



Silvio FOIERA :: Accelerator Operator :: Paul Scherrer Institut

Chasing The Heat

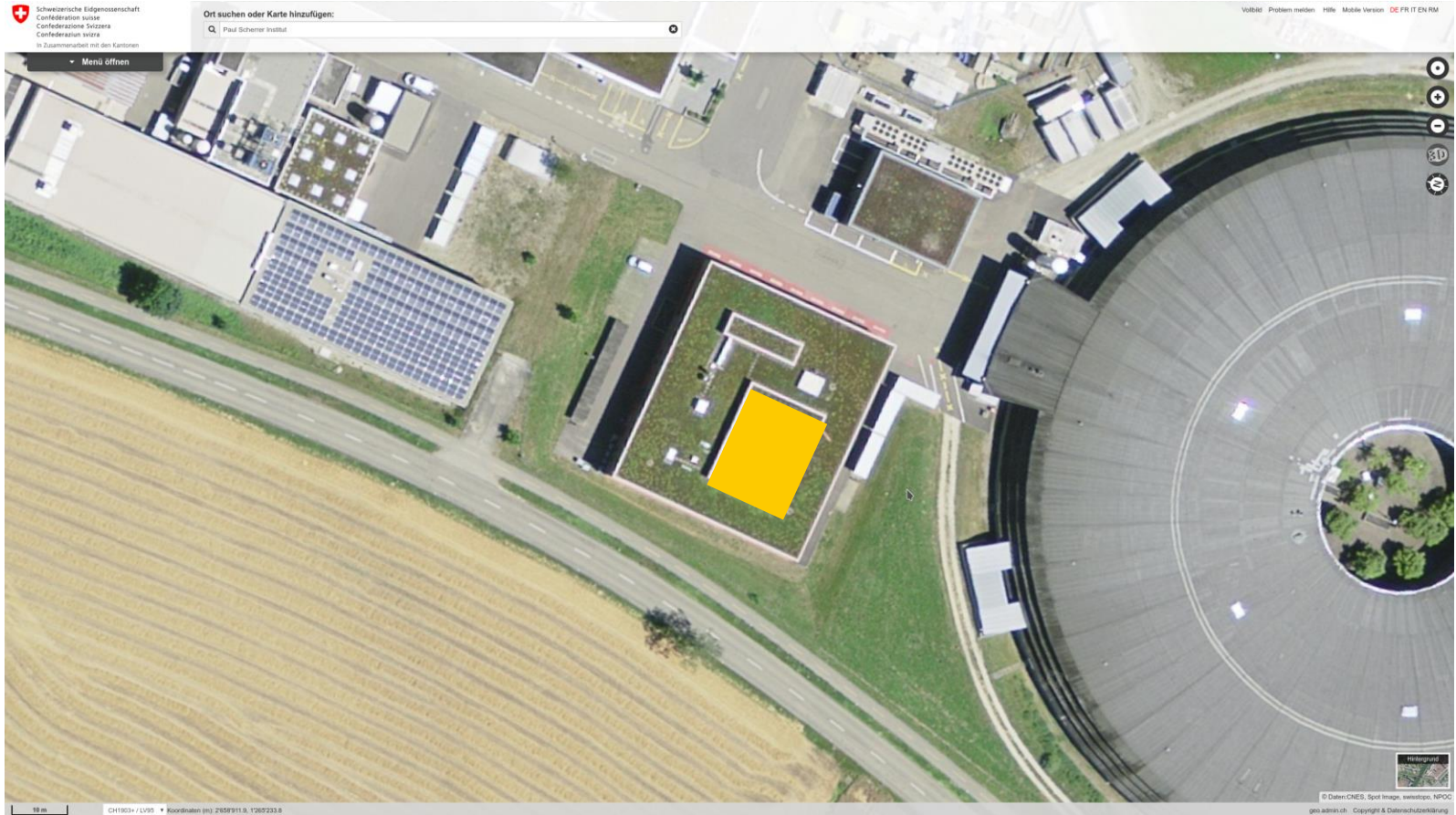
Workshop on Accelerator Operations - WAO2018, Stony Brook University / Brookhaven National Lab

- Heat Sources
- Cooling Techniques
- The PSI Accelerator Controlroom
- Approaches @ PSI
- Be aware of small changes

