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ECO Visit To Emerald Isle

CommScope Bray

March 5th 2015

The Modular Data Centre
….Economic, Technical and Efficiency Models

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Contents

- **Modular Designs**
- **Flexibility**

- **Efficiency**
- **Economic Advantages**

Containerised Data Centres

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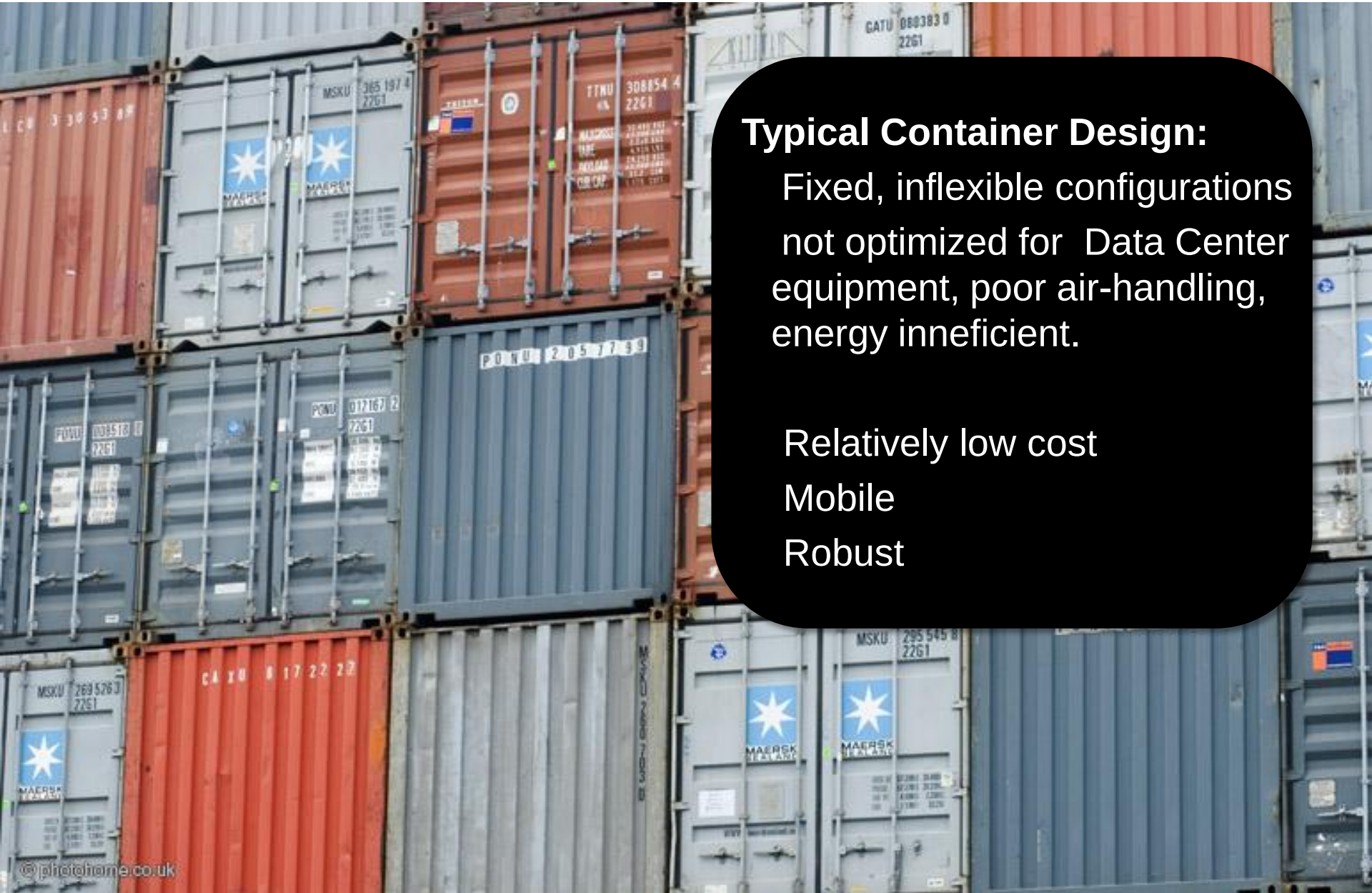


Typical Container Design:

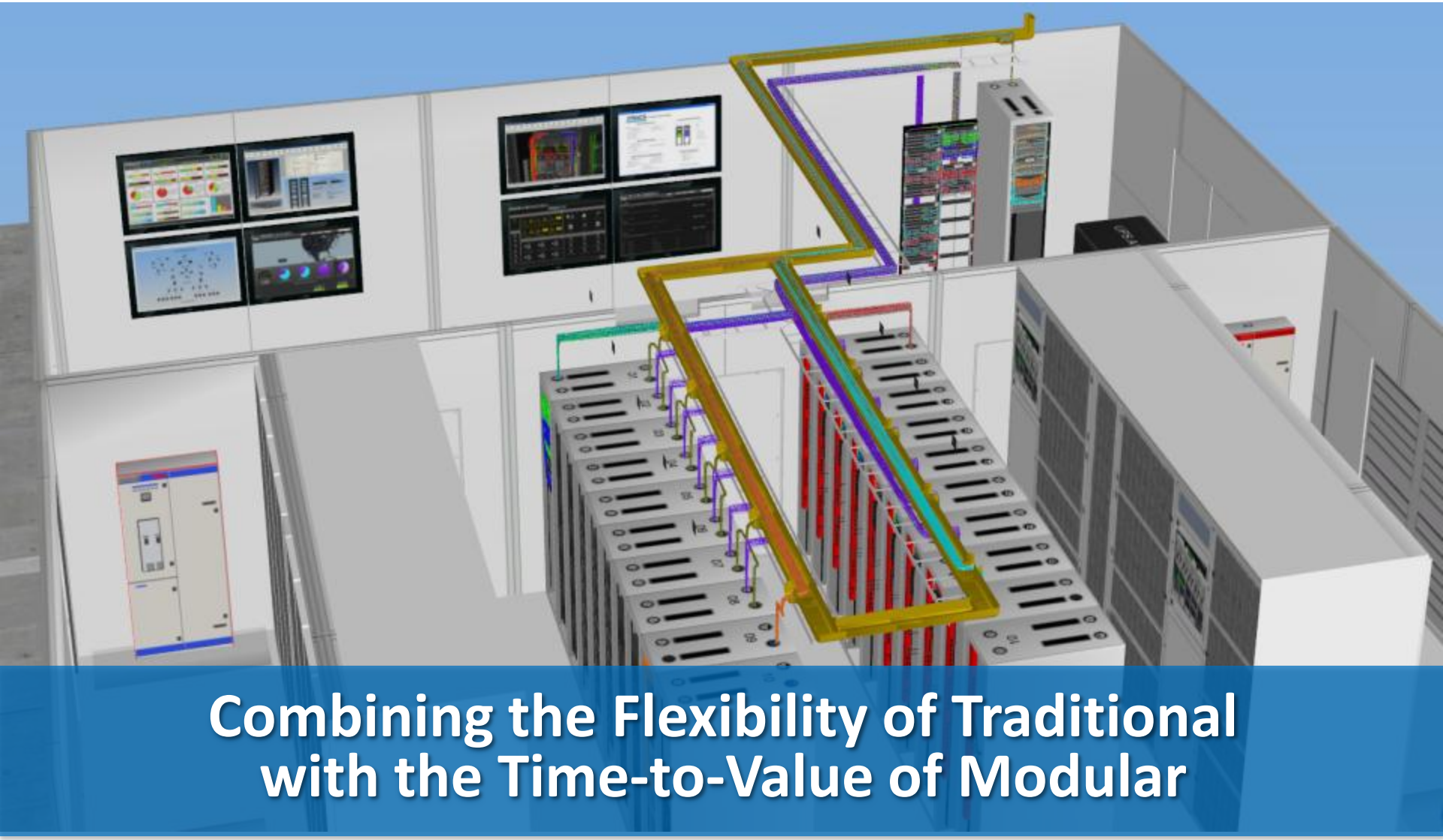
Fixed, inflexible configurations not optimized for Data Center equipment, poor air-handling, energy inneficient.

Relatively low cost

Mobile

Robust

Modular Designed Purpose-Built Data Centres



Combining the Flexibility of Traditional with the Time-to-Value of Modular

CommScope DCoD Solution Overview

Building Blocks

- DCU 01 (1 Rack)
- DCU 04 (4 Racks)
- DCU 10 (10 Racks)
- DCU 20 (20 Racks)
- DCU 30 (30 Racks

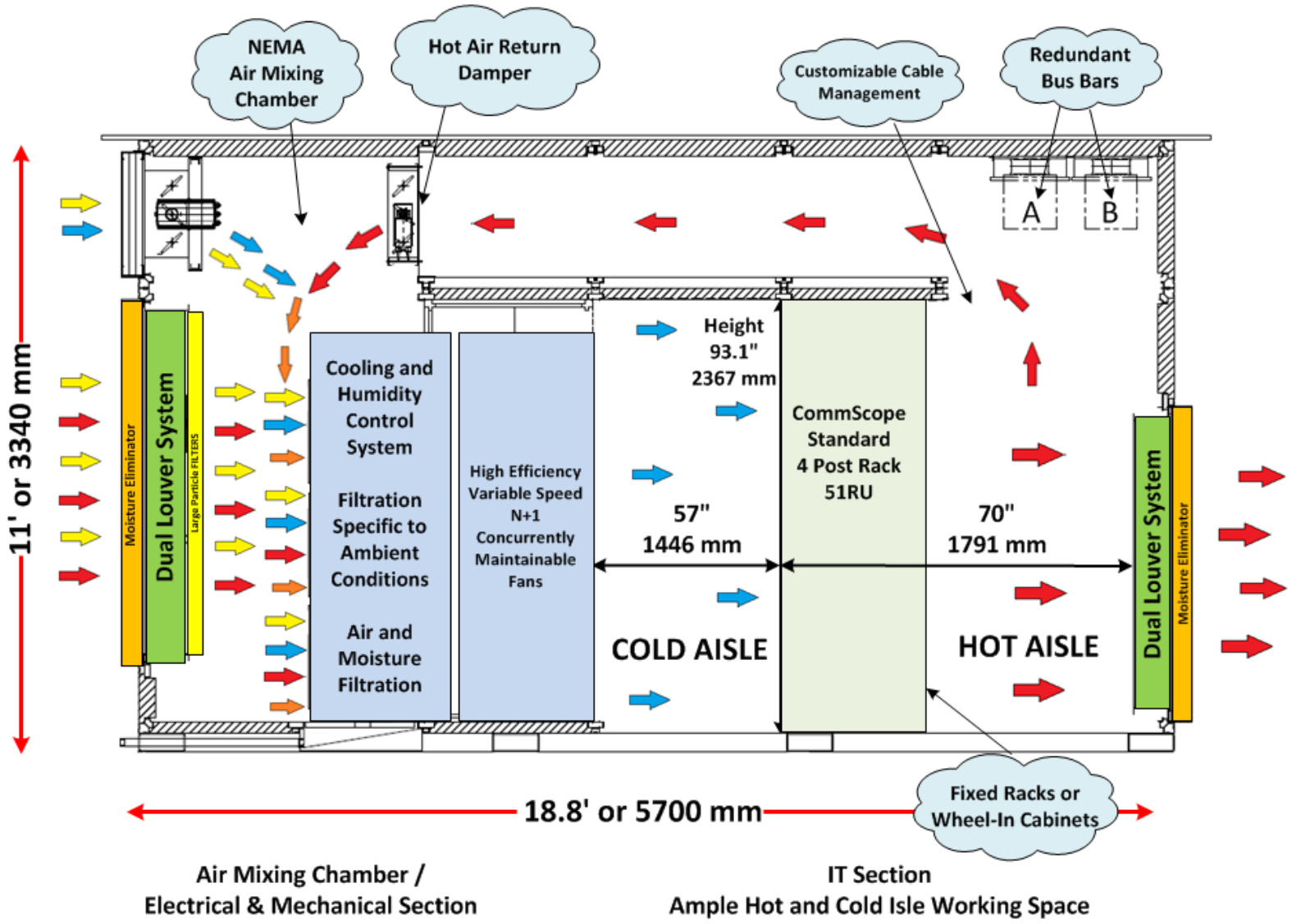
Universal Features

- 5 to 35 kW per Rack
- 3rd Party Racks, Cabinets, White Space
- TIER, Mechanical, Electrical, Security, Fire, Core Infrastructure Customizable

