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

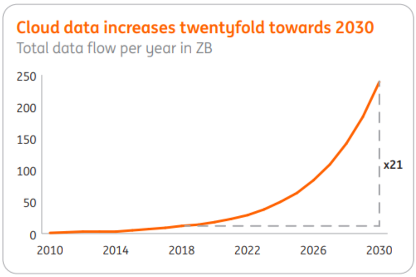
Staggering figures

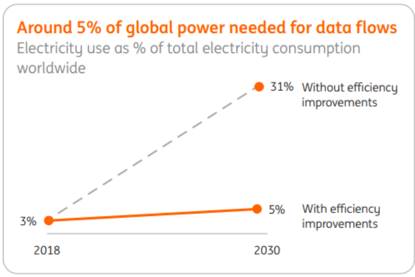
Data growth will be staggering. By 2030, global dataflows are expected to be more than 20 times those of 2018. This growth is driven by more people having access to the internet, more internet traffic per user, connected machines, cloud services flourishing and more big data and computations in AI.

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





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

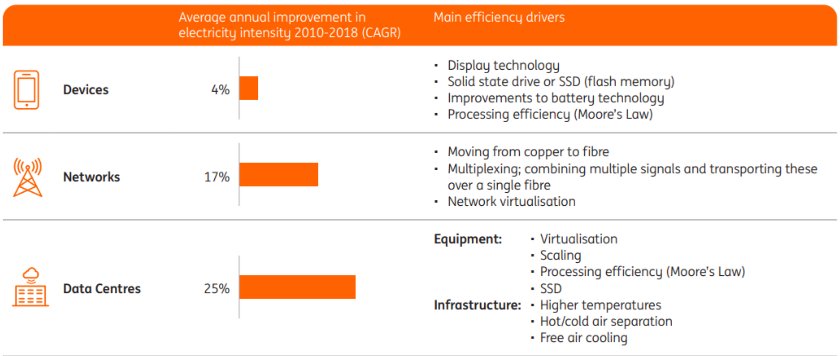
• Businesses are moving their activities online, into the cloud.

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



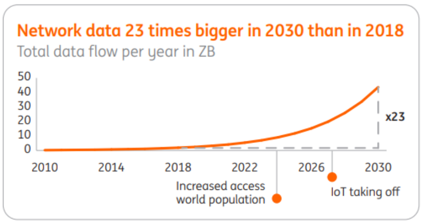
Source: ING Economics Department

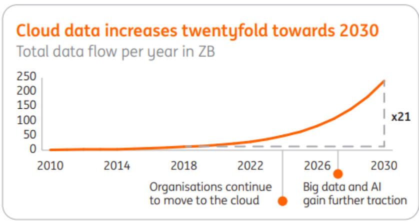
Devices, networks and data centres

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.

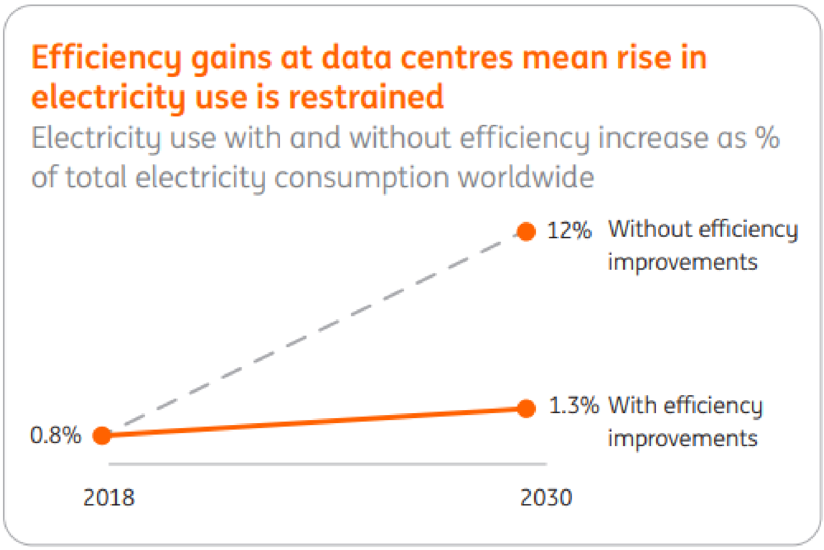
To overcome this, energy efficiency can be improved by:

- 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.

