

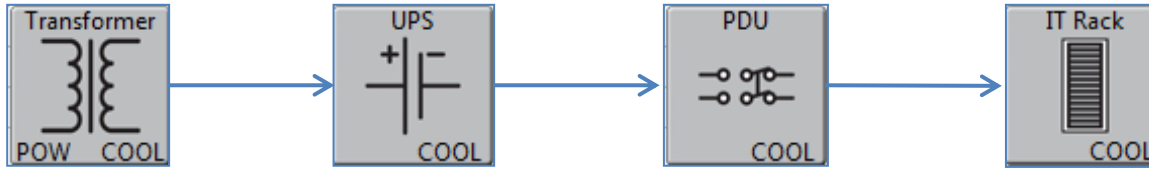


The data centre market

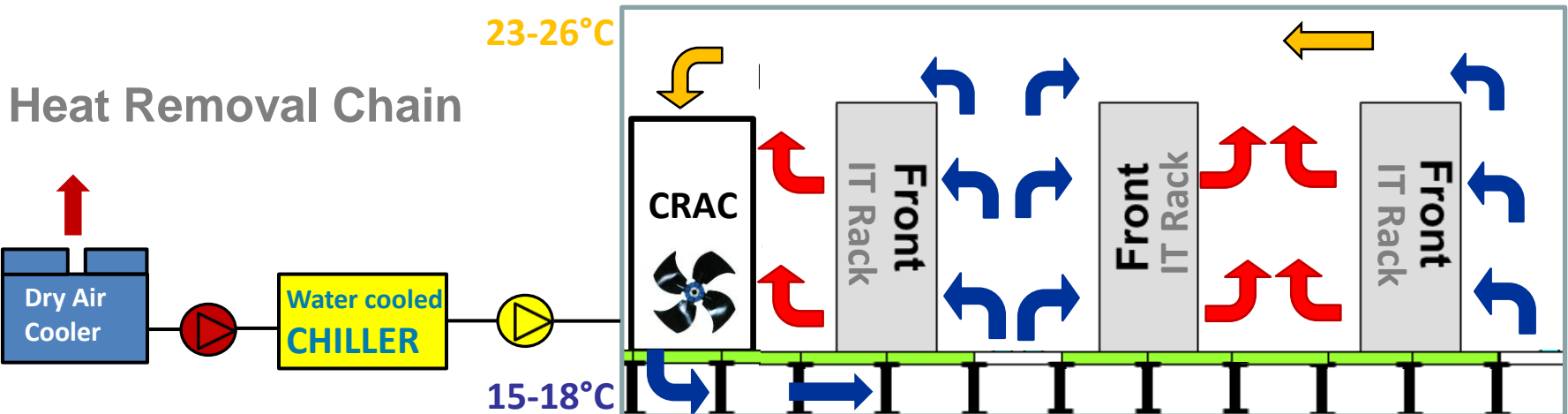
Dr Ehsaan Farsimadan

October 2013

Problem we are trying to solve...



Power Delivery Chain



Heat Removal Chain

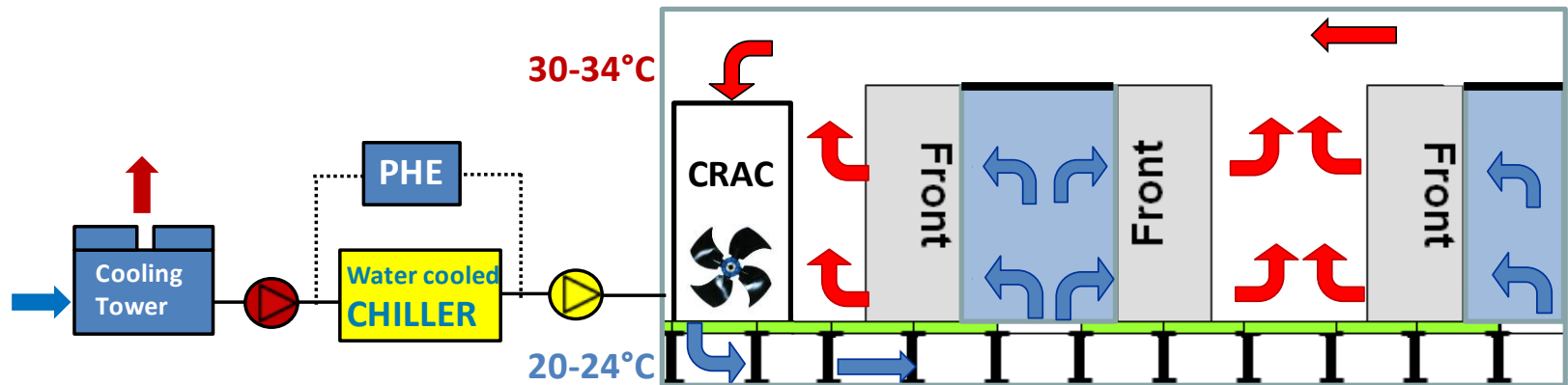
Typical 1MW Data Center consumes about 15GWh of energy annually

The data centre market

Some history

What has happened recently?

What do we expect?



