Efficiency gains are vital to limit data's huge electricity use

In an increasingly data-hungry world, we need to limit the climate impact of data's energy use. You can download our full report here
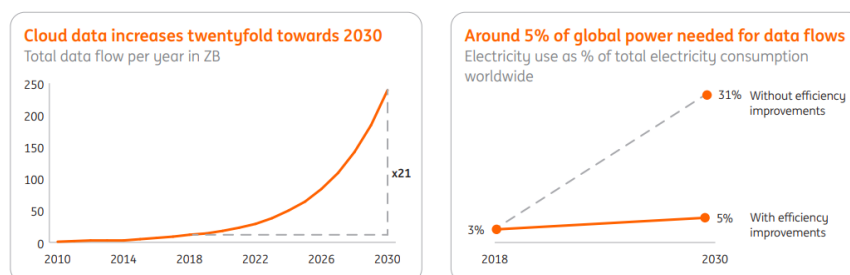

Staggering figures

Data growth will be staggering. By 2030, global dataflows are expected to be more than 20 times those of 2018. This growth is driven by more people having access to the internet, more internet traffic per user, connected machines, cloud services flourishing and more big data and computations in AI.

The share of data-driven electricity use will probably increase from 3% to at least 5% of global use. The exponential growth in data means power use for these flows will double and therefore grow to about 5% of worldwide electricity use in 2030. Networks and data centres, in particular, will see the strongest growth.

Without efficiency gains, this share will be more than 30%. Increasing data demand means network and data centre services require more and more power. To keep the rise in electricity use limited to 5% of global power use, electricity use by network and data centre services has to become substantially more efficient. Recent history shows that the efficiency improvement needed can be achieved, but it requires power-saving innovations to continue.

Cloud data and electricity use

Cloud data increases twentyfold towards 2030
Total data flow per year in ZB

Around 5% of global power needed for data flows
Electricity use as % of total electricity consumption worldwide

Source: LHS: ING Economics Department based on Cisco; RHS: ING based on BNEF

Power use for three key components

Devices, networks and data centers determine electricity use for data flows Our [full report](#) looks at total power use for data flows by taking the following as components:

1. Devices
2. Networks
3. Data centres

Currently, over 40% of electricity is consumed by devices, with networks responsible for about a third and data centres (DCs) for a quarter. To provide more insight into what makes up the three components of data-related electricity use, the table below presents a more detailed description of devices, networks and DCs.

Devices, networks and data centres determine electricity use for data flows

		Definition	What part of electricity use is in scope
	Devices	Computers, tablets, smartphones and other mobile phones of businesses and consumers generating, sending and receiving data.	• During use ('at the plug'), not manufacturing and disposal. • Electricity use of other connected devices out of scope because their primary role is not communication or data storage (e.g. connected washing machine, car).
	Networks	Mobile and fixed-line networks used to transfer data, operated by telecoms players and other carriers.	• Electricity use of equipment such as switches and routers, transmission link elements and supporting infrastructure for cooling, power, etc. • Traditional fixed telephony is excluded.
	Data Centres	Providers of storage, processing and distribution of data	• Power for the IT hardware (e.g. servers, storage drives and network devices) as well as the supporting infrastructure (e.g. cooling, lighting). Consists of single tenant (private), multi-tenant (co-location) and hyperscale data centres.

The amount of data and number of devices has grown in recent years. Data, in particular, has shown strong growth:

• More and more people and their devices are constantly online;

• More and more data is generated and collected; and

• Businesses are moving their activities online, into the cloud.

All this requires a constant movement of data. To enable these data flows, electricity is needed to

run the hardware and the software that transports data across the globe. It is estimated that more than 800 TWh is consumed yearly, about the power use of Belgium, the Netherlands and Germany combined. Between 2010 and 2018, the power needed increased by 23%, or by approximately 1.2 times that of 2010, despite the gigantic data increase. This means that the electricity intensity of data flows has decreased, requiring substantially less electricity per zettabyte of data.

