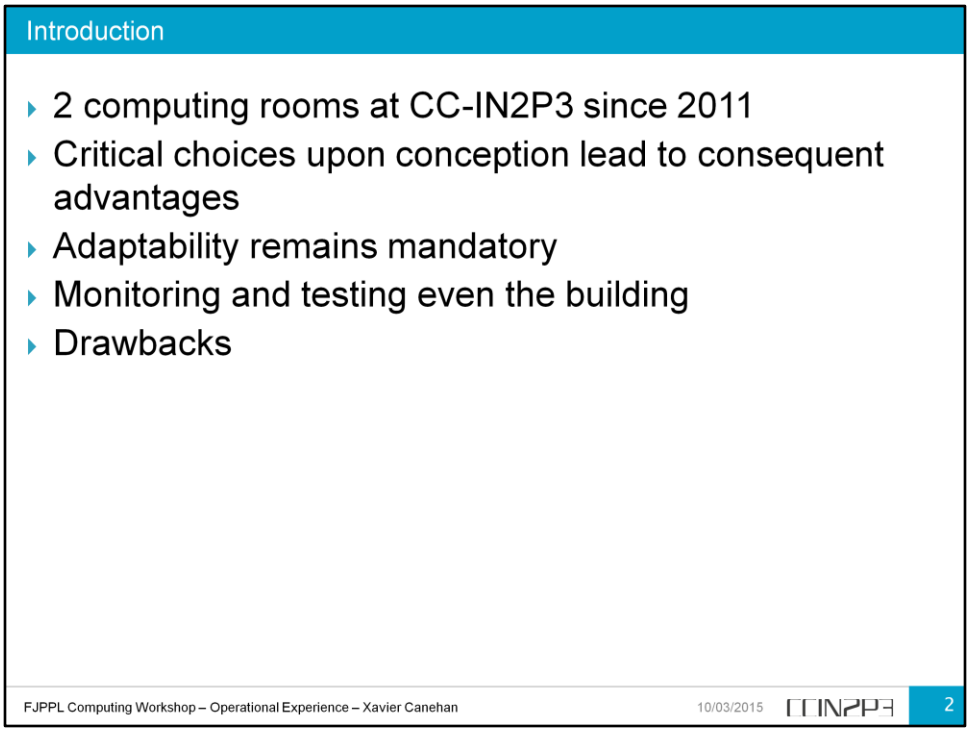
FJPPL Computing Workshop

Operational experience with second machine room at CC-IN2P3

Xavier Canehan

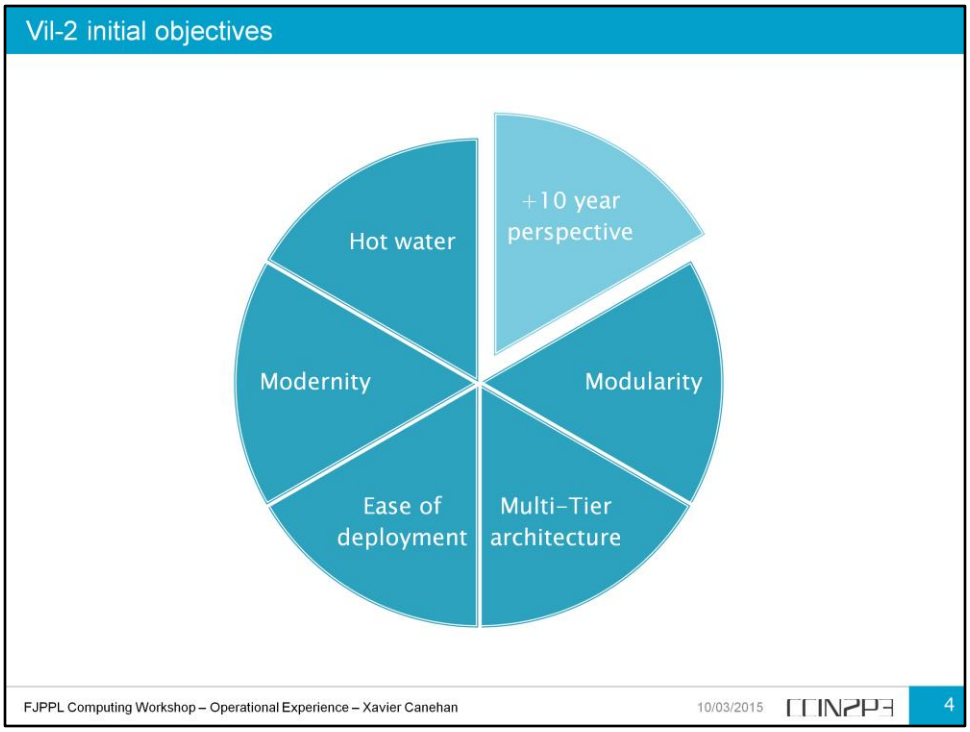


Testing the building: of course, testing UPS and backup systems.

Also, verify least expected equipements:
- Emergency boxes for alert cascading
- Cooling Pipes heating system…

2 computing rooms

Square feets and high power consumption



10 year perspective : last room could not stand any heavy restructuration.
1.6 MW building hard limit was touched.

Modularity from building to rack: building tought to allow deployment of new racks, new aisles, new infrastructure.

Multi-tier architecture: giving the right amount of security/redundancy to IT.

Ease of deployment: from building (ceiling rails, pre-positionned pipes) to Computing room (industrial power distribution) to racks.

Hot water: deal with University to get the land

