OCP FUTURE TECHNOLOGIES SYMPOSIUM

OCP Global Summit

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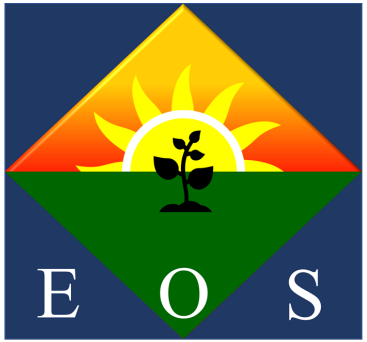
EOS Project - Super Conducting Data Center

A GAME CHANGER IN DATA CENTER EFFICENCY

Karl Rabe, Viktor Stark



The Problem

Borderstep Institute for Innovation and Sustainability

Data centers 2018

Cloud computing boosts growth

Efficiency gains are not enough: Data center energy consumption continues to rise significantly

Dr. Ralph Hintemann

In 2018, the power requirements of data centers in Germany rose significantly again. Compared to the previous year, the demand for electrical energy by servers and data centers increased by 6% to 14 billion kWh. This growth is primarily due to the strong expansion of cloud computing capacity in Germany. Substantial new data center capacities were built up, particularly in the greater Frankfurt area, but also at other locations. This development is expected to continue in the future. Trends such as edge computing and artificial intelligence are expected to lead to a significant expansion of data center infrastructures in Germany, Europe and worldwide. If the existing efficiency potentials are not realized, the energy consumption of data centers will continue to rise significantly.

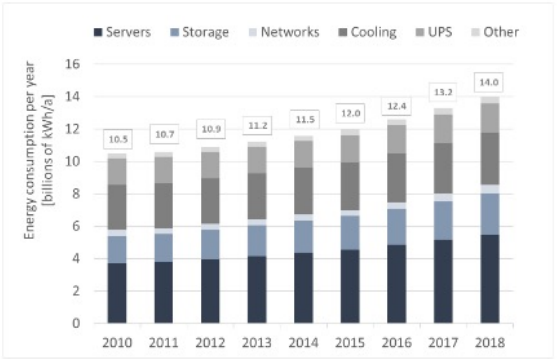


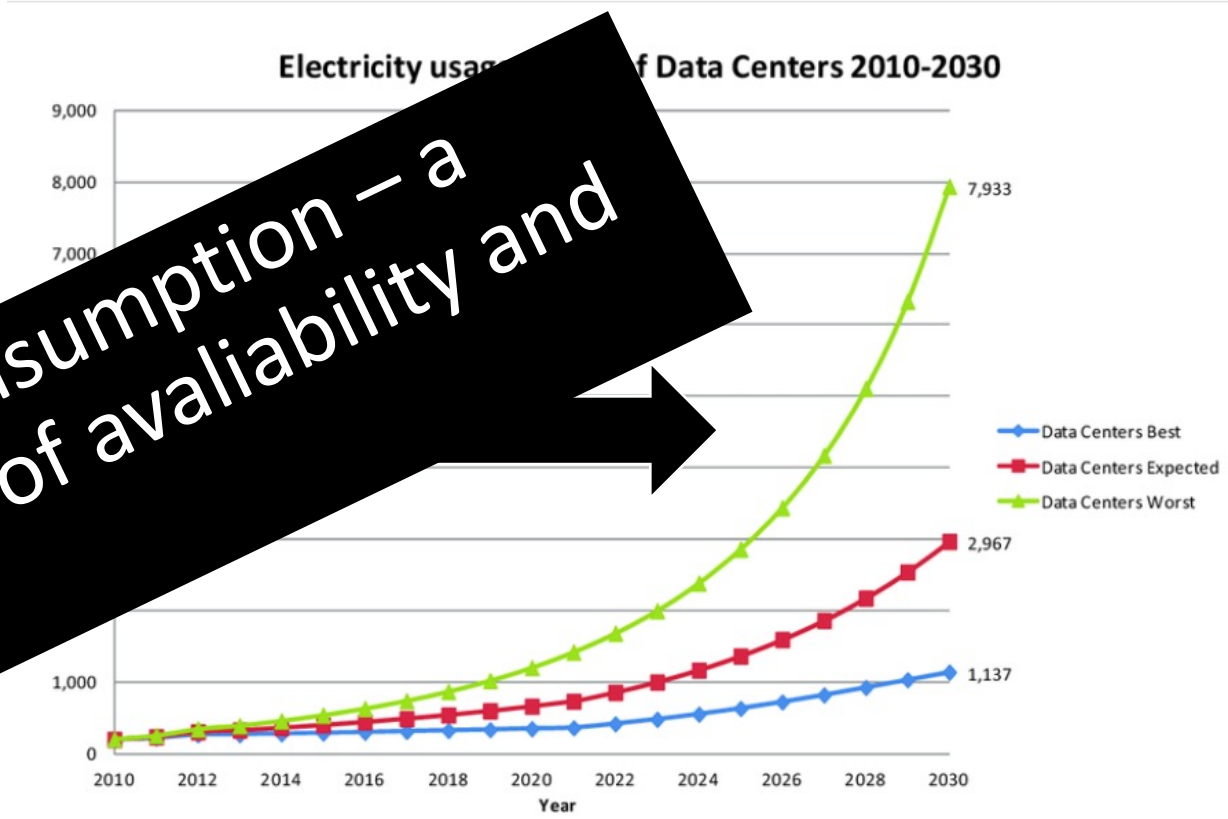
Figure 1: *Energy consumption of servers and data centers in Germany in the years 2010 to 2018 (Source: Borderstep)*