Substantial improvements are needed given the expected data increase

Potential explanations of this development are more efficient semiconductors plus advances in transmission technology and compression technology. The share of the technology and telco sector in total global electricity use is fairly stable at around 3%. So, despite the enormous increase in data flows, the sector has succeeded in limiting the rise in electricity demand by becoming more energy-efficient. The question is whether the sector can continue to keep its share in electricity use stable in the future, given an expected data increase. It will require substantial improvements in electricity intensity through further technological advancements.

## Electricity intensity decreased significantly between 2010 and 2018

Source: ING Economics Department

Devices, networks and data centres

Growth in the number of devices (computers, tablets, smartphones and other mobile phones) in use will be limited to 1.7% on average towards 2030. Global IP traffic over networks will continue to grow at a strong pace, roughly doubling in size every 2 to 3 years. Global cloud data will see strong growth, doubling approximately every 3 years. **There's far more detail on this in our full report here.**

A slow growth in numbers and a shift towards handheld devices keep electricity use in check. Low-energy design is the main route to further efficiency increases.

Network and cloud data demand
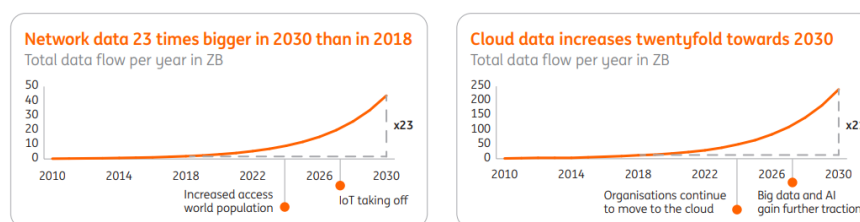
Source: ING Economics Department based on Cisco

Designing and improving 5G networks with energy efficiency in mind is crucial

The next generation networks, 5G, are being rolled out in the coming years. 5G technology is based on high frequency, shorter wavelength signals that can carry large amounts of data – but not nearly as far as current systems. This means investing in much more equipment and antennas. The main concern therefore, is that the increased speed of 5G (up to 20 times faster than 4G) will require a denser tower infrastructure and, consequently, require more electricity.
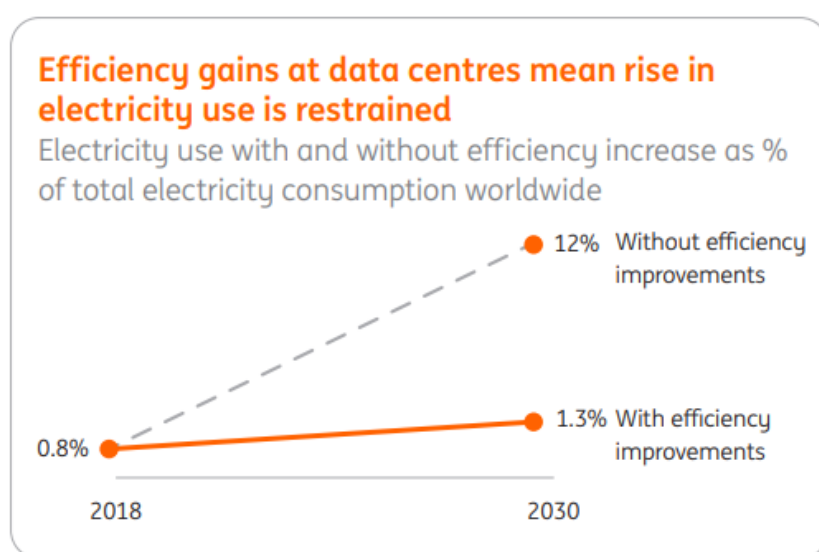
To overcome this, energy efficiency can be improved by:

- Power management for base stations (switching off when idle). This becomes more relevant as data can be transferred in a shorter time, creating longer periods in which the network connection can be idle.
- New 5G architecture leads to better infrastructure scaling, lower computational redundancy and fewer hardware systems, reducing overall energy consumption. Software defined networking enables a quick roll-out of energy efficiency enhancements.
- New protocols (e.g. on compression) and techniques (e.g. beamforming, directing radio transmission signals in a specific direction) reduce power consumption.

