

**Motivation use case Data Center** – Rising energy costs and performance demands – increasing technology advances – insufficient utilization and adaption to dynamicity in data centers

- ✓ Optimized but isolated systems of energy consumers
- ✓ Less Virtualization or static Consolidation
- ✓ No forecasting models for different demands

**Urgently Needed:**

- ✓ Compare ability of heterogeneous data center designs
- ✓ Efficient utilization maximization of ICT resources
- ✓ Transparent energy costs – monitoring of components
- ✓ Holistic management of all load dependent energy consumers – among all systems
- ✓ Meeting memory demands both in size and access times

**Project objective** – As reducing the energy consumption of resources within a system of ICT components. Locally in data centers or distributed among different facilities.

**Government-funded** – BMWi (IT2Green)

**Duration** – 3 years, from 06/2011 to 05/2014

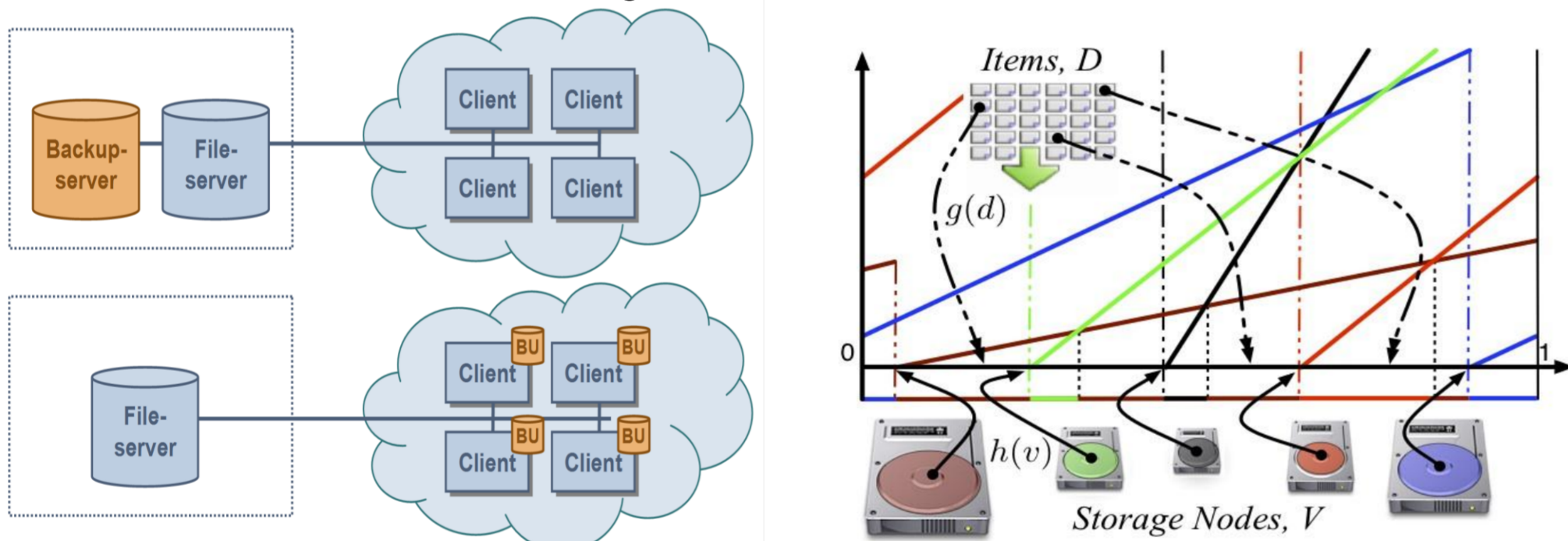


**Main Objectives**

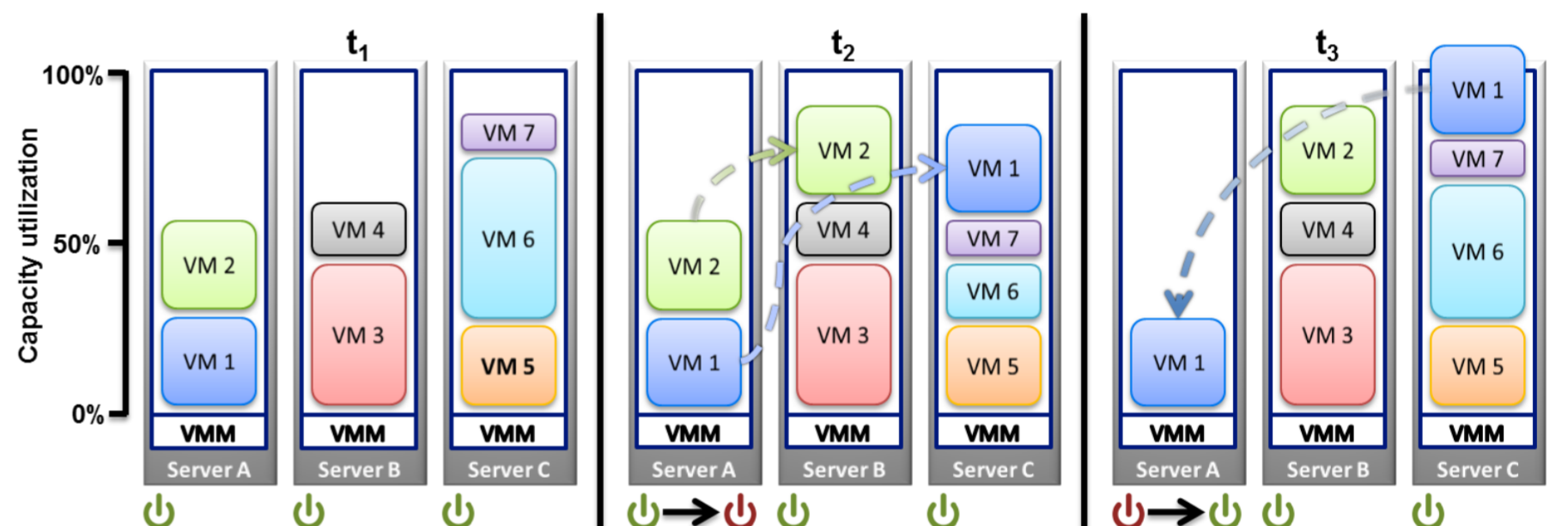
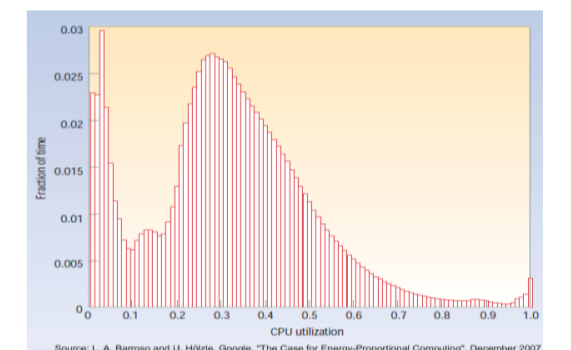
- T1 – Data center optimization:** proactive load and power management by migration and consolidation of VMs
- T2 – Distributed data centers:** Load distribution among connected facilities, respecting the network, enhancement of efficiency by including local energy relevant parameters like temperature (active cooling), wind => energy costs, ...