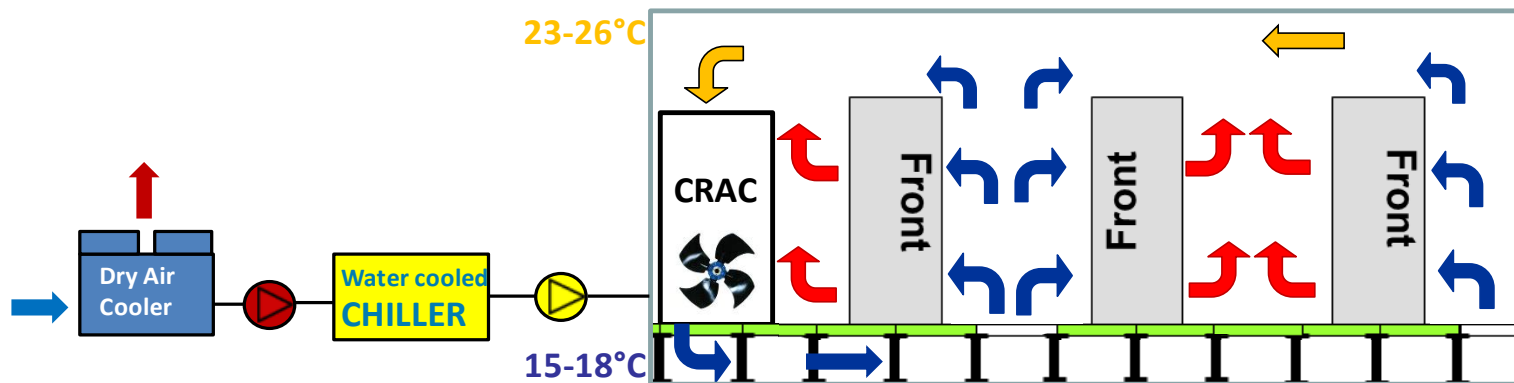
Some history - The current state

- **Current state of most data centres**
 - Unnecessary levels of redundancy and environmental control
 - Very low power density $\ll 1\text{kW/m}^2$ 2kW/rack
 - Very poor efficiency in operation
 - **2%+ of global energy**
 - **Data centres in the EU consumed more electricity than Portugal in 2009**



Some history - Cause of the problem

- Out of date practices
- Vendor educated market, little training
- Problems not addressed at source
- Most operators treating symptoms
- Industry focussed on the only metric it has “PUE”

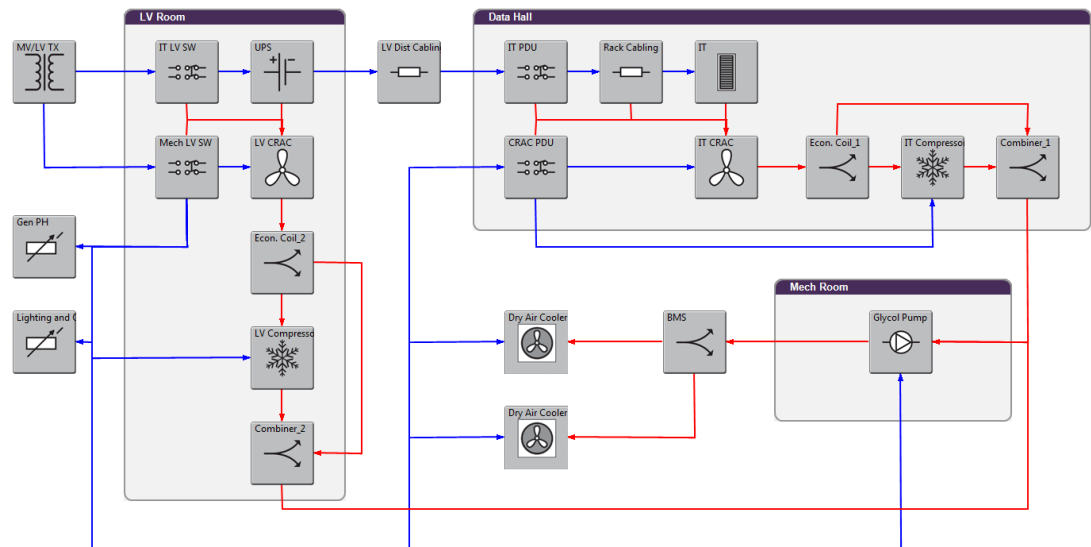


The data centre market

Some history

What has happened recently?

What do we expect?



What has happened recently?

- **Education and standardisation**
 - EU Code of Conduct for data centre energy efficiency
- **Cloud scale computing has brought some economic reality to the market**
 - Cloud is the globalisation of data centres, some will adapt
 - Your data centre can be anywhere you want
- **Some attempts to standardise design**
 - Open Compute
 - Commoditisation of equipment to lower costs

What has happened recently?