Modernity: no raised floor, pipes above the racks, efficient cooling system, delivery room, heavy duty elevator

High Quality results of Initial Conception

- Modern computing room (details shown during visit)

Initial plan for 2011 - 2019

Target:

2011	2015	2019
50 racks	125 racks	240 racks
0.6 MW	1.5 MW	3.6 MW
Tier II	Tier III	Tier III-IV

- Multi-tier by design
- 3 phase deployment
  - first one dedicated to computing farm
  - relying upon regular budget

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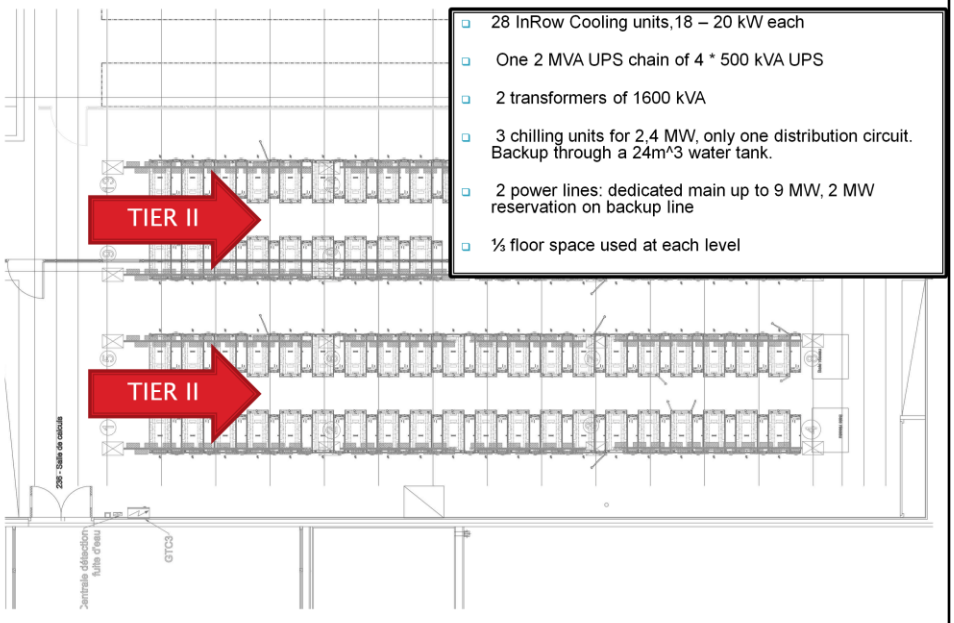
We choosed a hot aisle confined corridors technology: consequence of our commitment to provide hot water to our surroundings.

Multi-tier, as defined by the Uptime Institute:
- Tier II : minimal redundancy, 2 paths for electrical distributions
- Tier III : every circuit is doubled
- Tier IV : every component doubled, Grade A cooling system.

