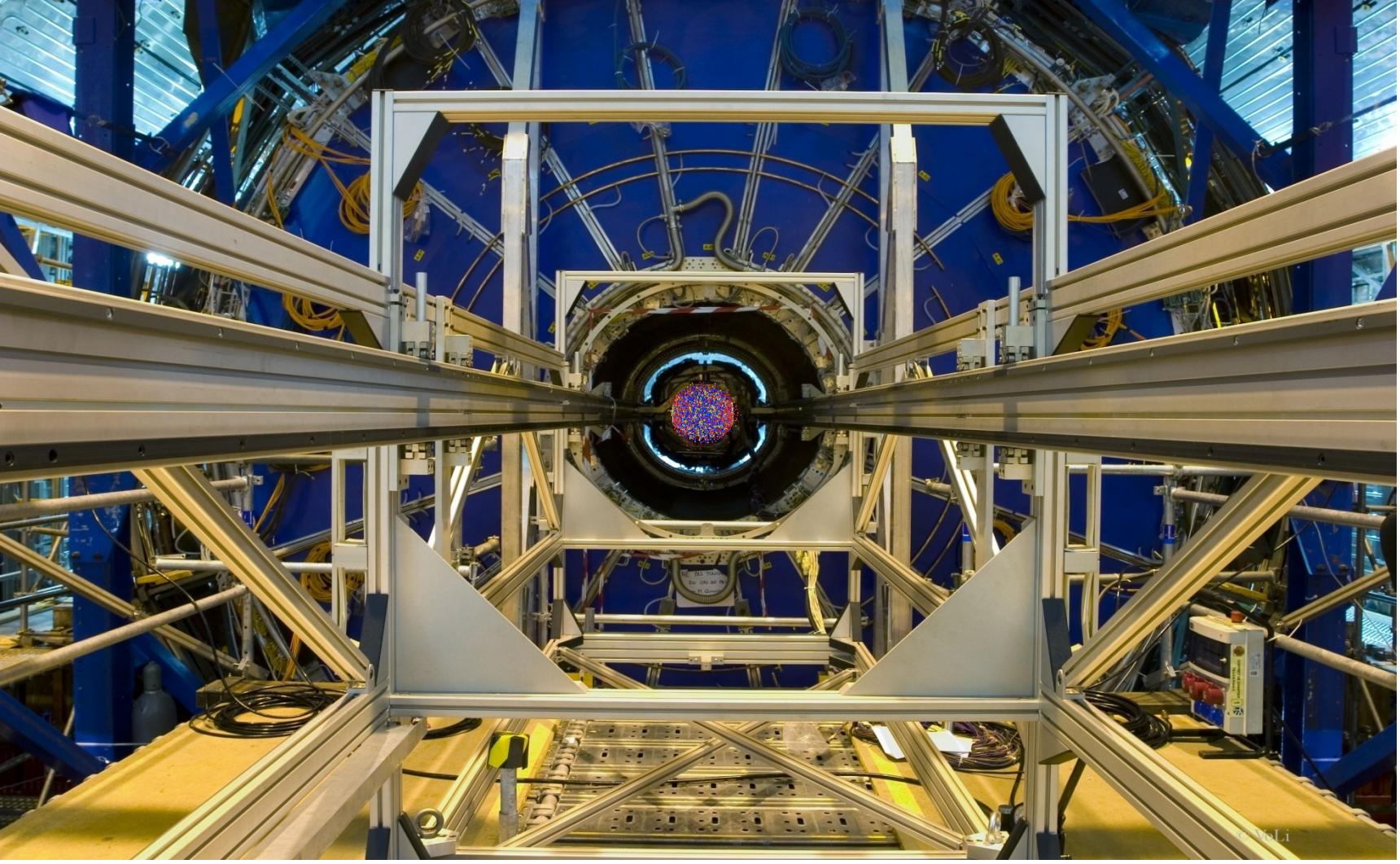

ISC 2016

Energy Efficient Working Group