- **Power density**

– Circa 2000	500W – 800W / m ²	< 2kW / rack
– Circa 2009	1.5kW – 2kW / m ²	> 5kW / rack
– Circa 2013	2.5kW – 8kW / m ²	5kW to 20kW / rack

- **Large data centres are now > 100MW per site**

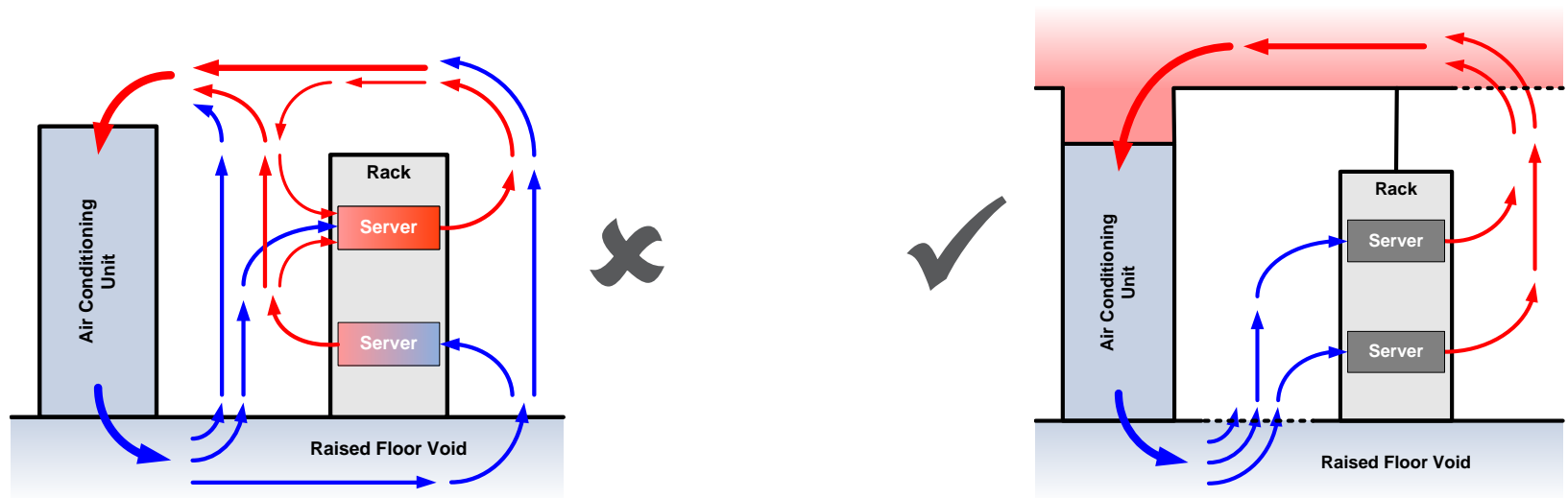
- **Many are built in modular 2MW chunks**