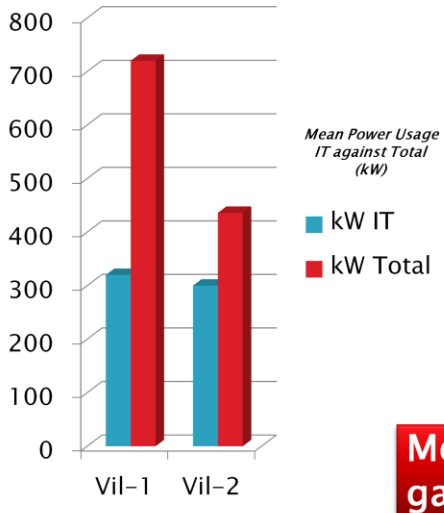
Our conception process gave us a long lasting, but versatile tool.

First phase: Tier II over 2 lines



- 28 InRow Cooling units,18 – 20 kW each
- One 2 MVA UPS chain of 4 * 500 kVA UPS
- 2 transformers of 1600 kVA
- 3 chilling units for 2,4 MW, only one distribution circuit. Backup through a 24m^3 water tank.
- 2 power lines: dedicated main up to 9 MW, 2 MW reservation on backup line
- ⅓ floor space used at each level

Site mean power usage, **PUE advantage to Vil-2**

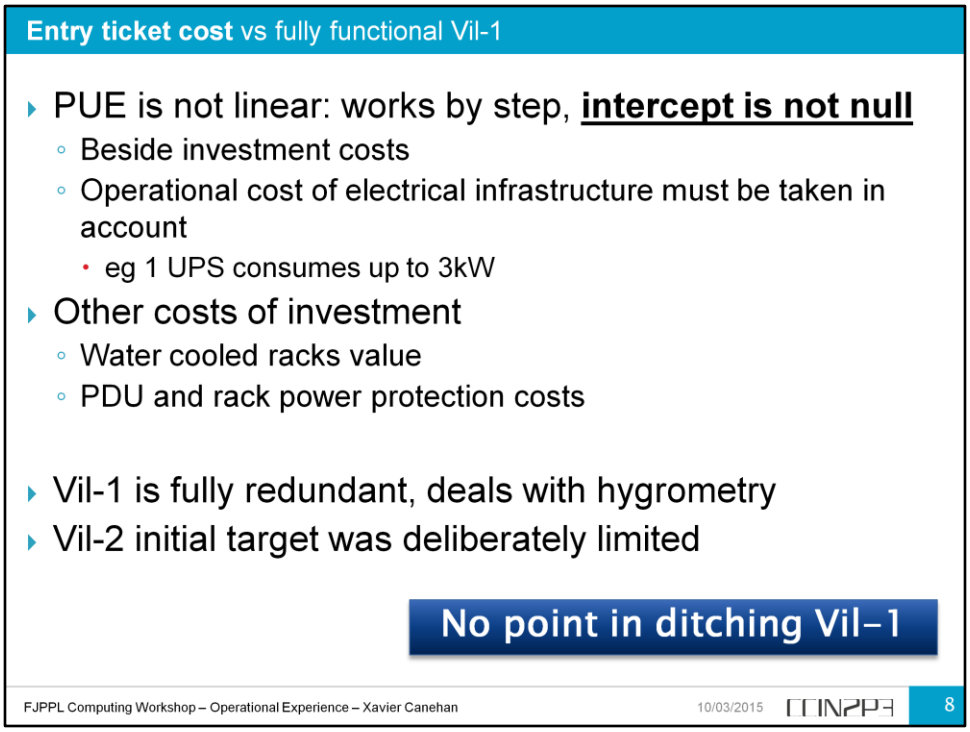


Site power consumption around 1.1 MW

Room	kW IT	kW Total	PUE
Vil-1	320	720 (-130)	1.84
Vil-2	300	440	1.46

Best PUE in Vil-2

Moving from Vil-1 to Vil-2 gains ~20% of power cost



You may think about PUE in terms of proportions, but it relies upon steps.
Those steps depend upon infrastrcuture capacity, which sets hard limits.

Moreover, an empty computing room will still have a cost of operation, depending on the minimal hardware needed to operate it.

