Saving Energy at DESY

Energy situation at DESY

General measures

IT related measures

Yves Kemp, DESY IT, with contributions from many other DESY people

Hepix Autumn 2022 Workshop

Umeå, 2.11.2022

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY.

SPIEGEL International

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Energy Crisis Fallout

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Energy crisis especi
2023 possibly "ever

F+ VERVIELFACHUNG DER KOSTEN

Energiekrise und Inflation bremsen die deutsche Spitzenforschung aus

Brian Owens

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Energy

1 minute read · October 21, 2022 12:00 PM GMT+2 · Last Updated 6 days ago

Germany's parliament approve
euro fund to tackle energy crisi

Warum Forschern nun eine Triage droht

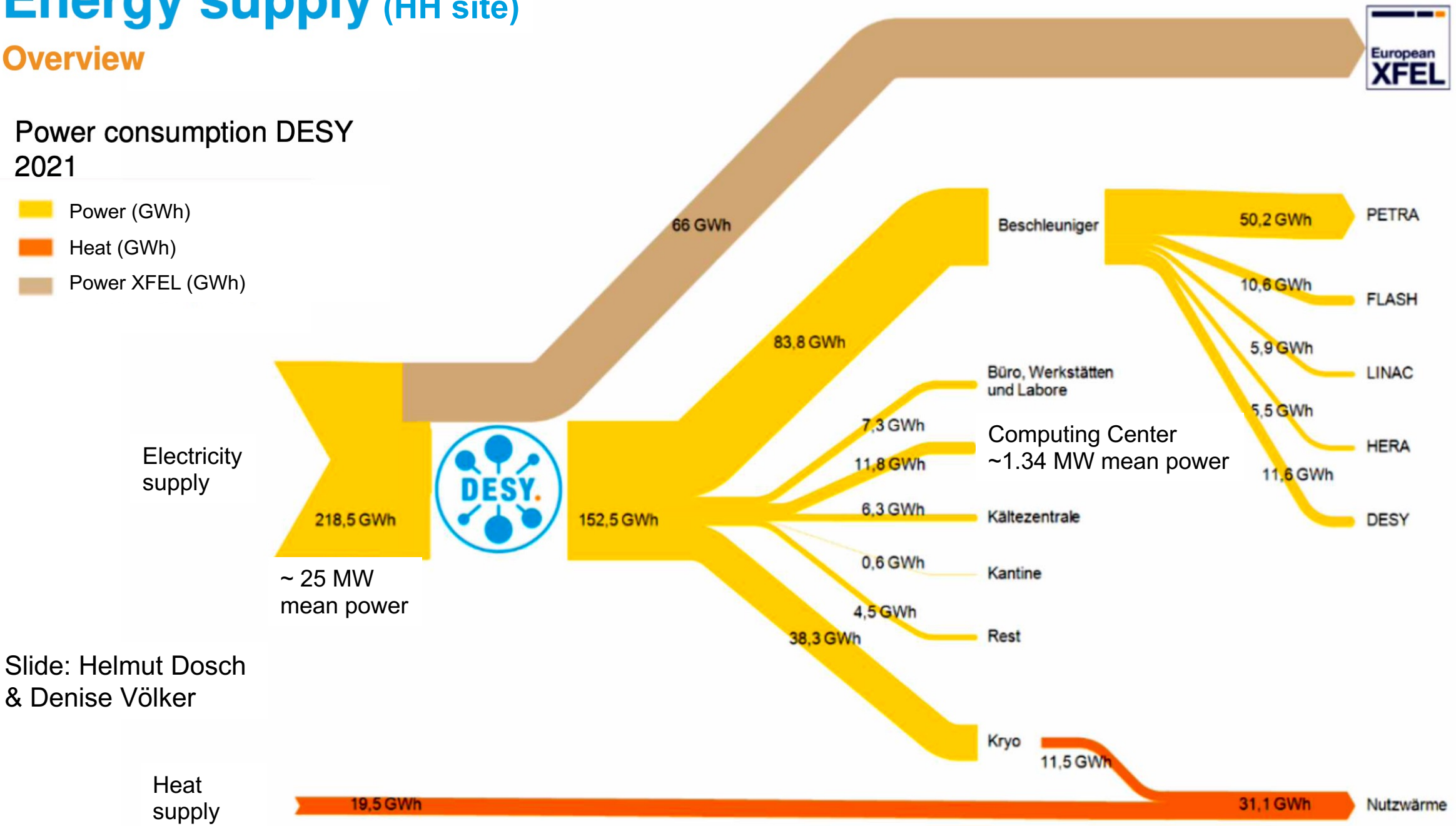
Veröffentlicht am 06.10.2022 | Lesedauer: 7 Minuten

