FCCN UNIDADE DA FCT
Tecnologia para o Conhecimento

# A DATACENTER NETWORK FOR THE PORTUGUESE NREN

## (NATIONAL RESEARCH AND EDUCATION NETWORK)

João Pagaime, FCT-FCCN

IBERGRID 2022

Oct 10 – 13, 2022
Universidade do Algarve

IBERGRID

FCCN

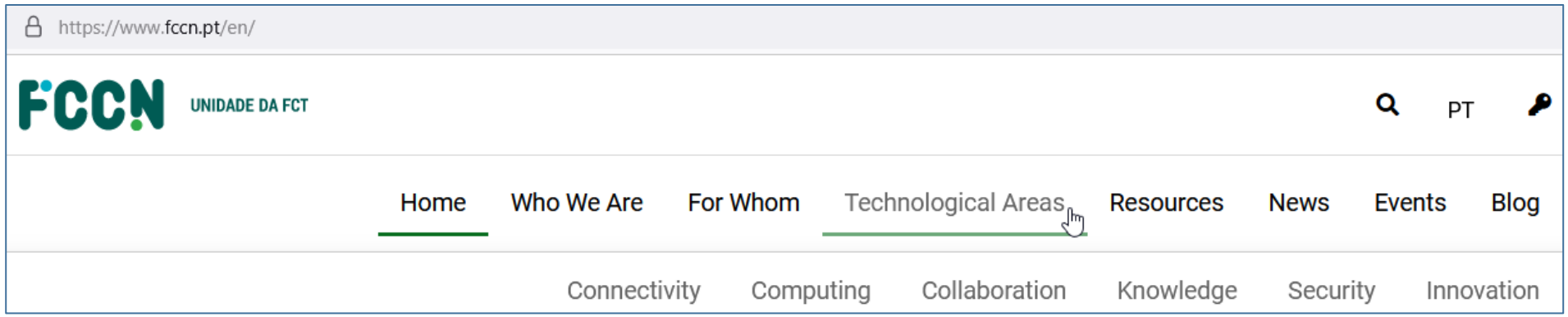
ESTATUTOS DA FUNDAÇÃO PARA A CIÊNCIA
E A TECNOLOGIA, I. P.

2 — A organização interna da FCT, I. P., integra ainda a unidade orgânica da Computação Científica Nacional.

## FCCN Services

- Portuguese **NREN** - National research and education network
- Connectivity (multilayer) – IP, logical, physical . Eduroam. Voice over IP, …
- Computing
  - Advanced Computing Network
  - Cloud (administrative, european)
  - Datacenter services - Housing

- … and more… see:



# DATACENTERS

(also know as "equipment room“)


30 m2
(co-management)

200+100 m2
(Direct management)

25 racks
(commercial contract)

3 racks
(colocated at UTAD – Protocol)

2 racks
(Colocated at U. Aveiro – Protocol)

Other locations restricted to telco services only (no servers co-located there)

# LISBON DATACENTER (200M2)

- Started operating 2008

- Multi-purpose:
  - NREN “can’t stop” type of services and
  - Advanced Computing / High Performance

