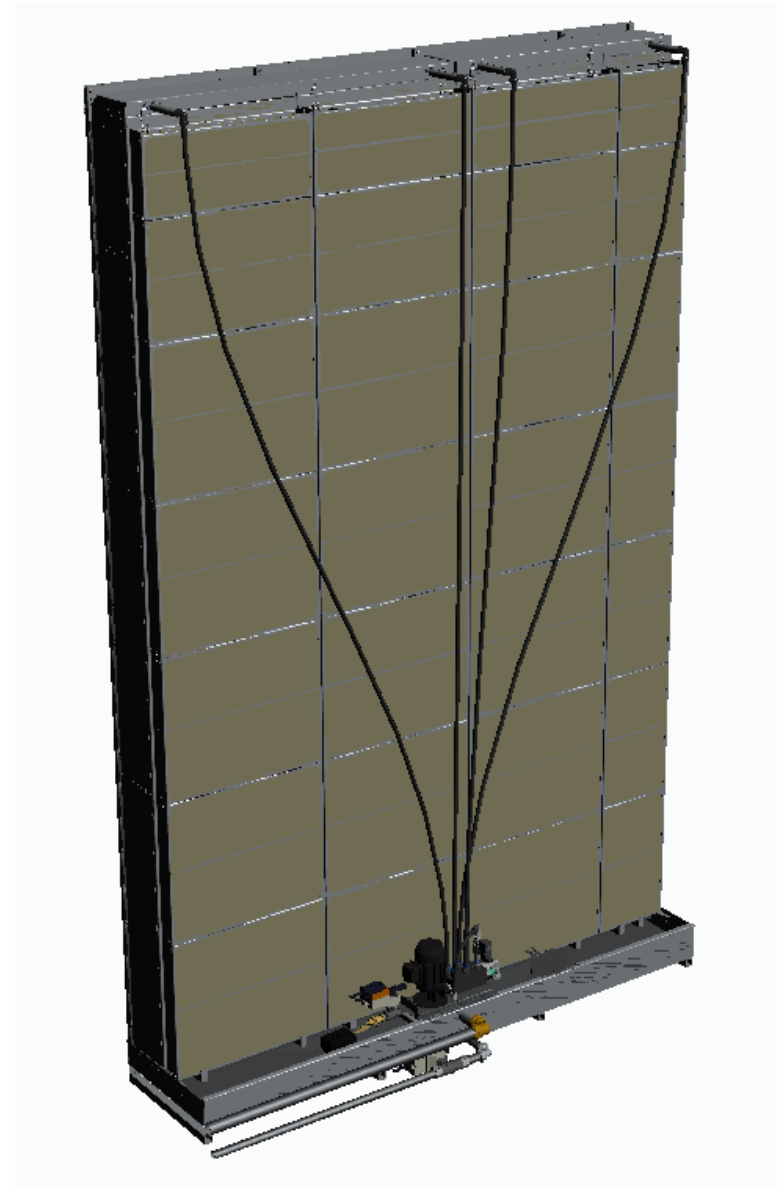
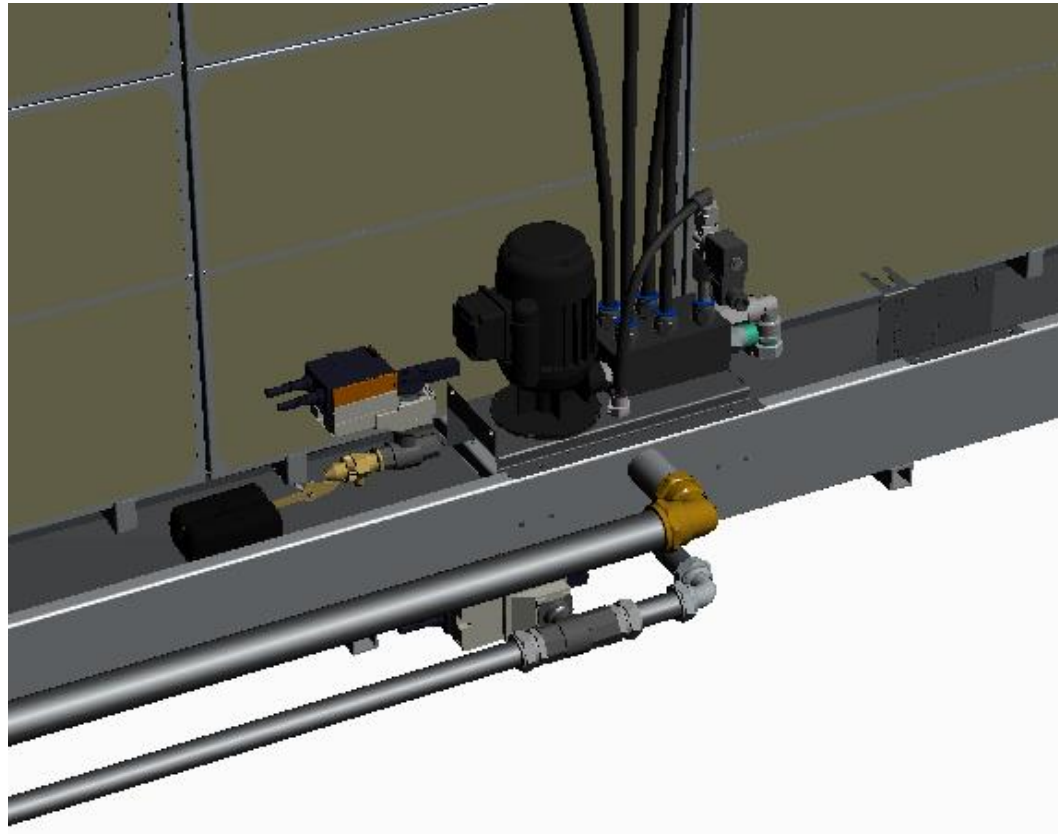
Custom Solutions



