Munters
Your Perfect Climate

Data Center Solutions: OASIS™ Indirect Evaporative Cooler

Craig MacFadyen
EMEA & APAC Technical Sales Manager Data Center Solutions

Over 50 years of experience in Evaporative Cooling technology

A Corporate Culture of **Technical Innovation** and a History of **Customer Service**

1946 Munters CargoCaire manufacture under licence

1955 Munters Sweden bought UK/US CargoCaire

1960 Munters Worldwide

1997 on Swedish stock exchange

2007 Acquire Des Champs USA

2008 Acquire TN Belgium

2010 MCS divestment

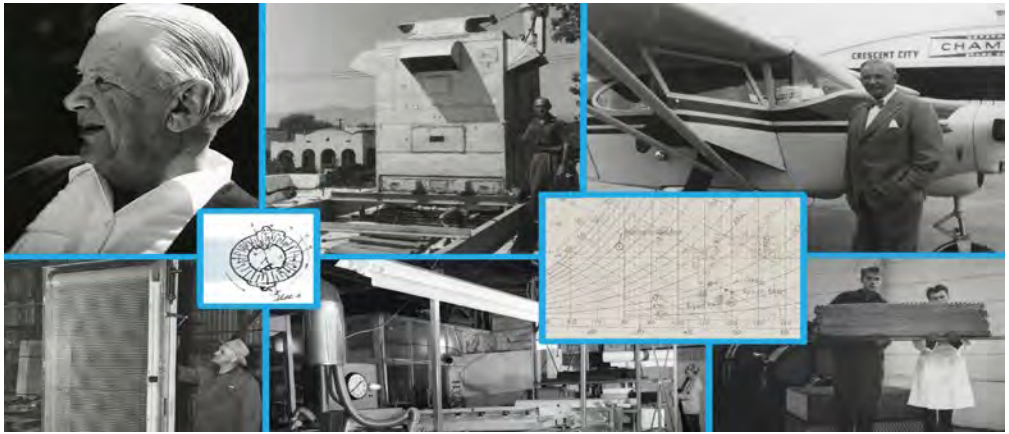
2010 Acquired by Nordic Capital

2011 Acquire Keruilai China

Carl Munters (1897-1989)

- Swedish inventor and entrepreneur
- A pioneer in desiccant rotor & evaporative cooling/humidification
- Applied for close to 1,000 patents
- Invented Desiccant rotor technology over 30 years ago

Worldwide Award Winning Organisation



Carl George Munters – 1897- 1989
ASHRAE PIONEER OF THE INDUSTRY
Contributions to Air Conditioning, Heating and Ventilation