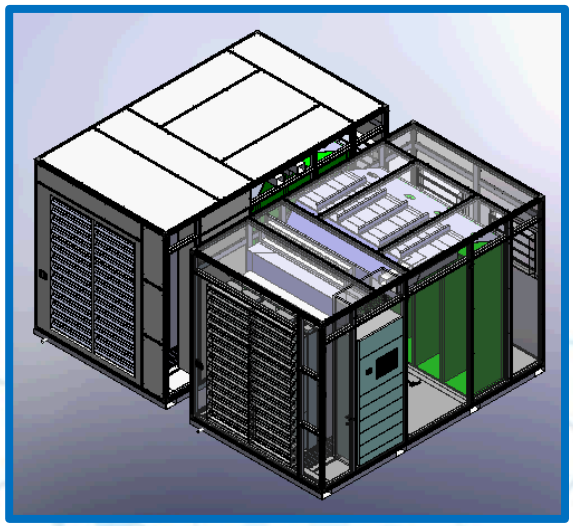
Vestibule

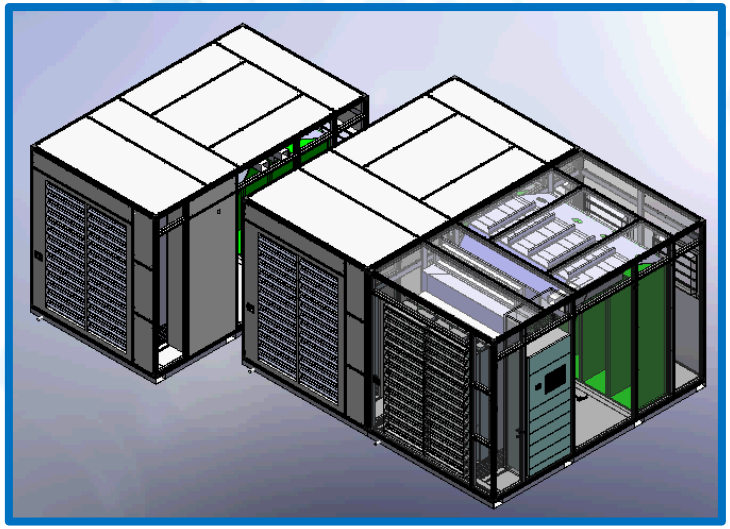
- Standard and Large
- Adjoining white space for: (optional infrastructure; UPS; Switch Gear; Patch Panels; Technician Workstations)

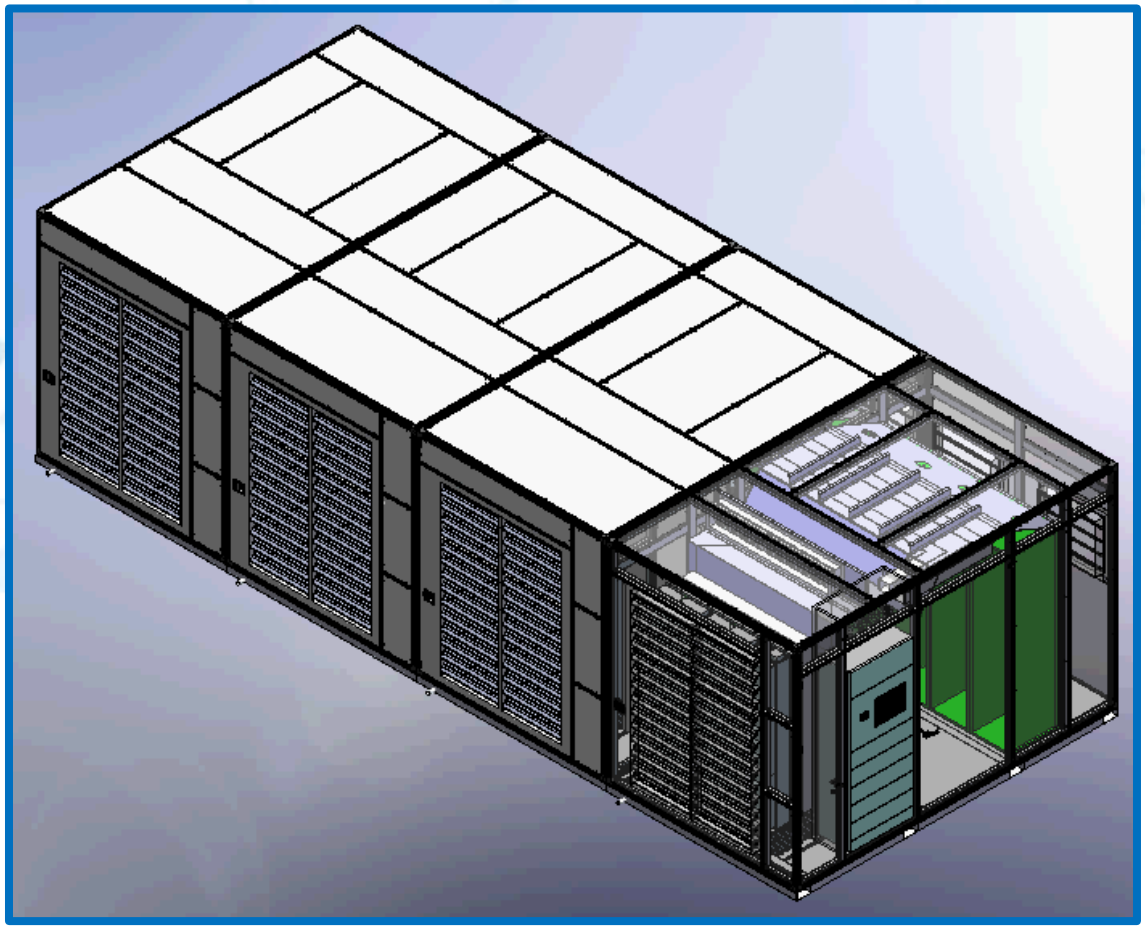
CommScope DCU-04, 4 Rack Data Center



CommScope DCU
Expandability – Seamless Hot/Cold Aisles

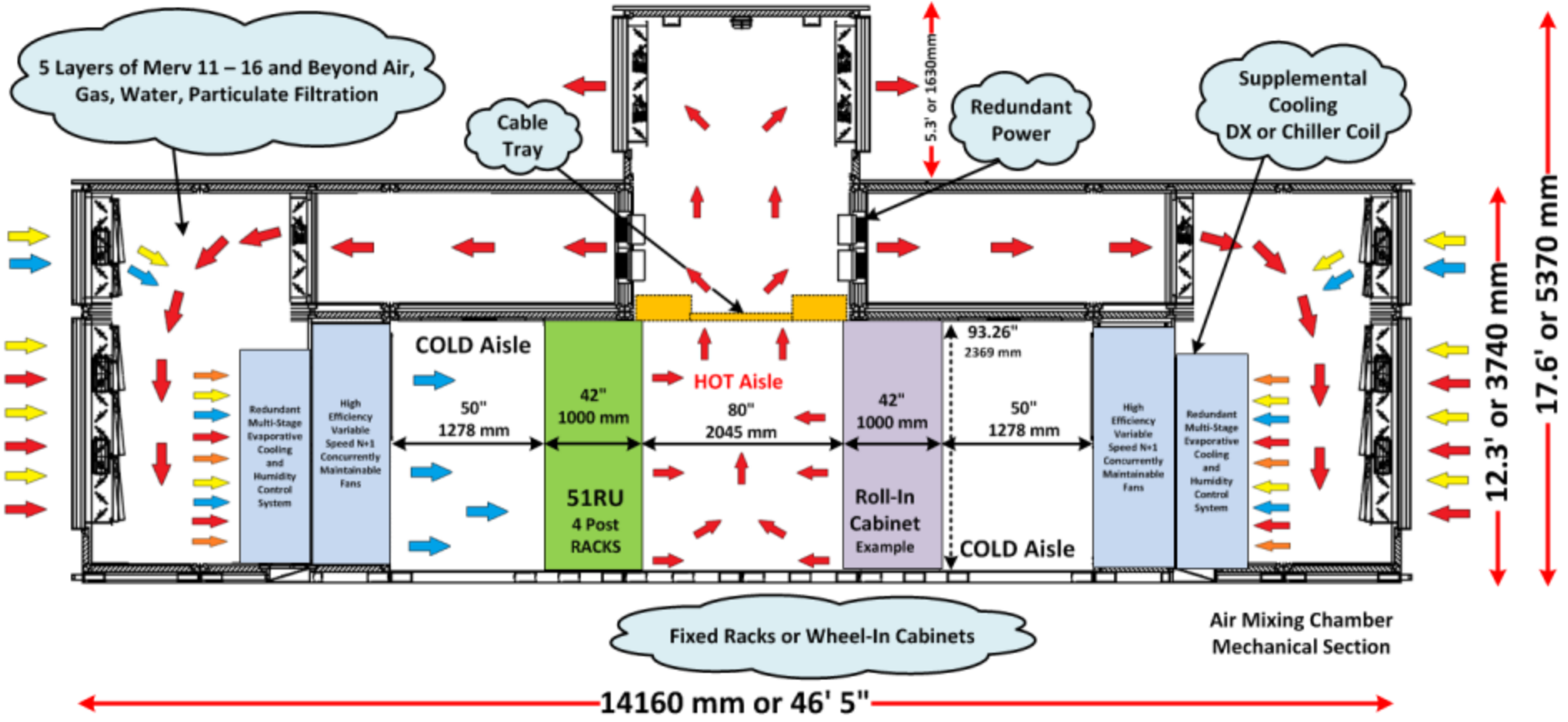






CommScope DCU-20

EXPANDABLE 20 Rack Data Center



CommScope DCU-30 (30 Racks)