https://www.borderstep.de/wp-content/uploads/2020/04/Borderstep-Datacenter-2018_en.pdf

The Problem

More and more data cente

Power Consumption – a question of avaliability and OPEX



Global electricity demand of data centers 2010-2030.

https://www.researchgate.net/figure/Global-electricity-demand-of-data-centers-2010-2030_fig2_275653947

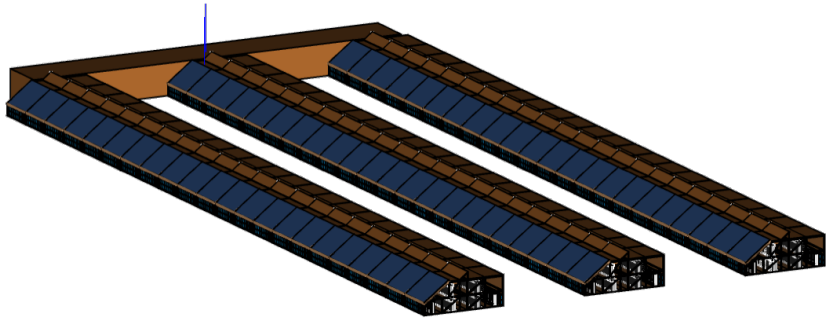
The **REAL** Problem

Beyond PUE measures: SCOPE 3 EMISSIONS

- electrical losses in the powerline
- inefficient power system
- polluting construction material
- transportation and recycling

The Solution is Technology!

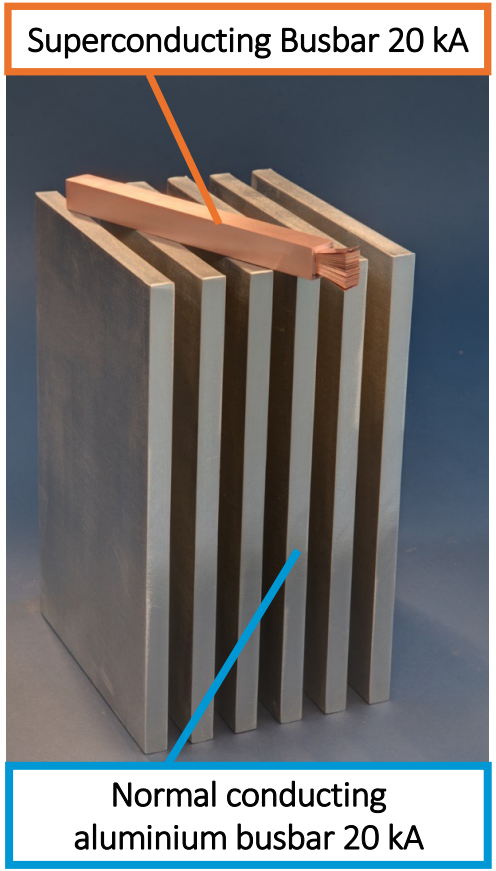
- **E**cological
- **O**pen Standard
- **S**uperconducting



Superconducting?