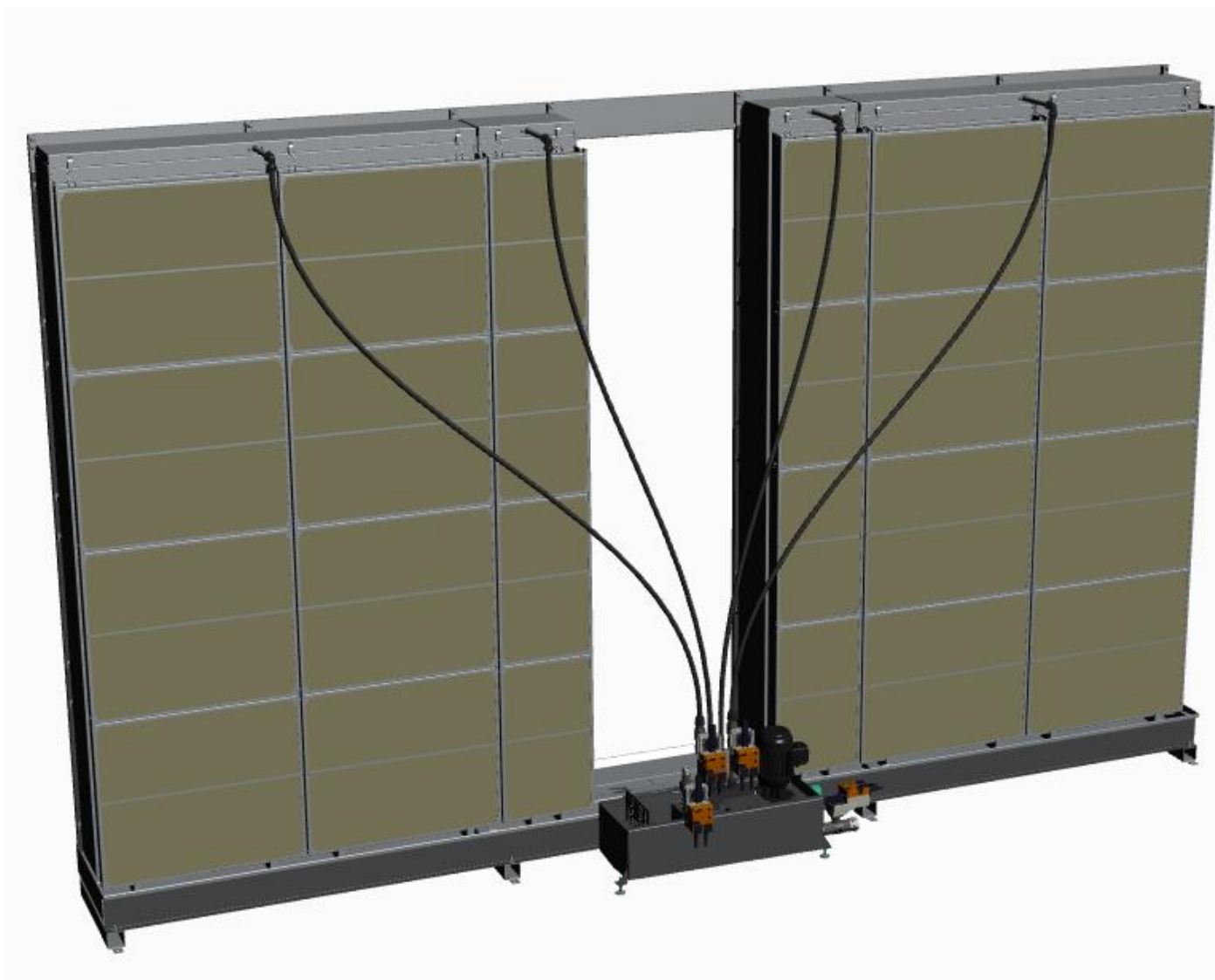


ME – Variants