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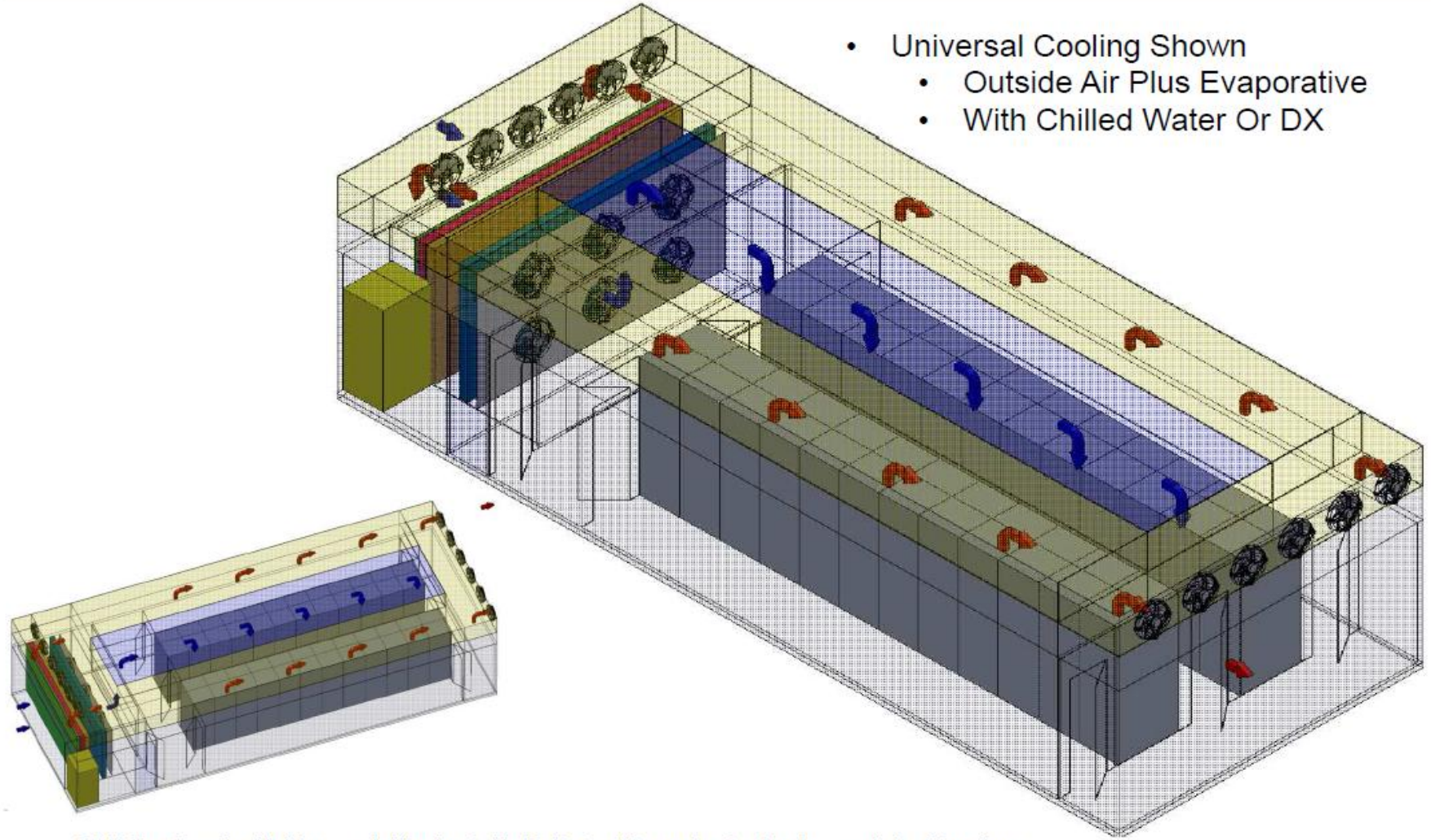
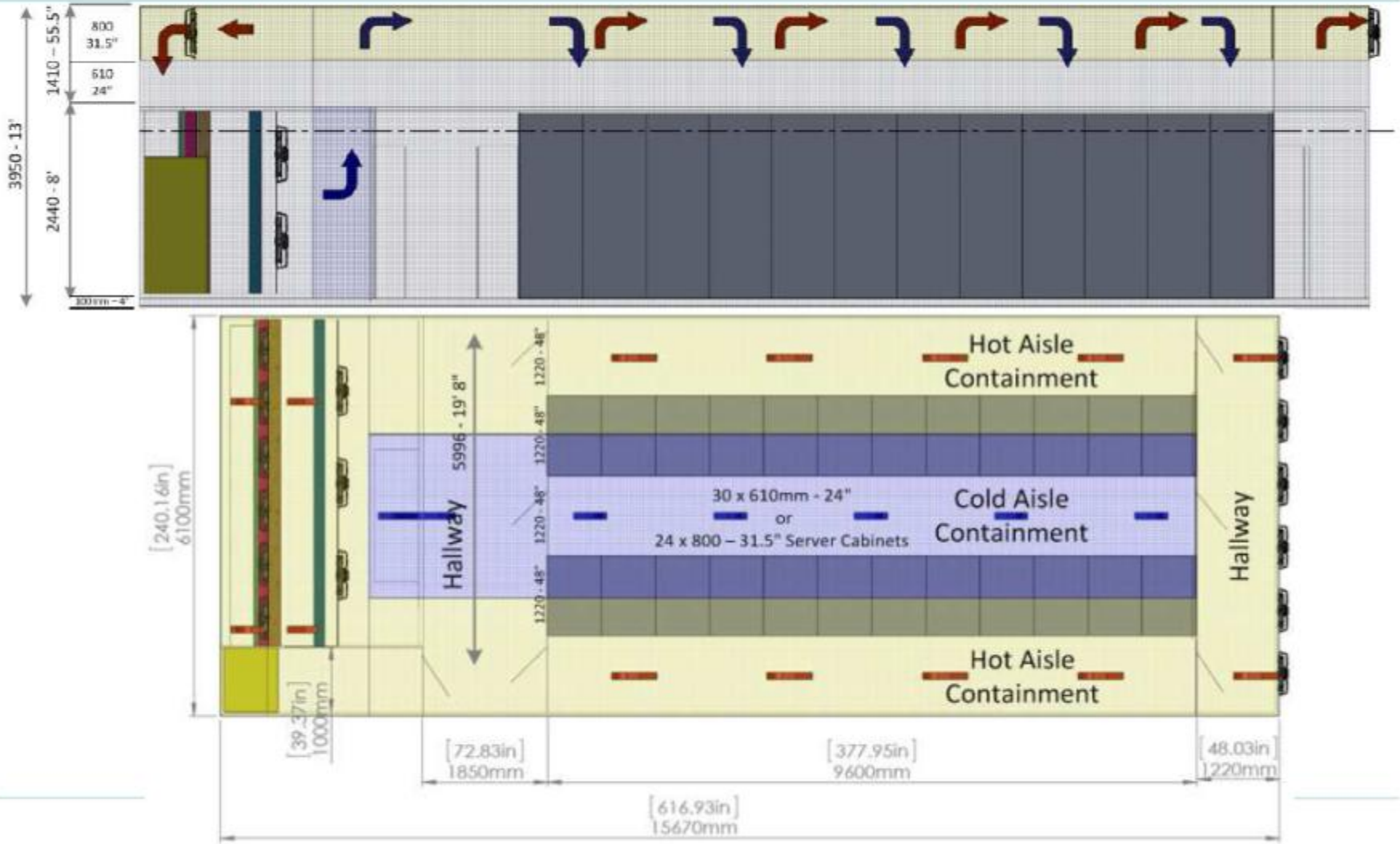


- Universal Cooling Shown
  - Outside Air Plus Evaporative
  - With Chilled Water Or DX

CommScope DCU-30 – Side and Plan Views



DCoD Technology

DCoD Technology

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DCoD Technology

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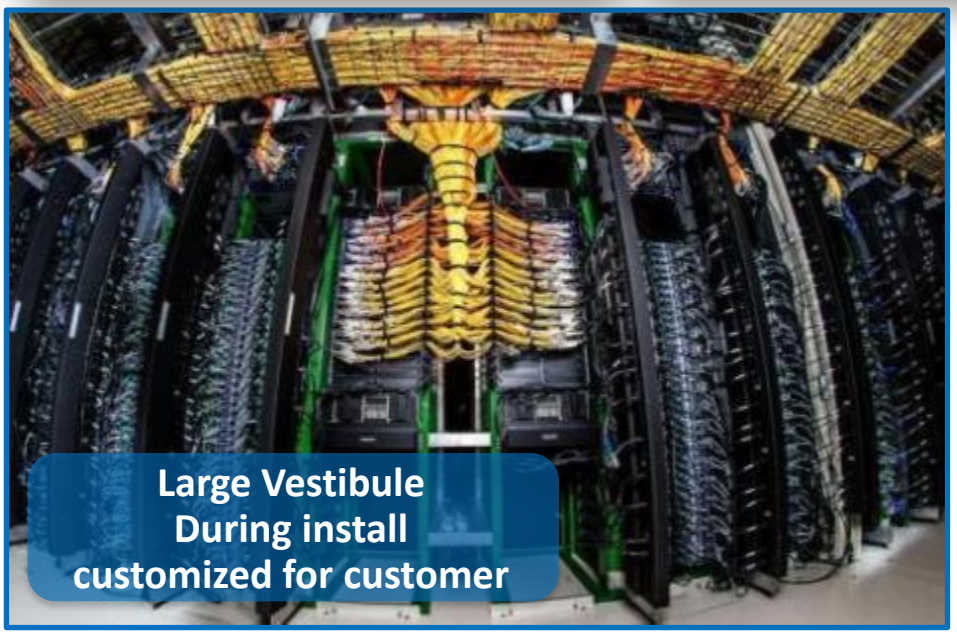
ASHRAE Air Quality

Class	IT Equipment Type	Environment Control (dust and particulates filtering)
A1	Enterprise servers and critical data storage	Tightly controlled MERV 6 + MERV 14 new air MERV 10 Air recycled
A2	Enterprise servers and data storage	Controlled MERV 6 + MERV 14 new air MERV 10 Air recycled
A3	Other servers and data storage, workstations	Same as A2
A4	Other servers and storage, workstations	Same as A2