Moving grounds

Adaptation remains mandatory

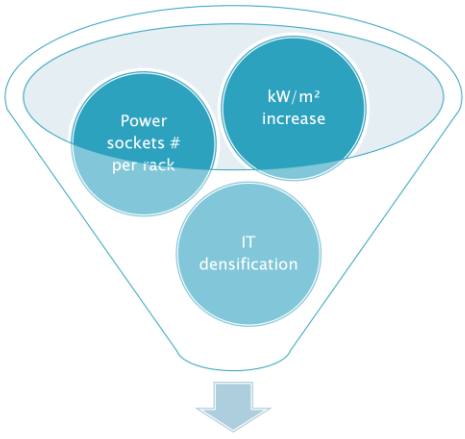
Have to evolve

- Environment changes
- Needs and perspectives clarify and evolve

- IT technology is volatile
- Infrastructure pace stays slower

- Monitoring everything

Environment – IT densification effects upon racks



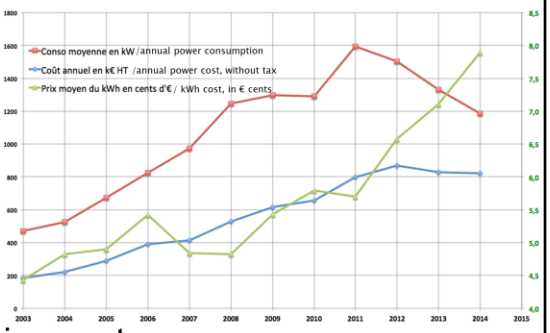
At rack limits

- Space floor is no more a problem
- 14 C6200 Dell PowerEdge will
  - approach InRow Cooling unit capacity (18kW)
  - need 45 sockets, 3 phases PDU
  - **(dedicated PDU development)**

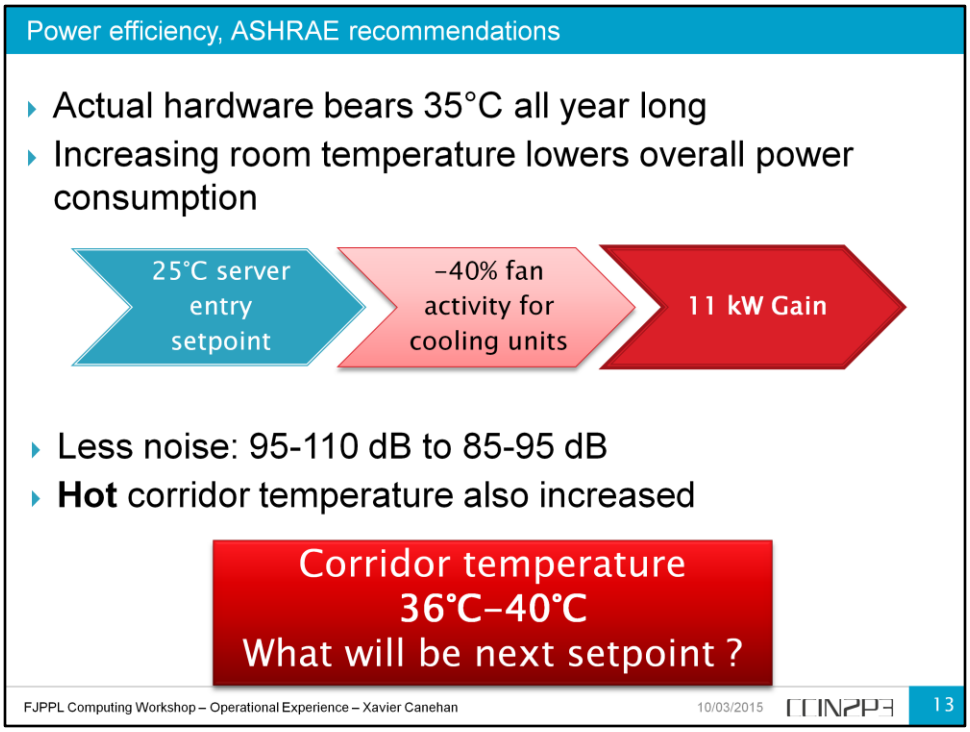
Partially filled racks to limit constraints