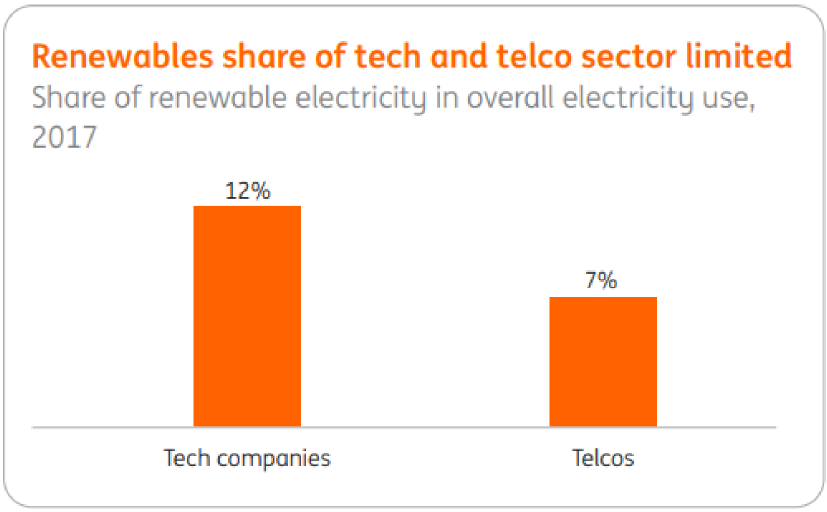


Source: ING Economics Department calculations, BNEF

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



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

Players	Focus area	Steps
Data centre operators (hyperscalers, hosting, co-location, single tenant)	Efficiency	• Focus on efficiency of infrastructure technology, especially cooling • Monitor and improve efficiency of equipment (hyperscale, hosting) • Monitor and advise clients on efficiency of their equipment (co-location)
	Renewable energy	• Create new renewable power generation facilities through PPAs and self-generation. • Use excess heat for agricultural, industrial and residential purposes (excess heat offsets)
Network operators (MNOs, carriers, tower companies)	Efficiency	• Increase network efficiency through power management • Phasing out early-generation mobile networks
	Renewable energy	• Switching power for off-grid and bad-grid towers from oil generators to renewables
Software companies (Independent software vendors, ISVs)	Efficiency	• Measuring energy consumption of software: to identify software inefficiencies, improving software engineers' skills set and the evolution of the software product • At a strategic level: adding sustainability as a product characteristic, improving overall product quality and potentially increasing the success of the product
IT service providers (system integrators, managed services providers)	Efficiency	• Make electricity use/climate impact of solutions/decisions transparent to clients • Work with suppliers of equipment and services that are focused on limiting electricity use

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

Author

Alissa Lefebre
Economist

alissa.lefebre@ing.com

Deepali Bhargava
Regional Head of Research, Asia-Pacific
Deepali.Bhargava@ing.com

Ruben Dewitte
Economist
+32495364780
ruben.dewitte@ing.com

Kinga Havasi
Economic research trainee
kinga.havasi@ing.com

Marten van Garderen
Consumer Economist, Netherlands
marten.van.garderen@ing.com

David Havrlant
Chief Economist, Czech Republic
420 770 321 486
david.havrlant@ing.com

Sander Burgers
Senior Economist, Dutch Housing
sander.burgers@ing.com

Lynn Song
Chief Economist, Greater China
lynn.song@asia.ing.com

Michiel Tukker
Senior European Rates Strategist
michiel.tukker@ing.com

Michal Rubaszek
Senior Economist, Poland
michal.rubaszek@ing.pl

This is a test author

Stefan Posea
Economist, Romania
tiberiu-stefan.posea@ing.com

Marine Leleux

Sector Strategist, Financials
marine.leleux2@ing.com

Jesse Norcross
Senior Sector Strategist, Real Estate
jesse.norcross@ing.com

Teise Stellema
Research Assistant, Energy Transition
teise.stellema@ing.com

Diederik Stadig
Sector Economist, TMT & Healthcare
diederik.stadig@ing.com

Diogo Gouveia
Sector Economist
diogo.duarte.vieira.de.gouveia@ing.com

Marine Leleux
Sector Strategist, Financials
marine.leleux2@ing.com

Ewa Manthey
Commodities Strategist
ewa.manthey@ing.com

ING Analysts

James Wilson
EM Sovereign Strategist
James.wilson@ing.com

Sophie Smith
Digital Editor
sophie.smith@ing.com

Frantisek Taborsky
EMEA FX & FI Strategist
frantisek.taborsky@ing.com

Adam Antoniak
Senior Economist, Poland
adam.antoniak@ing.pl

Min Joo Kang
Senior Economist, South Korea and Japan

min.joo.kang@asia.ing.com

Coco Zhang
ESG Research
coco.zhang@ing.com

Jan Frederik Slijkerman
Senior Sector Strategist, TMT
jan.frederik.slijkerman@ing.com

Katinka Jongkind
Senior Economist, Services and Leisure
Katinka.Jongkind@ing.com

Marina Le Blanc
Sector Strategist, Financials
Marina.Le.Blanc@ing.com

Samuel Abettan
Junior Economist
samuel.abettan@ing.com

Franziska Biehl
Economist, Germany
Franziska.Marie.Biehl@ing.de

Rebecca Byrne
Senior Editor and Supervisory Analyst
rebecca.byrne@ing.com

Mirjam Bani
Sector Economist, Commercial Real Estate & Public Sector (Netherlands)
mirjam.bani@ing.com

