

# TOTAL ENERGY MANAGEMENT FOR PROFESSIONAL DATA CENTERS

## 1. INTRODUCTION

More than 12 TWh/a are consumed yearly by around 50 000 Data Centers in Germany quantity expected to grow to 14 TWh/a by 2020 (Hintemann, 2014). Information and Communication Technology (ICT) Products have a short lifetime (2-5 years), indicating that the energy consumption outside of the service phase is also of relevance. The amount of servers grew by 28% for the period 2010-2014 (Hintemann, 2015). This is accompanied by the increasing material intensity in data centers, so the material demand for these applications rose in parallel to the energy consumption.

The aim of the research is to **increase the material and the energy efficiency of data centers**, through the development of a holistic **assessment of the energy efficiency** of data centers and the conception and development of **efficient technologies**. With these technologies to be developed, energy savings for server and storage applications can reach high levels.

## 3. DATA CENTER ENERGY CONSUMPTION

Energy consumption is considered as energy consumed during the use phase. What do we know about the grey energy? Therefore the material composition and their cumulative energy demand is analysed and referred to case studies

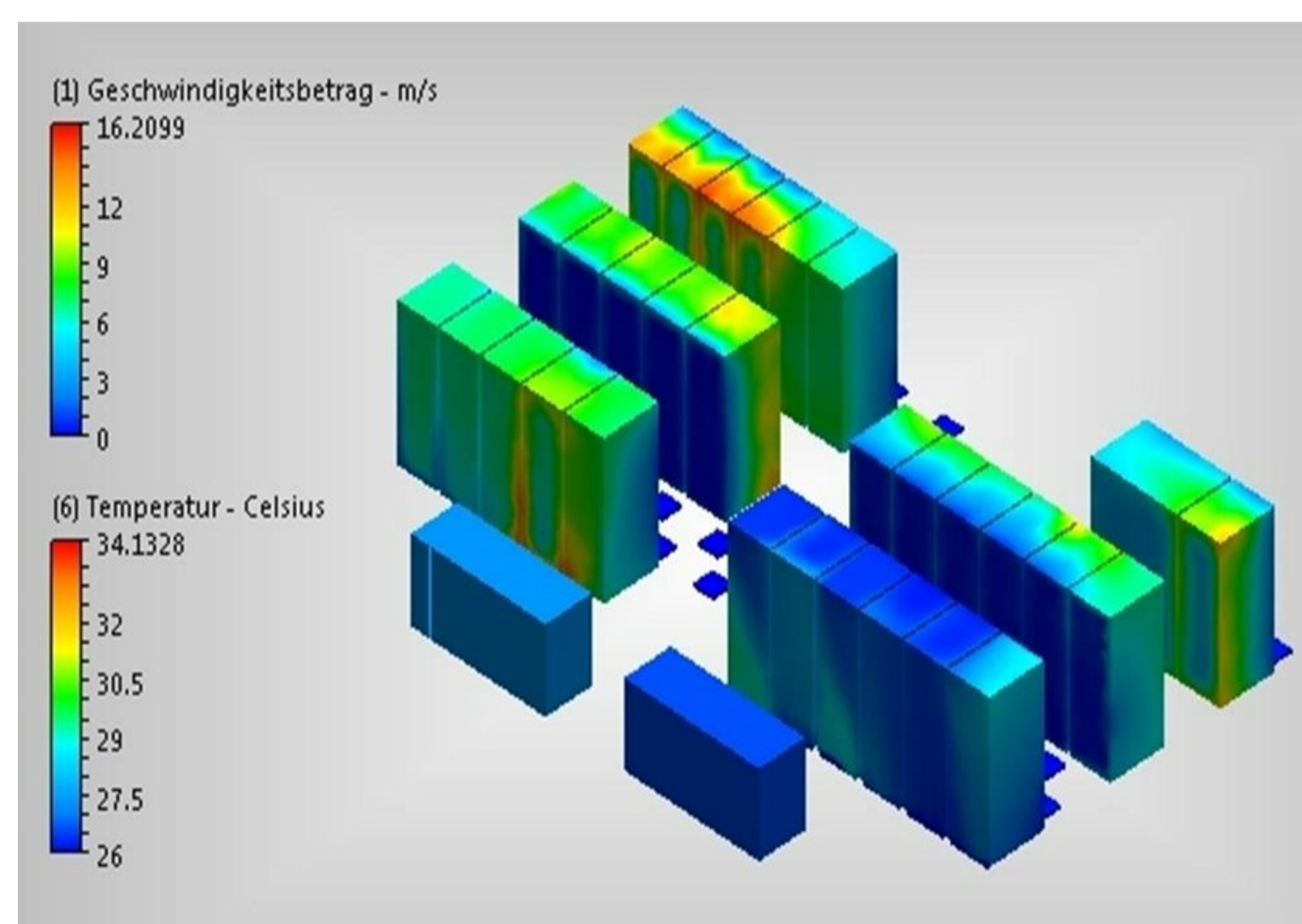


Figure 1. Analysis of the Temperature Distribution in a Data Center using Computational Fluid Dynamics