Green Cube
Lefdal

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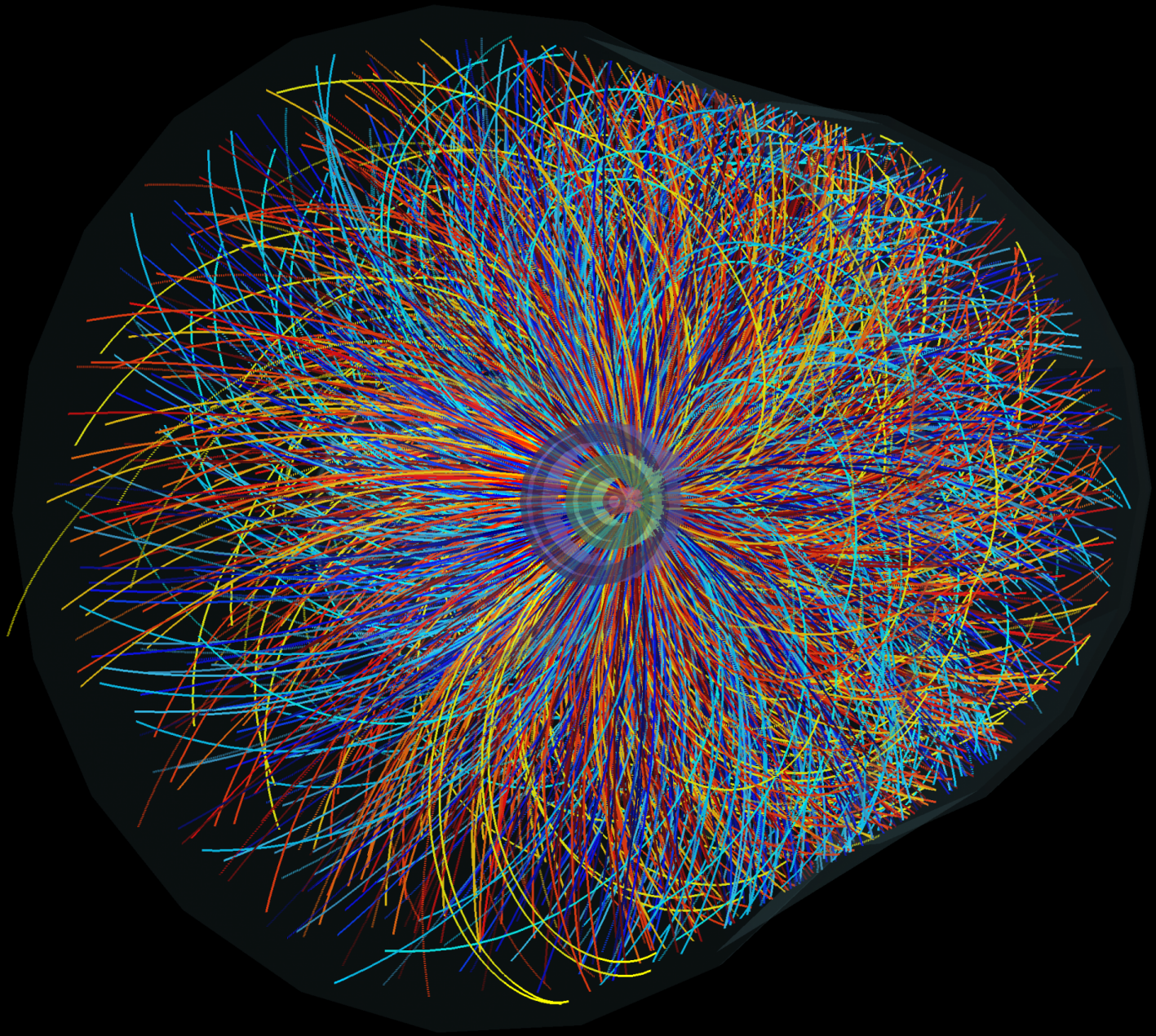
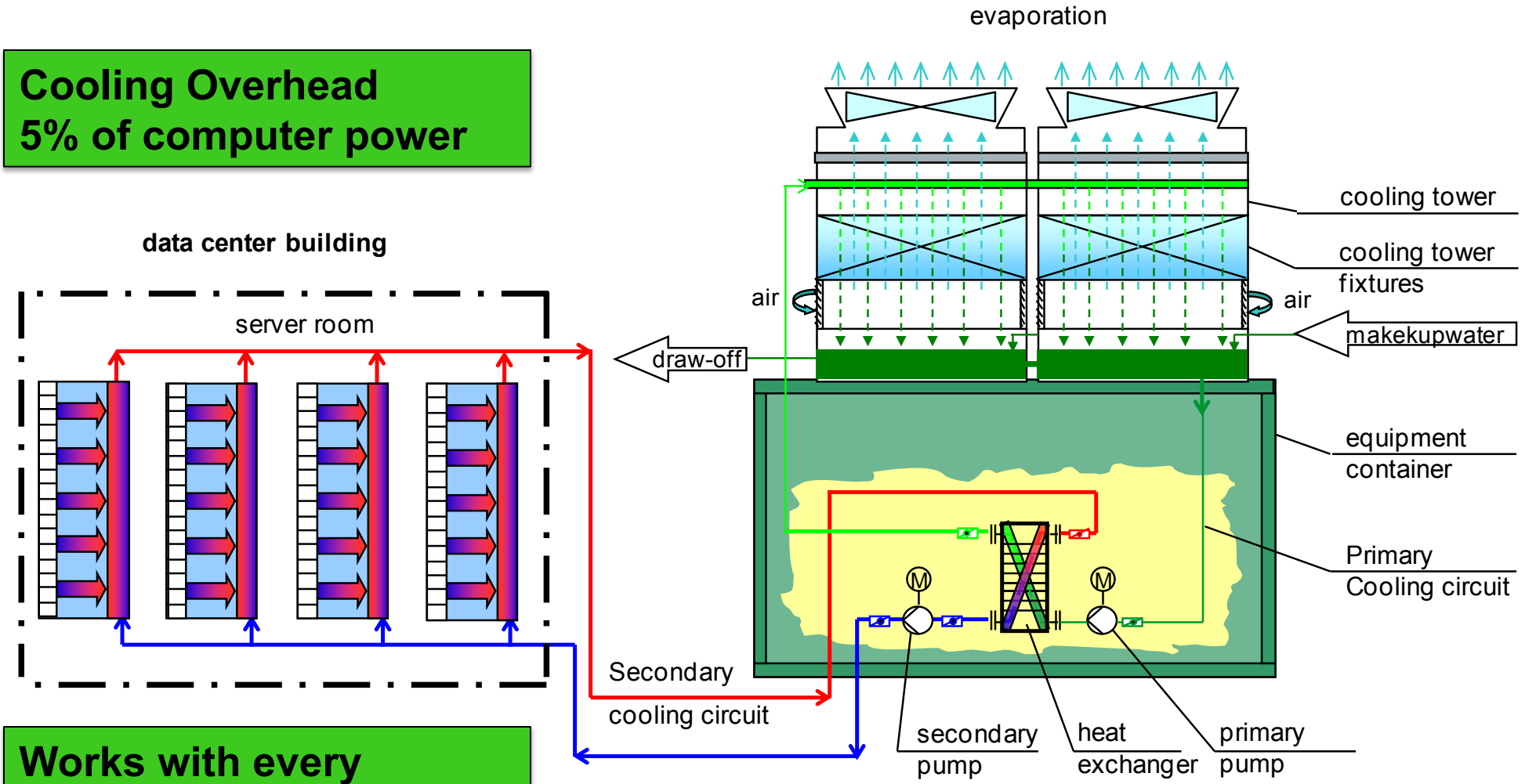