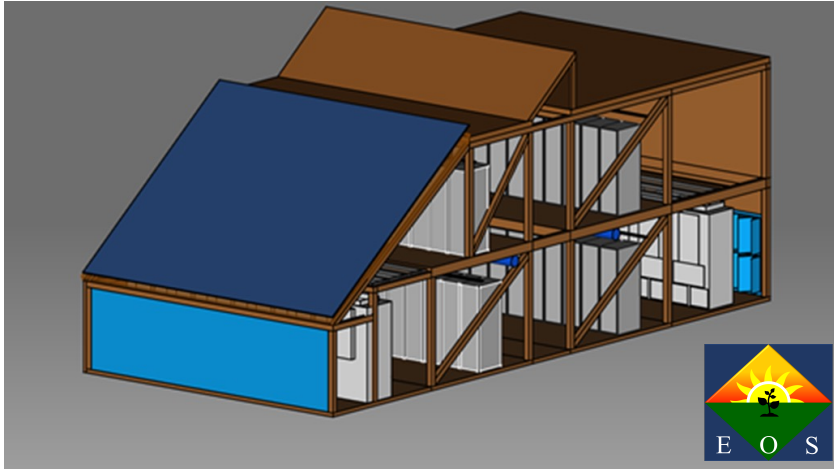
1. No electrical losses with DC
2. Works ony with low temp of 77 K (-321 °F)
3. Extremely high power density up to 62 A per mm2

- Already installed with a current of 20 kA in a chlorine plant
- Working on a 200 kA demonstrator in an aluminium plant (www.demo200.de)



Main Benefits

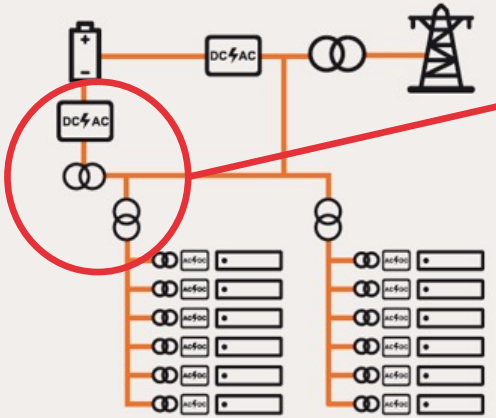
- significant Scope 3 emissions reduction
- 30% higher rack density
- 15 % energy savings in the power line
- shorter ROI with increasing MW
- no powershelfs



significant Scope 3 emissions reduction:

good

CONVENTIONAL POWER SUPPLY

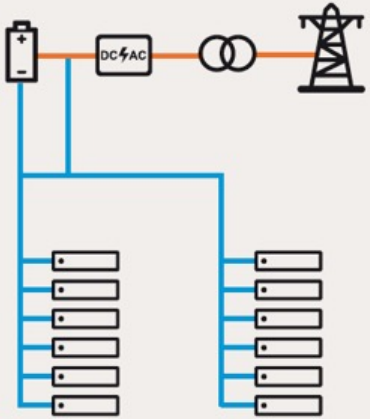


Many AC / DC Converters and transformers needed

- no ac-converter
- no transformers
- no power losses
- modular system reusable
- less material
- less recycling