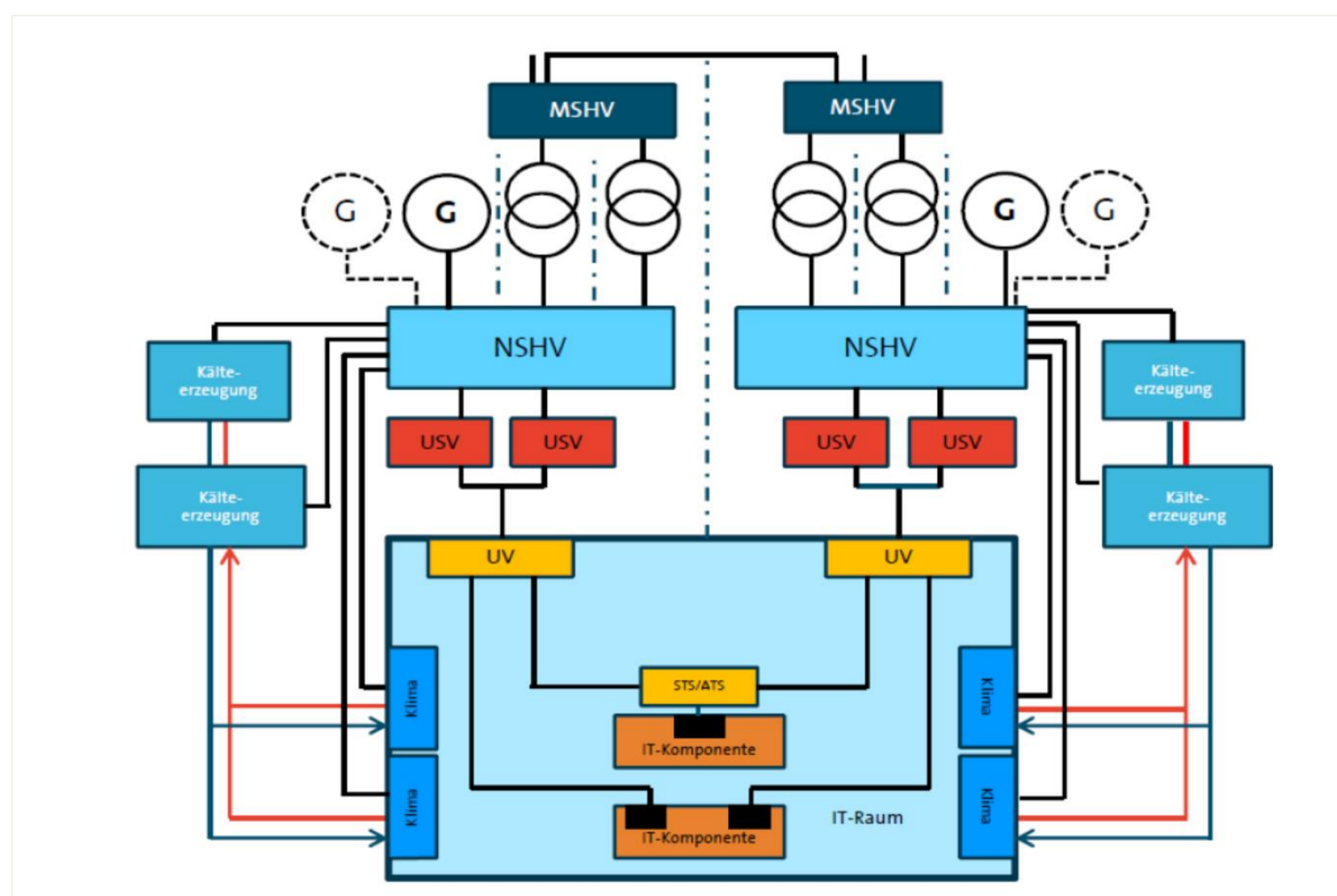


Figure 2. Data Center Components Tier IV: 99,991% availability (Herzog, 2016)

References: Herzog, C. (2013). Betriebssicheres Rechenzentrum - Leitfaden. BITKOM Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e.V.; Fichter, K. & Hintemann, R. (2014). Beyond Energy. The Quantities of Materials Present in the Equipment of Data Centers. Journal of Industrial Ecology, 18 (6), 846-858; R. Hintemann, (2014). „Consolidation, Colocation, Virtualization, and Cloud Computing – The Impact of the Changing Structure of Data Centers on Total Electricity Demand“, in ICT Innovations for Sustainability. Advances in Intelligent Systems and Computing, L. M. Hilty und B. Aebischer, Hrsg. Berlin, Heidelberg: Springer; Hintemann, R. (2015). Studie zur Entwicklung von Rechenzentren im Jahr 2015. Berlin: Borderstep Institut.

