

Commentary

Information Technology and Industry 4.0 in the viewpoint of sustainability

In 2006, as much as 10% of world's electricity was consumed by information technology [1], with forecast of a strong increase. In 2017, we better assume more than 15%. The Kitakyushu Research Group for Sustainability estimates: Until 2025, the data traffic will increase by a factor 200, the required electricity consumption by factor 5.

5 x 15% = 75% electric energy consumption? From a sustainability point-of-view, this would be a disaster.

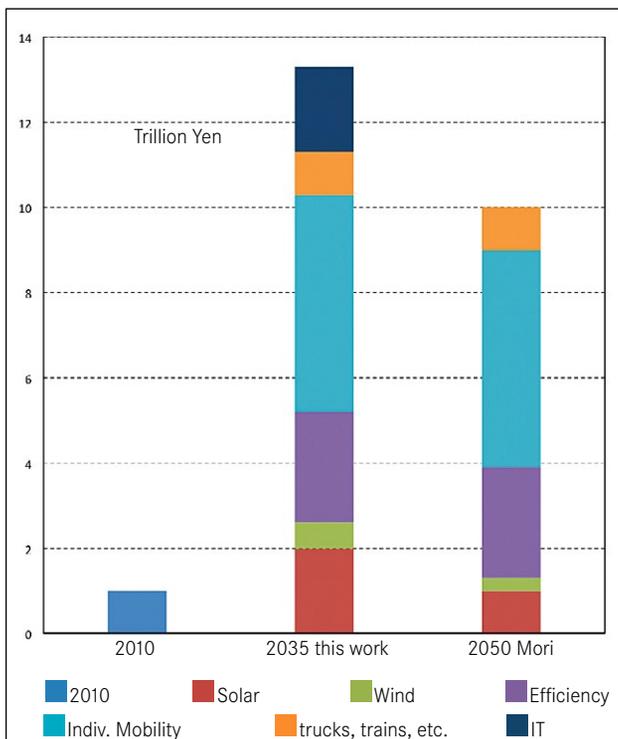
Electric energy demanded by data centers and servers in Europe was 56 TWh in 2007 and was forecast to have an increment to 104 TWh in 2020. In a typical data center, less than half of this power is delivered to the compute load, which includes microprocessors, memory and disk drives. The remainder of the power is lost in power conversion, distribution, and cooling [2]. Conventional AC-distributed architectures suffer from low efficiency. Using DC distribution at 400 V and high-efficiency converters, the overall efficiency can be increased from 50% to 70% with power electronics. There are further strong activities necessary to reduce energy consumption of microprocessors etc.

Wireless communication is highly electricity consuming. The high number of smartphones and the charging of their batteries is not the main contribution, here the technology is quite effective. The large energy consumption is mainly due to the base stations. A typical base station (2007) was equipped for input power of 2 kW, with an average power consumption of 1.3kW. The radiation output power was 20 W, comparatively much for usual short transmission distances [3]. A typical telecom radio base station with an output power of 120 W has a power consumption of more than 10 kW. This translates into a system efficiency of 1.2% [2]. It can hardly be claimed that such technology is modern and efficient.

The efficiency of the central device, the power transmitter, is barely 6% [2]. Innovative solutions like the use of multilevel converters and a linear regulator allow for the use of a switching frequency equal to the bandwidth of the envelope signal [4]. For RF-devices, progress with the GaN HEMT has shown that it is possible to realize highly efficient switch-mode amplifiers at microwave frequencies [2].

A wide extension of IT applications is intended in the industrial production with the slogan "Industry 4.0", even the term "next industrial revolution" is used. Unfortunately, energy efficiency is not considered in the "Industry 4.0" communicated outlines and roadmaps. Computing and wireless communication shall increase in a high amount. With existing IT technologies, such plans conflict with ecology. It is even spoken of a "next industrial revolution". No, that is not a correct denotation. A next industrial revolution must consider sustainability: From linear economy (natural resource – production – consumption – waste) which is our dominating mode today, to a global circular economy [5] which is characterized by recycling, circular processes and renewable energy.

„Sustainability is the most important criterion. Plans which conflict with it are no progress for society.“ – Prof. Josef Lutz, TU Chemnitz



[1] EPE/ECPE Position Paper on Energy Efficiency – the Role of Power Electronics, March 2007
 [2] J. Popovic-Gerber et al "Power electronics enabling efficient energy usage: energy savings potential and technological challenges" IEEE Transactions on Power Electronics, vol. 27, no. 5, pp. 2338-2353, May 2012
 [3] <https://www.teltarif.de/arch/2007/kw22/s26105.html>: "Vodafone startet Energiesparprogramm", 2007
 [4] M. Vasic, O. Garcia, J. A. Oliver, P. Alou, D. Diaz, and J. A. Cobos, "Multilevel power supply for high-efficiency RF amplifiers," IEEE Trans. Power Electron., vol. 25, no. 4, pp. 1078–1089, Apr. 2010
 [5] C. A. Volkert: „Wirtschaft gegen Umwelt: Grundsatzkritik an der Wegwerfproduktion“, Tagungsband Offene Akademie 2015, <http://www.offene-akademie.org/?p=369>

Expected market volume of power semiconductors. Forecast 2050 by M.Mori, forecast with higher engagement for sustainability (Figure: Prof. Lutz)