Von **Norbert Lossau**
Chefkorrespondent Wissenschaft

Energy supply (HH site)

Overview

Power consumption DESY 2021



Slide: Helmut Dosch & Denise Völker

Energy supply

- DESY (HH) buys so-called futures in tranches and thus minimizes price risk
  - 2022: 100% fixed, 2023: 80%, 2024, 60%, 2025 40%
  - Extreme price developments: Electricity futures for 2023 on 28.9: ~5x working price for 2022
- Additional shortage possible

- Heating:
  - Hamburg: Using district heating, can be reduced by using waste heat (if accelerators are running)
  - Zeuthen: Gas, contract ends 2022, new provider needed for 2023

Image: https://www.tnn.ltd/energy-supply/

Slide Eva Leister / Sustainability office

Waste Heat Usage 1

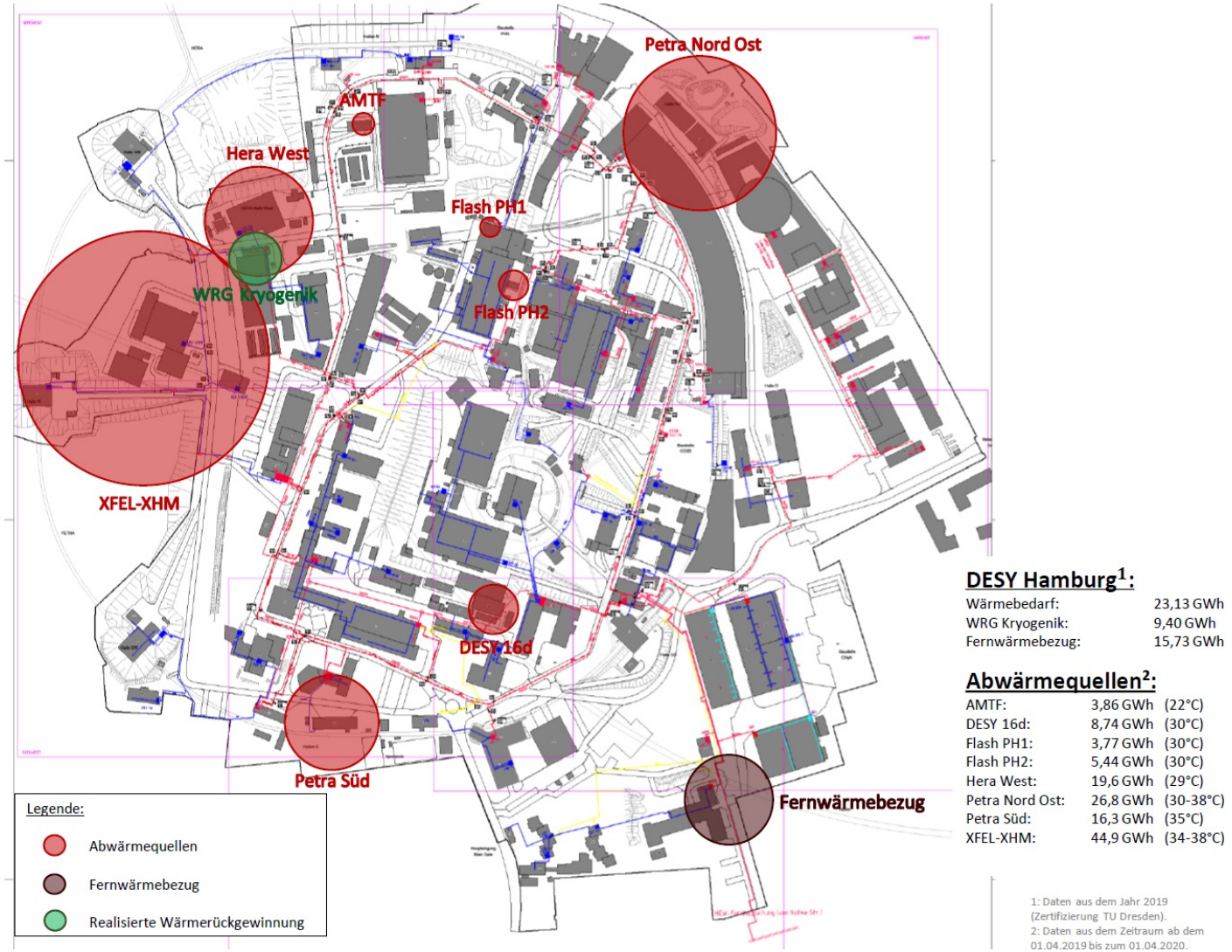
Cryogenic Plant - in use since 2017

- waste heat recovery from cryogenic plant commissioned in June 2017
- helium cooled down to minus 271 degrees Celsius (2 Kelvin) for operation of the superconducting accelerators
- process generates waste heat at a temperature of about 70°C
- two heat exchangers that connect the cooling system of the oil-cooled screw compressors with the local heating network
- Yearly heat extraction of >10 GWh (gigawatt hours)
- >1/3 of the total heat demand at DESY