- **Recent activities show up broken old methods**

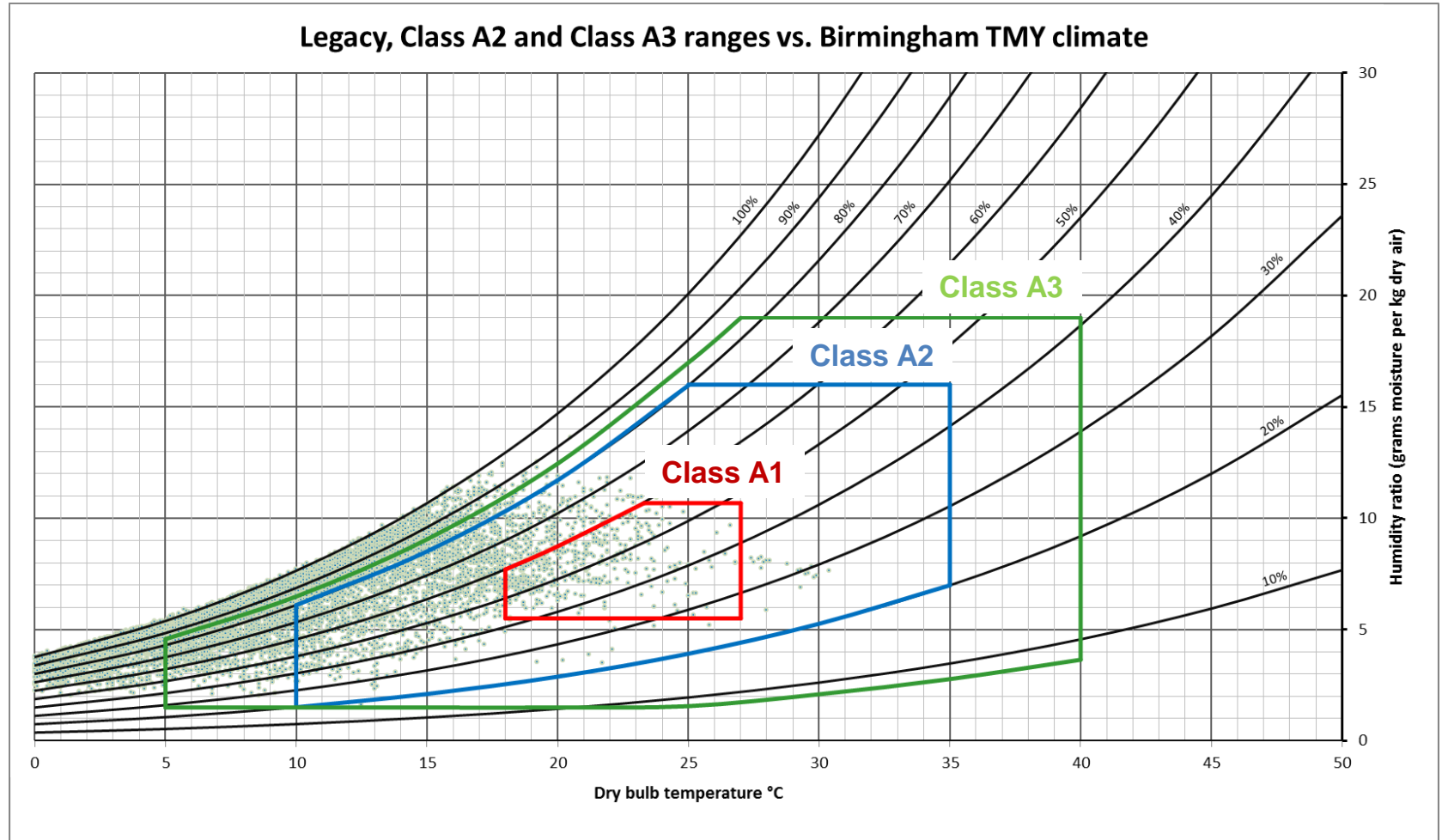


What has happened recently?

- **Starting to deal with root causes instead of symptoms**
 - Computers are not fragile – No need to air condition them like the sarcophagus of Tutankhamun
 - Expansion in the environmental ranges through ASHRAE TC9.9
 - Use of contained air flow in place of “waft and hope” designs

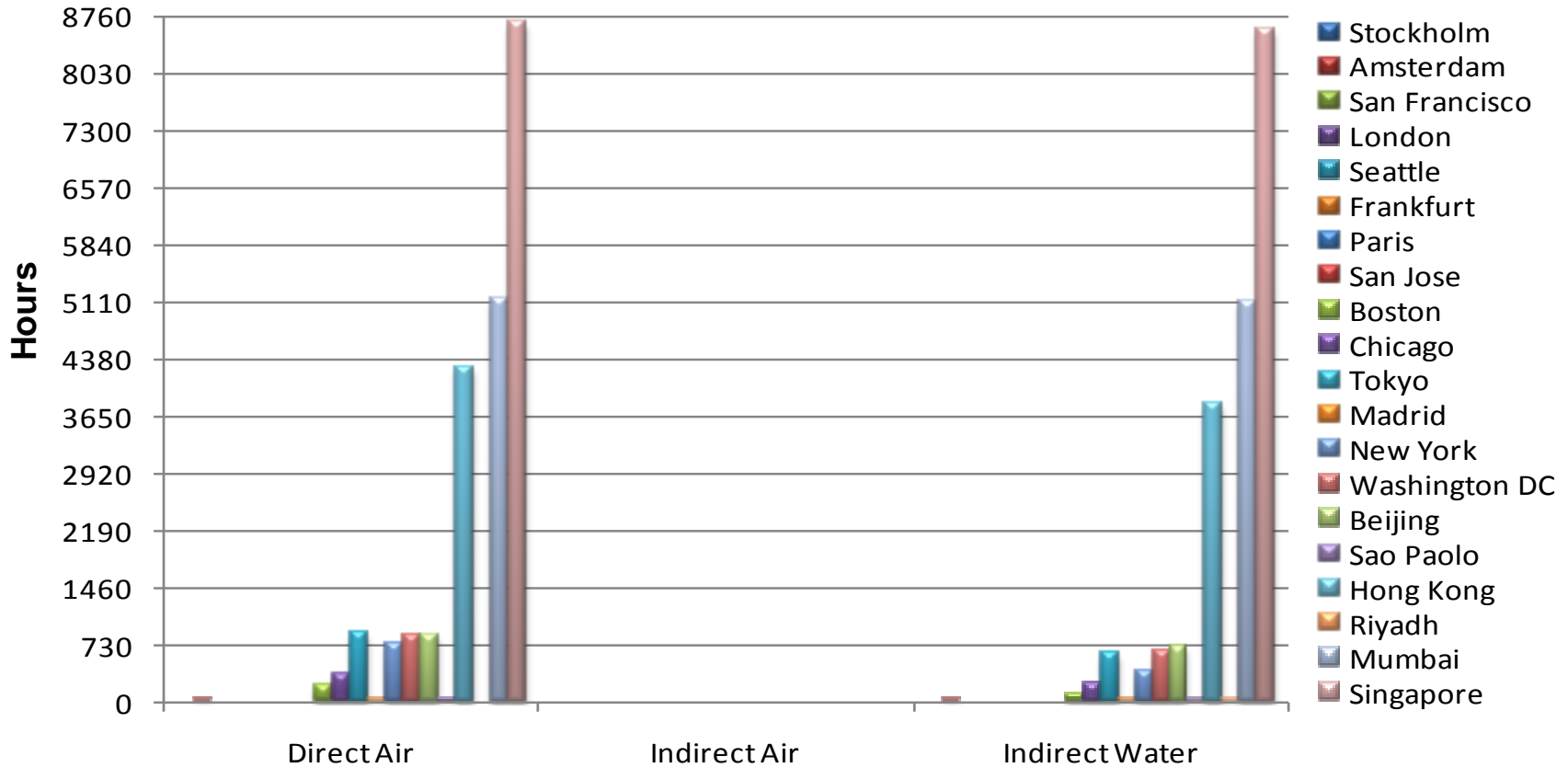


What has happened recently?