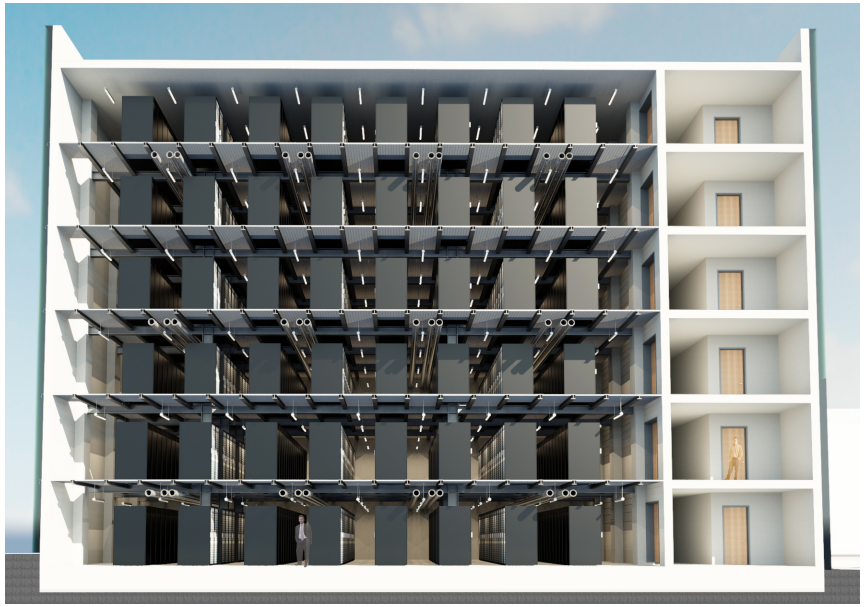
Innovative Cooling System Architecture

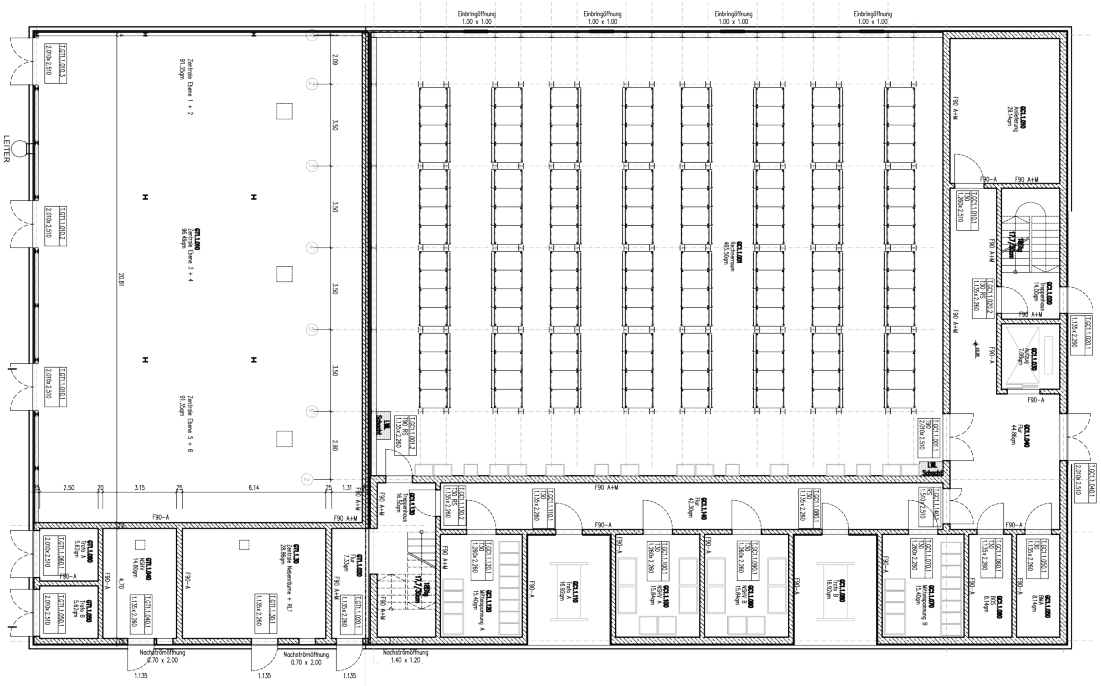
Cooling Overhead
5% of computer power



Works with every commercial computer

The FAIR Data Center (Green Cube) KPI





- 768 19” racks (35,000 U)
- 4 MW cooling (baseline)
- max cooling power 12 MW
- fully redundant (N+1)/2N

- Works with any commercial IT
- no battery backup required
- PUE <1.07 average @ 20kV
- building cost 16 M€ (@ 12MW)

Cost consequences

- **Avoidance of mechanical chillers**
  → OPEX savings at least 20% (2 M$/a @10 MW)
- **Very simple design**
  → ~50 k$/a operation, ~70 k$ maintenance
- **Avoidance of cold / warm isles allows 3D installation**
  → more than 60 kW/sqm demonstrated
- **Typical Tier 3 data center cost >4$/W**
  → demonstrated <1.7$/W

Boundary Conditions

- Typical separation between CAPEX and OPEX leading to false economy
- Energy savings do not improve budget
- In data center industry cooling overhead often sold with extra overhead → no incentive for effinciency
- Average PUE in Germany 1,6
- Net energy cost ~13C/kWh (54% tax)
- Industry rather lobbies government to lower the taxes than to implement energy efficient technology

+ Green Cube done as holistic approach including all aspects with a total cost of ownership optimization
  + Building cost + operating/maintenance cost + electricity over ten years minimized
  + Inclusion of computer architecture optimized also for low TCO including power requirement and space
  + 3D architecture allows shorter HPC cabling