Agility - Flexibility - Manageability



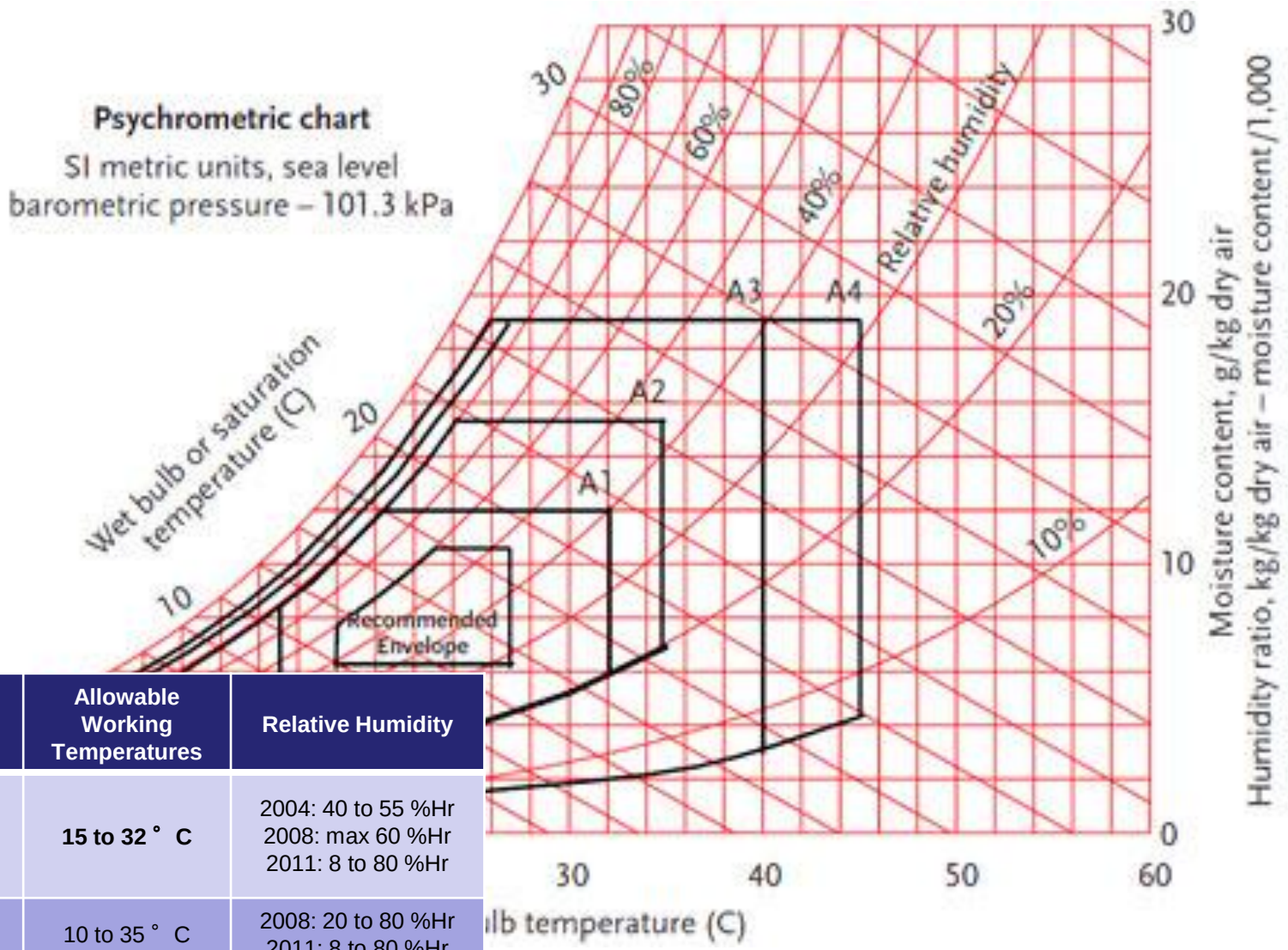
Global Deployments

CommScope Cooling System Overview

Highly Efficient Proprietary Evaporative Cooling and Re-Heating system

- Direct Outside Air System
- Multi Stage Air Filtration and Moisture Elimination
- Filtration Options Based on Environment
- Multi-Stage Redundant Evaporative Cooling
- Proprietary Air Mixing Chamber
- Overall System Eliminates typical DX or Chilled Water Infrastructure
- Requires little water when used. No chemical waste
- Optional Integrated DX or Chilled Water Coils for supplemental Peak cooling and 100% recirculation with no outside air IF required

ASHRAE



Class	Recommended Working temperatures	Allowable Working Temperatures	Relative Humidity
A1	2004: 20 to 25 ° C 2008: 18 to 27 ° C **2011: 18 to 27 ° C**	**15 to 32 ° C**	2004: 40 to 55 %Hr 2008: max 60 %Hr 2011: 8 to 80 %Hr
A2	Idem	10 to 35 ° C	2008: 20 to 80 %Hr 2011: 8 to 80 %Hr
A3	Idem	5 to 40 ° C	8 to 85 %Hr
A4	Idem	5 to 45 ° C	8 to 90 %Hr

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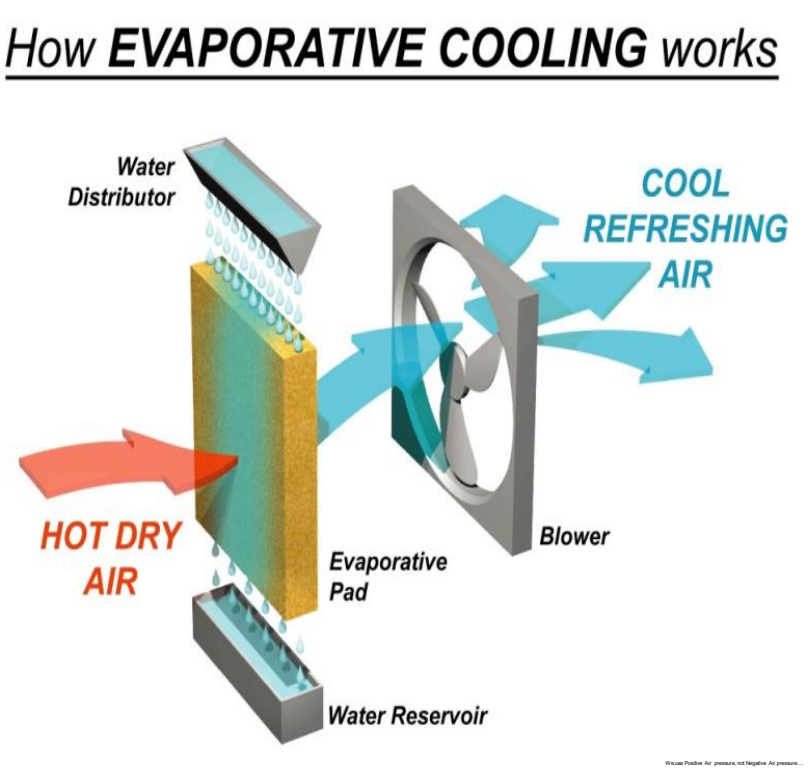
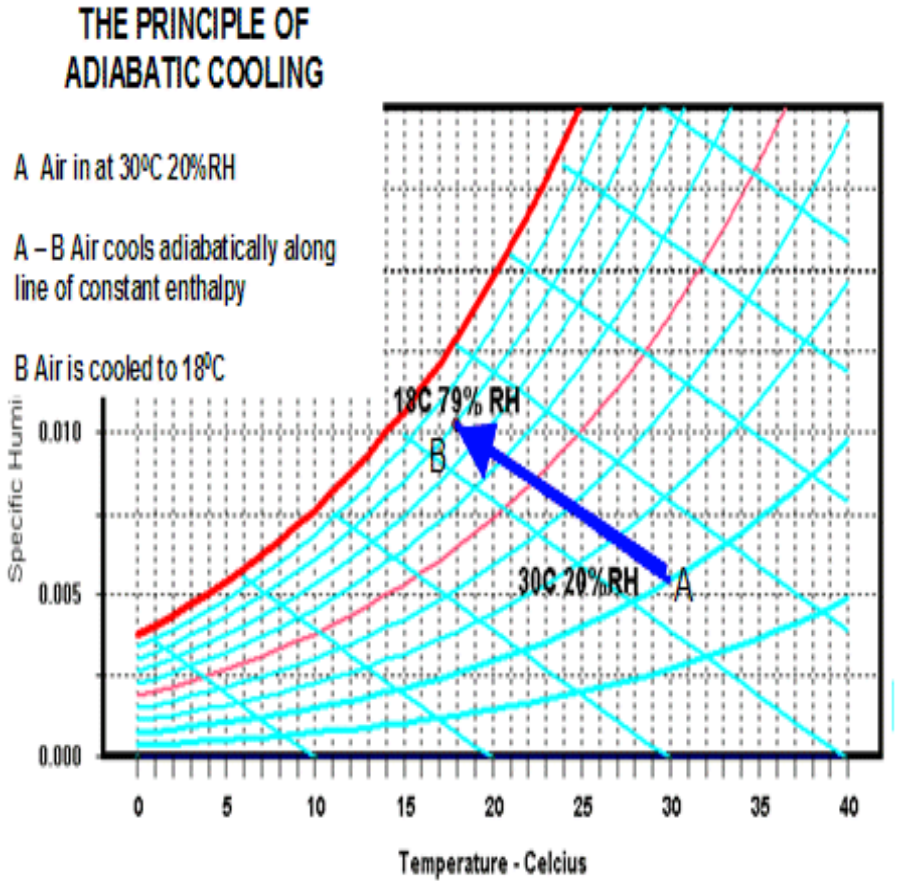
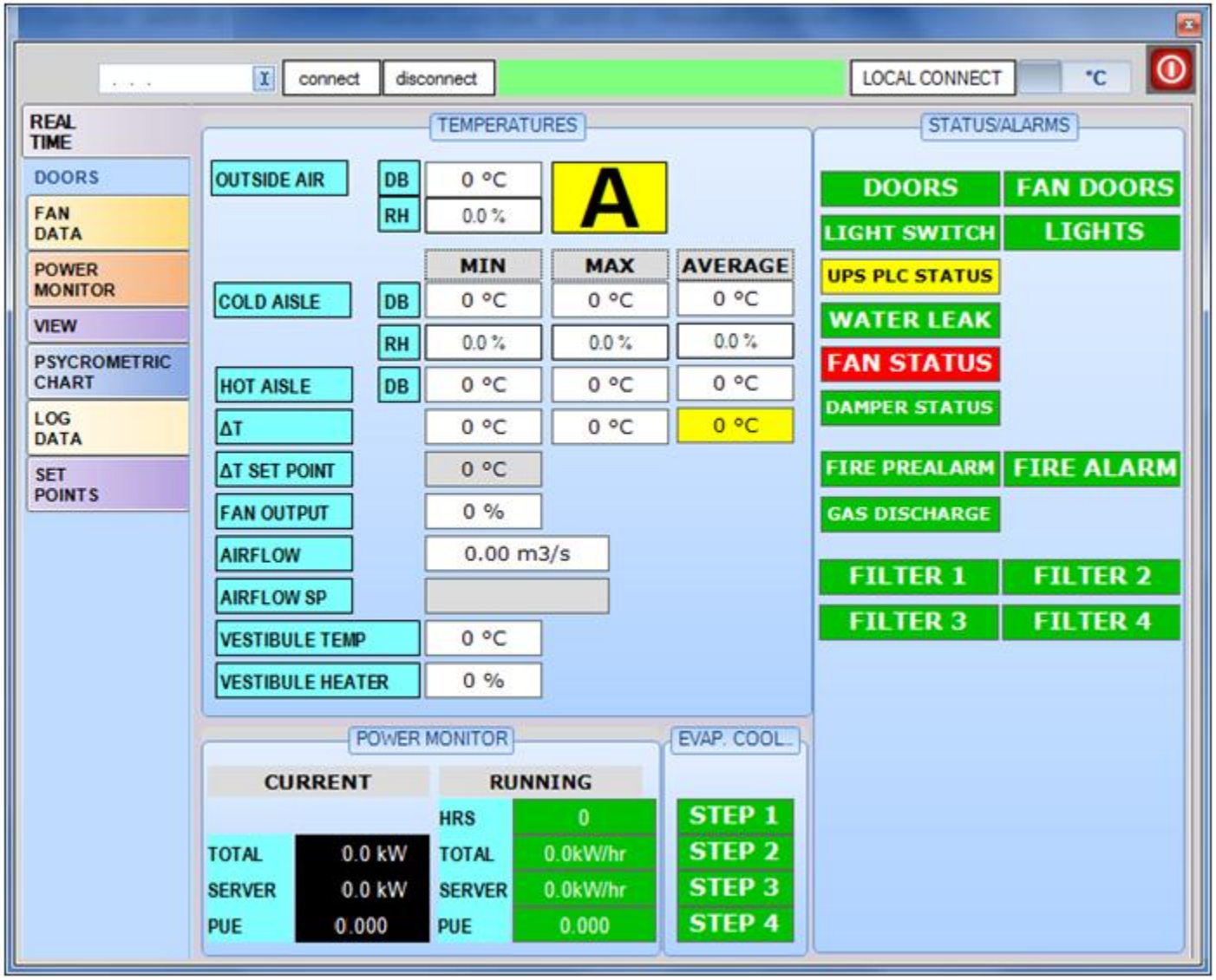
Evaporative Cooling Works