Environment – Power costs evolution

- 5% to 7% of annual power cost increase
- Looking for IT efficiency
- Fine tuned power contract helps to minimize costs



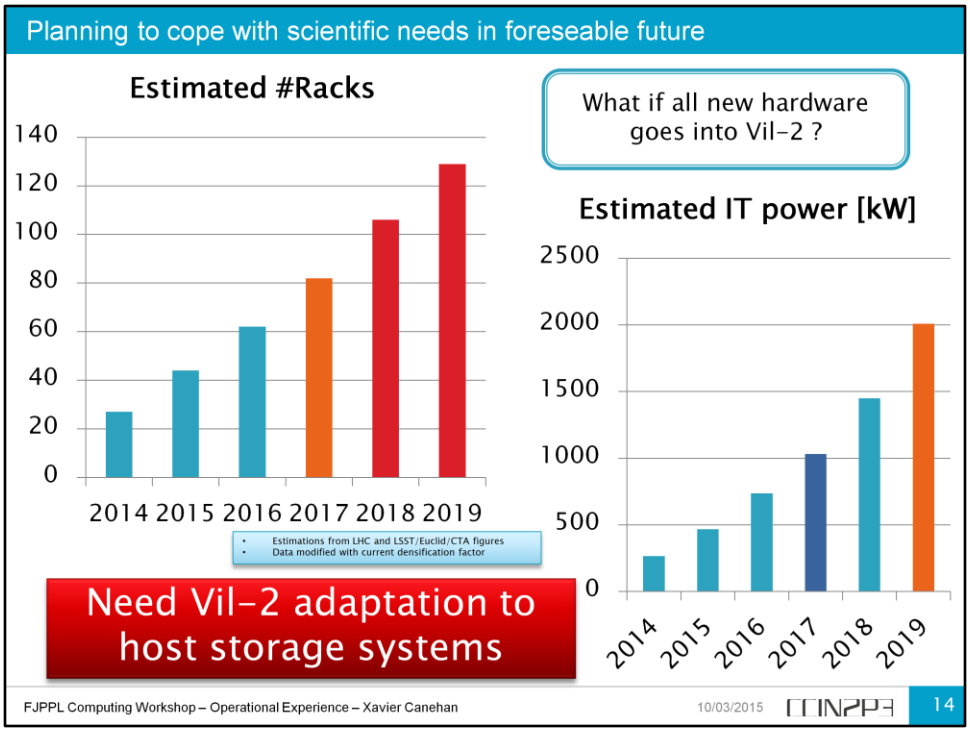
Seek the more efficient IT hardware in the most efficient room



If you don't need to cool, you get a major gain at the CRAC level.

35°C to 40°C : Class III ASHRAE recommendation, dew point is not a problem for us.

Conter-intuitive effect: people tend to open the doors when working in the hot corridor.
Less succion => InRow Units are less effective => front temperature increases => hot corridor temperature increases.



FUN fact: improving IT hardware efficiency will negatively impact PUE.

Changing IT cannot go without adaptation of building infrastructure.

Initial Plans revision

- Previous power and cooling distribution systems implied evolution by pair of hot corridors

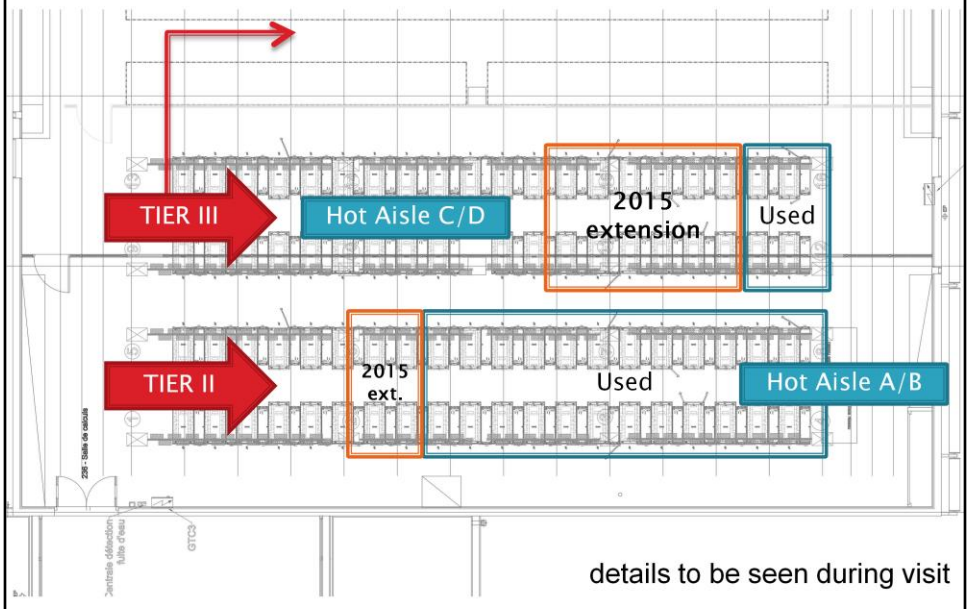
Infrastructure cost for each new lane: ~1.5 M€