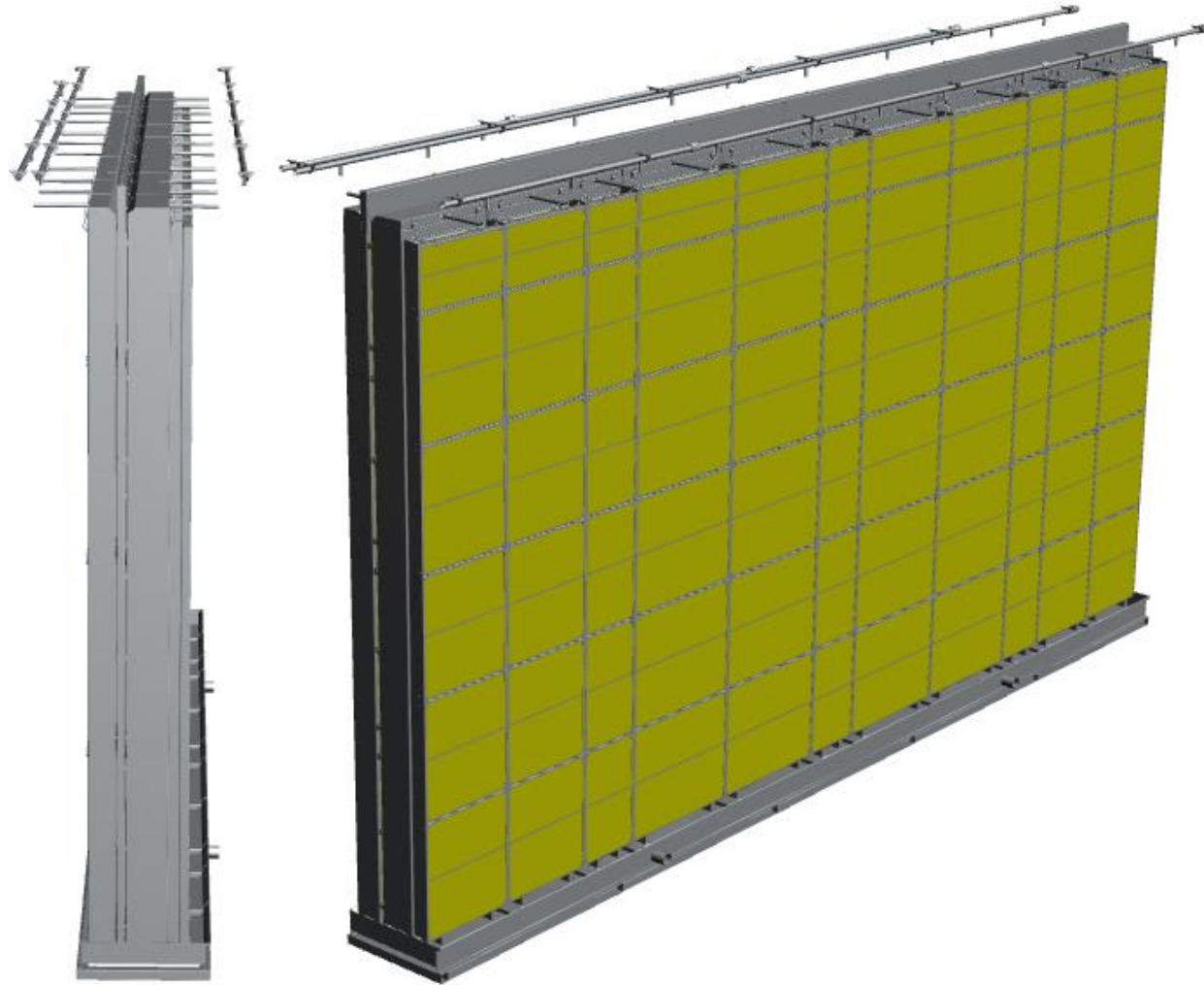


Integrated Bypass Channel (ME and ME OEM)





