Executive Summary

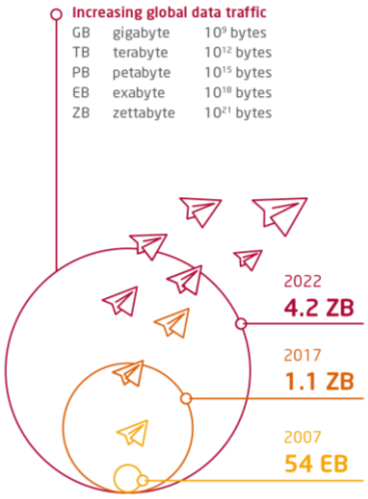
clean-IT: Energy-efficient Digitalization

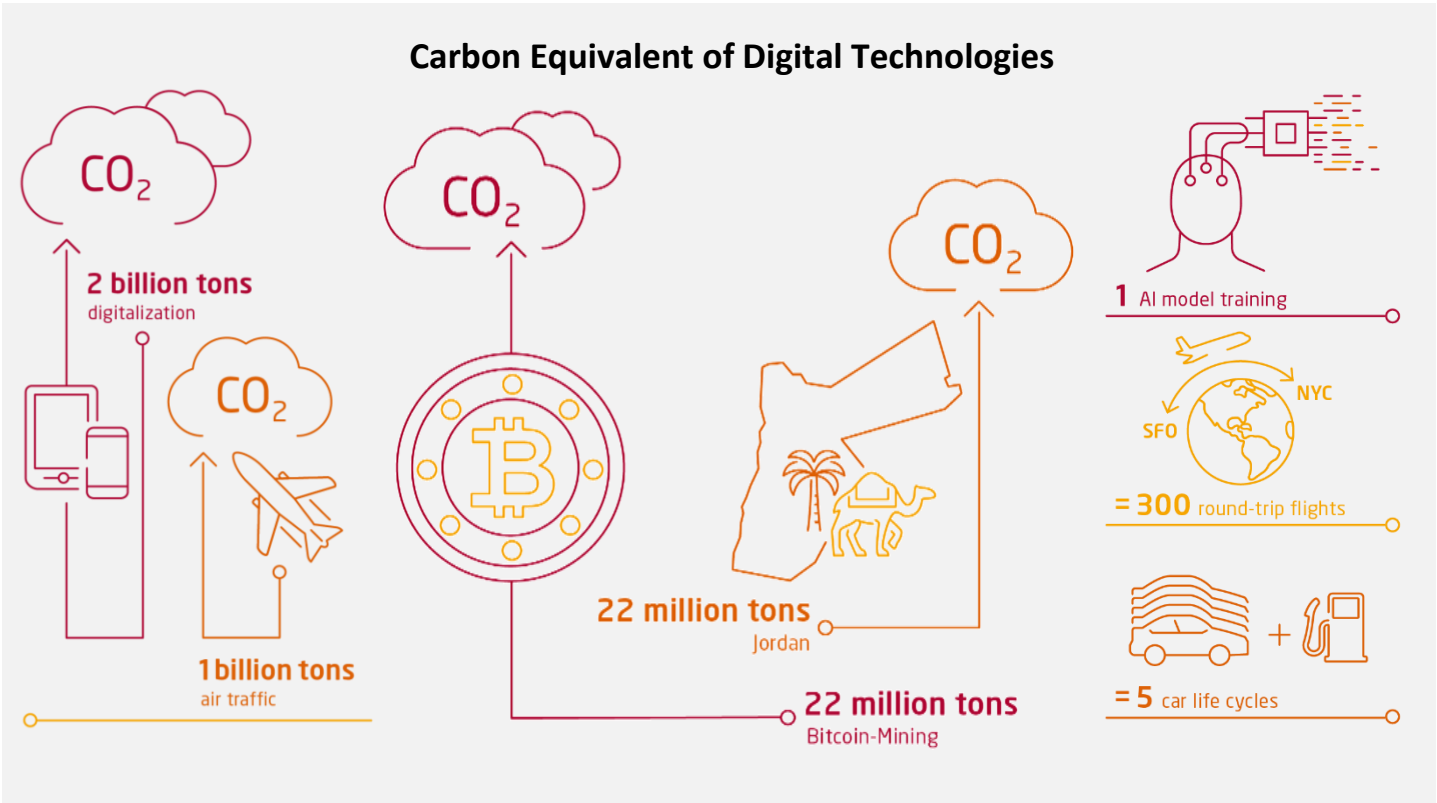
Digital technologies are rapidly taking over our living and working environments on a global scale. It is now clear that they are indispensable for achieving the United Nations Sustainable Development Goals (SDGs) and reducing carbon emissions in many sectors. Digital technologies are the key to reduce poverty, malnutrition or hunger, conflict and inequality. They can provide scalable opportunities for education, clean water and energy. They are driver for innovation in sectors such as manufacturing, retail and public communities. Without digitalization the SDGs cannot be achieved and decarbonizing the industry and consumption will fail. However, digital systems have immense energy requirements themselves for their countless devices, data centers, applications, and global networks. Numerous studies suggest that the carbon footprint of digitization is positive. Nevertheless, efforts must be made to greatly improve the energy-efficiency of IT systems. This includes measures that systematically survey the energy consumption of digital systems, make it comparable and develop methods that make IT systems more energy-efficient. To achieve this goal, the principle of "sustainability by design" in computing must become the fundamental paradigm of IT system development worldwide.