+ one budget for maximized availability of compute power

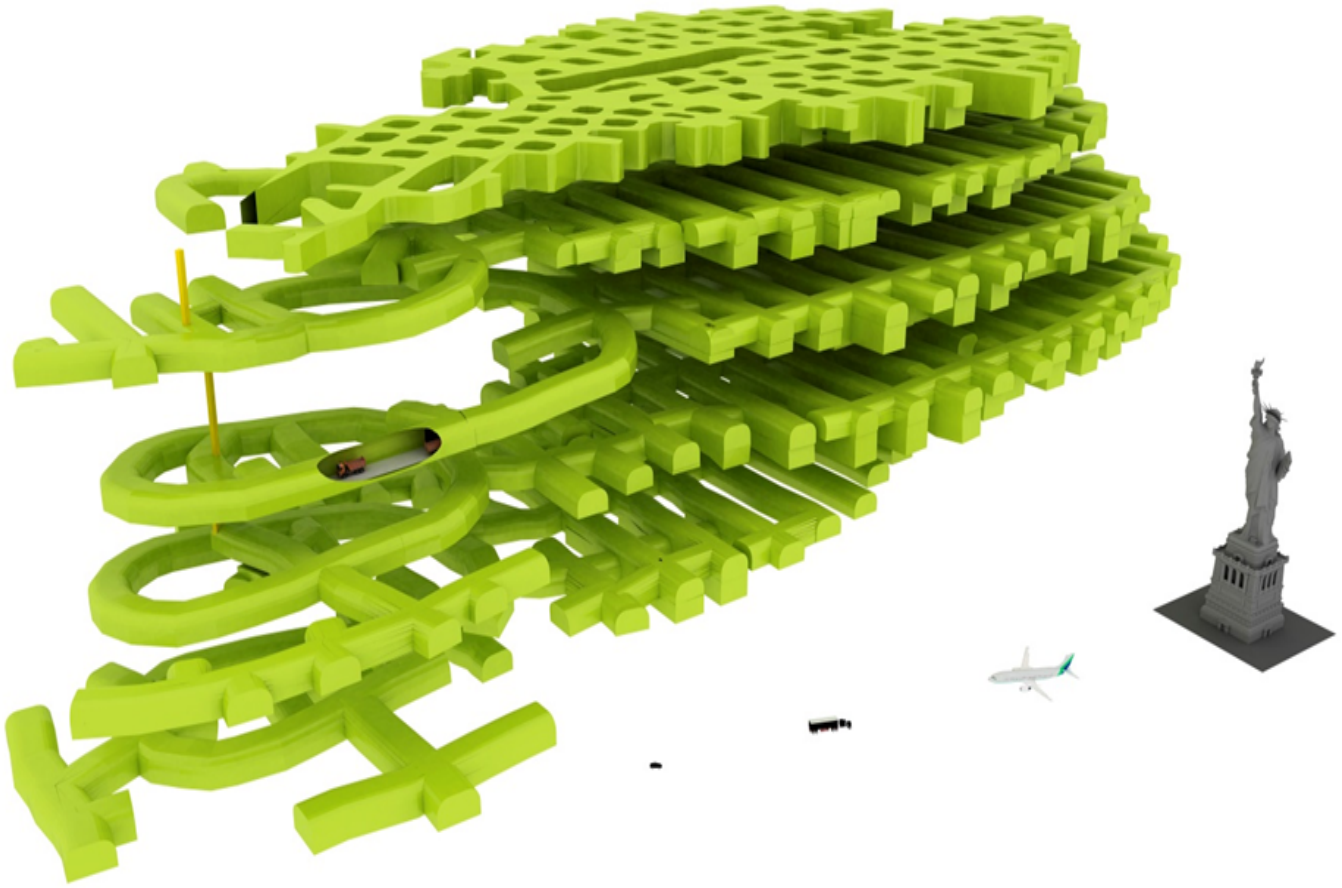
LEADING DATACENTER SOLUTION - EUROPE

COST EFFECTIVE
TCO – 40-60% lower than rest of Western Europe. Low build out cost and low power costs.

FLEXIBLE
Grow as you go. 200+MW. All product Solutions. Quick time to market. High density available.

GREEN
Low power consumption. Green power. Limited footprint. “0” CO2 emissions and water usage.