Waste Heat Usage 2

Unused Potential at DESY Campus in Hamburg

- Currently heating is DESYs 3rd biggest CO2 emission source
- Waste heat from accelerators not yet in use
- project with University of applied science in Hamburg (HAW) to identify potential
- Result: 129 GWh/y of waste heat available at a temperature level of 30°C - 40°C
- Can cover all of DESYs heat demand (ca. 12 GWh/y) – usable in existing and new buildings
- possible CO_2 savings at DESY campus of about 4.000 tons/y
- Surplus can be used in neighborhood; if we get the 129GWh in use saving will be up to 40.000 tons CO_2/y



Energy saving measures in winter

- Two new laws (EnSikuMaV and EnSimiMaV) force us to implement:
  - Reduce room temperature by 1 °C (offices max. 19 °C,
  - medium-heavy activity while walking and standing max. 16 °C)
  - Heating of common areas prohibited, except toilets and kitchenettes
  - Switch off warm water for hand washing
  - Switch off lights that do not serve safety purposes.
- obligation to implement economic efficiency measures in companies with an energy consumption of 10 GWh/a or more

→ Development of energy saving plan for small consumers: aiming for a 2-3% reduction

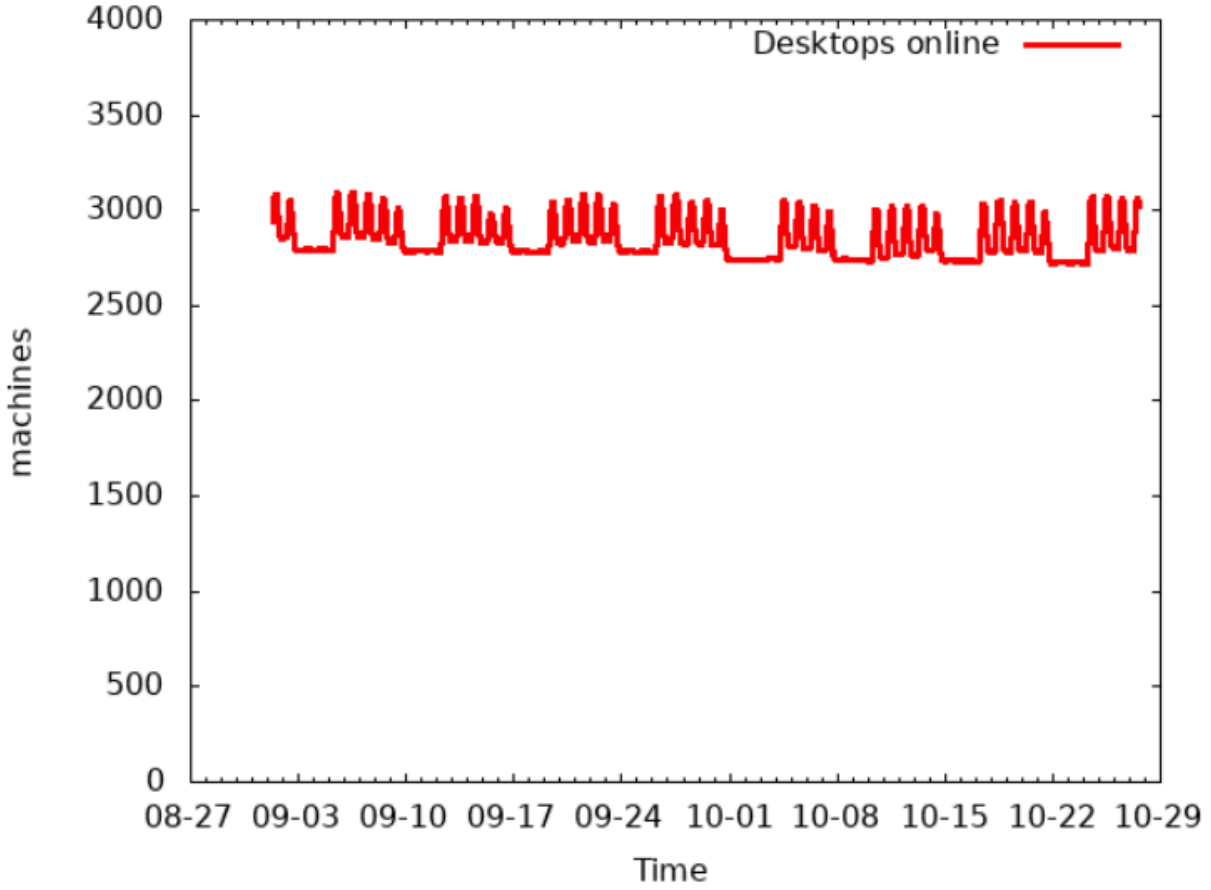
→ Accelerator options:

- Checking power reduction, will influence photon energy for user operation
- considering longer winter shutdowns

http://www.weyershausen.de/week.html (27.10.22)

Measures in IT: Desktops etc.