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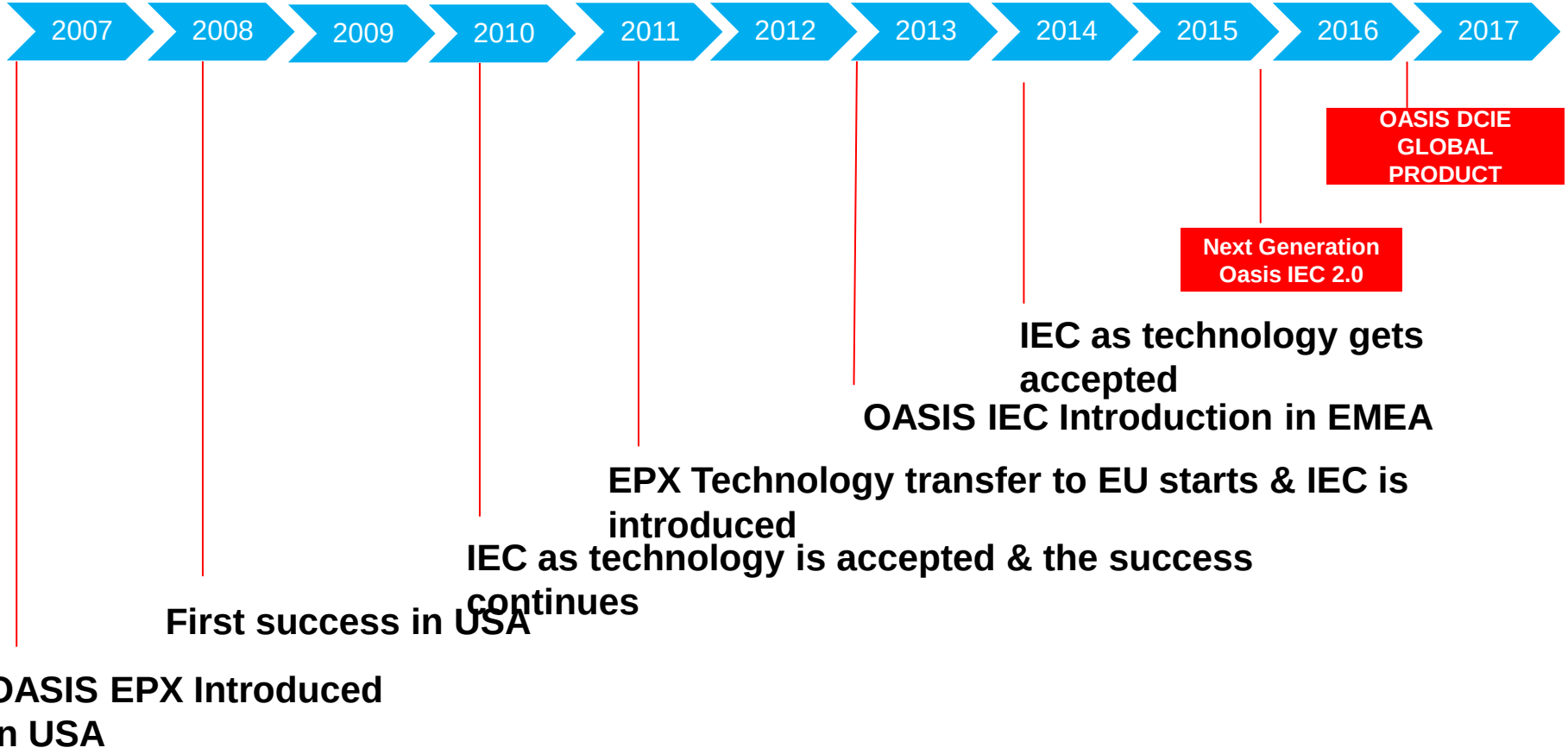
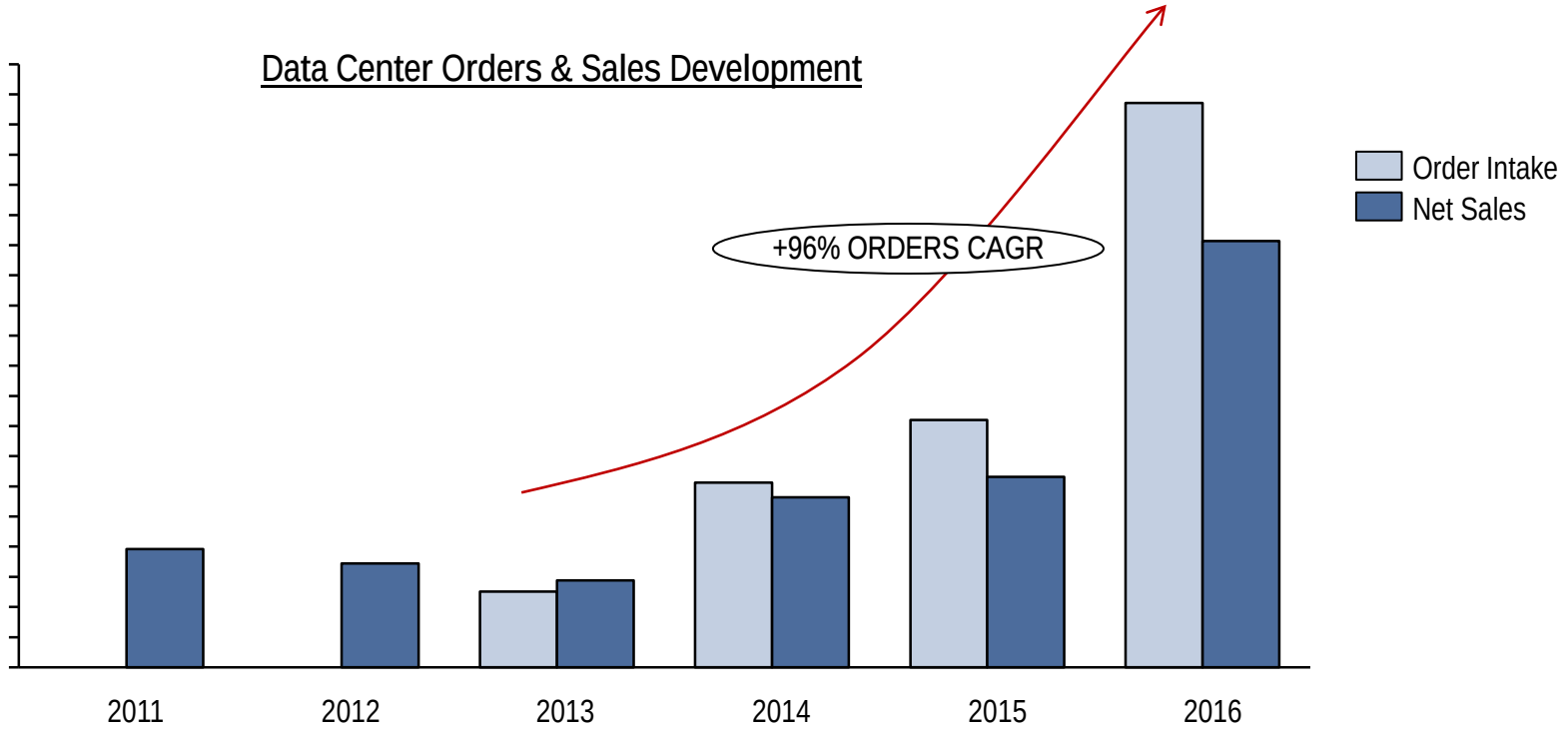
Oasis IEC Family Product Evolution