ME Direct Feed - Series Stage Design



Media bank 4"

500	500	500	500	500	500	500	500	500
750	750	750	750	750	750	750	750	750
750	750	750	750	750	750	750	750	750
750	750	750	750	750	750	750	750	750

Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
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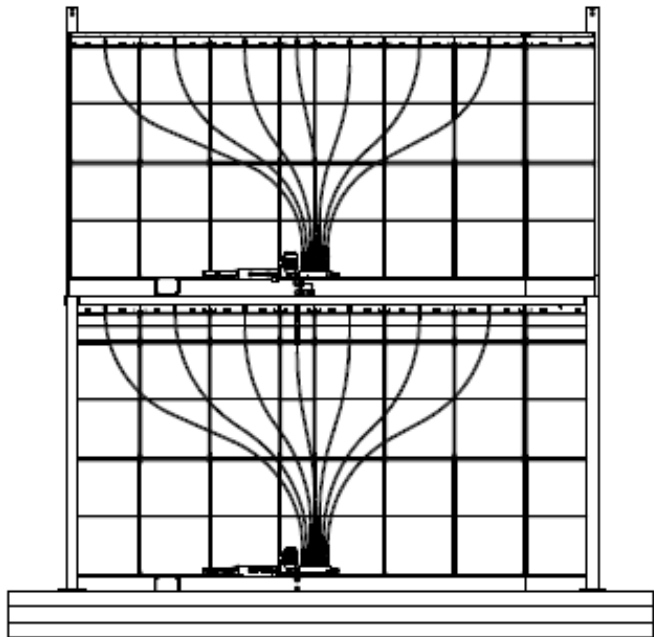
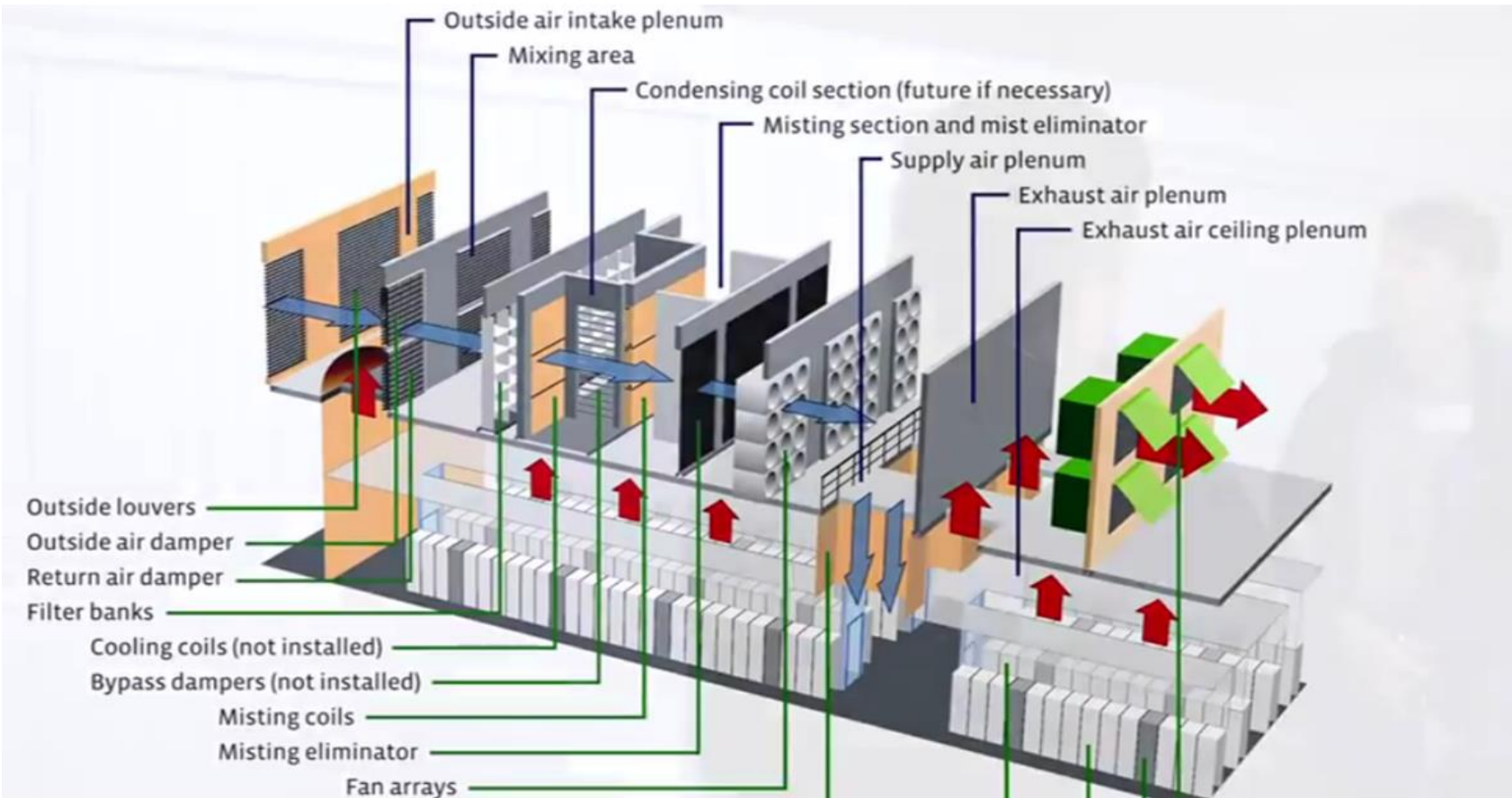
300	600	300	600	300	600	300	600	300
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Media Bank 6"