SECURE
Mountain hall with high access security. Tier 3. EMP protected data.

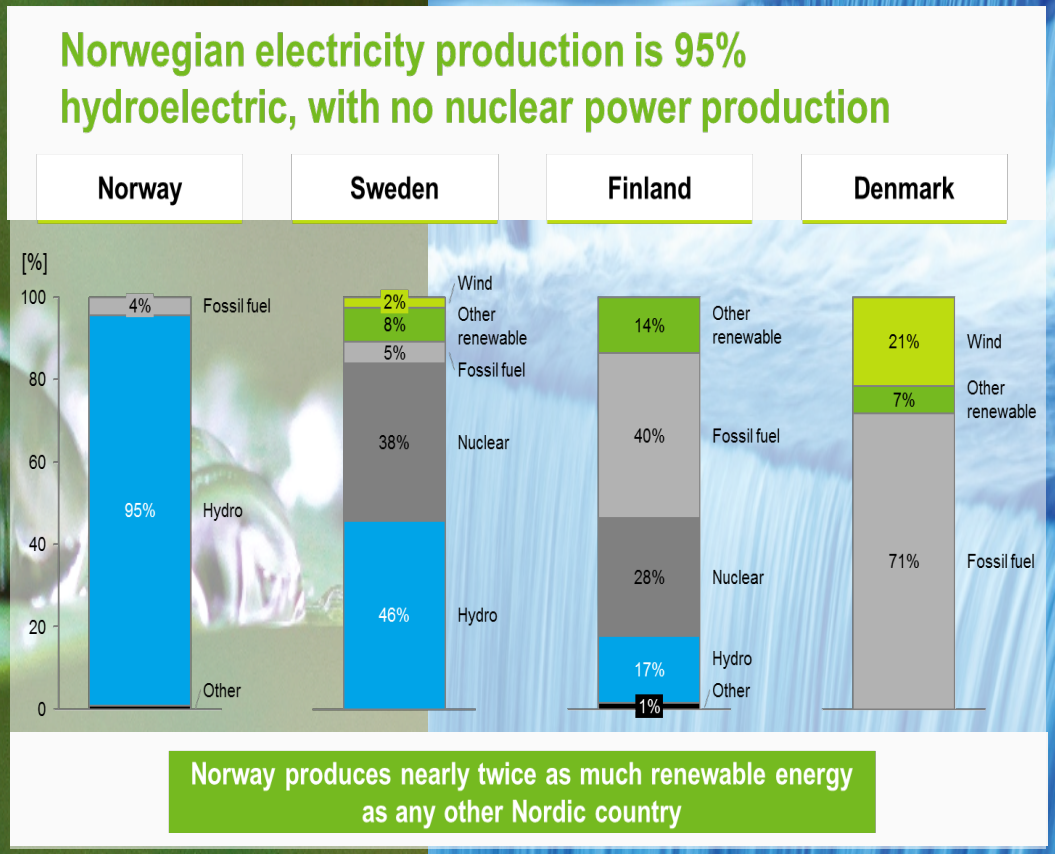


TCO 5Years 100 KW, 50% server utilisation:

- **Lefdal: 300k EUR rent plus 130k EUR power costs = 430k EUR**
- **Interxion: 900k EUR plus 560k EUR power costs = 1.5m EUR**