better

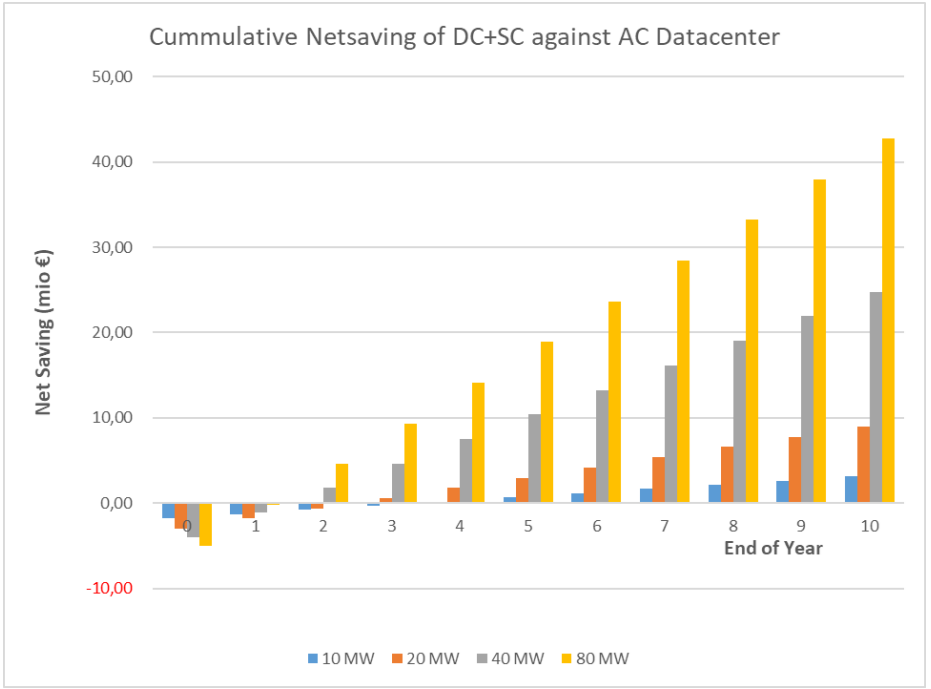
SUPERCONDUCTING POWER SUPPLY



Connect your servers directly with battery voltage level

ECO also means ECOnomical

80 MW Data Center =
4 million per year savings



More details – IEEE paper:

Efficiency and Reliability Analyses of AC and 380V DC Distribution in Data Centers

BIJEN R. SHRESTHA[1], UJJWOL TAMRAKAR[2], (STUDENT MEMBER, IEEE), TIMOTHY M. HANSEN[2], (MEMBER, IEEE), BISHNU P. BHATTARAI[3], (SENIOR MEMBER, IEEE), SEAN JAMES [4], AND REINALDO TONKOSKI[2], (SENIOR MEMBER, IEEE)

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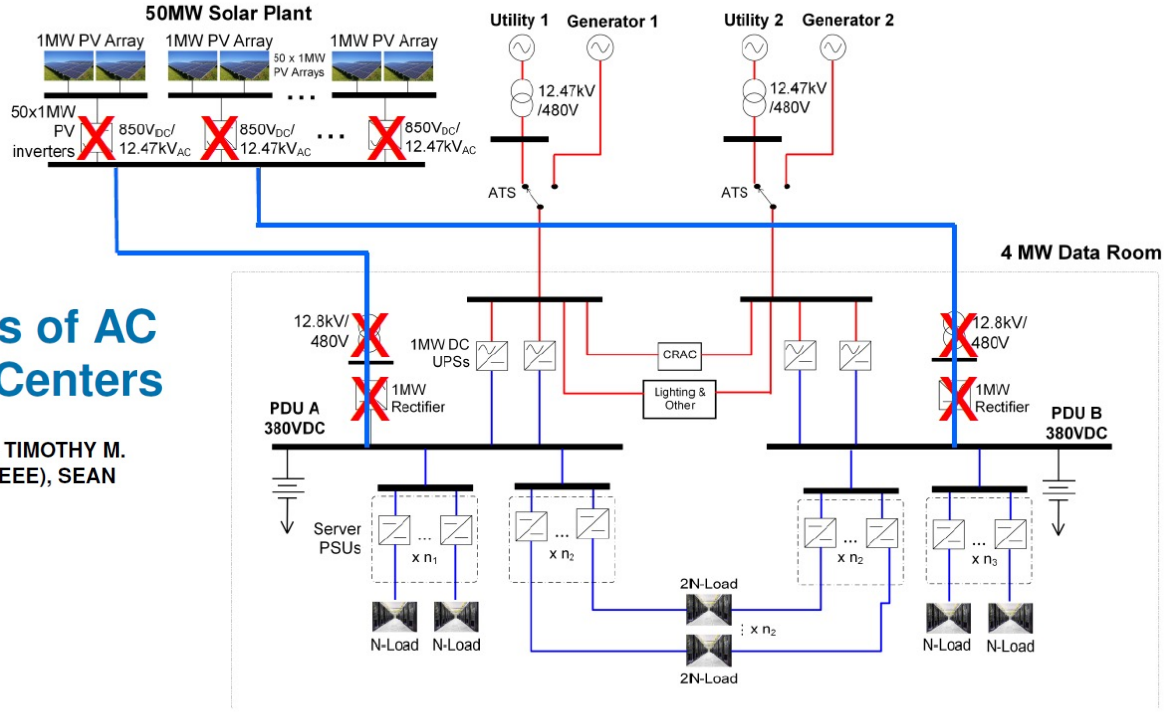
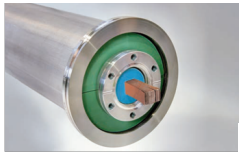
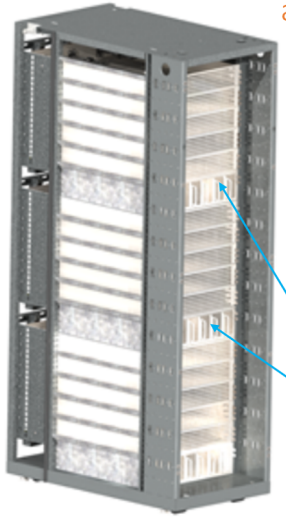