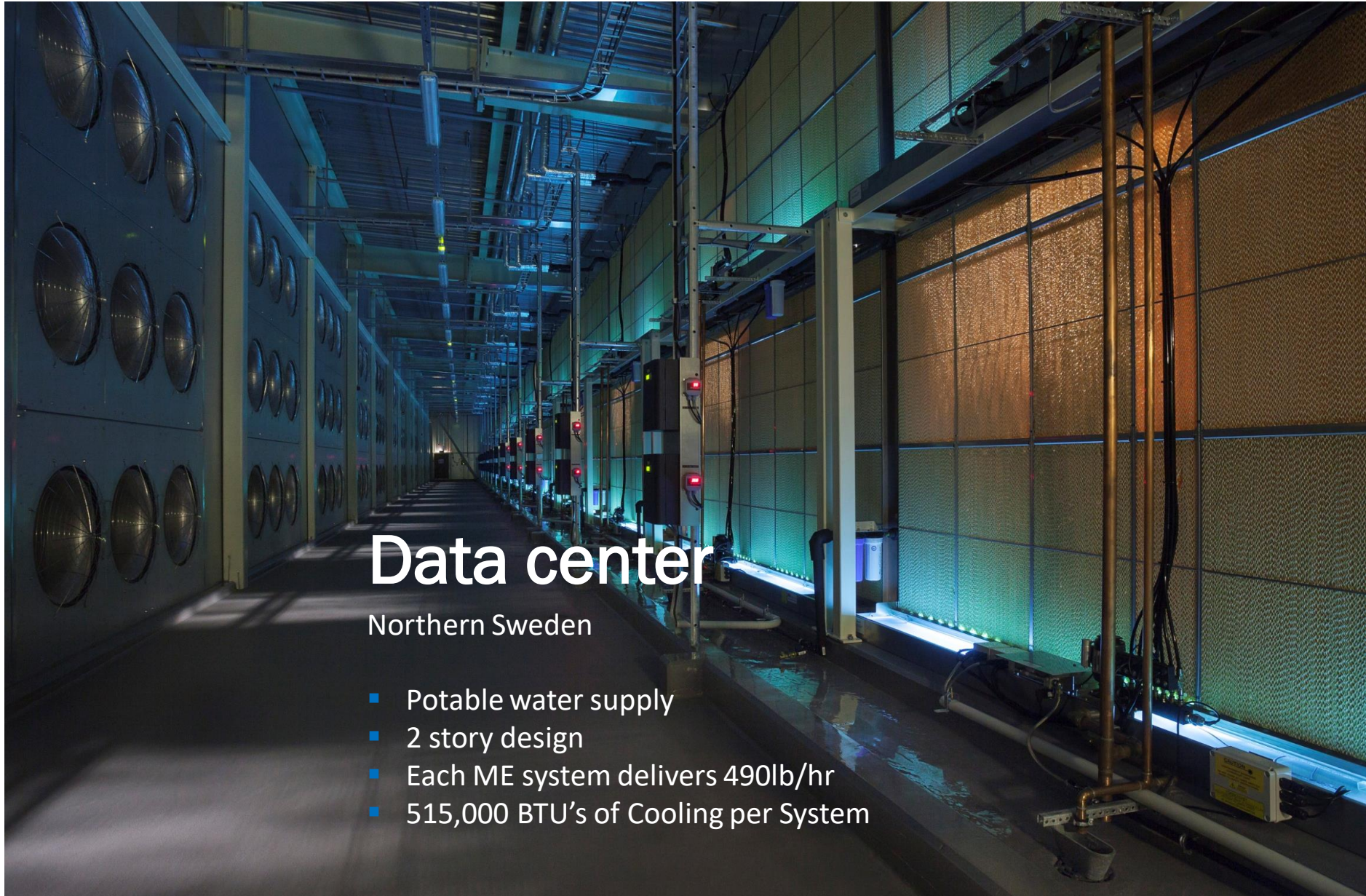
500	500	500	500	500	500	500	500	500
750	750	750	750	750	750	750	750	750
750	750	750	750	750	750	750	750	750
750	750	750	750	750	750	750	750	750