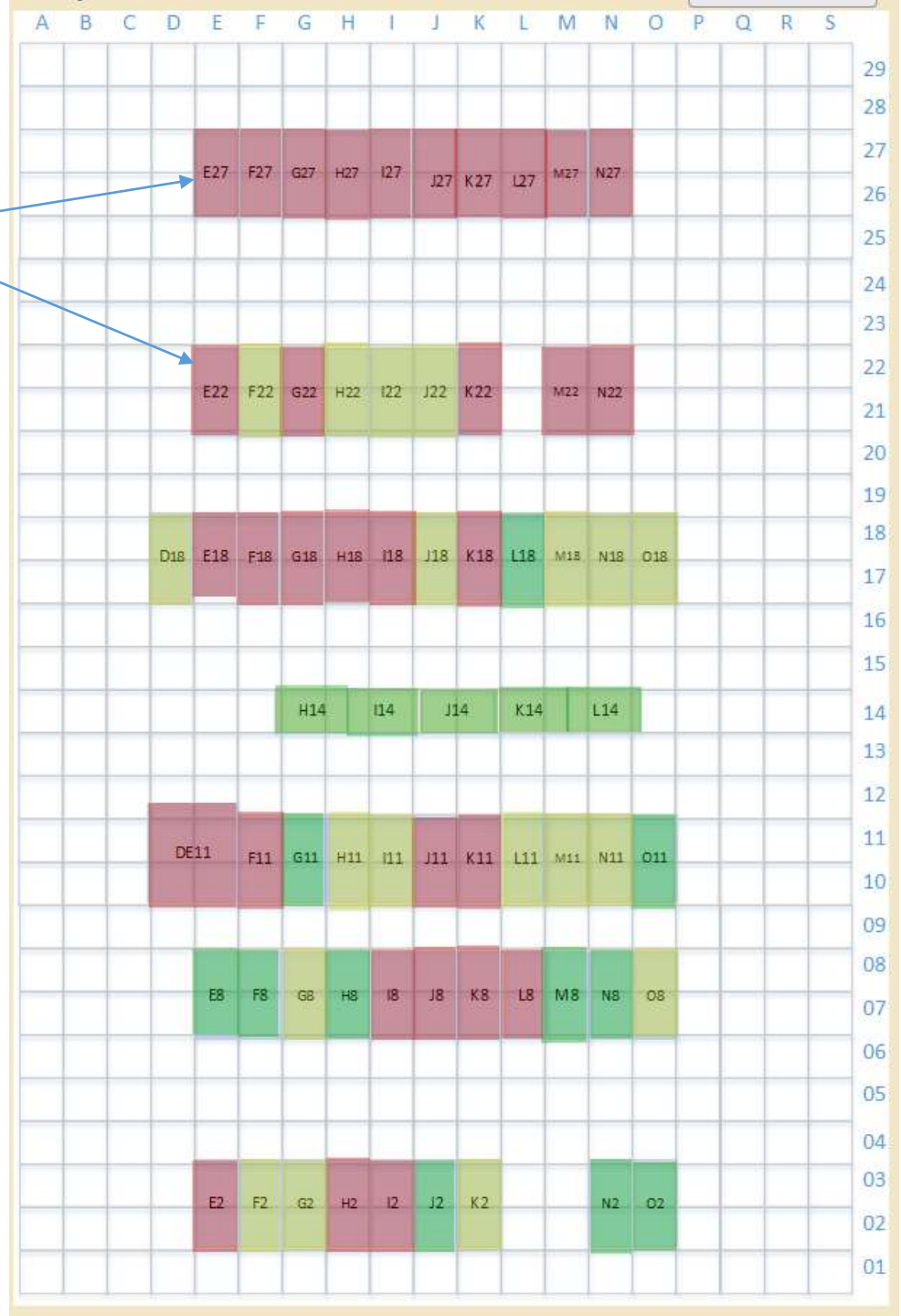
- Evolutive topologies, formally a Tier-1 (no secondary generator set)