Timothy Rahill
Credit Strategist
timothy.rahill@ing.com

Leszek Kasek
Senior Economist, Poland
leszek.kasek@ing.pl

Oleksiy Soroka, CFA
Senior High Yield Credit Strategist
oleksiy.soroka@ing.com

Antoine Bouvet
Head of European Rates Strategy

antoine.bouvet@ing.com

Jeroen van den Broek
Global Head of Sector Research
jeroen.van.den.broek@ing.com

Edse Dantuma
Senior Sector Economist, Industry and Healthcare
edse.dantuma@ing.com

Francesco Pesole
FX Strategist
francesco.pesole@ing.com

Rico Luman
Senior Sector Economist, Transport and Logistics
Rico.Luman@ing.com

Jurjen Witteveen
Sector Economist
jurjen.witteveen@ing.com

Dmitry Dolgin
Chief Economist, CIS
dmitry.dolgin@ing.de

Nicholas Mapa
Senior Economist, Philippines
nicholas.antonio.mapa@asia.ing.com

Egor Fedorov
Senior Credit Analyst
egor.fedorov@ing.com

Sebastian Franke
Consumer Economist
sebastian.franke@ing.de

Gerben Hieminga
Senior Sector Economist, Energy
gerben.hieminga@ing.com

Nadège Tillier
Head of Corporates Sector Strategy
nadege.tillier@ing.com

Charlotte de Montpellier
Senior Economist, France and Switzerland

charlotte.de.montpellier@ing.com

Laura Straeter
Behavioural Scientist
+31(0)611172684
laura.Straeter@ing.com

Valentin Tataru
Chief Economist, Romania
valentin.tataru@ing.com

James Smith
Developed Markets Economist, UK
james.smith@ing.com

Suvi Platerink Kosonen
Senior Sector Strategist, Financials
suvi.platerink-kosonen@ing.com

Thijs Geijer
Senior Sector Economist, Food & Agri
thijs.geijer@ing.com

Maurice van Sante
Senior Economist Construction & Team Lead Sectors
maurice.van.sante@ing.com

Marcel Klok
Senior Economist, Netherlands
marcel.klok@ing.com

Piotr Poplawski
Senior Economist, Poland
piotr.poplawski@ing.pl

Paolo Pizzoli
Senior Economist, Italy, Greece
paolo.pizzoli@ing.com

Marieke Blom
Chief Economist and Global Head of Research
marieke.blom@ing.com

Raoul Leering
Senior Macro Economist
raoul.leering@ing.com

Maarten Leen

Head of Global IFRS9 ME Scenarios
maarten.leen@ing.com

Maureen Schuller
Head of Financials Sector Strategy
Maureen.Schuller@ing.com

Warren Patterson
Head of Commodities Strategy
Warren.Patterson@asia.ing.com

Rafal Benecki
Chief Economist, Poland
rafal.benecki@ing.pl

Philippe Ledent
Senior Economist, Belgium, Luxembourg
philippe.ledent@ing.com

Peter Virovacz
Senior Economist, Hungary
peter.virovacz@ing.com

Inga Fechner
Senior Economist, Germany, Global Trade
inga.fechner@ing.de

Dimitry Fleming
Senior Data Analyst, Netherlands
Dimitry.Fleming@ing.com

Ciprian Dascalu
Chief Economist, Romania
+40 31 406 8990
ciprian.dascalu@ing.com

Muhammet Mercan
Chief Economist, Turkey
muhammet.mercan@ingbank.com.tr

Iris Pang
Chief Economist, Greater China
iris.pang@asia.ing.com

Sophie Freeman
Writer, Group Research
+44 20 7767 6209
Sophie.Freeman@uk.ing.com

Padhraic Garvey, CFA
Regional Head of Research, Americas
padhraic.garvey@ing.com

James Knightley
Chief International Economist, US
james.knightley@ing.com

Tim Condon
Asia Chief Economist
+65 6232-6020

Martin van Vliet
Senior Interest Rate Strategist
+31 20 563 8801
martin.van.vliet@ing.com

Karol Pogorzelski
Senior Economist, Poland
Karol.Pogorzelski@ing.pl

Carsten Brzeski
Global Head of Macro
carsten.brzeski@ing.de

Viraj Patel
Foreign Exchange Strategist
+44 20 7767 6405
viraj.patel@ing.com

Owen Thomas
Global Head of Editorial Content
+44 (0) 207 767 5331
owen.thomas@ing.com

Bert Colijn
Chief Economist, Netherlands
bert.colijn@ing.com

Peter Vanden Houte
Chief Economist, Belgium, Luxembourg, Eurozone
peter.vandenhoute@ing.com

Benjamin Schroeder
Senior Rates Strategist
benjamin.schroder@ing.com

Chris Turner

Global Head of Markets and Regional Head of Research for UK & CEE
chris.turner@ing.com

Gustavo Rangel
Chief Economist, LATAM
+1 646 424 6464
gustavo.rangel@ing.com

Carlo Cocuzzo
Economist, Digital Finance
+44 20 7767 5306
carlo.cocuzzo@ing.com