## 2. SCIENTIFIC AND TECHNICAL OBJECTIVES

### Establishment of a validation basis for the energy and material efficiency of data centers

- Survey of energy demand, resource stocks and resource efficiency in data centers.
- Analysis of interactions and interdependencies between raw materials and energy efficiency.
- Cradle-to-grave analysis of the selected equipment and installations.
- Analysis of concepts for the cascading use of ICT devices in data processing to achieve maximum energy efficiency.
- Development of a system for a holistic evaluation of the energy efficiency and of the raw material efficiency of data centers.

## 4. DATA CENTER MATERIAL COMPOSITION



Figure 3. Grinded Material from Server Components (TUHH, Hobohm & Kuchta)

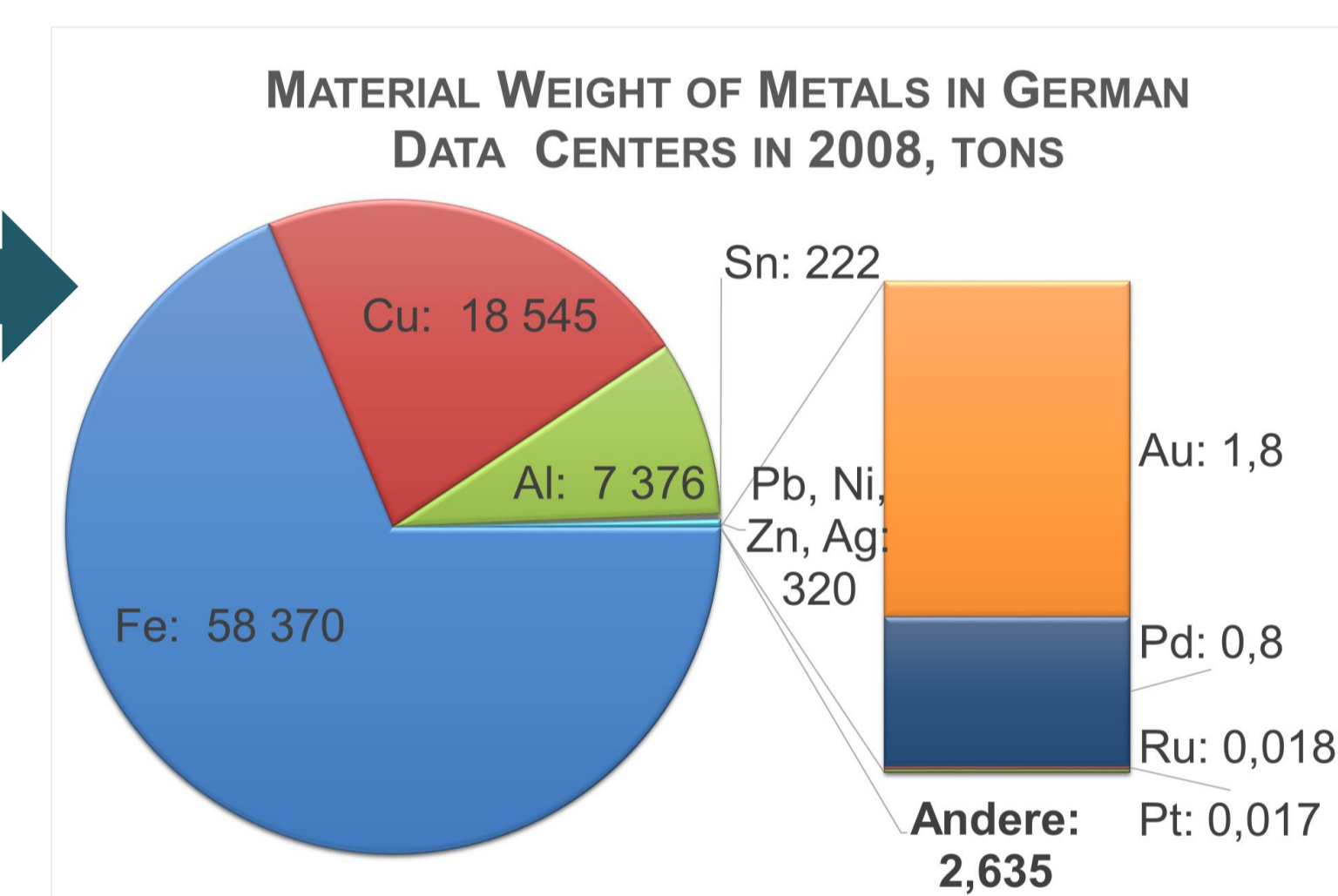


Figure 4. Material Composition of Data Centers in Germany (Data from Fichter and Hintemann, 2014)

## 5. EXPECTED RESULTS

1. Catalog of criteria for material demand in the lifecycle of products for ICT devices and facilities in data centers
2. Documentation of selection criteria for specific ICT devices and facilities
3. Selected documented cradle-to-grave lifecycle analysis for ICT devices and facilities

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