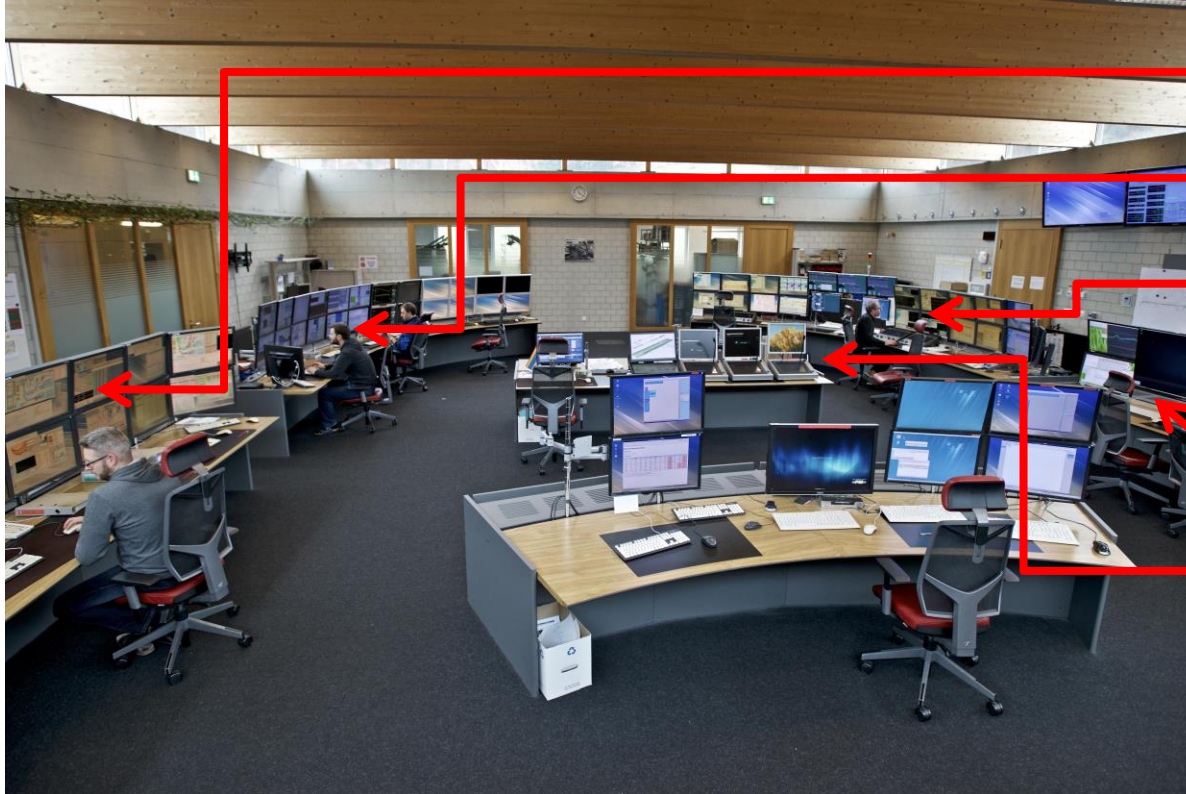
- System waste heat
 - IT Infrastructure / electric devices
 - Lighting
- Insolation
- Humans
 - Normal condition (puls rate 60-80) 80-100W
 - @Stress Situation (puls rate 120-140) 140-160W

- **#1 avoid unnecessary heat production!**
 - What does not has to be in the controlroom, does not has to be in the control room
 - If possible relocate stuff to separate compartments. Eg:
 - server room / printer room
 - coffee corner / office areas
 - Be aware of solar irradiation!
 - Irradiation through glass causes $\sim 500\text{W/m}^2$
 - Takes up to factor 3(!) energy expenditure for disposal
- avoid heat dissipation to room air
- use passive cooling technology
- use active cooling components

The PSI Accelerator Controllroom



The PSI Accelerator Controllroom



PROSCAN

(Proton Therapy Facility)

SLS

(Synchrotron licht Source)

HIPA

(Meson Facility &
Spallation Neutron Source)

SwissFEL

(Free Electron Laser)

Safety

- Access Control
- SCADA Facility Processes
- Radiation Safety

Heat Sources :: Equipment



Installed Equipment:

- **45 PCs**
up to 330W | 13.5kW
- **100 24" Screens**
@ ~100W | 10kW
- **3 27" Screens**
@ ~160W | 0.5kW
- **1 48" 4K Screen**
@ ~560W | 0.5kW
- **5 55" Large Screen**
@ 190W | 1kW

Total P_{\max} ~25.5kW

Total $P_{\text{determined}}$ ~14kW

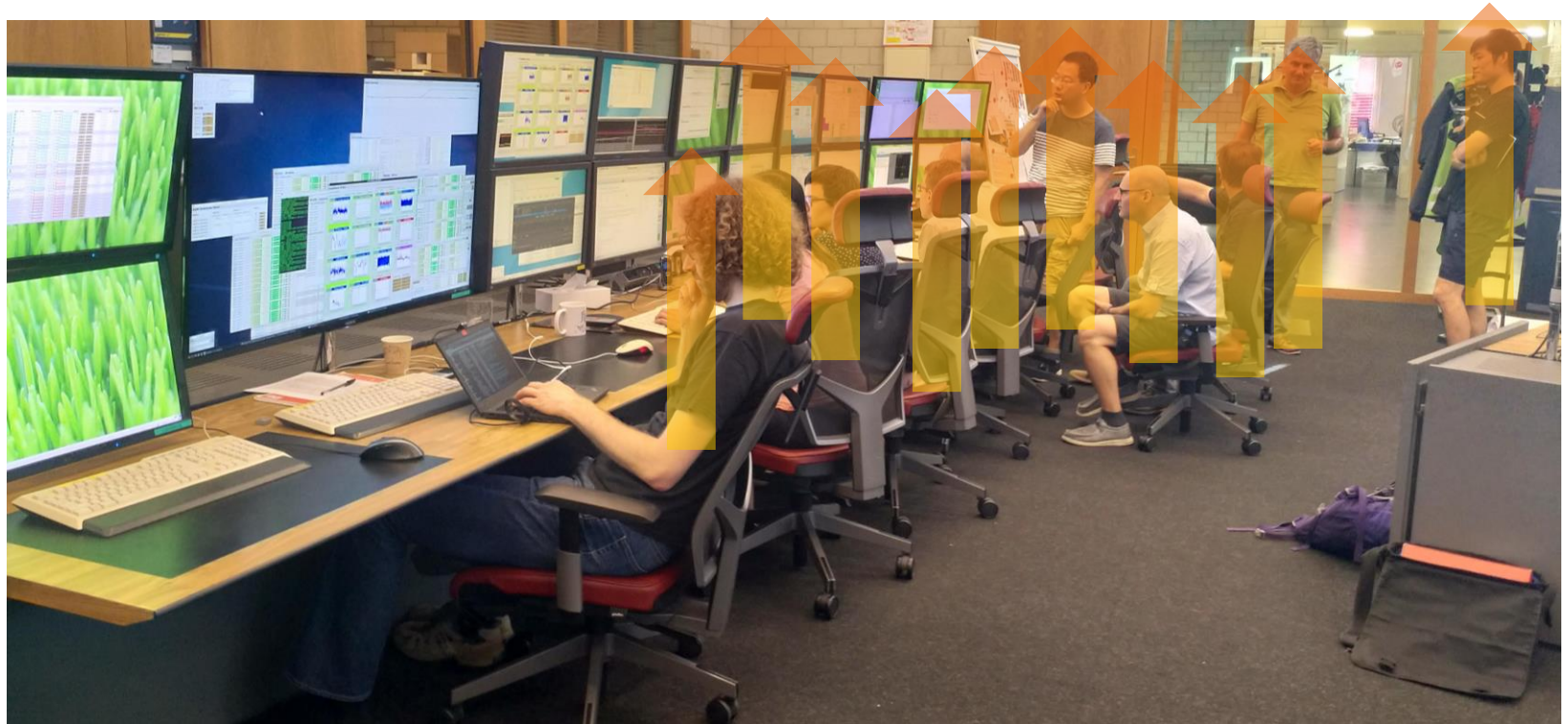
Heat Sources :: Insolation



Heat Sources :: Lighting



Heat Sources :: Humans (body heat)