- First reflexes:
  - Disconnect Mobile phone chargers
  - Print less
  - Switch off desktops
  - …
- Measure before optimizing!



- Turned out we do not know lots about energy usage of desktops etc.
  - Measured, and discussed impact of non-availability
  - Told people they could turn off their desktop over night/weekend (Oct. 4th)
  - Theoretical savings moderate. Effective savings → See plot

Profiling: Who is the largest power consumer?

- Scientific infrastructures are by far the largest sytems in DESY computing centers
  - Grid cluster: HTCondor governed production oriented cluster
  - User/Interactive: NAF: HTCondor governed user analysis facility & Zeuthen farm
  - HPC/SLURM: Maxwell: cluster with online analysis features & Zeuthen HPC
  - dCache storage systems
  - GPFS storage systems
  - Management systems (CE, VOMS, …), collaborative tools, …

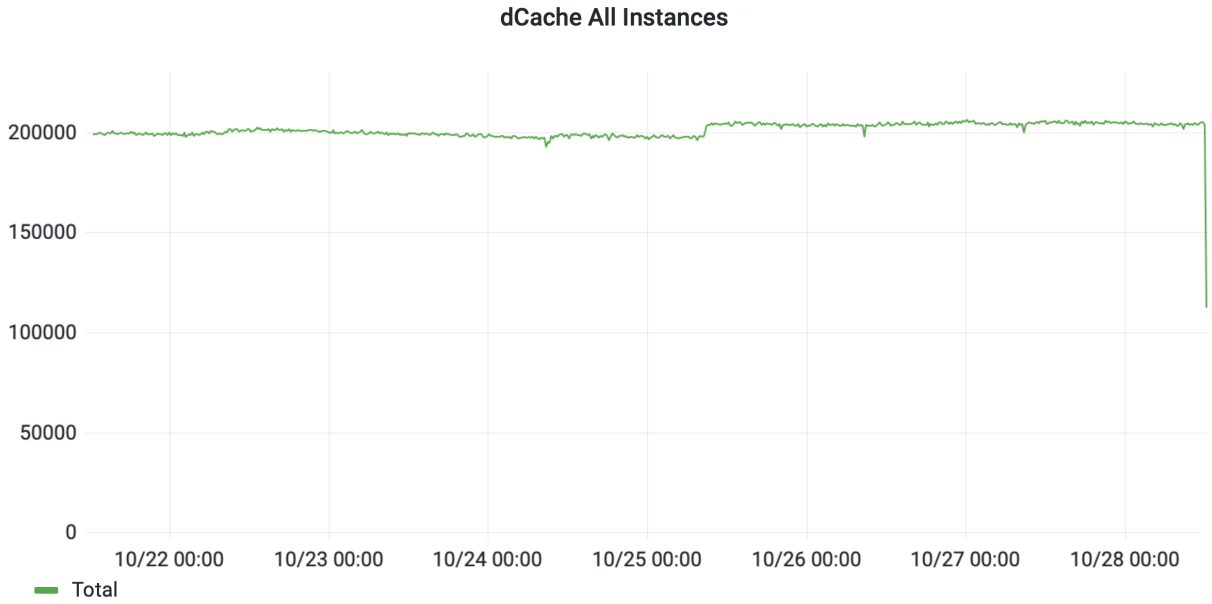
Save energy in scientific infrastructures: How?