Remote Real Time Monitoring & Controls



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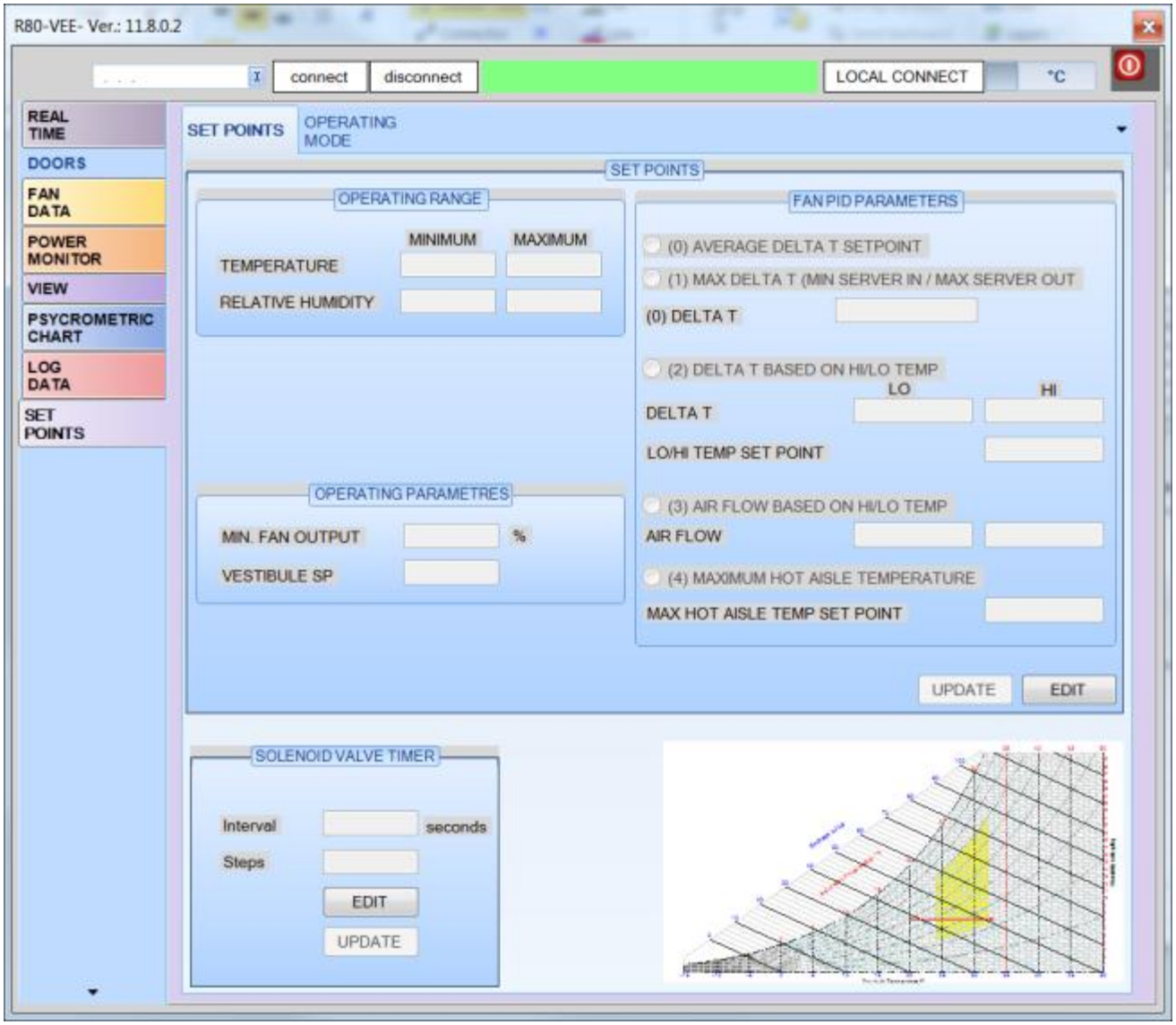
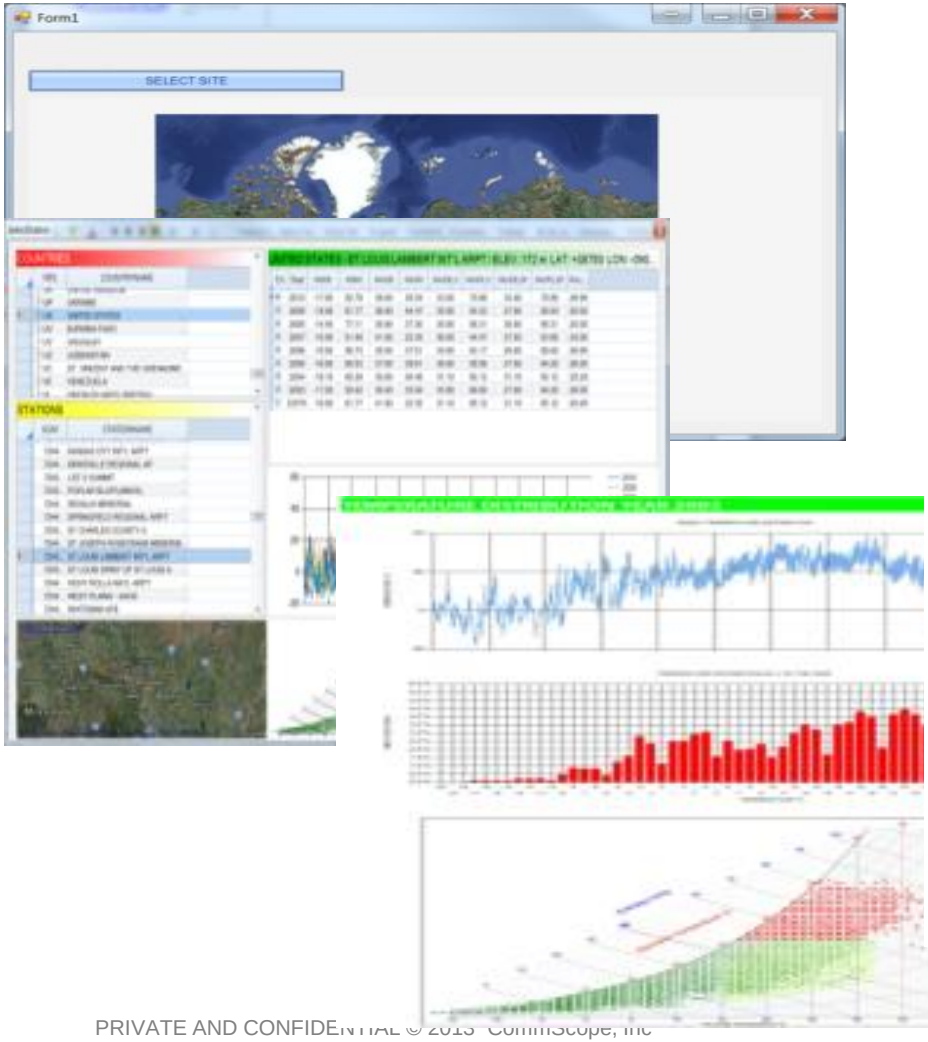


Weather/Site Analysis Tools

Know Exactly how a DCU will Perform, Anywhere, Hourly

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE



SUMMARY

LOWEST OUTSIDE AIR DRY BULB TEMPERATURE	-10.00 °C
PRECENTAGE OF THE YEAR WITH COLD AISLE DRY BULB TEMPERATURE HIGHER THAN TEH MAXIMUM ALLOWED DRY BULB	0.000 %
PERCENTAGE OF THE YEAR WITH COLD AISLE RELATIVE HUMIDITY HIGHER THAT THE MAXIMUM RH	0.000 %
PERCENTAGE OF THE YEAR WITH COLD AISLE DEW POINT HIGHER THAN THE ALLOWED MAXIMUM DEW POINT	0.377 %
EVAPORATIVE COOLER RUNNING %	0.000 %
EVAPORATIVE COOLER RUNNING TIME	154 hr
TOTAL EVAPORATED WATER	5,403 l/year
TOTAL EVAPORATED WATER (BASED ON 100KW OF IT LOAD)	6,484 l/year
TOTAL WATER CONSUMPITION (BASED ON 100KW OF IT LOAD)	9,726 l/year

RECOMMENDED OPTIONS

CHILLED WATER OR DX SUPPLEMENTARY COOLING	NO	Unit running in evaporative cooling mode is able to maintain the dry bulb and relative humidity within the limit of the ASHRAE class A1. However it is not able to maintain the dew point below the limit of the A1 class (17°C Outside air conditions 5,6 & 8). If this is not acceptable supplementary cooling (DX or CHILLED WATER) to be sized for 100% of the IT load + 10% for fan heat rejection. Supplementary cooling to run for **0.361 % of the year** with unit running in full recirculating mode
WATER PIPE HEAT TRACING	YES	
INTERNAL ELECTRIC HEATER	YES	
DAMPERS DEFROST HEATER	YES	Also require actuators with heat tracing
100 MM THICK THERMAL INSULATION	NO	

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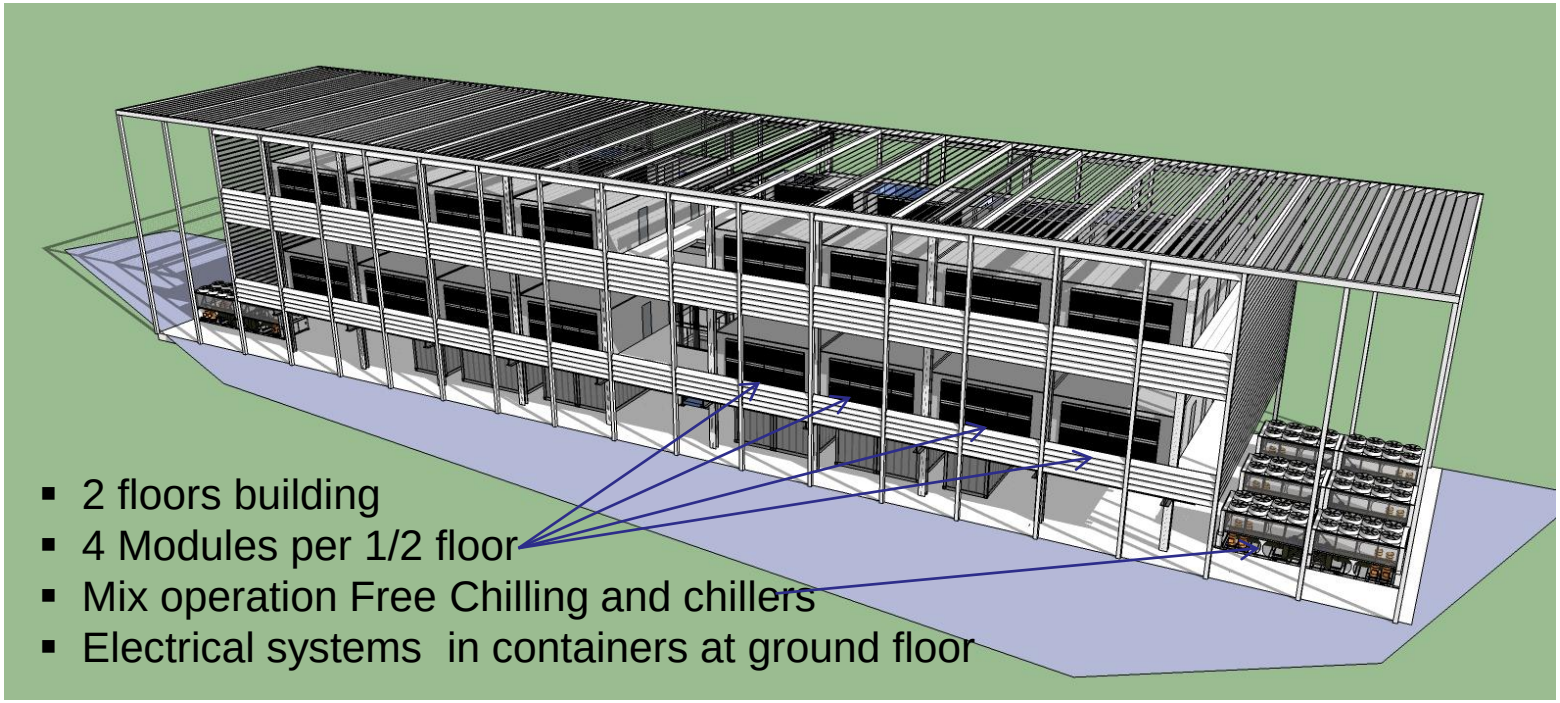
Sample Project Layout Design
80 to 320 Cabinets (up to 4.8Mw IT HQ)