Challenge: Increasing energy demand of digital systems

It is a widespread misconception that digital devices, products, and services do not contribute (or contribute very little) to global CO2 emissions because of their intangible nature. This assumption is wrong. Although digital technologies support and are the necessary condition to sustainable development in many sectors, digital devices and applications contribute to the global carbon footprint themselves.

All data traffic requires energy. The total amount of annual Internet traffic has grown exponentially in recent years and continues to rise steeply. While only 54 exabytes of data were transmitted over the Internet in 2007, that amount increased 20-fold to 1.1 zettabytes in 2017, according to the International Energy Agency. By 2022, annual data traffic will quadruple, reaching approximately 4.2 zettabytes.





We need more, but energy-efficient digitalization

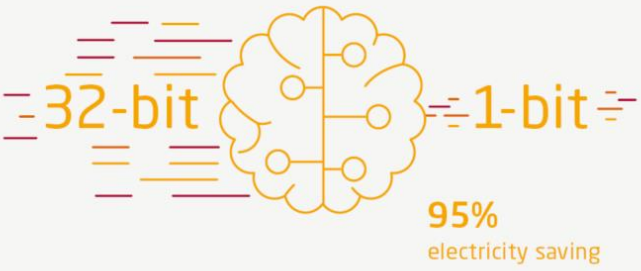
"Sustainability by Design" in computing is yet a major blind spot in most Green IT initiatives, which mostly focus on the physical production of digital device, renewable energy sources and "digital sobriety". Reducing the use of digital technologies will not contribute to support the quest for a carbon-free planet. Digital technologies and their various innovative applications such as Big Data, AI, Blockchain, etc. are essential to reducing carbon emissions in many sectors such as energy production, manufacturing, and agriculture.

Why "clean-IT" and "Sustainability by Design"?

The increasing carbon footprint of digitization is avoidable. Computer systems, based on the interaction of hardware and software and organized by algorithms, can be designed in many ways to achieve the same result. Unnecessarily complicated programming or design of computer systems often results in higher energy consumption compared to energy-efficient algorithms. Innovative software architectures can achieve the same or slightly lower precision or data throughput while saving enormous amounts of energy. How algorithms and computer systems are designed matters, because every algorithmic operation consumes energy.

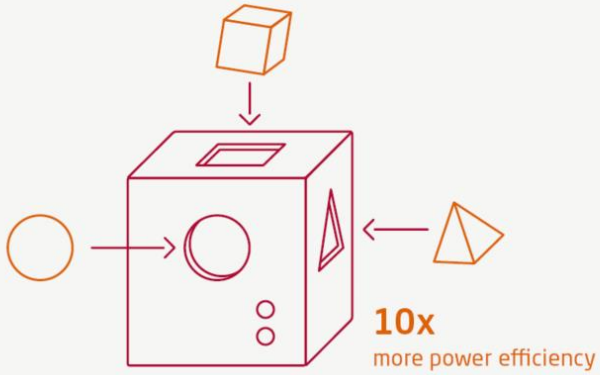
Examples of clean-IT: Binary Neural Networks

While the best AI systems train neural networks based on 32-bit algorithms, the procedure can also be carried out with "binary neural networks" (1-bit algorithm). This drastically reduces the effort in the individual calculation steps and immediately leads to energy savings by a factor of 20.



Examples of clean-IT: Energy-Aware Computing

Next-generation data centers can execute workloads on the best-suited hardware. Power efficiency can be improved significantly, e.g. by a factor of 10 for weather simulation models using FPGA accelerators instead of general-purpose processors.



Proposals to the G7/G20 to reduce the carbon footprint of digitalization

1. Member states should form an international working group to assess the current state and implementation of sustainable digital technologies. IT should should gather information on the topic as well as to produce policy recommendations for the G7/G20 on how to reduce the carbon footprint of computer systems design and usage.

2. Member states should establish and coordinate incentives for research and public education in the field of "Sustainability by Design" in computing and performance/energy consumption trade-offs in digital engineering. To this end international research centers for the assessment of the digital carbon footprint should be established.

3. Member states should update their software procurement guidelines towards energy-efficient software solutions in a coordinated manner.

4. Member states should establish an internationally recognized energy-efficiency label for computer systems. For widespread awareness and penetration of energy-efficient software in public and private enterprises, internationally recognized quality labels and standardization can play a major role. Common standards need to be put in place.