Technology gained traction in 2013 – Orders CAGR of 96% since then



Exponential growth as the market shifts away from compressor-based cooling

World Wide Energy Consumption by Country

Rank	Country	Uesage
1	China	4.69 Trillion kWh
2	Unites States	3.89 Trillion kWh
3	Russia	1.04 Trillion kWh
4	Japan	859.7 Billion kWh
5	India	698.9 Billion kWh
6	Germany	549.1 Billion kWh
7	Canada	499.9 Billion kWh
8	France	471 Billion kWh
9	Brazil	455.8 Billion kWh
10	South Korea	455.1 Billion kWh
11	**DATA CENTRES**	**416.2 Billion kWh as of 2016**
12	United Kingdom	329.3 Billion kWh
13	Italy	313.8 Billion kWh
14	Spain	249.7 Billion kWh
15	Taiwan	242.2 Billion kWh

http://www.independent.co.uk/environment/global-warming-data-centres-to-consume-three-times-as-much-energy-in-next-decade-experts-warn-a6830086.html

INDEPENDENT

Indirect Evaporative Cooling Solutions for Data Centre

- Free Cooling Options from Munters
  - Direct Air Operation
  - Indirect Evaporative Cooling
- Data Centre Key Drivers
  - Energy
  - Footprint
  - Reliability
  - Flexibility