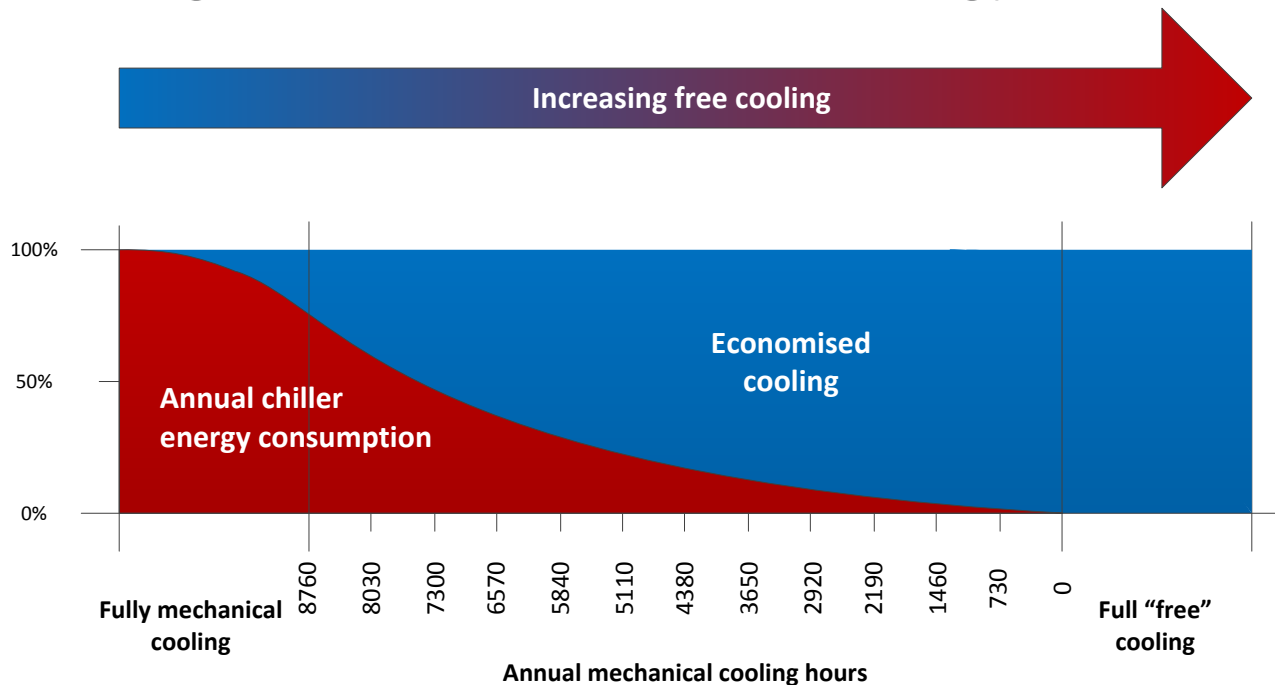
What has happened recently?

Annual Chiller Hours (Adiabatic Cooling) Class 2



What has happened recently?

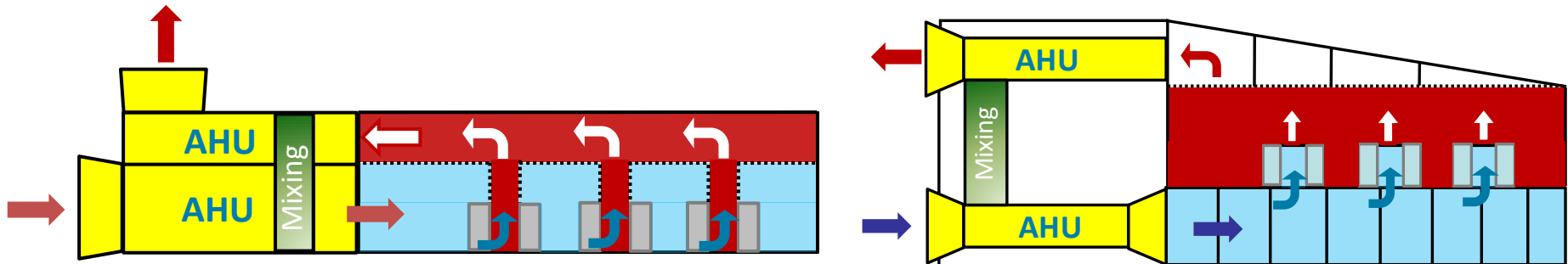
- **We realised that mechanical cooling is**
 - Unnecessary and undesirable in many locations
 - Not a significant contributor to energy or opex cost



What has happened recently?

