# The Future of Data Center Energy Demand
## The Impact of the Changing Structure of Data Centers

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*Abstract*— **The IT industry in general and data centers in particular are subject to a very dynamic development. Within a few years, the structure and components of data centers can change completely. This applies not only to individual data centers, but also to the structure of the data center market at the national or international level. This poster shows the structure and development of the data center market in Germany. These are results of the project "Adaptive Computing for Green Data Centers" (AC4DC, www.ac4dc.com).**

## POWER CONSUMPTION OF DATA CENTERS

- Data centers consumed 1.1 to 1.5 % of global electricity in 2010 (in the US 1.7 to 2.2 % [1], in Germany 1.8 % [2].
- Global electricity consumption of data centers increased by 56 % from 2005 to 2010[1].
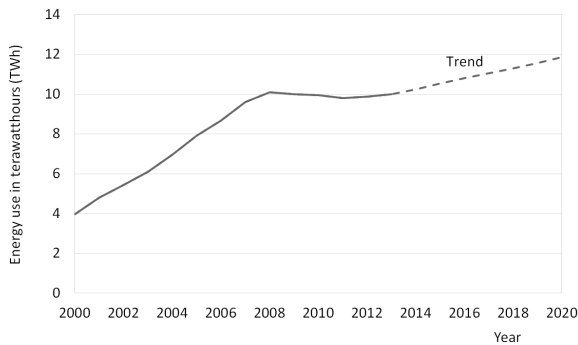- Frankfurt area: data centers account for more than 20 % of power consumption [3].



Fig. 1.  Development of energy consumption by servers and data centers in Germany (Source: Borderstep)

## CHANGING STRUCTURE OF DATA CENTERS

- The sizes, types, and locations of data centers are changing significantly. Reasons:
    - Consolidation of data centers,
    - Increasing use of colocation data centers,
    - Virtualization and cloud computing.

| Data center size | No. of data centers in Germany (2013) | Change Rate 2008 - 2013 | Colocation data center | Cloud computing and hosting data center | Private data center | Public data center |
|---|---|---|---|---|---|---|
| **Server closet** up to 10 m$^2$ | Approx. 31,000 | -8% | | | | |
| **Server room** 11-100 m$^2$ | Approx. 18,000 | +/-0% | | | | |
| **Small data center** 101-500 m$^2$ | Approx. 2,100 | +23% | | | | |
| **Medium sized data center** 501-5,000 m$^2$ | Approx. 300 | +27% | | | | |
| **Large data center** more than 5,000 m$^2$ | Approx. 70 | +40% | | | | |

Fig. 2.  Typology of data centers (overview) (Source: Borderstep)

## COLOCATION DATA CENTERS

- More than 200 providers of colocation facilities.
- Roughly 45% of large data centers are colocation data centers [4].
- Biggest colocation data centers in Germany have more than 50,000 m$^2$ of IT floor space and power consumption on the order of 50 megawatts.
- Increasing IT floor space in colocation data centers in Germany:
    - + 25% between 2008 and 2013 [4],
    - 2013: 18% of total data center space [4],
    - Forecast: + 33 % between 2012 and 2016 [5].

## CLOUD COMPUTING AND HOSTING DATA CENTERS

- More than 2,000 hosting providers in Germany.
- Cloud market: 40% annual growth from 2011 to 2015 [6].
- Some cloud and hosting data centers are very large, e.g. Deutsche Telekom cloud data center in Magdeburg, 24,000 m$^2$ [7]
- IT floor space of cloud and hosting data centers in Germany increased by approx. 25% from 2008 to 2013 [4].
- 2013: 14% of all IT floor space in Germany [4].

### DATA CENTERS USED BY COMPANIES THEMSELVES ("PRIVATE DATA CENTERS")

- Almost 90% of data centers in the categories server closet and server room fall into this category.
- Private data centers account for just under 60% of total data center space in Germany [4].
- Approx. 20% of the large data centers fall into this category (e.g. financial, telecommunications, or automobile sectors) [4].

### DATA CENTERS IN PUBLIC AGENCIES AND OTHER PUBLIC INSTITUTIONS ("PUBLIC DATA CENTERS")

- Approx. 5,000 public data centers in Germany in 2013 [4]
- Approx. 10% of the total space of all data centers [4]
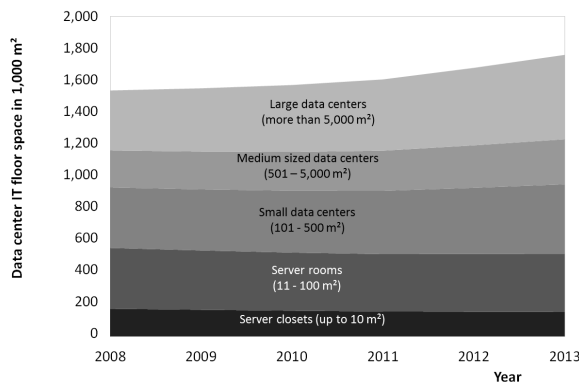- Approx. 1,000 data centers at the federal level [4].



Fig. 3. Development of IT floor space in German data centers by group according to size (Source: Borderstep)

### CONCLUSIONS

- The structure of data centers in Germany (and worldwide) is changing: the number of small locations has clearly decreased since 2008, while the number of larger data centers is increasing.
- There is a substantial relationship between the structure of data centers and their energy consumption.
- The number of colocation, cloud, and hosting data centers with more than 5,000 m² of IT floor space is growing particularly rapidly.
- Due to a high proportion of electricity costs in relation to total costs in colocation, cloud, and hosting data centers, they have a major incentive to use efficient technologies.
- There are certain limits to a further increase in energy efficiency in colocation data centers, in particular there is no way to directly influence their customers' IT usage.

- Cloud data centers will grow so much that their energy use will increase overall in spite of improved efficiency. Therefore, a significant rebound effect in cloud computing is to be expected.

### REFERENCES

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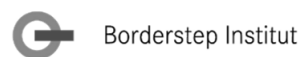[7] K. Schmitt, "Telekom baut größtes Cloud-Rechenzentrum," *Chip*, 16-Jun-2010.

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