FIGURE 6. 380 DC superconductor power distribution system with 50 MW PV integration

ICE®BAR -The Superconducting Busbar

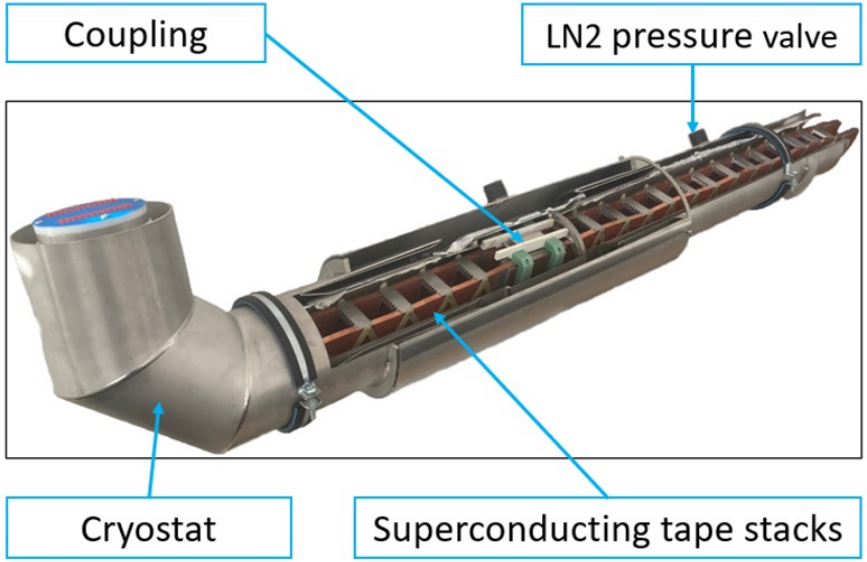


350 – 400 V DC up to 200 kA and 80 MW main power line

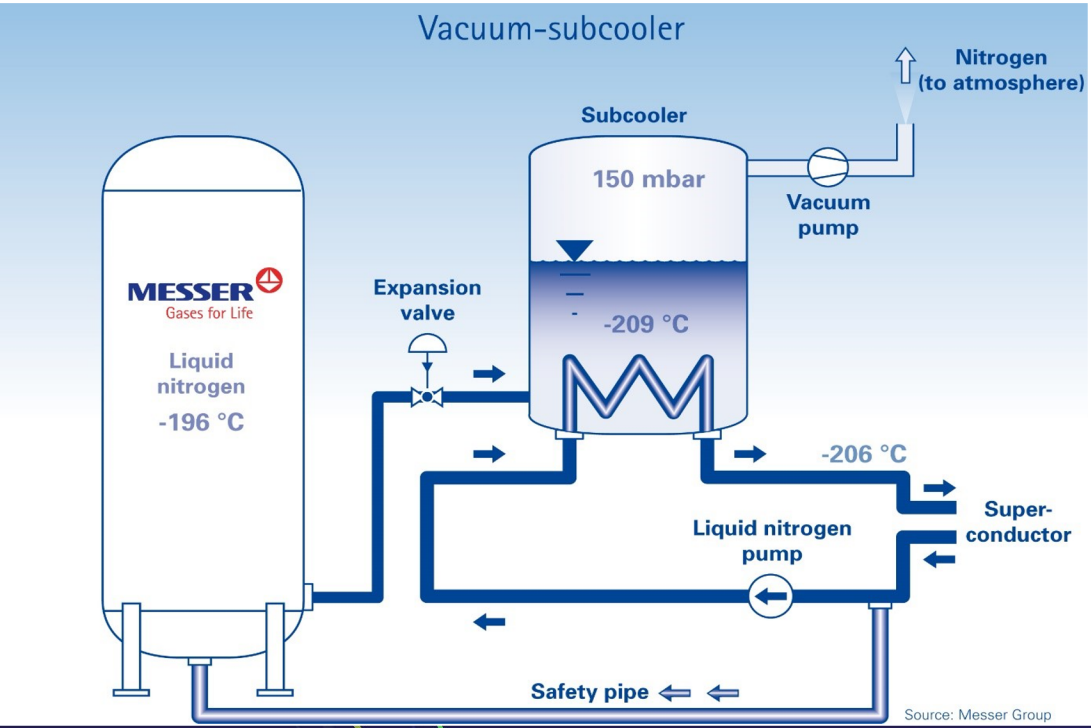


direct 12V or 48V DC/DC high power connection from main power line to the RACK

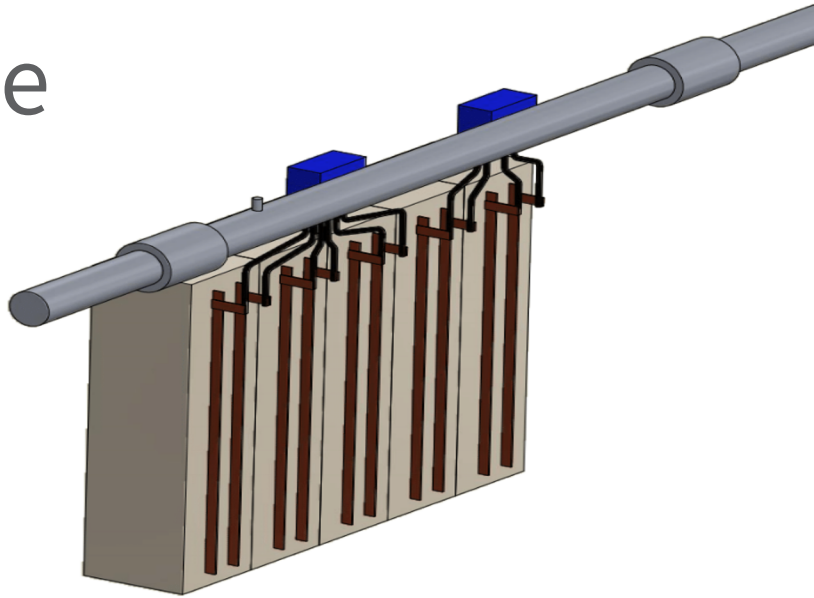
replace the power shelfs with servers

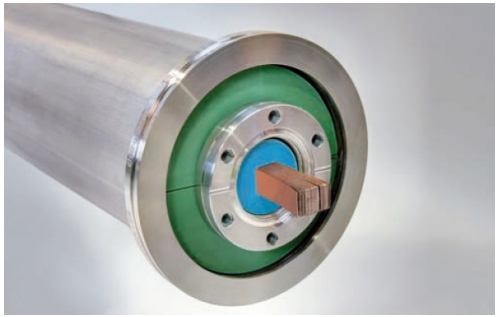