Stage 3								
---------	--	--	--	--	--	--	--	--

300	600	300	600	300	600	300	600	300
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- 2 x evaporative systems
 - 4500mm x 2500mm
 - 4500mm x 2250mm
- Total 52 x systems



Data center

Northern Sweden

- Potable water supply
- 2 story design
- Each ME system delivers 490lb/hr
- 515,000 BTU's of Cooling per System



Northern Sweden – Cold winters

Data center with high heat load – Adiabatic humidification is used in combination with recirculation and OA (Dry).

Zero Pre-Heat

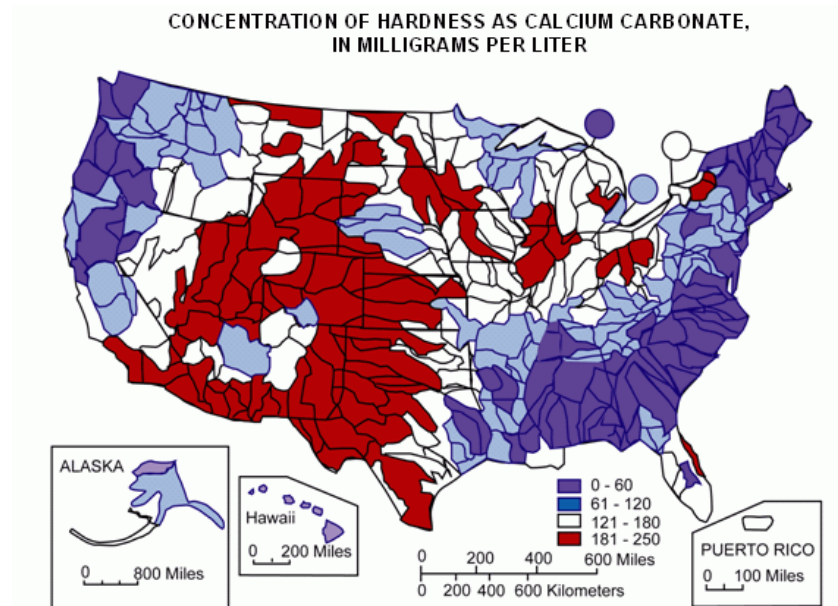




ME series – Water quality



- One of the major benefits of using a DEC system is that the water does not need to be treated (drinking water quality)
- Water quality varies by location as well as potentially throughout the year depending on the water source
- Water consumption in DEC systems can be optimized by finding a balance between waste/drain water and media life (scaling)



Source: <https://www.usgs.gov/media/images/map-water-hardness-united-states>

- Water hardness comes primarily from the content of dissolved Calcium and Magnesium
- As water is boiled or evaporated, the hardness will concentrate and begin precipitating out in different forms
 - This can lead to scale formation on the evaporative media pads (decreasing efficiency and increasing pressure drop)
- The solubility of calcium and magnesium are dependent on the content of dissolved CO₂ in the water, the pH, and the water temperature