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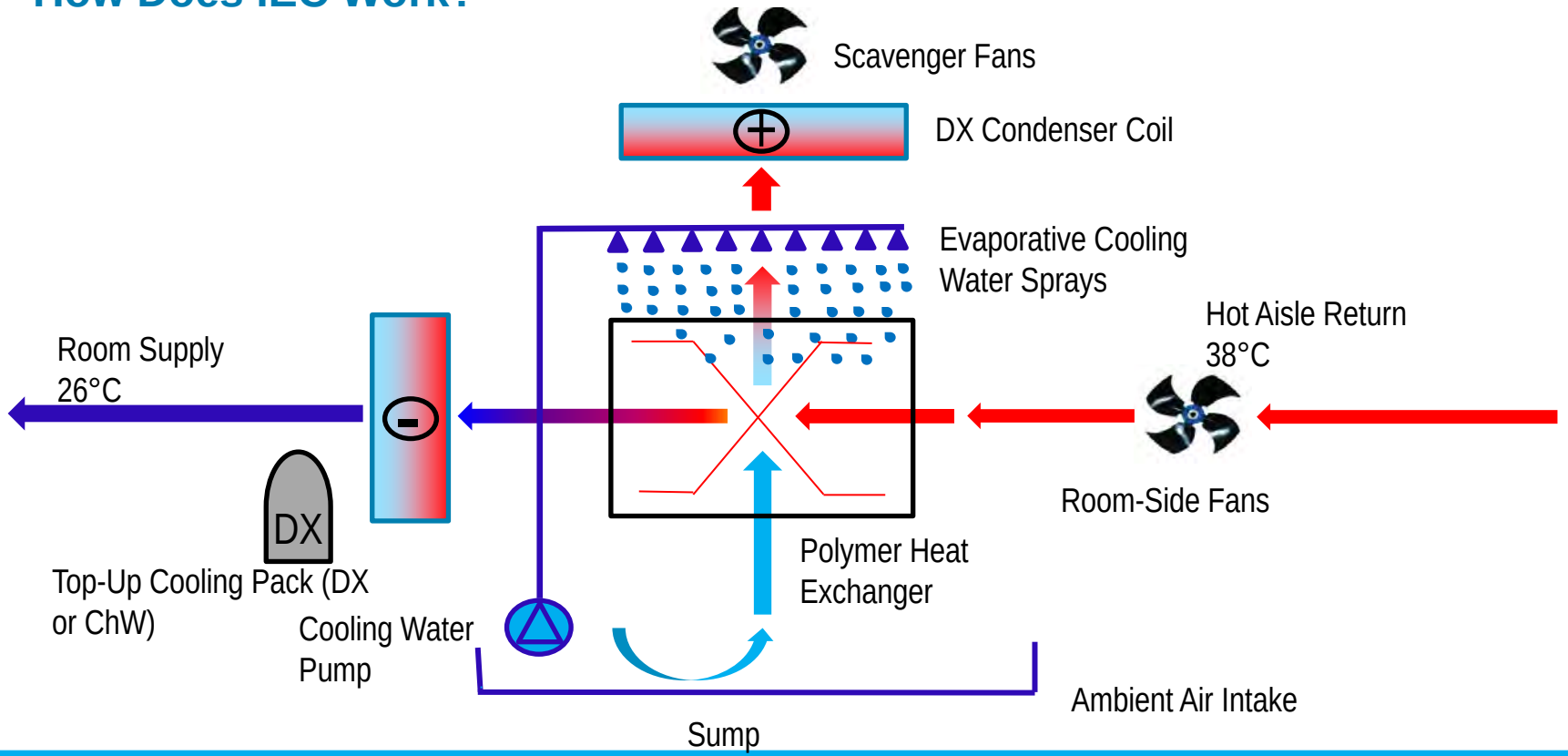
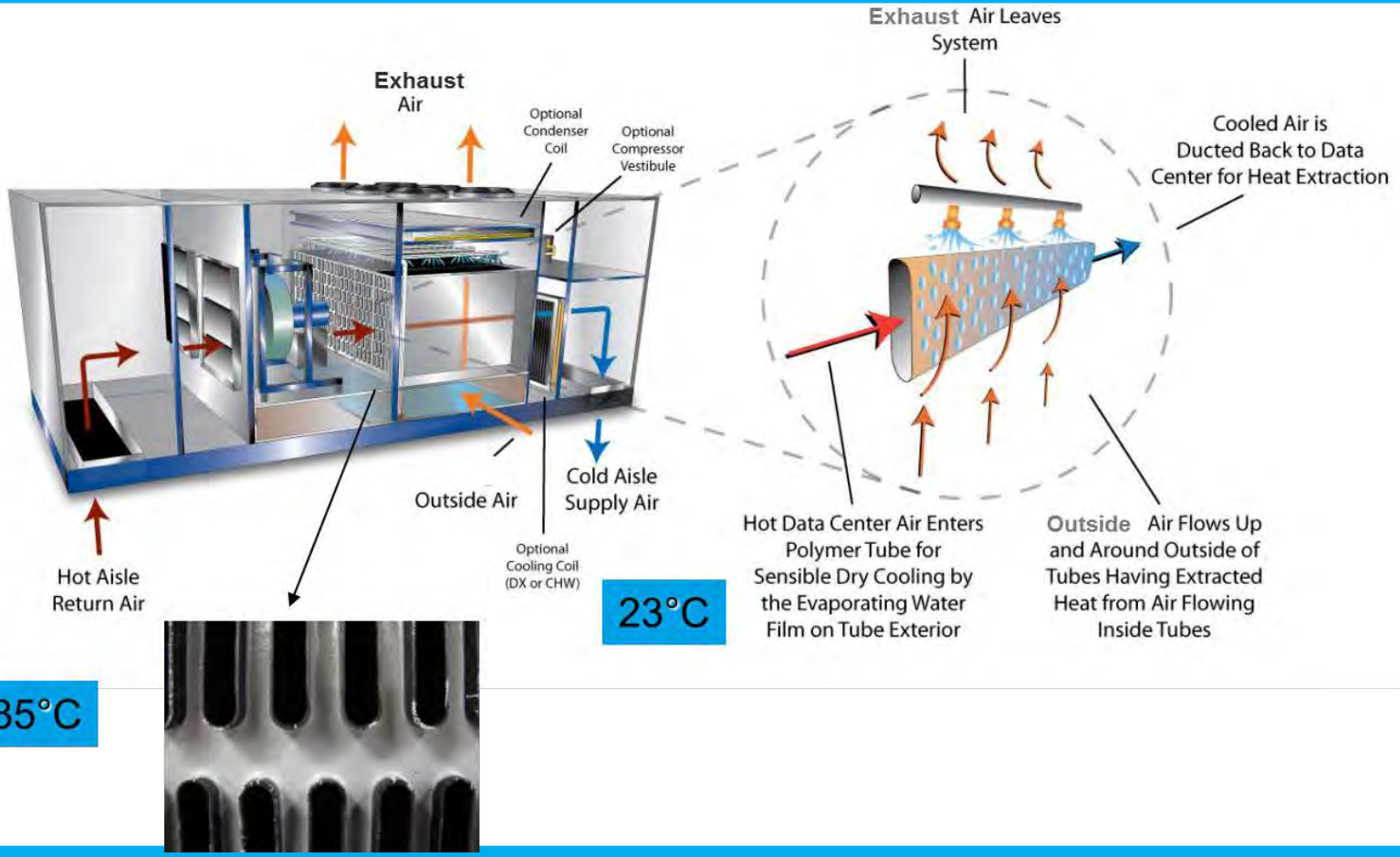
New Generation Data Center Coolers

Indirect Evaporative Cooling Working Principle

How Does IEC Work?