@ LNEC - National Laboratory for Civil Engineering

# LISBON (200M2)

Dense computing

- Area: 200 m2
- ~60 racks




@ LNEC - National Laboratory for Civil Engineering

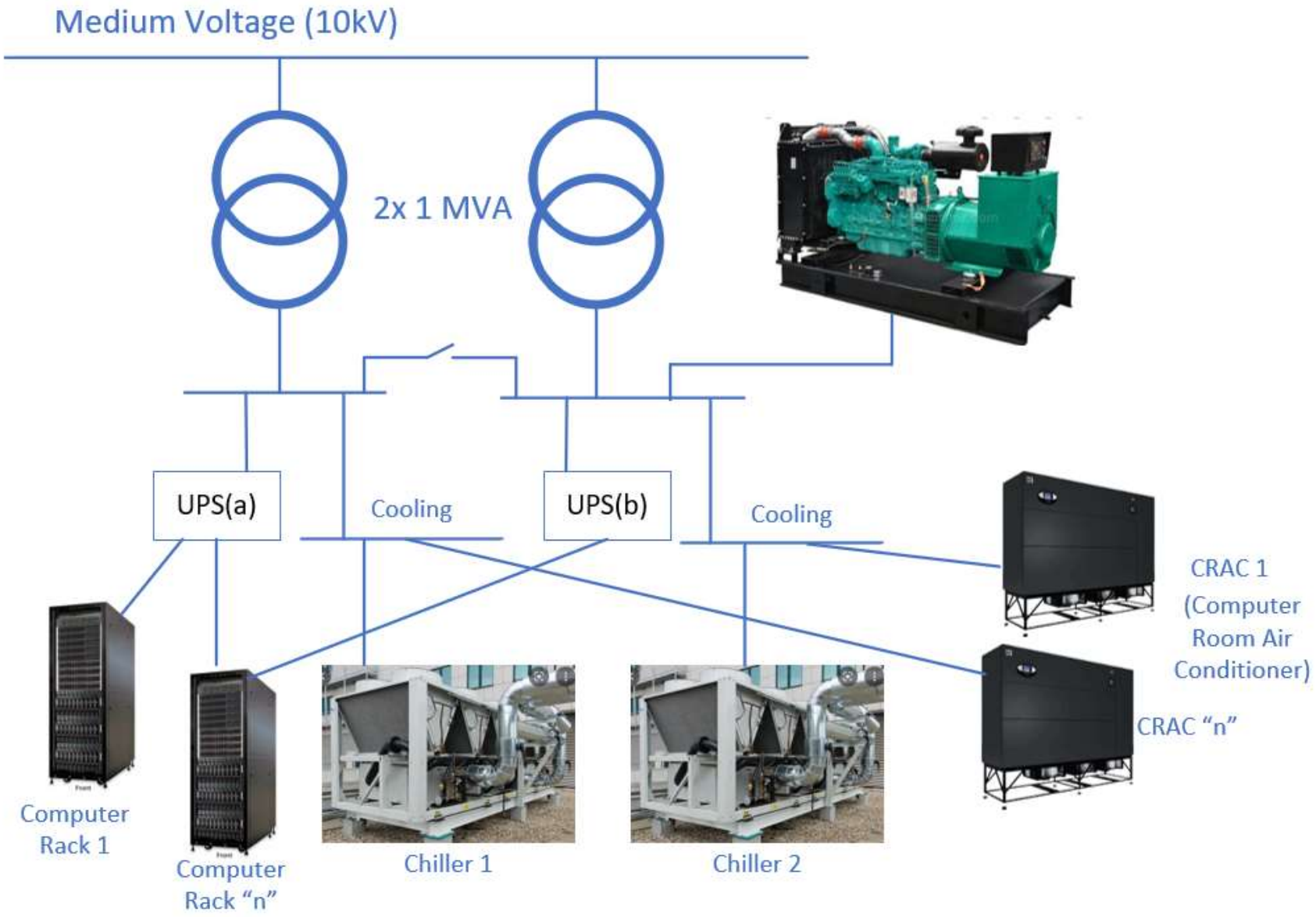
FCCN UNIDADE DA FCT

FCT Fundação para a Ciência e a Tecnologia

# LISBON DATACENTER (200M2)

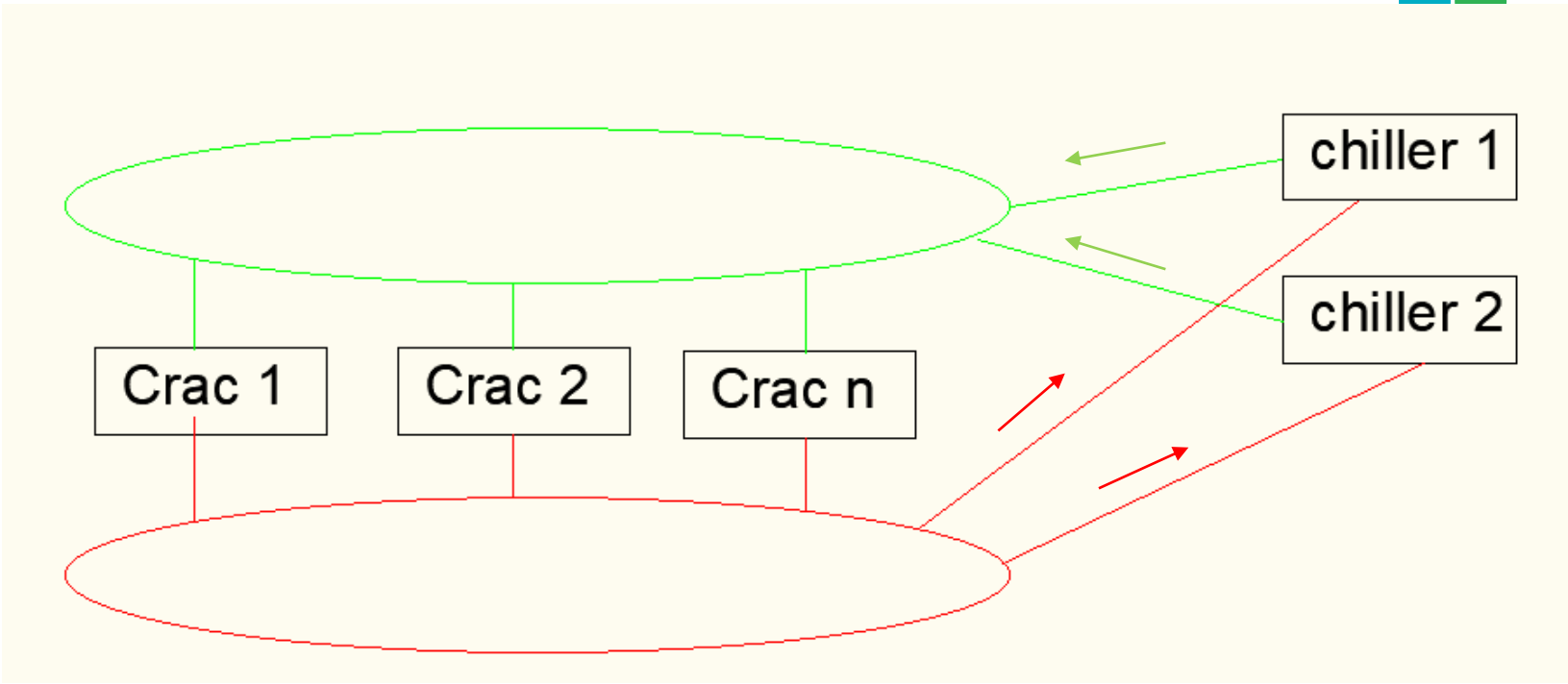
Simplified:

- Tier-1 (no secondary genset)
- mostly dual path
- Medium power density ~1,5 KW/m2



# LISBON (200M2)

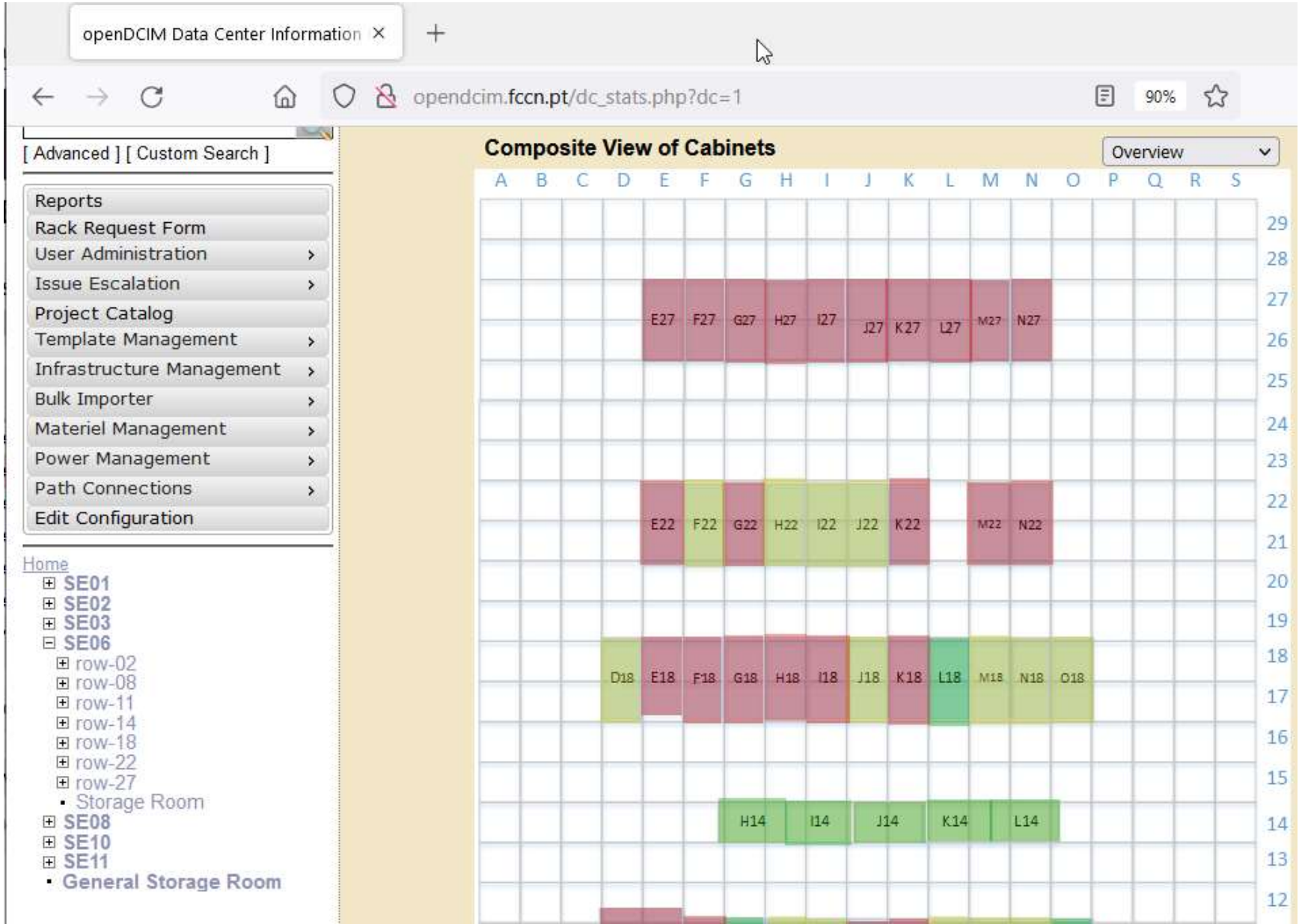
Simplified:




- Water coolled (2 chillers – air cooled – compressor)
- With alternative paths / ring topology.
  - Main goal: being able to repair/ replace any valve, or other single element
- CRAC units & raised floor (90cm), with nx200KW peripheral units
- Dense corridors have a maximum of 3 rows of perforated tiles (3x10 tiles)
  - Without additional fan-coils, can go up to 10KW /rack on the “dense” corridors

# MANAGMENT TOOLS

- Inventory
- Simple database model – easy exports and integrations




FCCN UNIDADE DA FCT

NagVis Open Actions User menu

FCCN Tecnologia para o Conhecimento — UNIDADE DA FCT — AIA 202

## SE01

Sala: 27

[7] [8]

27 27

## SE02

B-I4: 22 — B-F6: 20 HR% 47

[1] [2] [3] [4]