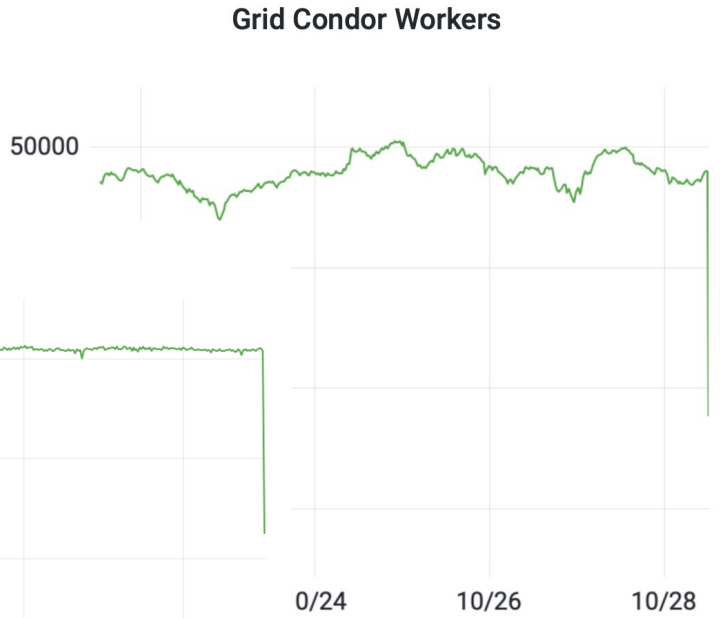
- Save energy … how?
  - Measure
  - Fast (and easy?) implementable optimization
  - Longterm infrastructure improvements
  - Changes in user workflows and tools

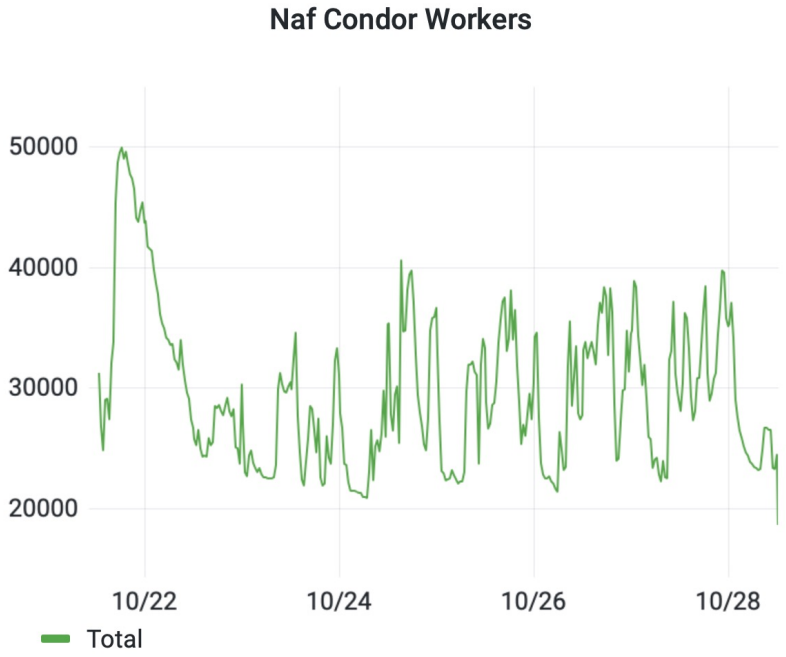
Wikipedia: File:Потьомкінські сходи 11.jpg

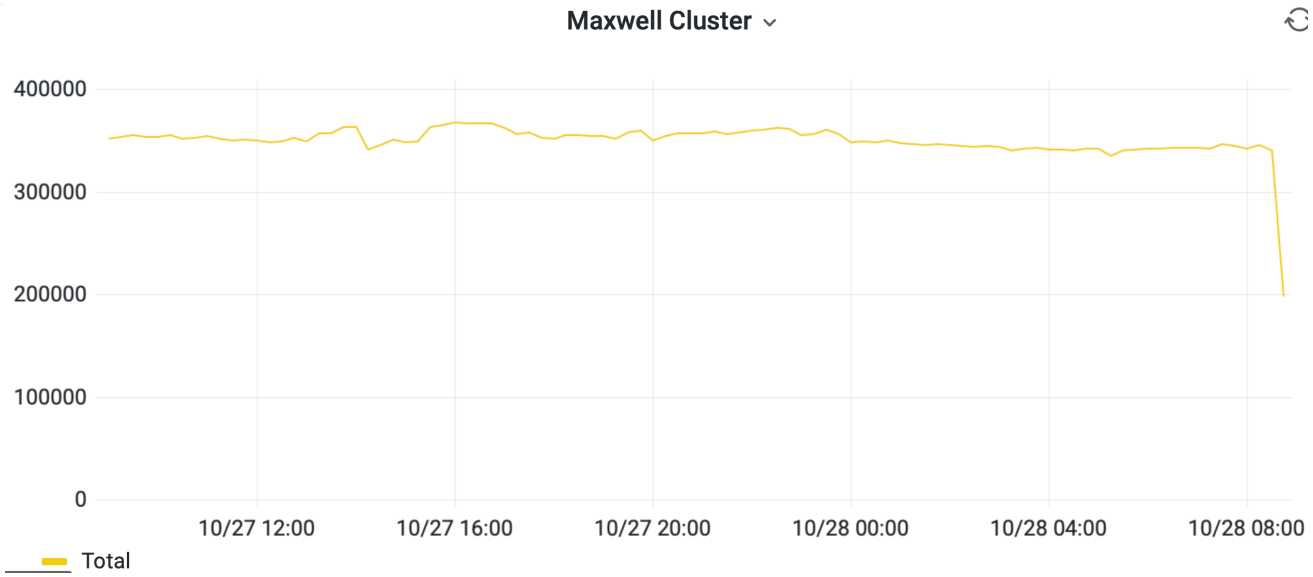
First plots (preliminary)

Thomas Hartmann et al.