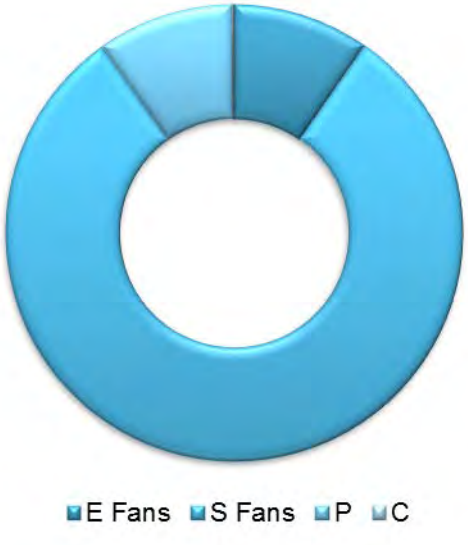
OASIS™ IEC: EPX Technology



Energy Usage within a unit

- Exhaust (scavenger) fans & Pump consume each ± 10% AEU
- ± 80% of the yearly energy consumption is taken by the supply airstream

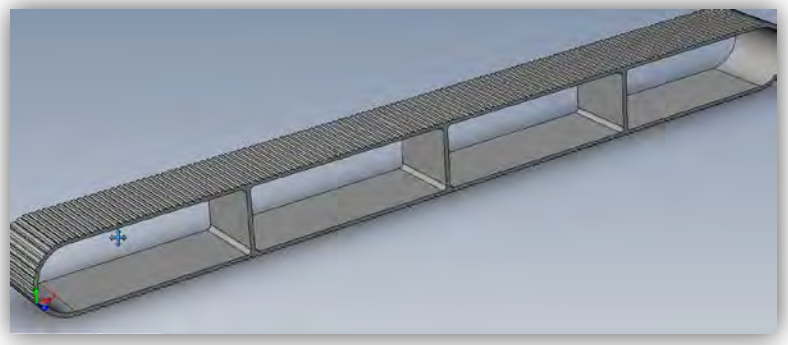
⇒ Optimizing the supply airstream = Energy efficient design



OASIS Supply Airstream Design

- ✓ Next Generation EPX Technology
  - 40% less pressure drop due to 25% more surface
  - Cooling performance remains
    - Increase surface area
    - Improved tube design to optimize the heat exchange efficiency
  - ➢ Results in ± 12% drop in energy usage vs current

- ✓ Aerodynamic internal design
  - ➢ Reduces resistance in the air path
  - ➢ Optimizes fan integration



OASIS Supply Airstream Design

- ✓ Supply fans
  - 3 Different fan wall types
  - 1 high power fan solution
  - All fans in OASIS use EC Motors
  - ➢ Optimize fan-motor to each project needs
  - ➢ High efficiency @ unit operating point
  - ➢ Lower power usage

- ✓ Filters & coil integration uses the full face area
  - ➢ Lowest possible pressure drop to save power