A modular approach build around the CommScope advance solution DCU-20:

- 20 Cabinets per module
- Up to 30 kW per cabinet
- Native Free Cooling for low PUE and reduced cost of operation
- Pre-manufactured solution for high quality and fast deployment



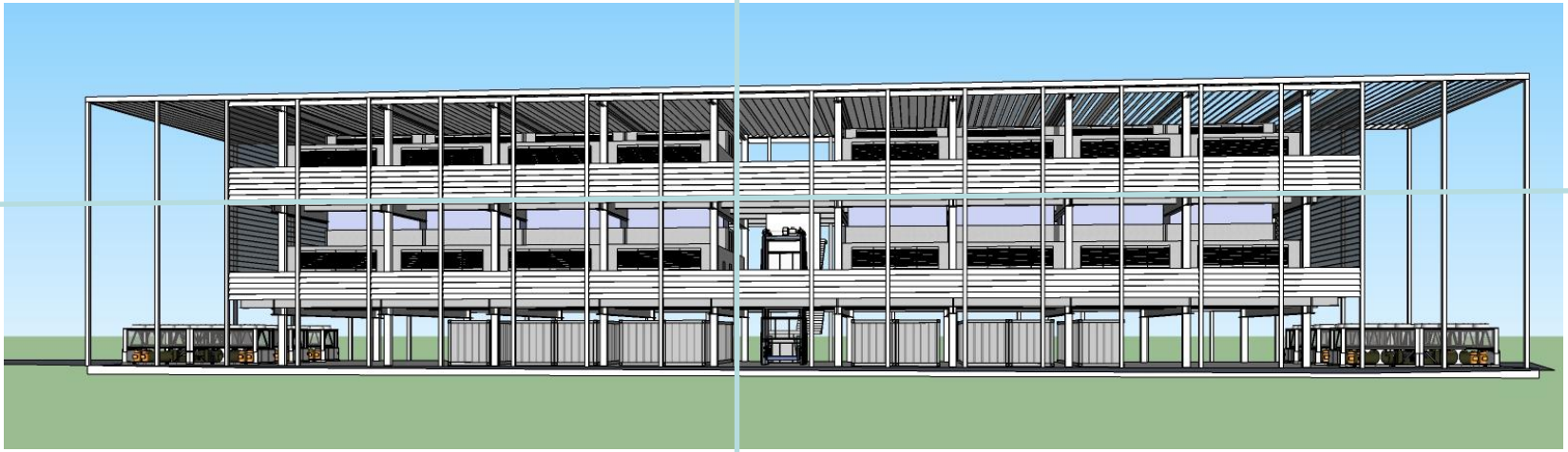
Sample Project Layout design Phase 600kw (60 cabs)

A modular approach for a phased investment up to 4 phases

- First phase construction lead time : max 8 months (not including building permit)
- Time to expand : max 4 months

Phase 4 / + Second floor
320 cabinets

Phase 1 / + Second floor
160 cabinets



Phase 3 / Ground floor + first floor
240 cabinets

Phase 1 / Ground floor + first floor
80 cabinets

Sample Project CAPEX estimates

These CAPEX estimates are calculated on a Tier 3 + configuration (equivalent to a Tier 4 infrastructure fully redundant 2N without the additional cost of the +1 component per stream)

Phase 1	7 kW / Rack	10 kW / Rack
Racks	80	80
Power HQ IT	**560 kW**	**800 kW**
kW / m²	3	4
CAPEX	***6 700 000 €***	***7 250 000 €***

Phase 4	7 kW / Rack	10 kW / Rack
Racks	320	320
Power HQ IT	**2 240 kW**	**3 200 kW**
kW / m²	3	4
CAPEX	***16 250 000 €***	***18 500 000 €***

Moving to a flat land will save the metallic structure estimated at 2,5 M€ (Phase 4)
Moving to a standard Tier 3 installation can save 10 to 15 % of the CAPEX figures

Sample Project –Cost Per Cabinet

Currently most Data Centre are designed for 2 to 3 kW Max per m² (except HPC DC)

- 2 kW / m² = 5 kW per Cabinet
- 3 kW / m² = 7,5 kW per cabinet (defined as high density)

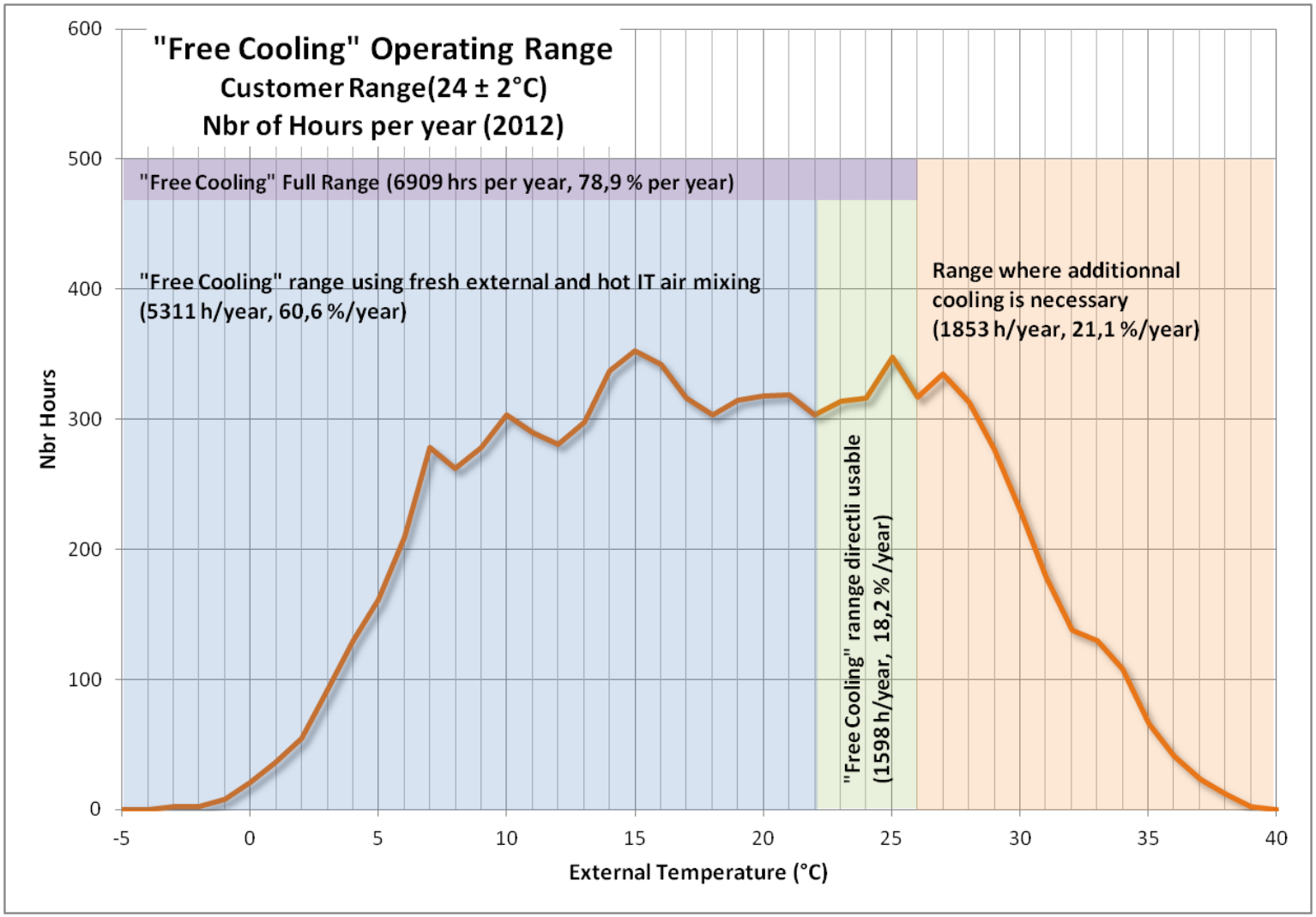
Tier 3 + reference							
k€	KW m²	Surface m²	Cost m²	Racks	Cost Racks	Surface Rack	Power Rack kW
13 000 000	1	1000	13000	400	32 500 €	2,5	2,5
16 000 000	2	1000	16000	400	40 000 €	2,5	5
19 000 000	3	1000	19000	400	47 500 €	2,5	7,5
21 000 000	4	1000	21000	400	52 500 €	2,5	10
24 000 000	5	1000	24000	400	60 000 €	2,5	12,5
27 000 000	6	1000	27000	400	67 500 €	2,5	15

Projet	Sample Project
Racks	CAPEX
320	10 400 000 €
320	12 800 000 €
320	15 200 000 €
320	16 800 000 €
320	19 200 000 €
320	21 600 000 €

Tiers 3 reference							
k€	KW m²	Surface m²	Cost m²	Racks	Cost Racks	Surface Rack	Power Rack kW
11 000 000	1	1000	11000	400	27 500 €	2,5	2,5
13 000 000	2	1000	13000	400	32 500 €	2,5	5
15 000 000	3	1000	15000	400	37 500 €	2,5	7,5
17 000 000	4	1000	17000	400	42 500 €	2,5	10
19 000 000	5	1000	19000	400	47 500 €	2,5	12,5
21 000 000	6	1000	21000	400	52 500 €	2,5	15

Projet	Sample Project
Racks	CAPEX
320	8 800 000 €
320	10 400 000 €
320	12 000 000 €
320	13 600 000 €
320	15 200 000 €
320	16 800 000 €