Cooling :: Cooling Roof



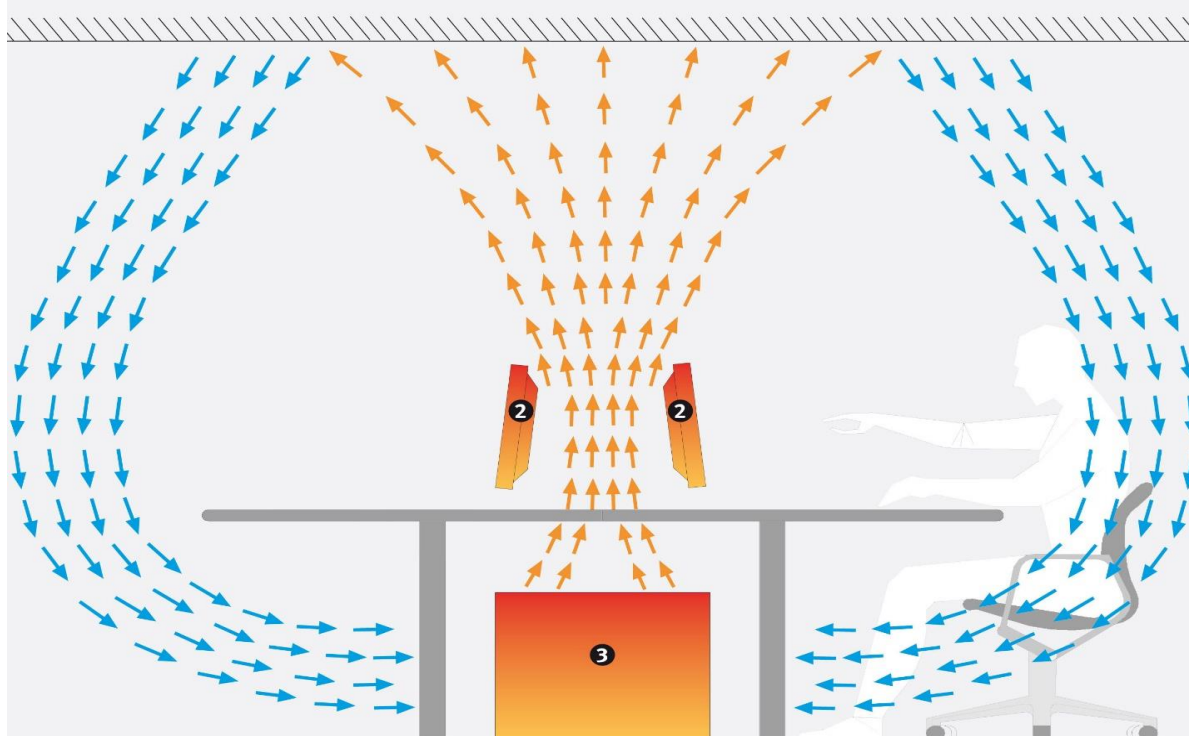
Cooling :: Air Condition



Cooling :: Device Cooling



Challenges: heat and draughts



- Conventional climate control systems are at full load
- Heat spreads throughout the room before it can be removed
 - > due to excessive air exchange, draughts are unavoidable
- workers under stress are even more sensitive to the effects of draughts
 - > resulting in complaints and probably absence from work due to sickness

Approaches @ PSI :: Virtualization / KVM



Image by matrox.com

Image by hp.com

Approaches @ PSI :: avoid heat spreading



Pro

- system heat doesn't get dissipated to room air
- central climate control can run throttled
- droughts can be reduced