- Minimizing costs by actual infrastructure hardware reuse

Adapting existing least used Tier II lane 2 phase plan less than 350 k€ per year

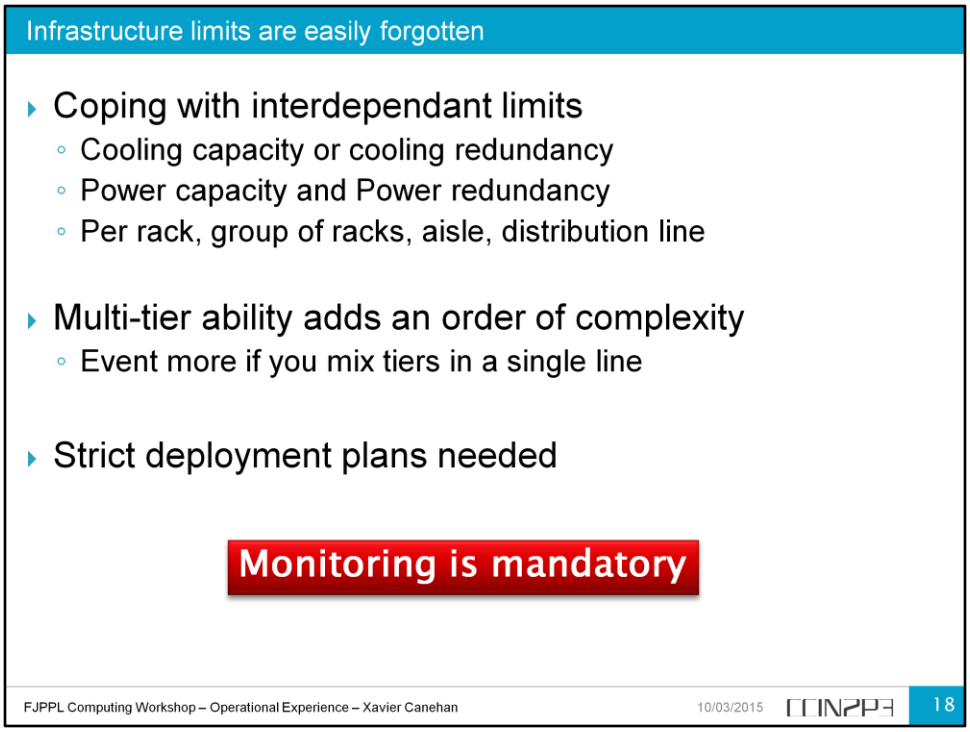
- 2017 aim:
  - 80 racks, 1 MW IT
  - 1 lane Tier II and 1 lane Tier III

Introducing Tier III – Phase 1, power redundancy



Drawbacks and limits

From details to major drawbacks



Rack cooling limit is 18 kW
Aisle cooling limit is 600 kW (per 150mm diameter pipe)
Power distribution is 32A 3 phases at 230V => ~ 22 kW max per rack
=> Lowest value must apply.