NAF + GRID + Maxwell + dCache in HH > 600 kW

- Older hardware is missing!
- Monitor power consumption:
  - Where to take reliable information from?
  - Power supplies? Smart PDU?

Fast (and easy?) implementable optimizations

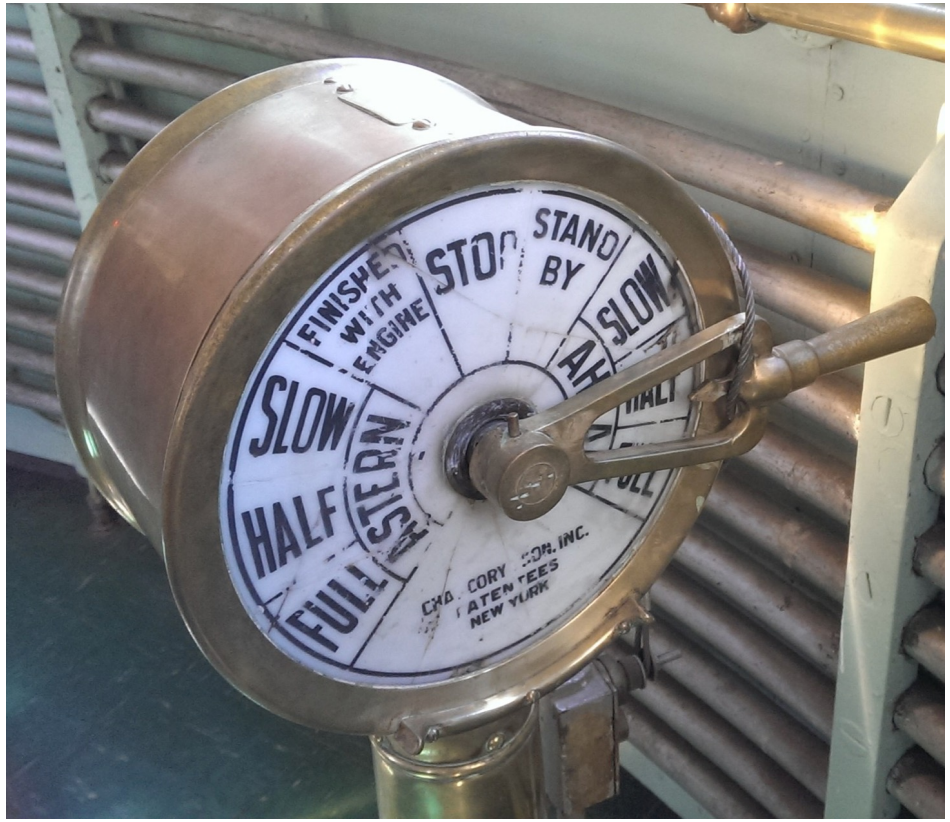
Thomas Hartmann, Christoph Beyer, Sven Sternberger, …

Saving energy basically means: shut down or throttle machines:

- Shutdown old hardware that is less power efficient
- Turn-off/on some machines (less user need ; low power; …)
- Reduce per-machine consumption by throttling CPU

Which systems?

- Worker nodes probably easier than storage
- Worker nodes: what happens to running jobs? How stable is the batch system?



Wikipedia: File:Engine Order Telegraph.jpg

Ideas at DESY?

Thomas Hartmann, Christoph Beyer, Sven Sternberger, …

- Prefere automated turn-off/on over throttling
  - but look at both
  - investigate integration into HTCondor and SLURM
- Discussion with HTCondor developers:
  - HTCondor well suited for [dis]appearing WNs
  - Idea: Have a max-power per cluster, which HTCondor will not trespass
- Potential:
  - NAF/Interactive: Many small jobs / HTC
  - SLURM: Whole node scheduling / investigate stability
  - Grid: Long/Pilot jobs. Many jobs per node. Throttling?
  - Storage: Turn-on/off no solution! Throttling? → dCache team some ideas