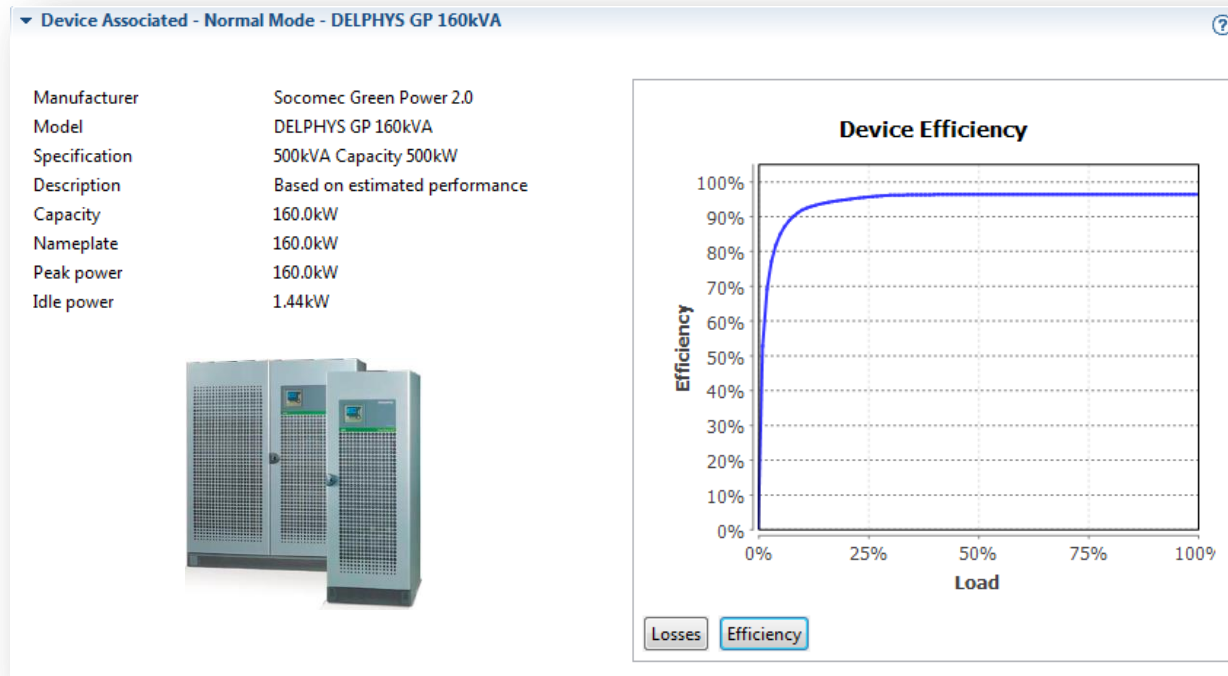
- **Summarising Cooling**

- Cooling should not be a significant overhead
- Correctly designed data centres can eliminate the need for cooling
- No need for new cooling technologies, no real problem left to solve



What has happened recently?

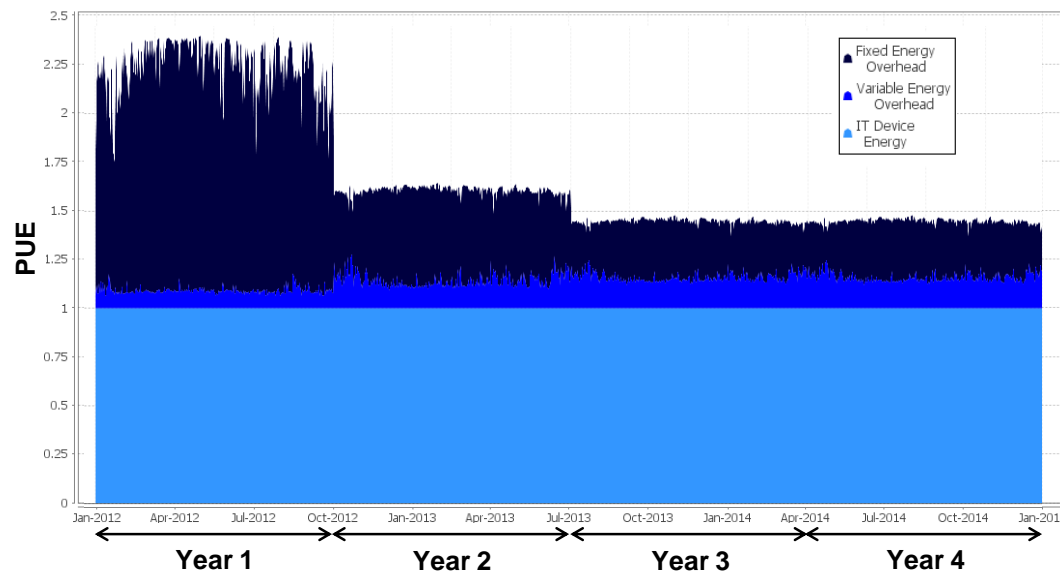
- **Electrical power systems**
 - Improvements in electrical infrastructure have made power to the server > 95% efficient



What has happened recently?

- **Effect on overall efficiency**

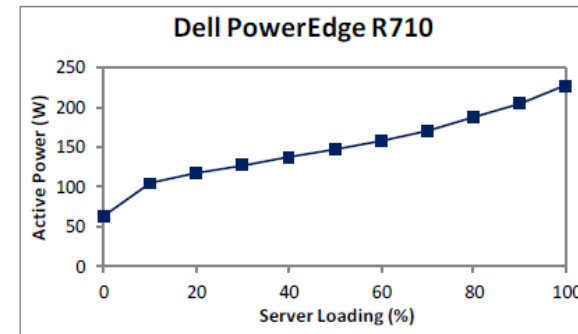
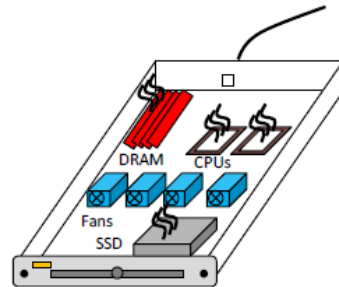
- Anyone can build a data centre with a PUE < 1.3, there are a very few climates where you can't
- Many will choose to build a data centre with a PUE > 1.3 because the economics don't work



What has happened recently?