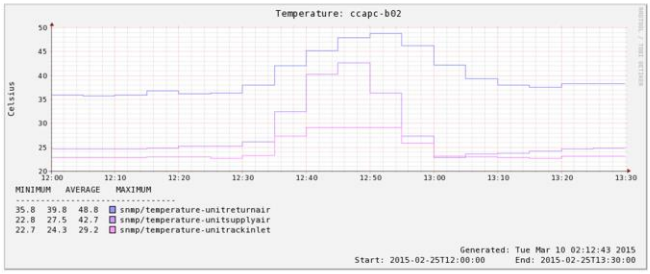
If some rack are around 20kW, others have to compensate.
Cooling limitation per aisle gives ~15kW per rack .

Dealing with cooling defect

Stopping InRow cooling units for **20 minutes** → **+15°C**

Increases corridor temperature around 49°C

Increases front temperature to 43°C



Need an efficient shutdown system

Our water tank provides 20 min delay

Smart versus dumb shutdown systems

- Smart shutdown relies upon IPMI
  - detects low continuous slope
  - or fast temperature change
- IPMI needs network
- If network switches shut down before servers, IPMI is useless
- Need a dumb backup power cut system

Won't reproduce a bad experiment with a water leak
-20°C on roof, +65°C in hot corridor

Cooling technology: hot water choice

- Improving global Campus Energy Reuse Efficiency ?

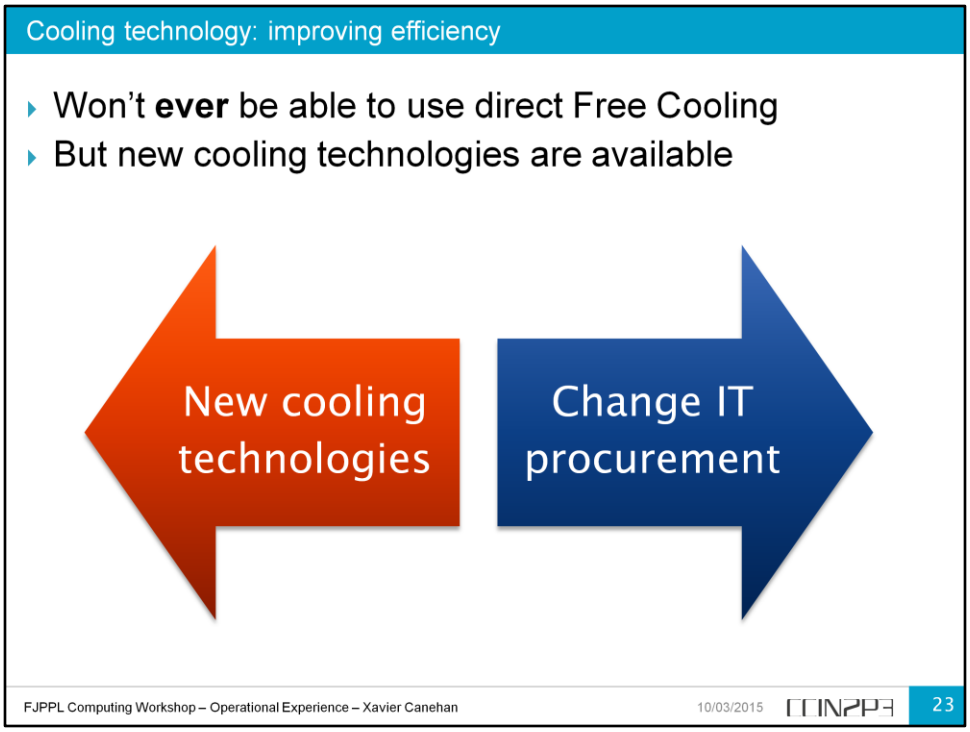
Land procurement
- Agreement to provide hot water on campus

Hot water need
- Very efficent chillers, allowing reuse of hot water
- Silent hardware

Fixed technology
- Campus is late
- 3 years spent

No windows and no bathroom.

In case of technical emergency, difficult to force calories extraction through forced fanning.



Several technologies could fit new aisles
- Adiabatic cooling, or some sort of deported cooling
- Hot water based cooling
- Oil based cooling

Last 2 are well suited for our room but imply that we change IT hardware procurement

Very valuable modularity outcomes

- Ceiling rails
- Preset pipes
- Movable separation wall between used and free space
- Roof as technical level

Questions?
Thank you!