https://debeste.de/42414/Expertenl-sung-um-den-Schalter-aus-dem-Nebenzimmer

(some) longterm infrastructure improvements

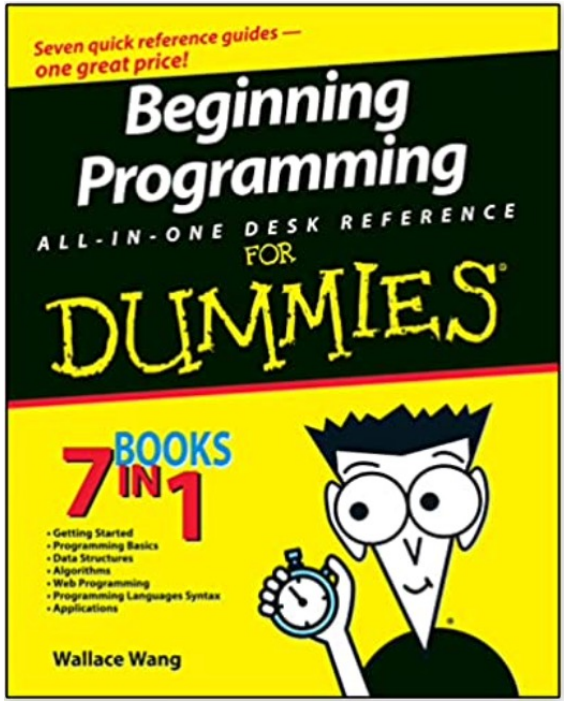
Kars Ohrenberg, …

- UPS:
  - Have two power feeds per worker node. Why additional UPS? (~3% efficiency loss)
  - Needs invest to provide additional non-UPS backed power feed in CC
- Cooling:
  - Changing to water-cooled racks (passive rear-door)
  - Investigate water cooling in the server (partly also due to increasing [C|G]PU power consumptions)
- Investigating on more efficient systems and architectures
  - Next procurements: Benchmark HepSpec/Watt
  - Architectures: ARM … well, user driven, not on the horizon

VertivTM Knürr® DCD Cooling Door

Change in user workflows and tools (examples)

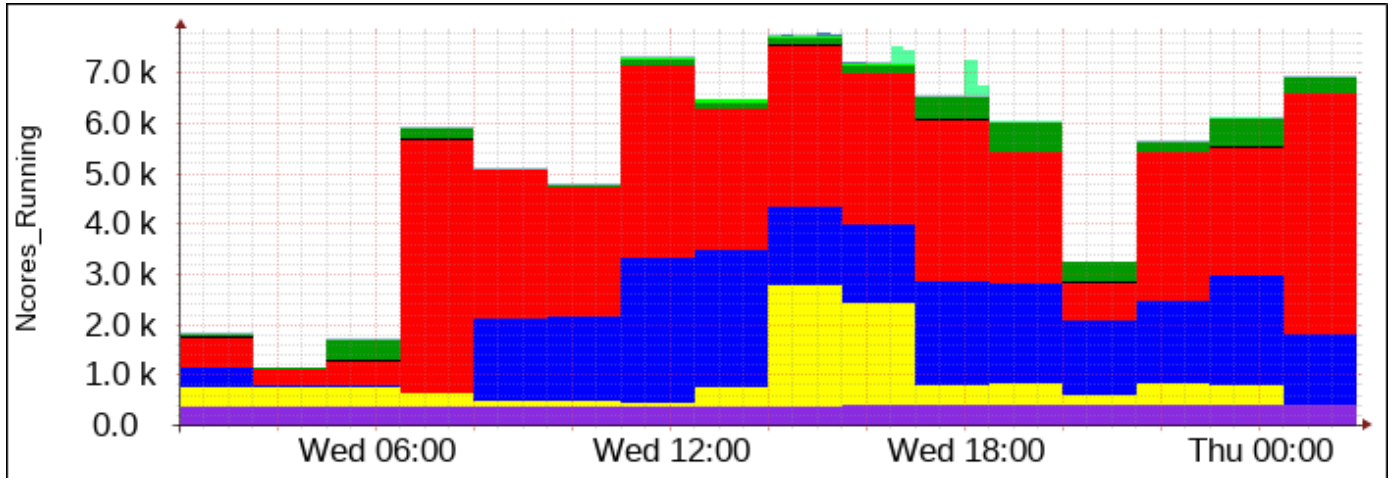
- Users:
  - Better software carpentry knowledge
  - More careful scaling of applications to large clusters
- VOs/Experts:
  - Very longlasting jobs are an issue. Rethink WLCG pilot jobs?
  - Help the scheduler: Add (runtime) requirements to the job.
  - Premptible jobs and workflows could further help the scheduler
- Provider duty:
  - Tell users their energy / CO2 footprint
  - Planning on writing NAF users regularly on power & CO2 consumption of their job
  - Simple inclusive approach, more an educational measure