- **IT equipment**

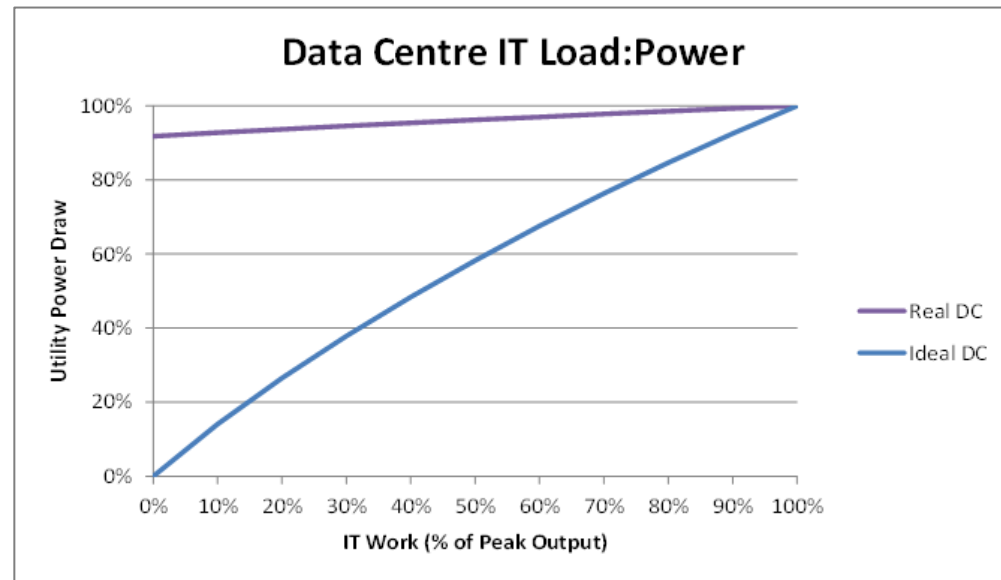
- IT equipment has continued to provide more stuff / kW
- Our utilisation of IT equipment is getting better
- IT equipment is slowly becoming more load:power linear
- Servers, storage and network equipment are now completely commoditised



What has happened recently?

- **Facility utilisation problems**

- The majority of the cost and energy consumption are a fixed entity
- The challenge is to make Utility power draw more linear with IT

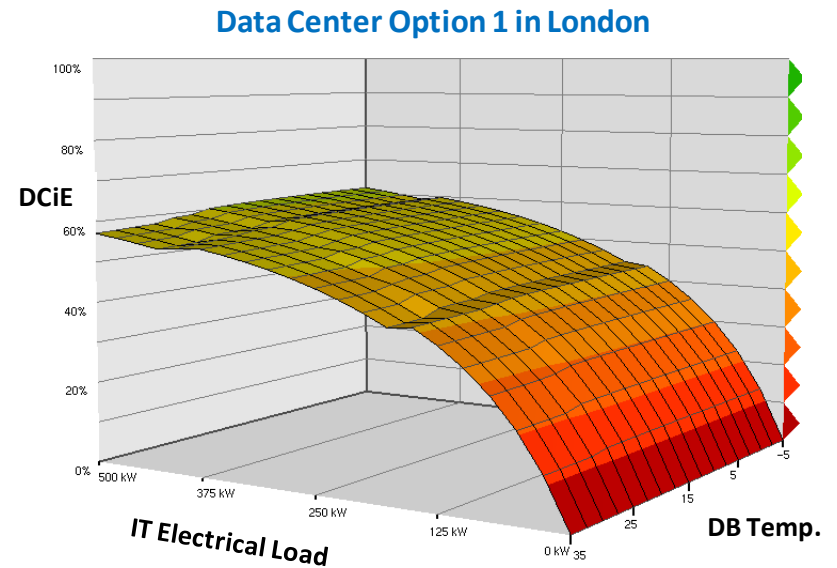


The data centre market

Some history

What has happened recently?

What do we expect?



What do we expect?

- **Continued commoditisation**
 - Less specialised equipment only a few classes of workload will be able to cost justify “HPC” equipment e.g. Cray
- **Data centres are moving to locations with the right mix of**
 - Cheap energy (US < \$0.05 / kWh, don't forget water!)
 - Climate (Anywhere outside the tropics)
 - Jurisdiction (Which intelligence agencies do you want to be hacked by?)

But you don't need to go to Iceland.....