Innovations and shifts between networks will probably lead to an estimated aggregate energy intensity improvement of 15% annually. This results in a rise towards 2.5% of worldwide power being used for networks in 2030.

Data centres

- The main driver of the improvement in electricity intensity is the shift towards large-scale, efficient data centres, with improved equipment, cooling efficiency, storage and utilisation. This shift leads to an approx. 20% decrease in electricity intensity early on, later slowing to around 10%.
- Energy management through AI contributes 5% per year to decreasing electricity intensity, starting in 2022.
- Other measures such as better UPS batteries, higher temperatures and reducing AC-to-DC conversion losses contribute 1% per year.

Efficiency gains at data centres mean rise in electricity use is restrained

Electricity use with and without efficiency increase as % of total electricity consumption worldwide

12% Without efficiency improvements

1.3% With efficiency improvements

0.8%

2018   2030

Source: ING Economics Department calculations, BNEF

Using renewable energy is key to limiting CO2 emissions

The expected rise in electricity needed for data flows will therefore make it harder to reach the Paris Climate Agreement goals if the corresponding power is generated by fossil fuels. As a result, the impact of data growth on carbon emissions depends on how this power is generated. As data centres and networks will be the main drivers of power use for data in the future. In our main report, we focus on how power is sourced in that domain.

Renewable electricity share

Renewables share of tech and telco sector limited
Share of renewable electricity in overall electricity use, 2017
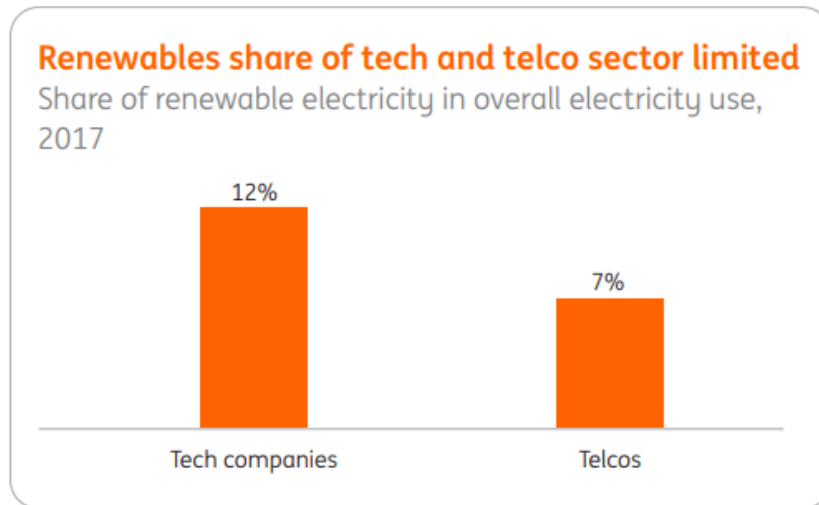
Source: IRENA

Combining innovation and renewables

For the tech and telco sector, contributing to the Paris climate goals will first and foremost require a decrease in networks' and data centres' electricity intensity. That responsibility for efficiency improvements is shared with suppliers and clients. Manufacturers for instance have to develop more efficient equipment before operators of networks and data centres and other clients can invest in it. Secondly, the sector can limit climate impact by using renewable electricity to enable the data flows. Some of the steps that specific players can take are listed below:

Steps different players can take to limit the climate impact of data

Click on the chart to enlarge

This article is a condensed version of our main report on 'Limiting the climate impact of an increasingly data hungry world'. Download it here.