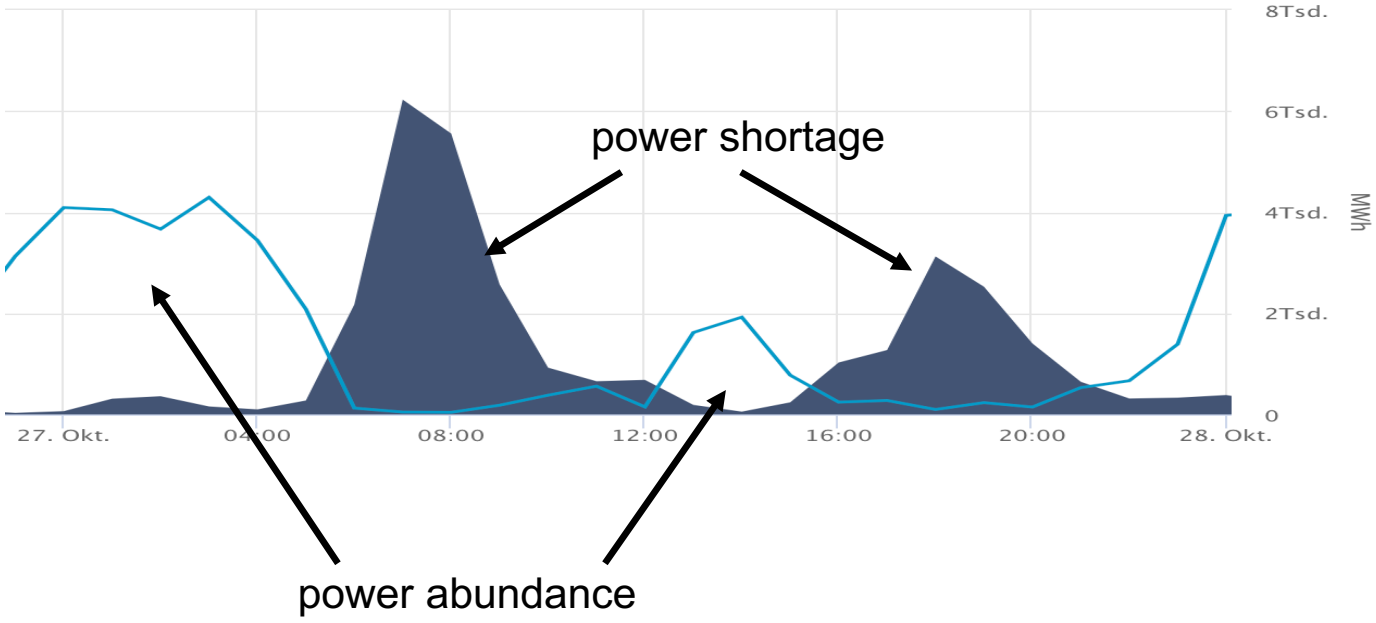
OK, we save some power.
Are we sustainable?
Are we ”green”?

Example question: When to turn-off/throttle bach nodes?

- Example NAF Utilization
  - … usually dip during night, and high occupancy during office hours



- Power availability:
  - light blue curve: Filling pumped storage (power abundance)
  - dark blue area: Pumped storage produces energy (power shortage)
  - Source: German SMARD portal



Dilemma

- Follow users?
- Follow power availability?

- At them moment, no monetary advantage for any scenario
- This will change in some more or less near future!

https://de.elv.com/elv-bausatz-lesekopf-mit-usb-schnittstelle-fuer-digitale-zaehler-usb-iec-155523

Sustainability thoughts

- Sustainability is more than just saving energy and purchasing “green energy”
- Sustainabilty means being flexible and adapting to availability of renewable energy
- Sustainability means looking at more than just the power
  - green-house-gases, materials, ….
  - machine lifecycle: gray energy, materials, repairs, …
  - infrastructure lifecycle: concrete going into computing centers and buildings, …
  - placement of infrastructures: place consumers close to electricity producers
- IT/Computing has a tremendous history of having increased efficiency. Rebound effects voided these gains.
- Sustainability will need: Do less. But do it in a more clever way.

https://blog.hubspot.de/sales/sustainability

Closing remarks

- Situation is tight. DESY is just on of the institutes in Germany being hit. Other countries hit as well.
- Some coordination and exchange platforms under way. I know of WLCG , GridKA-TAB, there are others.
- Some ideas. Will need implementation, testing, tuning. Exchange ideas and results.

- Do not be fooled by easy low hanging fruits … that are shiny but do not bring you lots of savings.
- Do not be fooled: Just saving power might not make you more sustainable.

- DESY sustainability office: https://nachhaltigkeit.desy.de/index_eng.html (Much more than just IT related)