24 [Ar*] 22 22 [Ar*] 23

0 0

[ºC]

38

[AVAC total] [AC3] 10 [kW]

5.97 [kW] [AC4] 2.51

[NRG01] 17 [total kW, s/AVAC]

## SE03

B-5C: 23 HR% 48 — B-3D: 23 — S. Energia: 26

[1] [2] [3, energia] [5] [6] [7]

20 15 [Ar*] 26 27 [Ar*] 17 17

[pressostato]

[ºC, topo] [1] [2]

24 Load_kW 11 13 12 Load_kW 14 10 13

kW 0.0

[NRG02] 1.12 [total kW]

Recurso SE06 2 [kW]

## SE06

Repartidor: 25 — S. Energia: 27 — zona LIP: 22 HR% 53 — Ambiente (exterior): 26.1

[1] [2] [3] [4, energia]

HR% 73.5 HR% 62.0

26.2 24.3 26.8 25.5

[teamwork] [Δlit] 0

[1] [2]

[H2O*]

19.9 10.1

0.0 50.0

[1.1, 1.2] [2.1] [2.2]

Load_kW 45 28 28 Load_kW 23 15 15 Load_kW 15 13 17

[NRG01] 186 [total kW]

[NRG02] 119

kW 0

[bombas 1 | 2]

[1] [2]

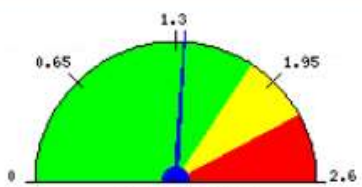
[kW] 1 62

## BOB

25 [ºC, B8.8]

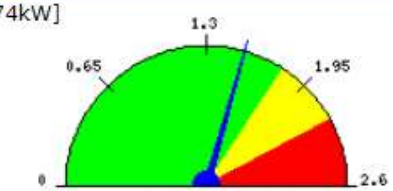
[kW]

## PUE

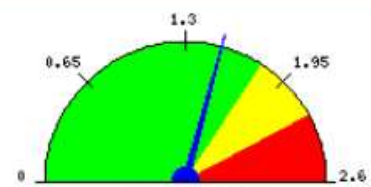



PUE: 1.358

[INF. estatica = 74kW]




PUE: 1.536

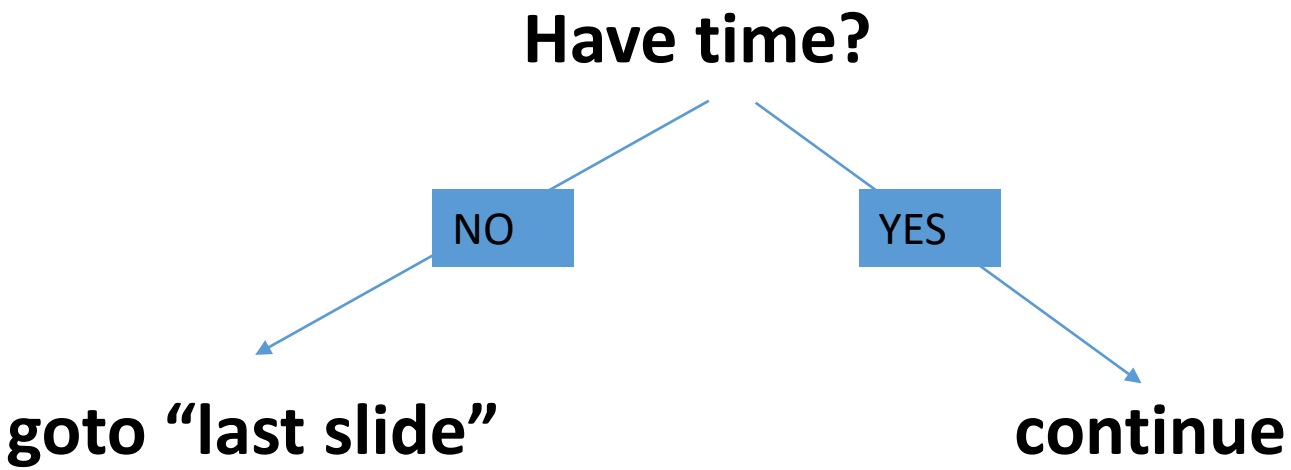



PUE: 1.524

# FUTURE PLANS

- 2022:
  - Universidade de Trás-os-Montes e Alto Douro

- 2023/4:
  - 200m2 - Avepark


Have time?
NO
YES
goto “last slide”
continue

# DENSE COMPUTING

## Main challenges

- Power distr. & Heat removal

- Tradeoffs: Energy efficiency / reliability

>=

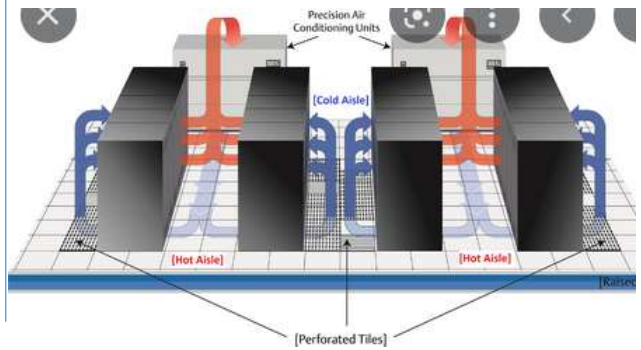
# DENSE COMPUTING

- **Solutions…**

Have a lot of free space? => you may not have a problem, just don't exceed airflow capacity of the access floor

Lower your density => no longer "dense computing". Problem solved!