Hardness [°dH]	European Scale	TDS [mg/L]
0-4	Very Soft	~0-110
4-8	Soft	~110-120
8-12	Medium Hard	~220-330
12-18	Quite Hard	~330-500
18-24	Hard	~500-660
24-30	Very Hard	~660-825
>30	Extremely Hard	~>825

Hardness [ppm CaCo ₃]	US Scale	TDS [mg/L]
0-60	Soft	~0-150
60-120	Medium Hard	~150-300
120-180	Hard	~300-450
180-350	Very Hard	~450-850
>350	Extremely Hard	~>850

- In a typical DEC system, as water is recirculated and mineral concentrations increase, a blow down cycle is used to bring the concentration back down
 - Some water is drained from the sump while fresh make up water is mixed back in

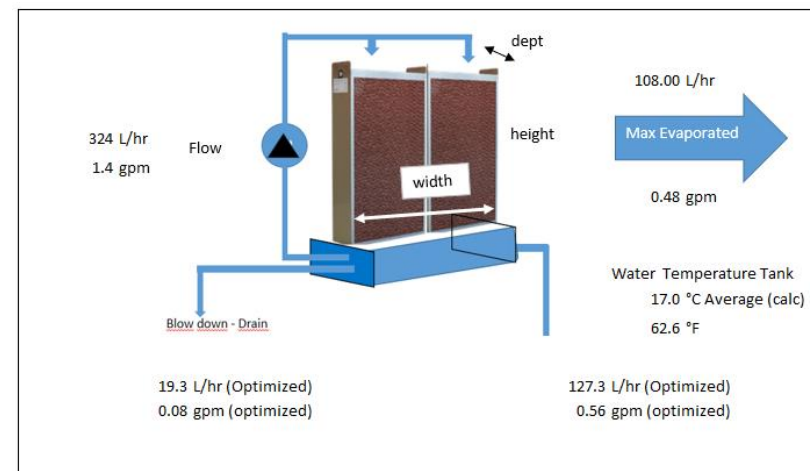
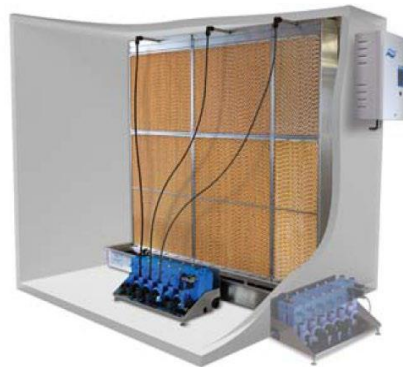
$$\text{Cycle of Concentration} = \text{COC} = \frac{\text{TDS in the DEC Sump}}{\text{TDS in the supply Water}}$$



- So by knowing a few parameters we are able to estimate based on empirical data, an optimized cycle of concentration in order to determine when a blow down cycle should occur while minimizing scale formation on the media
- This does not guarantee no scale formation (due to potential changing water qualities) but provides a good starting point for optimizing water usage

Parameters needed for COC calculation

1. System configuration (unit size, peak evaporation rate, design air conditions)
2. Supply water temperature, hardness, and pH





 DL
SERIES

- Most hygienic adiabatic system
- Short installation length
- Water efficient
- Low pressure drop – Ceramic Media
- Patented Silver Ion active dosing
- Up to 2200 lbs/hr spray capacity



 HP
SERIES

- One pump station capable of atomizing up to 2860 lb/hr
- Hygienic features like UV sterilization and automatic line flushing
- In-Duct & In-Space
- Modular – Master/Slave
- Optional integrated RO



 US
SERIES

- Up to 40 lbs/hr
- Self-contained
- Mounted or remote blower pack
- 35 W per lbs/h
- UV
- In-duct



 TE
SERIES

- Self-contained ceiling mounted humidifier
- Drop ceiling (for discrete operation) or suspended.
- Washable polyester media
- Cost effective < 97W
- Quiet < 40 dB



Adiabatic cooling technologies

- Energy Benefits
- Good payback for medium and large loads

Healthy IEQ

- Protect occupants with 40-60% RH
- Improve comfort and well-being

Condair experts – Application Support

- 70 years of experience

Contact:

- Nuno Silva – Product Manager, nuno.silva@condair.com
- William Truong – Business Development Manager, william.truong@condair.com



Thank you
Questions?