Cooling Concepts Available



Source: Messer Group

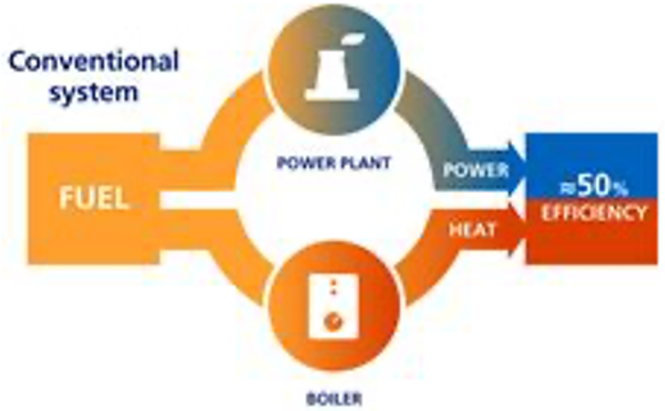




Wooden Construction

https://ecodatacenter.se/

Cooling system: Liquid Nitrogen and Gas-powered Co-generation Backups



20 year usage: Diesel Backup 300 hours
140.160 hours

Gas-Generator Powerplant

Cost Per MW: $ 300.000,--

CAPEX and OPEX paid by utility

The Challenge:

Leave the comfort zone!

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