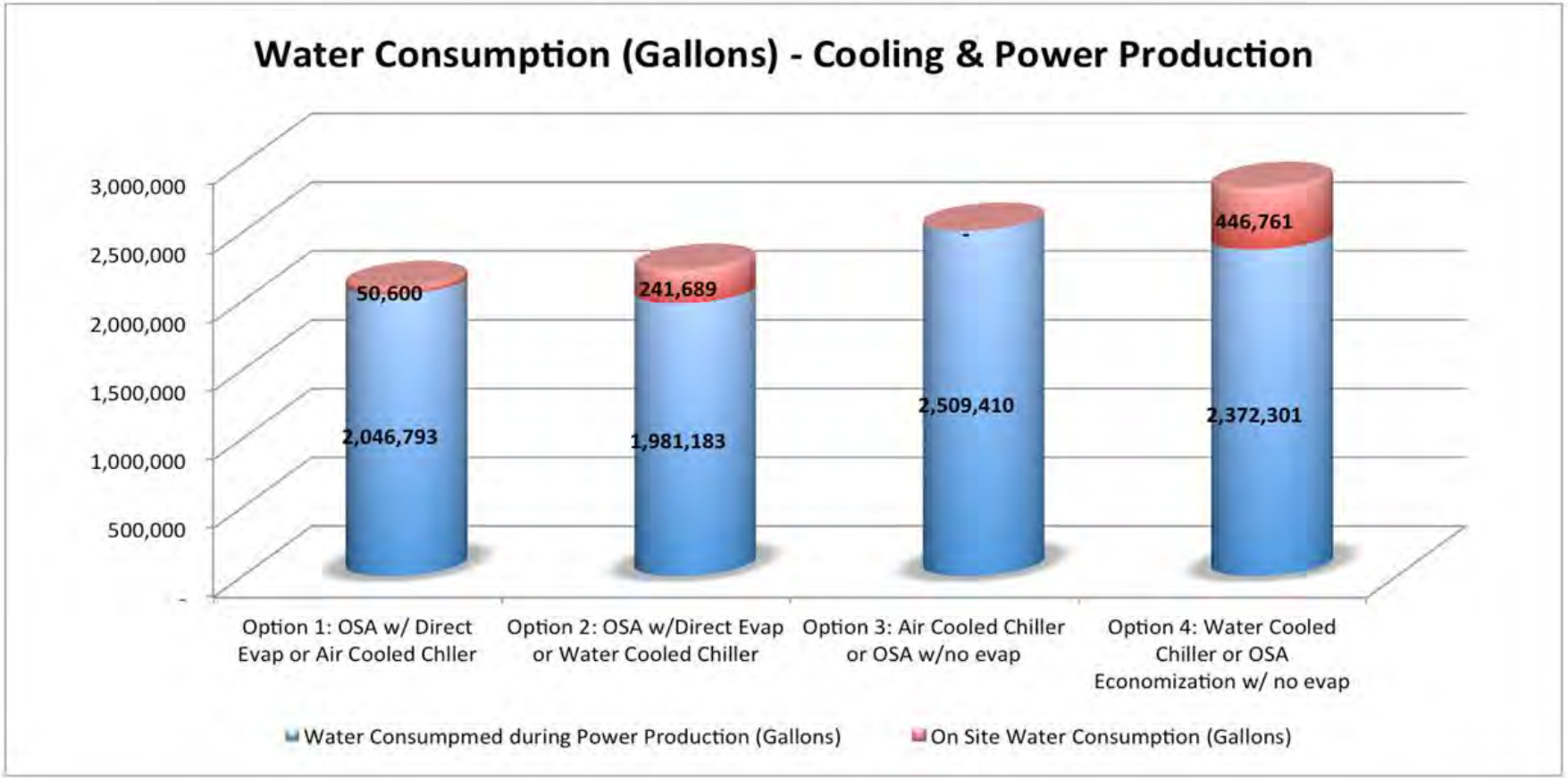
Energy Usage – 2MW Hall in Moscow – 24/36 Supply/Return – 11xOasis 200 (N+1)