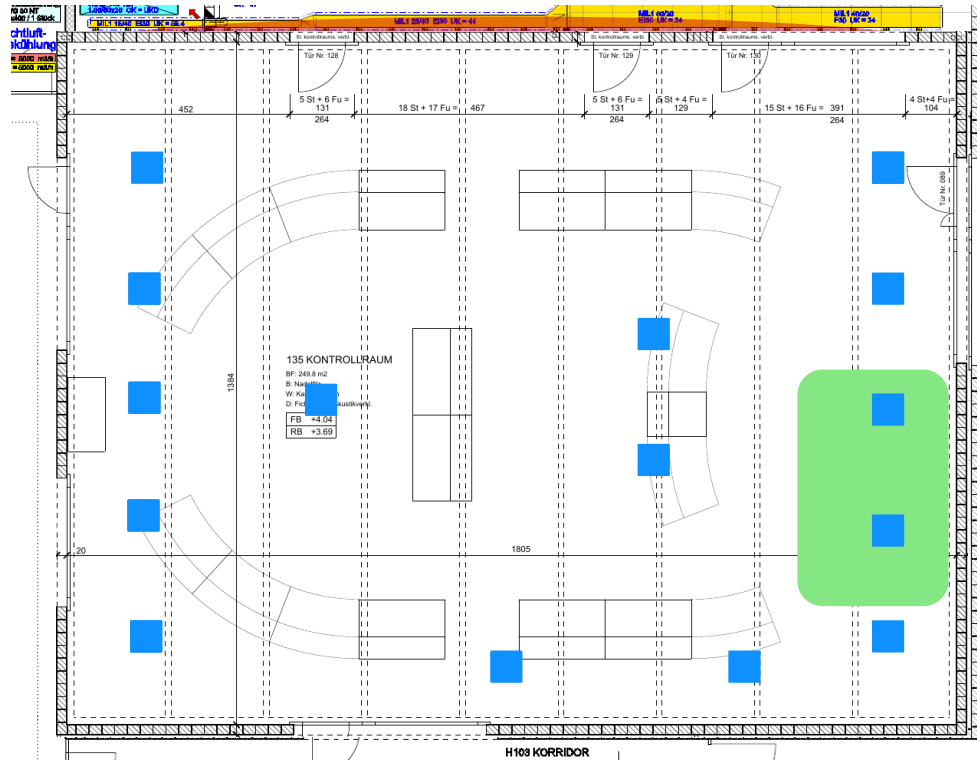
Challenges

- existing/new cooling infrastructure necessary
- raised initial costs
- flexibility