Conventional raised floor



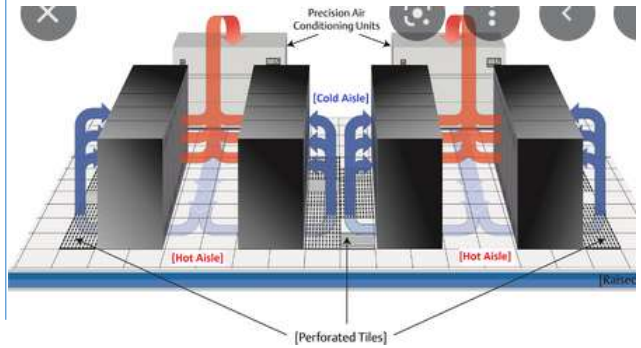
# DENSE COMPUTING

- **Solutions…**

There are now 30cm, +30 kW of in-row-type units! (each unit)

"In-row" type of solution

Conventional raised floor

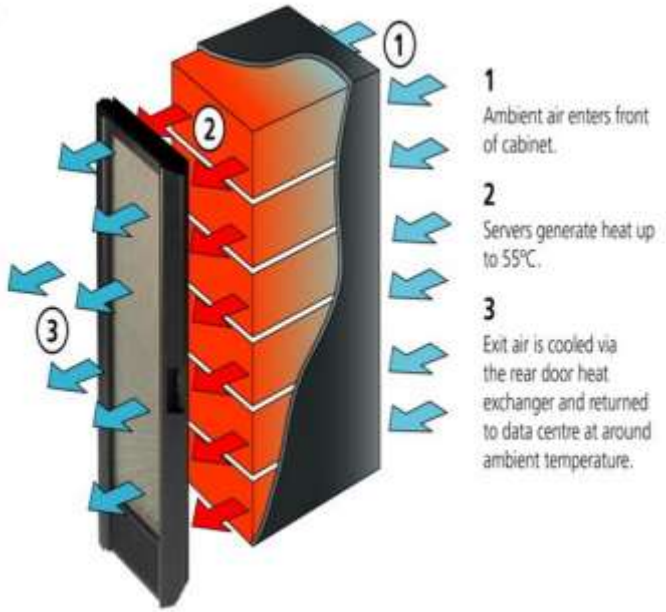


# DENSE COMPUTING

- **Solutions…**

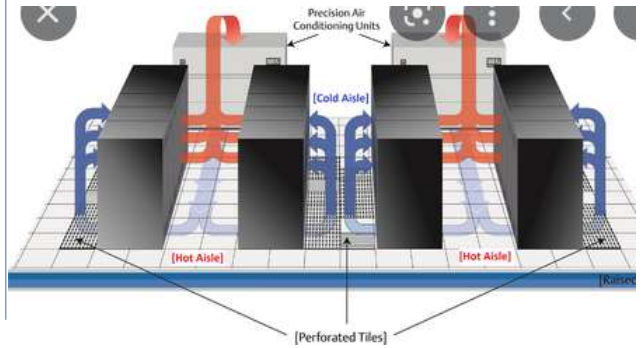
50 KW per rack!
(“fan-coil” door)