- T3 – Distributes data storage:** Private cloud storage consisting of free capacities of connected client systems or NAS used by servers during backups

**Resources and the uncertainty of demands leads to unwanted over provisioning**

- ✓ Cost efficiency by usage of available resources, like unused client storage capacity
- ✓ T3 Concept „distributed data backups from serves by clients“ with DHHT
- ✓ A “Private Cloud Storage Service” consisting of dynamic storage nodes like Desktop Clients or network attached storages aka. NAS



- ✓ Resource shortage as consequence
- ✓ Shortage not fixable immediately
- ✓ Forecast avoids resource shortage
- ✓ Provisioning prospective needed resources just in time as needed



**The final holistic solution for data centers**

- ▶ **Minimizing need resources** like physical servers, storage capacity, air condition, ...
- ▶ **Different forecasting models** will allow the adaption of all adjustable energy consumers
- ▶ **Comparison** of facilities to allow load balancing among different locations
- ▶ **DC – Components:** Server, Storage, Network, air condition, power supply, ...
- ▶ **Objective is holistic** consideration of data centers
  - ▶ optimize locally and among distributed data centers
  - ▶ increasing cost and resource efficiency

**Solution:** System management, optimization, forecast models, combining distributed data centers  
**Locally:** monitoring and pro active controlling of all adjustable components  
**Globally:** pro active migration among facilities based on energy price differences