Approaches @ PSI :: lowering inlet temp



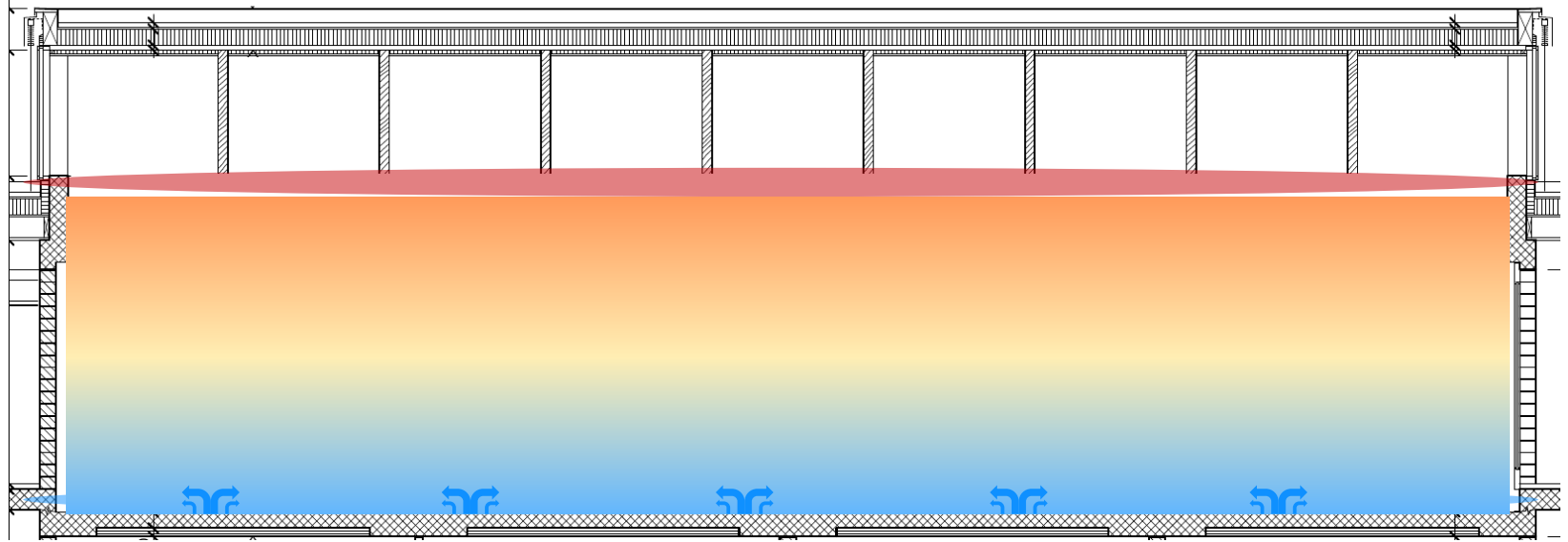
Approaches @ PSI :: Air Condition



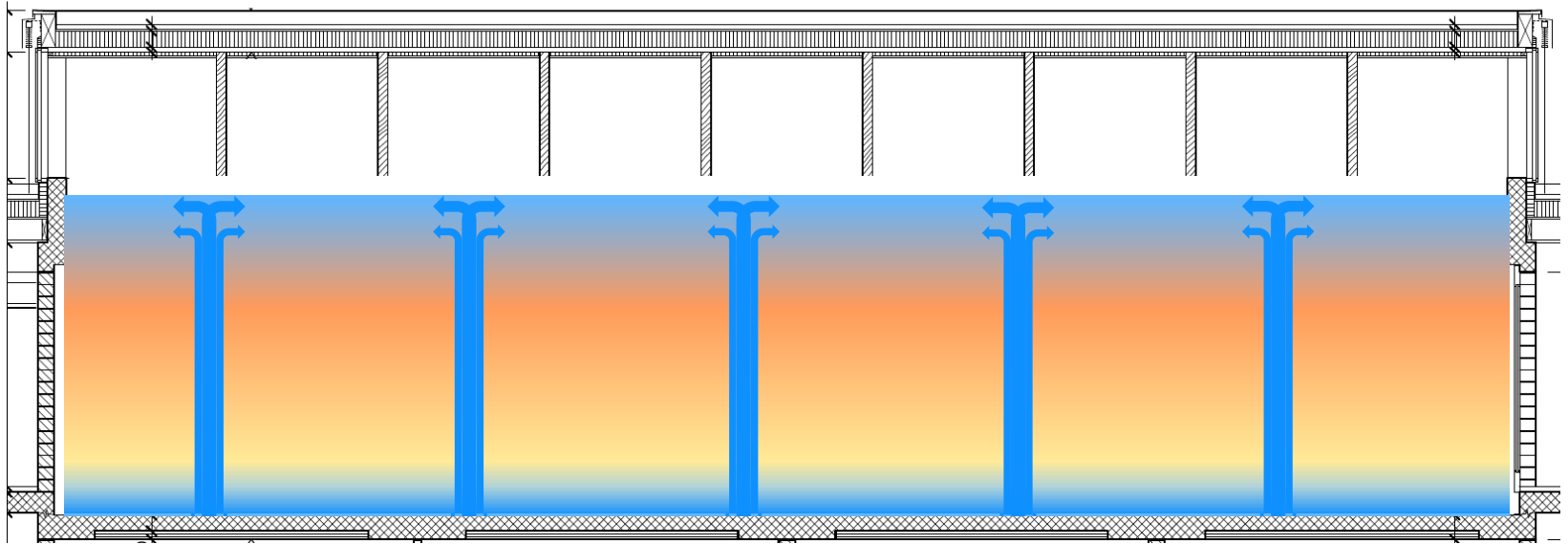
Air Conditioning

- 6kW design power
- 2000m³/h air circulation
 - 500m³/h fresh air
- 10 ground outlets

Approaches @ PSI :: Air Condition



- Increasing air condition airflow



Approaches @ PSI :: Lighting - FL to LED



small change :: big impact

- minor changes
- replacing comp



Power
consumption

20W

34W

40W

47W

75W

120W

260W

Conclusion:

- **provide some headroom.**
no matter what they tell
you, demands will rise.
for shure.
- **there is no simple
solution.**
possible approaches
depend on your system
capabilities and options.
- **keep the big picture in
mind.**
even small changes could
have a big impact.



My thanks go to

- Dr. Andreas LÜDEKE
(Operations Head)
- Mr. Emanuel HÜSLER
(electricity)
- Mr. David REINHARD
(climatization)
- Mr. Kurt HUBER
(@ ErichKeller.com)