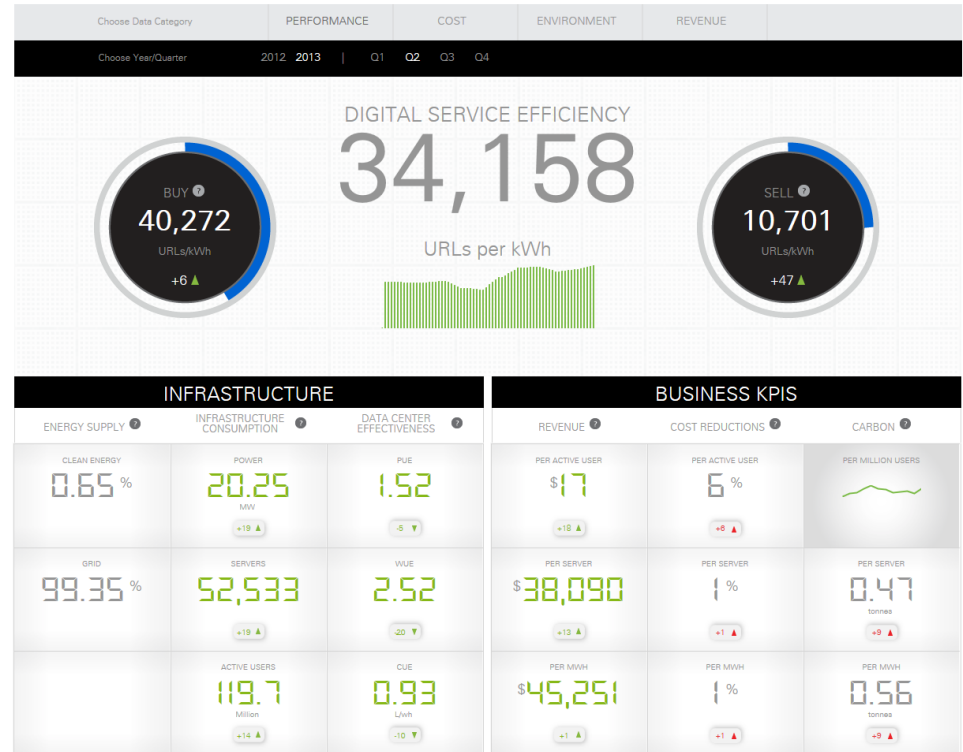
What do we expect?

- **Compute is going in two different directions:**
 - **Lower power 1 to 10 Watt processors**
 - ARM has led the way (for non CPU intensive tasks)
 - **Higher power**
 - General purpose compute (Intel) is getting denser
 - Starting to hit the limits of air cooling at > 15kW per rack
 - Many will move to direct liquid cooling - Iceotope
 - If you take liquid to the data floor – take it all the way to the chips

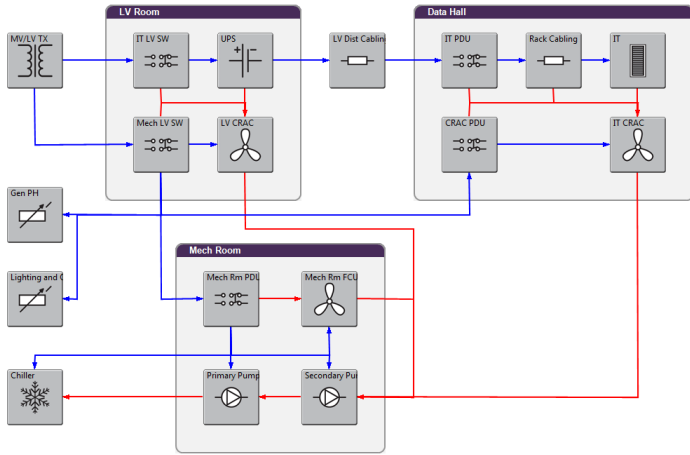
What do we expect?

What about software?

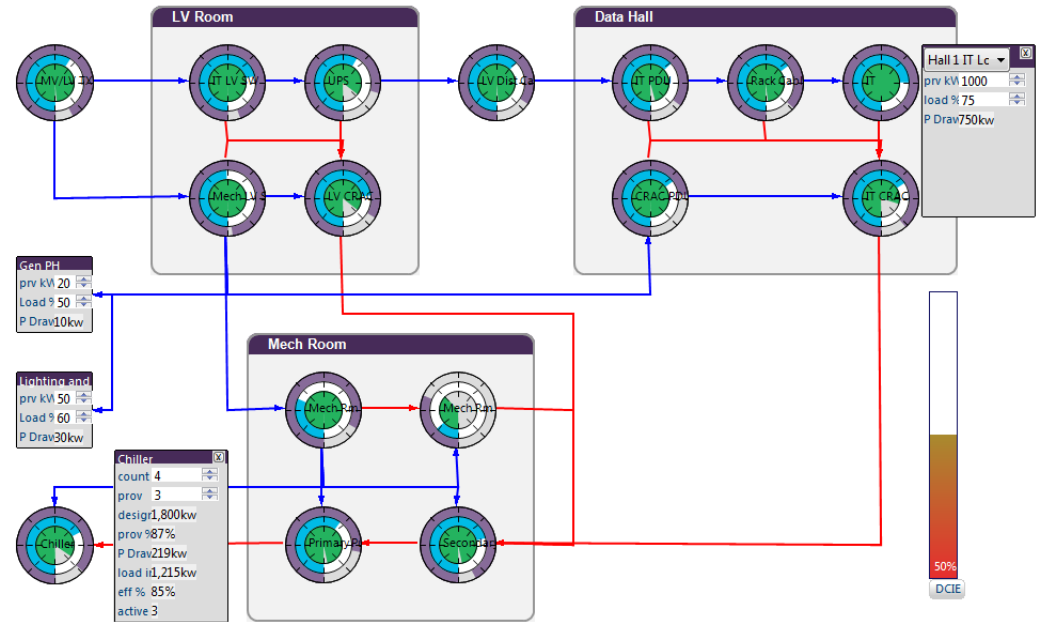
- Data is only useful if it can be consumed and processed
- More emphasis towards business metrics
- Count the cost of running the Data Center



We now know how..



– Does my design actually work?



Air cooled Data Center with Free cooling