Mid point temp (°C)	Average temp (°C)	Humidity (g/kg)	Time (h)	Electric energy process fan (kWh)	Electric energy process fan (kW)	Electric energy scavenger fan (kWh)	Electric energy scavenger fan (kW)	Pump energy cooling (kWh)	Pump energy cooling (kW)	Electric energy Dx cooling (kWh)	Electric energy Dx cooling (kW)	Total electric energy (kWh)	Total electric energy (kW)	Water (m³)	Water sewage (m³)	Evaporative cooling (kW)	Dx cooling (kW)
31	30.6	12.36	4	34.9	8.73	43.4	10.85	4	1.00	53.3	13.33	135.6	33.90	1.2	0.24	144.1	51.7
29	28.6	11.48	49	426.1	8.70	523.6	10.69	49	1.00	491.6	10.03	1490.3	30.41	14.5	2.9	155.86	38.12
27	26.8	11.54	69	600.6	8.70	733.6	10.63	69	1.00	616.2	8.93	2019.4	29.27	19.25	3.85	161.97	30.97
25	24.8	10.11	110	954.7	8.68	1147.1	10.43	110	1.00	671	6.10	2882.8	26.21	31.43	6.29	177.92	12.61
23	22.8	9.3	174	1462.4	8.40	1097	6.30	174	1.00	0	0.00	2733.4	15.71	45.96	9.19	184.83	0
21	20.9	9.47	279	2346.5	8.41	1094.9	3.92	279	1.00	0	0.00	3720.4	13.33	65.48	13.1	184.95	0
19	18.9	8.88	425	3574.9	8.41	863.7	2.03	425	1.00	0	0.00	4863.6	11.44	91.4	18.28	185.19	0
17	16.9	8.89	518	4363	8.42	941.5	1.82	518	1.00	0	0.00	5822.5	11.24	104.86	20.97	185.29	0
15	14.9	8.04	573	4826.3	8.42	810.9	1.42	573	1.00	0	0.00	6210.2	10.84	110.37	22.07	184.38	0
13	13	7.22	634	5337.1	8.42	597.5	0.94	634	1.00	0	0.00	6568.5	10.36	117.81	23.56	184.3	0
11	10.9	6.6	650	5466.8	8.41	421.9	0.65	650	1.00	0	0.00	6538.7	10.06	116.82	23.36	184.35	0
9	9	5.91	522	4391.9	8.41	237.1	0.45	522	1.00	0	0.00	5151	9.87	91.82	18.36	184.25	0
7	7	5.07	485	4087.5	8.43	171	0.35	485	1.00	0	0.00	4743.5	9.78	83.95	16.79	184.32	0
5	4.9	4.2	420	3544.2	8.44	1257.7	2.99	0	0.00	0	0.00	4801.8	11.43	0	0	183.59	0
3	2.8	3.85	644	5444.8	8.45	1396.3	2.17	0	0.00	0	0.00	6841.1	10.62	0	0	183.53	0
1	1	3.47	726	6156.2	8.48	1220.4	1.68	0	0.00	0	0.00	7376.6	10.16	0	0	183.43	0
-1	-1.1	2.84	559	4718.2	8.44	805.9	1.44	0	0.00	0	0.00	5524.1	9.88	0	0	184.03	0
-3	-2.9	2.37	511	4308.3	8.43	676.6	1.32	0	0.00	0	0.00	4984.9	9.76	0	0	184.05	0
-5	-5.1	1.93	360	3028.2	8.41	411.2	1.14	0	0.00	0	0.00	3439.3	9.55	0	0	183.27	0
-7	-6.9	1.65	263	2214.4	8.42	251.9	0.96	0	0.00	0	0.00	2466.3	9.38	0	0	183.16	0
-9	-8.9	1.43	187	1564	8.36	152.9	0.82	0	0.00	0	0.00	1716.9	9.18	0	0	183.07	0
-11	-11	1.17	171	1439.8	8.42	120.7	0.71	0	0.00	0	0.00	1560.4	9.13	0	0	183.16	0
-13	-13	0.97	89	745.2	8.37	53.1	0.60	0	0.00	0	0.00	798.3	8.97	0	0	182.93	0
-15	-15	0.8	140	1165	8.32	70.1	0.50	0	0.00	0	0.00	1235.1	8.82	0	0	182.87	0
-17	-17	0.68	121	1001.6	8.28	54.6	0.45	0	0.00	0	0.00	1056.2	8.73	0	0	182.89	0
-19	-18.9	0.59	39	323.6	8.30	16.1	0.41	0	0.00	0	0.00	339.7	8.71	0	0	182.76	0
-21	-20.9	0.5	23	190.9	8.30	8.6	0.37	0	0.00	0	0.00	199.5	8.67	0	0	182.7	0
-23	-23.2	0.4	12	98.8	8.23	4	0.33	0	0.00	0	0.00	102.8	8.57	0	0	182.59	0
-25	-24.2	0.35	3	25.4	8.47	1	0.33	0	0.00	0	0.00	26.4	8.80	0	0	182.76	0
Unit Totals			8760	73841.3		15184.3		4492		1832.1		95349.3		894.85	178.96		
Site Total												1048842.3		9843.4	1968.56		

Typical Energy Use with Chiller/CRAC with COP of 3 would be 5,840,000 kWh – Above uses approx 1,050,000 kWh – a saving of 82%

Expected annual costs of Energy and Water

Figure 5.1.2. Total annual costs of energy and water consumed by the data hall.

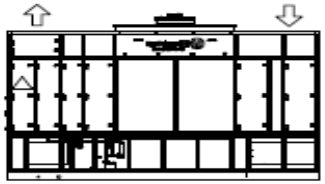

Water Consumption (Gallons) - Cooling & Power Production
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
-
50,600
2,046,793
241,689
1,981,183
2,509,410
-
446,761
2,372,301
Option 1: OSA w/ Direct Evap or Air Cooled Chller
Option 2: OSA w/Direct Evap or Water Cooled Chiller
Option 3: Air Cooled Chiller or OSA w/no evap
Option 4: Water Cooled Chiller or OSA Economization w/ no evap
Water Consumpmed during Power Production (Gallons)
On Site Water Consumption (Gallons)

OASIS™ IEC Range overview

OASIS 100	OASIS 200	OASIS 300	OASIS 400
			
< 125.00 kW	< 240.00 kW	< 365.00 kW	< 480.00 kW
10000 - 24000 Sm³/h	22000 - 48000 Sm³/h	32000 - 72000 Sm³/h	44000 - 96000 Sm³/h
5.92 x 1.36 x 4.17 m / 8.05 m²	5.92 x 2.58 x 4.17 m / 15.27 m²	5.92 x 3.94 x 4.17 m / 23.32 m²	5.92 x 5.16 x 4.17 m / 30.55 m²