Sample Project
Free & Additional Cooling Hours



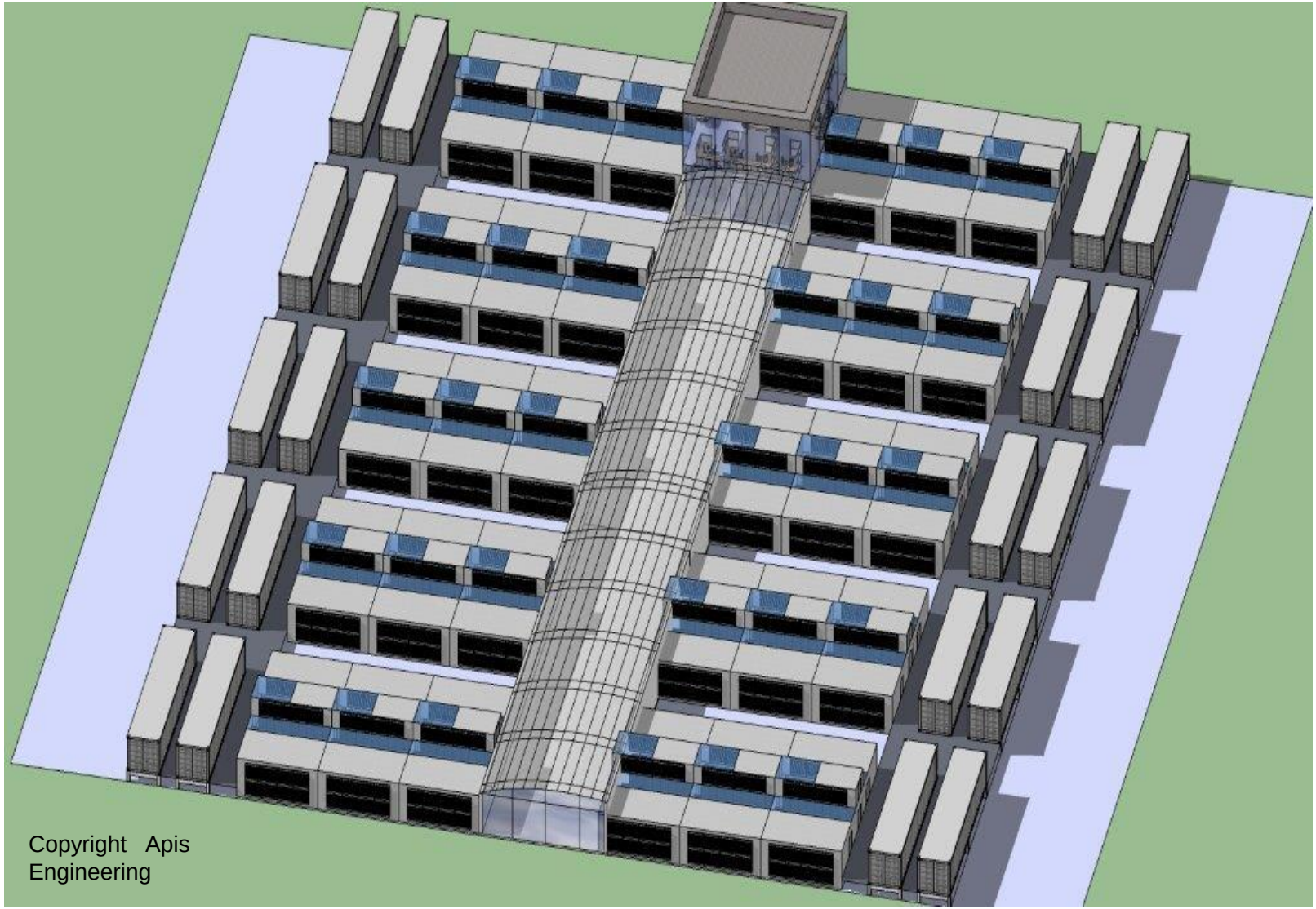
Sample Project
OPEX Energy / Saving with Free Cooling

Year		2015	2016	2017	2018	2019	2020	2021	2022
Phase		1		2		3		4	
Target IT Load (kW)		800		1600		2400		3200	
IT Load (KW)		400	800	1200	1600	2000	2400	2800	3200
Load rate		50%	100%	75%	100%	83%	100%	88%	100%
PUE Chillers ASHRAE 2008 (Reference)		1,87	1,63	1,69	1,63	1,66	1,63	1,65	1,63
	Energy (MWh/Year)	6 552	11 423	17 765	22 846	29 083	34 269	40 471	45 692
	Energy Cost (k€/year)	721	1 257	1 954	2 513	3 199	3 770	4 452	5 026
	Cumulative Energy Cost (k€)	721	1 977	3 931	6 445	9 644	13 413	17 865	22 891
PUE Free Cooling + Chillers ASHRAE 2011		1,49	1,31	1,35	1,31	1,33	1,31	1,32	1,31
	Energy (MWh/Year)	5 221	9 180	14 191	18 361	23 302	27 541	32 377	36 722
	Energy Cost (k€/year)	574	1 010	1 561	2 020	2 563	3 030	3 561	4 039
	Energy Savings (MWh/year)	1 332	2 243	3 574	4 485	5 782	6 728	8 094	8 970
	Cost Savings (k€/year)	146	247	393	493	636	740	890	987
	Energy & Cost Savings (%/year	20,32%	19,63%	20,12%	19,63%	19,88%	19,63%	20,00%	19,63%
	Cumulative Energy Cost (k€)	574	1 584	3 145	5 165	7 728	10 758	14 319	18 359
	Cumulative Cost Savings (k€)	146	393	786	1 280	1 916	2 656	3 546	4 533
	Cumulative Cost Savings (%)	20,32%	19,88%	20,00%	19,86%	19,86%	19,80%	19,85%	19,80%
PUE Free + Evaporative Cooling ASHRAE		1,41	1,23	1,27	1,23	1,25	1,23	1,24	1,23
	Energy (MWh/Year)	4 941	8 620	13 350	17 240	21 900	25 860	30 415	34 479
	Energy Cost (k€/year)	543	948	1 469	1 896	2 409	2 845	3 346	3 793
	Energy Savings (MWh/year)	1 612	2 803	4 415	5 606	7 183	8 410	10 056	11 213
	Cost Savings (k€/year)	177	308	486	617	790	925	1 106	1 233
	Energy & Cost Savings (%/year	24,60%	24,54%	24,85%	24,54%	24,70%	24,54%	24,85%	24,54%
	Cumulative Energy Cost (k€)	543	1 492	2 960	4 857	7 266	10 110	13 456	17 248
	Cumulative Cost Savings (k€)	177	486	971	1 588	2 378	3 303	4 409	5 643
	Cumulative Cost Savings (%)	24,60%	24,56%	24,71%	24,64%	24,66%	24,63%	24,68%	24,65%

More than 20 % energy saving positioned

Up to 3,5 M€ of OPEX reduction aver 7 years

CommScope – Example DCU-30 Expandable

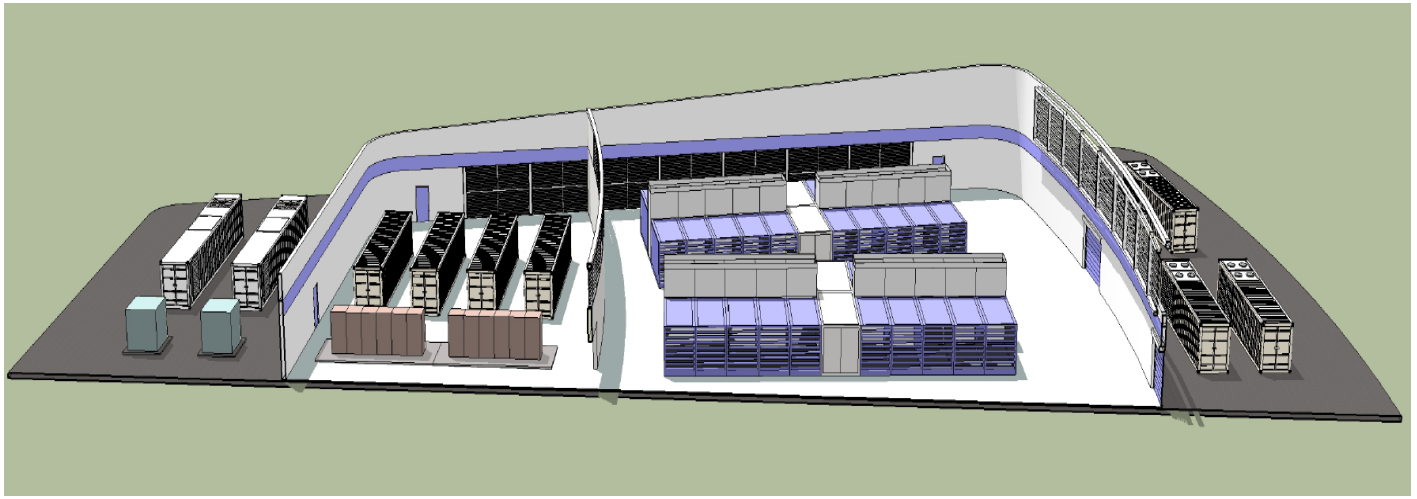


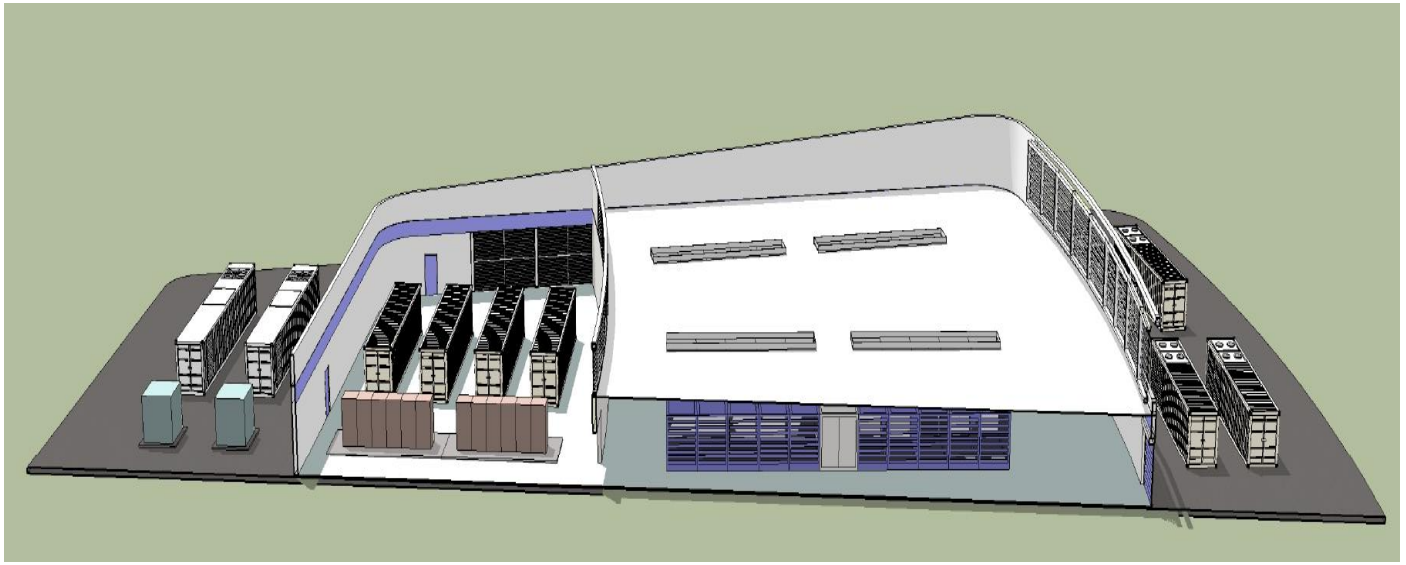
CommScope – Example DCU-20 Vestibule

True Collocation Hallway, Ample room for Rack and Pallet Movement,
Doors on IT Rooms and Electrical Panels Not Shown
Customizable Room for Technician Benches, Patch Panels (MDF/IDF), UPS