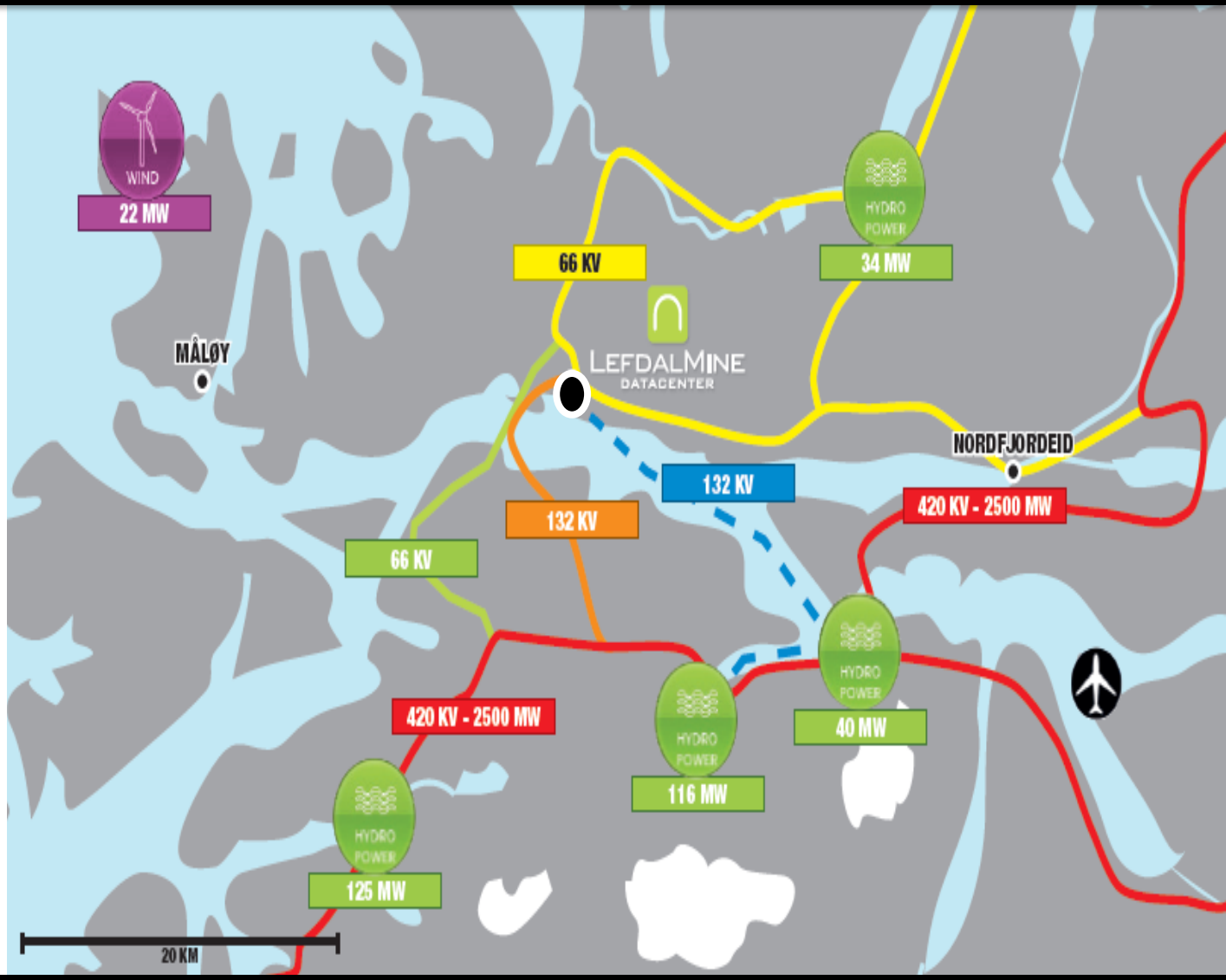
THE GREENEST DATA CENTER IN EUROPE

- 95 % of all power production in Norway is renewable - Hydro power
- Minimum transmission losses – Short travelled power
- Low power consumption – PUE of 1,08
- CO2-neutral – “0” carbon emissions
- The mine is already there – Limited footprint
- **Limited** visual impact
- No evaporative systems for cooling – “0” WUE
- Norwegian green code of conduct



POWER GRID AND CAPACITY

- 350 MW local power production
- Four hydropower plants
- One windmill park
- National grid in area – 2 500 MW
- No transmission loss
- Redundant power feeds – Tier 3
- Leading price of power – Europe
- Long term contracts available
- Future sea cable – blue line in picture – will be able to guarantee secure power delivery from two hydro power stations inside a



Use Case HPC aas

Customer Case: CERN Access to DBCE/iNNOVO Openstack IaaS

CERN has used the following architecture to fully automatic schedule it‘s scientific workload/jobs onto the iNNOVO/DBCE IaaS platform

- DBCE marketplace is used by CERN procurement for buying an IaaS resource pool across 4 DBCE providers (75% is coming from iNNOVO)
- The buying process includes the benchmarking of the IaaS DBCE performance to define a unit of work with a price tag
- Within a procured IaaS resource pool, CERN automatically rolls out virtual Linux machines of specific sizes
- The launched virtual machines automatically call back to the CERN job scheduler to get workloads assigned for processing
- Once the jobs finished the jobs report back the results to CERN for collection
- CERN constantly monitors the performance of the running VMS to ensure compliance to the contractual agreed performance level


Thank you
for your attention