OASIS™ IEC Range overview: Connections

TOP - TOP



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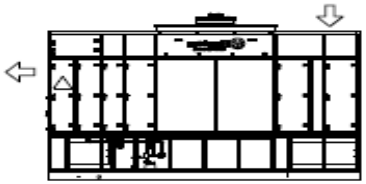

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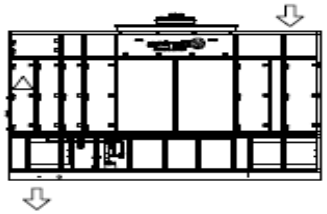

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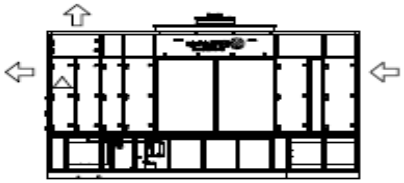

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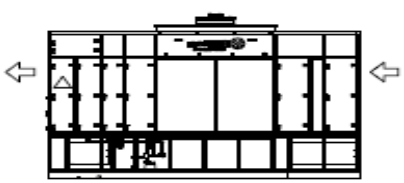

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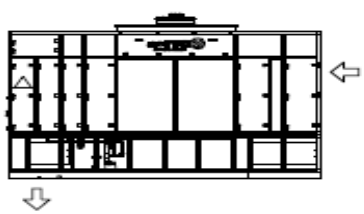

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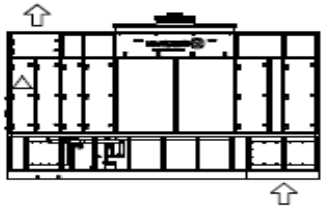

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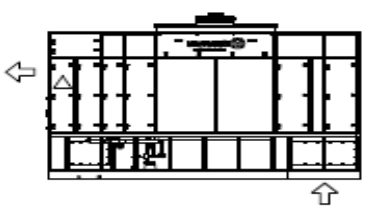

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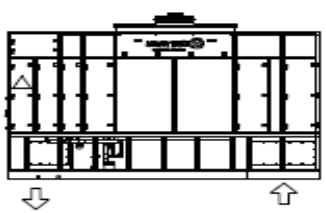

Data Center Test Facility

- Leakage testing
- Controls and Alarm simulation testing
- A visual inspection of the unit
- Variable load/performance testing, 1.7°C up to 33°C WB
- Real server rack simulation over 300kW load

Tests performing in accordance with ASHRAE-std143-2015

Fully Calibrated & Certified by LEUVEN KUL University

Existing Installations

DataInn, Lithuania – Oasis IEC key to advanced cost efficiency

"Munters cooling solutions enable us to achieve an annual PUE of 1.3 or less, which will make us very cost-effective and competitive in the market. Every 0.01 reduction in our PUE represents an energy saving of approximately 210,000 kWh in our data centre."

- Secure, reliable data hall climate
- Data centre air fully separated from outside air
- 65% lower energy than common free cooling solutions
- 25% reduction in refrigeration, switchgear, generator sets

Data Inn Development Manager Edvinas Bakanas, says:

"The Lithuanian electric energy sector, data communication operators and biggest banks need their data to be safe and accessible without interruptions, as well as cost –effective and eco friendly. The high efficiency and innovative design were our main reasons for choosing Munters' Oasis™ IEC"

"The proven technology fits well with the climate conditions in Vilnius and offers a high degree of flexibility, operating in different cooling modes – depending on weather conditions."

DigiPlex Oslo – Largest Indirect Evaporative Cooled DC in Europe

Energy efficiency of 1.12 PUE

- Annual pPUE of 1.06
- Data centre air fully separated from outside
- Lower capital costs on refrigeration/switchgear
- 52 Oasis IEC 200's

Greg MCCulloch DigiPlex's Chief Operating Officer:

"Driving energy efficiency in our industry is a major focus for us and this system halves the amount of energy used to keep our servers working at an ideal temperature.

This not only helps save our customers thousands of pounds in energy costs but also ensures that our facilities are amongst the most sustainable in the sector"

Summary Equinix LD6

- One of the most energy efficient data centres in Equinix Portfolio
- 8,000m²
- Two three-storey, air-cooled buildings, for Phase 1
  - 2,770 Cabinets
  - 8MW IT Load
  - 40 x Munters Oasis IEC on Phase 1
  - Aim to become accredited to LEED Platinum Level
  - Predicted cooling pPUE 1.06
  - Predicted project PUE1 1.2
  - Building Innovative design
    - Mechanical plant on top level to be closer to the airflow entry
    - Rainwater harvesting system

EQUINIX

Thank You

Thank You

Any questions, please come and see us at Munters Stand