## Rear door Heat Exchanger (Deucalion)




## “Inrow” type of solution

## Conventional raised floor



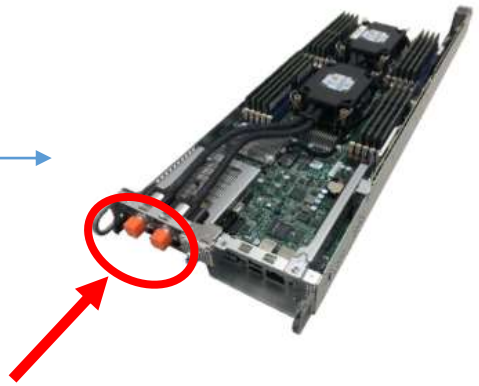

FCT Fundação para a Ciência e a Tecnologia

# DENSE COMPUTING

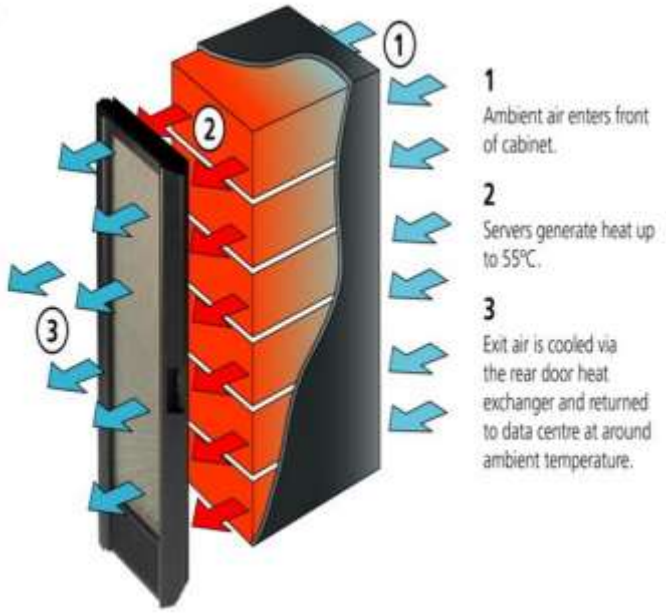
- **Solutions…**

- Not “ordinary” servers
- Heat goes directly to the datacenter water circuit, or maybe through a heat exchanger

“Water to the server/Blade”

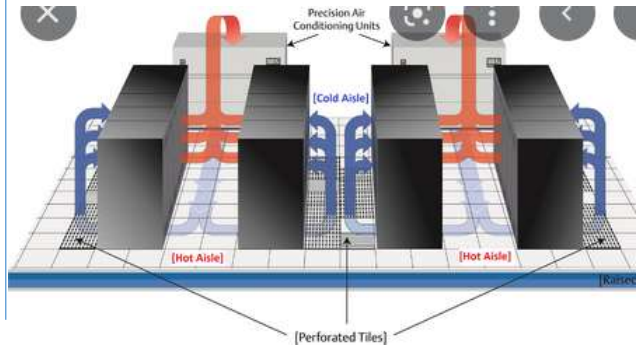


Rear door Heat Exchanger (Deucalion)