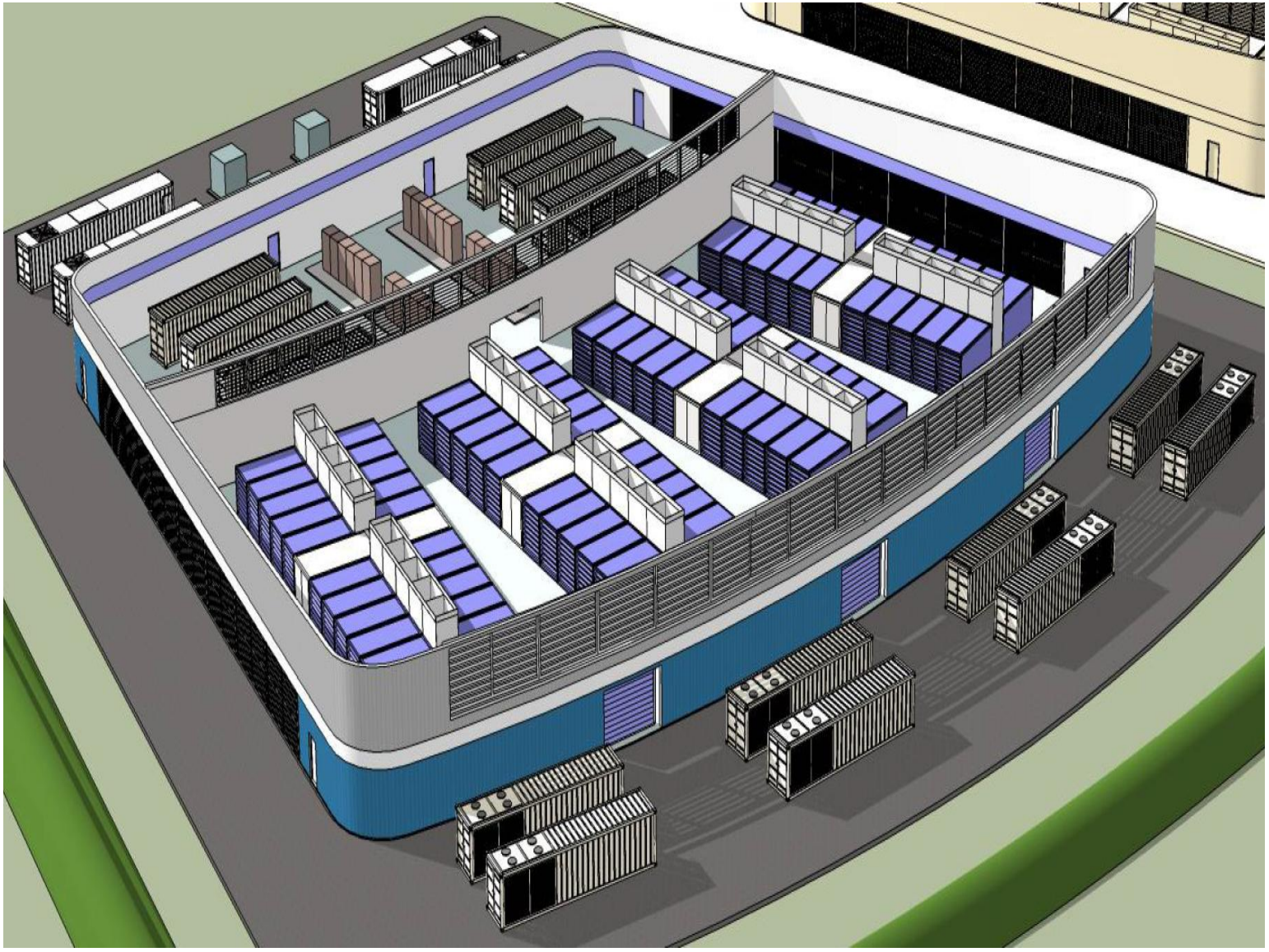
CommScope – Example 120Rack
Tier 3 Secure Building

CommScope – Example 120Rack
Tier 3 Secure Building

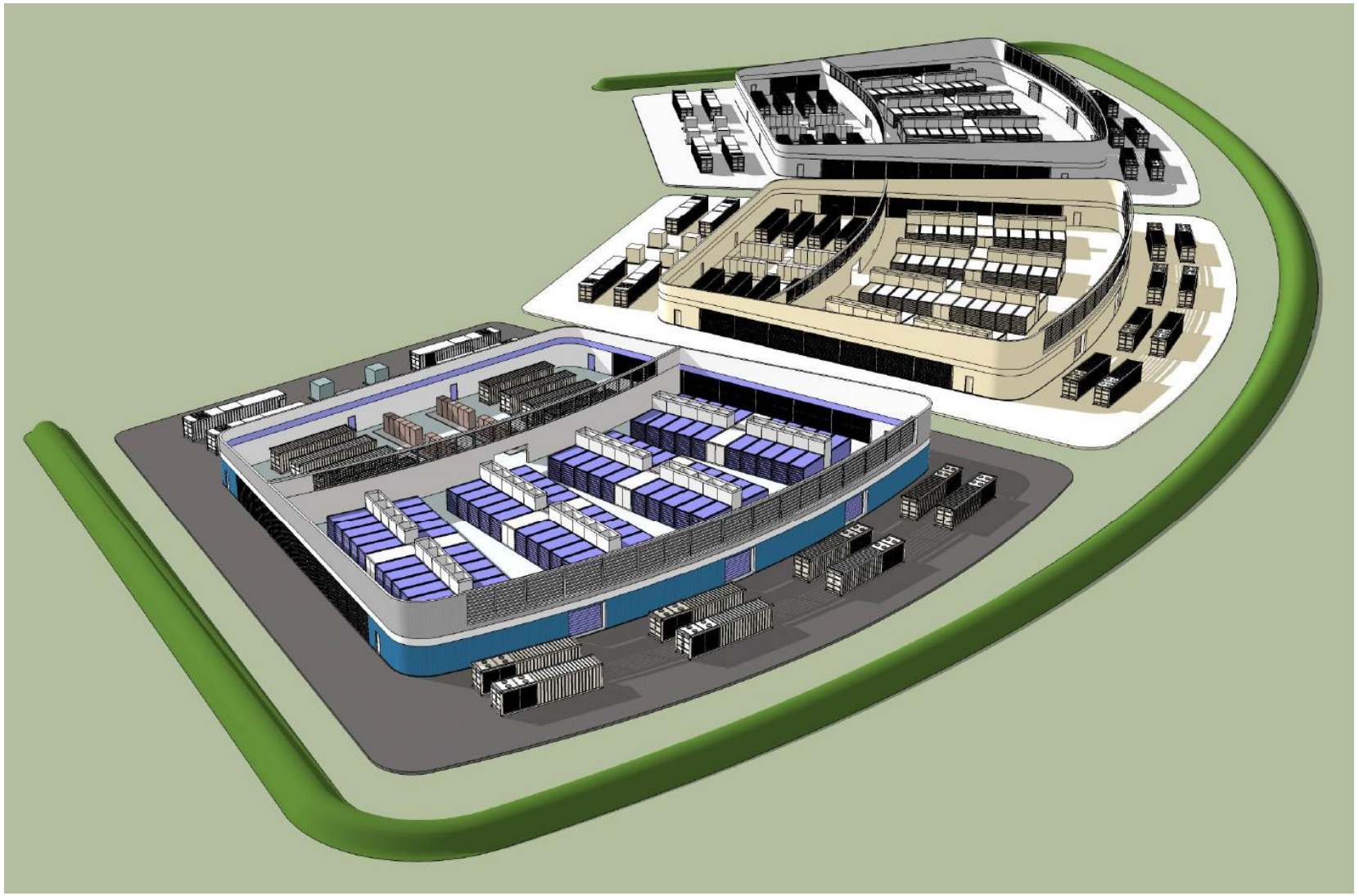




CommScope – Example 120Rack
Tier 3 Secure Building



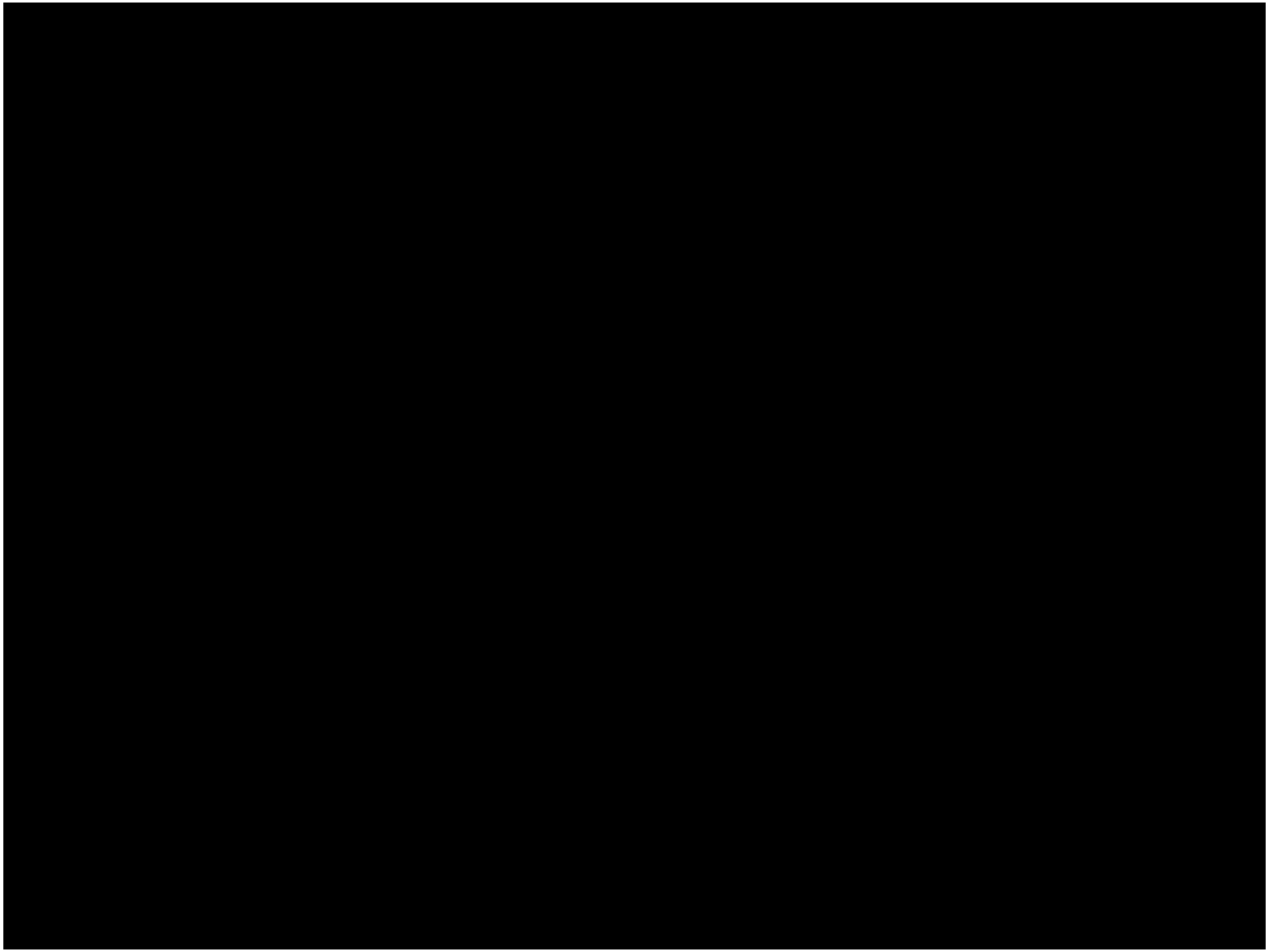
CommScope – Example 120Rack
Tier 3 Secure Building



DCoD – Purpose Built Data Centers

- **TCO**
  - Highly Efficient Data Centers (PPUE) of **1.03 to 1.06**
  - Extremely Competitive Cost PER MW
  - Right Sized Based on Your Requirements
  - Outside Air, Innovative Evaporative Cooling and Re-Heating System
- **Agility and Flexibility**
  - Expandability On Demand
  - CommScope Designs and Delivers Infrastructure
  - Racks, Cabinets, White Space
  - Off-the-Shelf Options or Customized
  - Deployed indoor or outdoor
- **Operational Manageability**
  - Comprehensive Fully Remote DCIM
  - Familiarity
  - Extremely Low Maintenance

CommScope DCoD



Thank You