“Inrow” type of solution

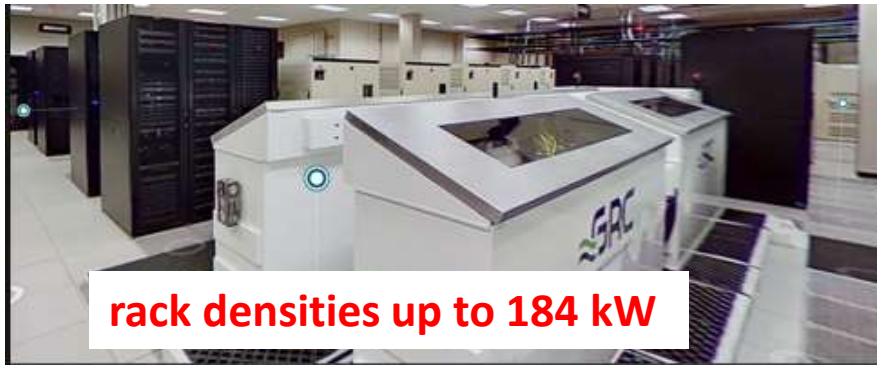
Conventional raised floor



# DENSE COMPUTING

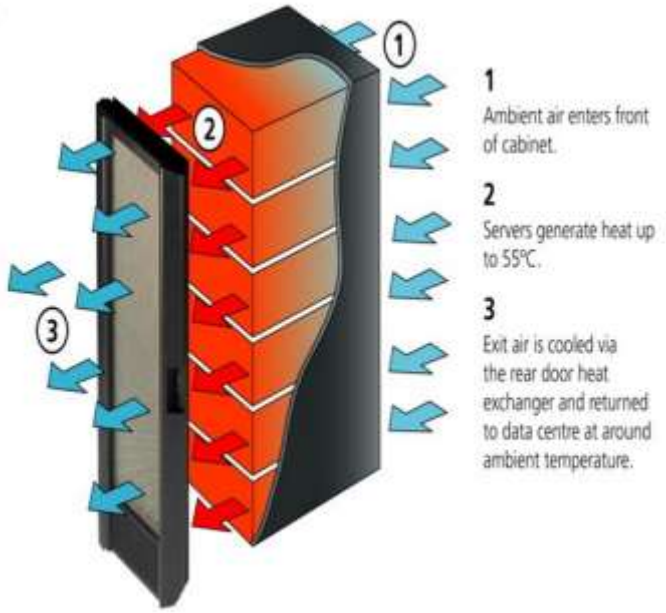
- **Solutions…**

## Liquid-Immersion Cooled (Frontera - TACC)



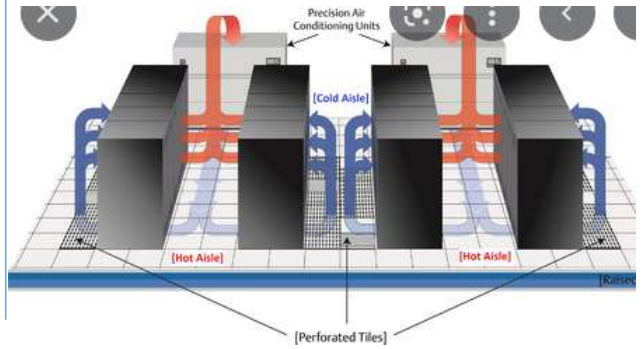

## “Water to the server/Blade”

## Rear door Heat Exchanger (Deucalion)




## “Inrow” type of solution

## Conventional raised floor




FCT Fundação para a Ciência e a Tecnologia

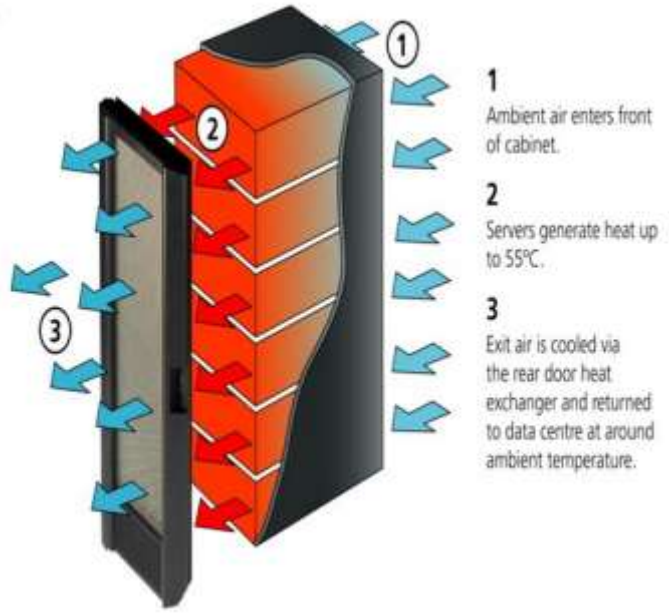
# DENSE COMPUTING

- **Solutions…**

Liquid-Immersion Cooled (Frontera - TACC)

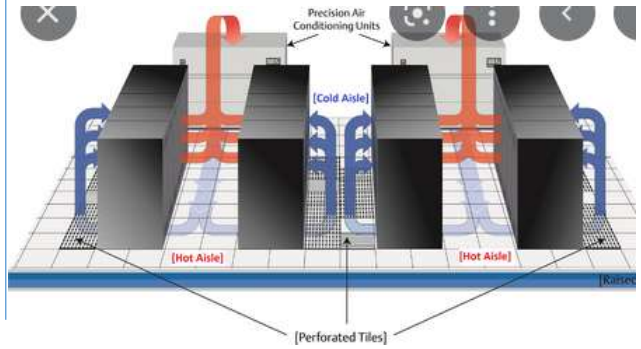
"Water to the server/Blade"

Rear door Heat Exchanger (Deucalion)




"Inrow" type of solution

Conventional raised floor




Other: custom build

- engineered to a specific function
- Tipically more static solutions, less flexible

# DENSE COMPUTING

- Power Usage Effectiveness (PUE) - efficient cooling makes a significant contibution to this metric

"Modern" environmentally responsible metrics (Green Grid Data Center Sustainability Metric)

- Energy Reuse Effectiveness (ERE) - can you reuse the heat?
- Water Usage Effectiveness (WUE) - evaporative cooling or mechanical (compressor) cooling? (or other) How to strike a balance?
- Carbon Usage Effectiveness (CUE) – what's your carbon footprint?

# CHALLENGES AHEAD

September 2022, Reuters

**ELECTRICITY DEMAND CUT**

EU countries also agreed to a mandatory target to cut their electricity consumption from December to March, to ensure Europe has enough fuel to last the colder months.

During the 10% of hours of highest electricity demand each month, EU countries would be required to curb their power use by 5%. National governments would be responsible for designing measures to lower demand.

Europe could face a winter of mobile network blackouts - DCD - **Data Center** Dynamics

Data Center Dynamics

This potentially increases the prospect of mobile phone **outages**. This has led some European countries to try and ensure communications can resume ...

"In 2021 renewable electricity generation rose by almost 7%, a record 522 TWh increase, with wind and solar PV technologies together accounting for almost 90% of this growth. The share of renewables in global electricity generation reached 28.7% in 2021"

- intermittent nature of solar and wind (green energy sources)

- Should datacenter operators worry?
- Maybe it's a good time to remember:

The core premise, as set forth in the Tier Standard: Topology, is that the only reliable source of power for a data center is the engine-generator plant.

Can (will?) states invest in standby power?

# Thank you!

Melhores cumprimentos / Best regards,
Computação Científica Nacional (FCCN) / National Scientific Computing, of
Fundação para a Ciência e Tecnologia / Foundation for Science and Technology
(Technical Area Director) Joao.Pagaime (Arroba) FCCN.pt, +351 21 844 0 100