Research report

COMMITTEE: Digital Committee
ISSUE: How can we make data centers more eco-friendly ?
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How can we make data centers more eco-friendly?

INTRODUCTION

Hello everyone ! My name is Andrés Viana Oporto, I am 16 years old and I study at the Lycée international de Ferney-Voltaire in France. This will be my second year participating in FerMUN and I'm excited to be able to take care of the digital committee during this upcoming conference. In my free time I enjoy sports in general, mainly climbing, but I also spend a lot of time playing guitar. My favorite subjects are the ones related to science, which is why I was directly interested in this committee whose issues are related to the increasing importance of technology in today's world. I wish you all the best of luck for the conference, and hope that it goes well for everyone.

KEY WORDS

ICT (Information and Communication Technologies): Corresponds to the field of telematics, which by using different techniques, allow users to communicate, store, manipulate, produce and transmit information in different forms and access information sources. Examples: computers, websites...

Data center: physical site regrouping computer installations in charge of organizing, processing and storing data. There are two main types of data centers:

1) **Cloud data center:** data center that uses cloud computing technologies, allowing for an infrastructure with more automated operation, and giving more independence to users when accessing computing resources.

2) **Hyperscale data center:** Data center of at least 5000 servers and measuring more than approximately 930m². They are considerably more efficient than a traditional data center and also have a lower PUE.

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PUE: Power Usage Effectiveness. It is used to qualify the energy efficiency of a data center and corresponds to the ratio of the power consumed by the infrastructure to the power used by its IT equipment.

Machine learning: Field of study of artificial intelligence. It consists in giving computers the ability to "learn" by themselves from data, and thus be able to perform tasks for which they have not been directly programmed.

Liquid immersion cooling: Consists in submerging the servers (installed vertically) in a dielectric liquid which, by being in direct contact with the components of these, absorbs the heat. This hot liquid is then pumped out and cooled down in order to be reintroduced and start the cycle again, all in order to cool down the servers.

Spam: Unwanted e-mail, especially used to send advertising.

ECOHZ: The world's leading independent green energy provider with more than 400 hydro, wind, solar, geothermal and bioenergy power plants around the world.

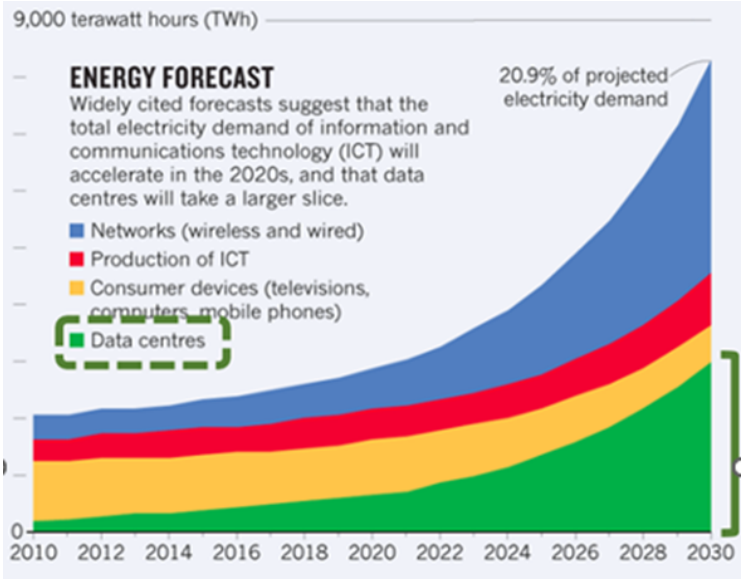
GO²: This ECOHZ initiative aims to help companies reduce their carbon footprint by purchasing renewable energy and financing new renewable energy power plant projects.

OVERVIEW

Since the creation of the world's first data center in New York City in 1989, data centers have rapidly become more and more important. This has reached the point where, according to Greenpeace, data centers consume about 200 TWh per year, an amount greater than the global consumption of countries like Iran, South Africa or Egypt. This corresponds to about 1% of global electricity demand, and 7% of total energy production. Data centers alone contribute 0.3% of global carbon emissions and together with the ICT industry, their carbon footprint is the same as that of the aviation industry (2% of global emissions).

According to estimates, the ICT industry will probably correspond to 21% of the total global electricity demand in 2030, and will only be able to correspond to 8% in the best case (see image).

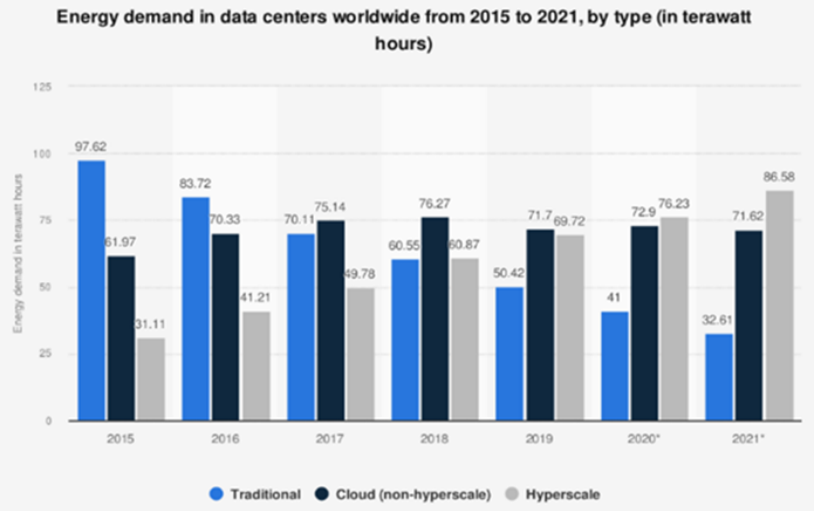
For these reasons, we need to start now to implement the necessary solutions to address the energy overconsumption of data centers and make them more eco-friendly.



To achieve this goal we need to identify the separate parts of the problem:

1) First, globally, most traditional data centers have an average PUE between 1.67 and 1.8. This means that in the long run, a fairly considerable amount of the electricity used is wasted, since a PUE of 1 is the indicator of a perfectly efficient center. However, it could be found that hyperscale data centers like Google's are generally more efficient and have a PUE of around 1.2.

As this graph shows, traditional and cloud data centers consume more energy in total per year than hyperscale ones. As a result, a huge amount of energy is wasted by these types of data centers.



2) Secondly, several studies show that in a data center the servers are underutilized. As a result, the energy constantly consumed is not used efficiently, the problem remains that companies usually invest in low-cost, often less environmentally friendly energy.

3) Third, in the EPA (Environmental Protection Agency) report on energy efficiency of servers and data centers, it is stated that servers consume on average 75% of the energy dedicated to all information technology (IT) equipment. It is also estimated that older server models consume 60% of the energy of all servers for only 4% of the center's performance capacity. In addition, a survey conducted by Forbes magazine to IT professionals from 100 different companies, showed that in more than half of these companies the servers are only used to 20-40% of their capacity. Yet these servers continue to consume energy and contribute tens to millions of tons of carbon emissions.

4) Fourth, per year, data centers produce 4% of the world's electrical and electronic equipment waste (E-Waste), which is more than 2 million tons of E-Waste. This waste is not biodegradable and accounts for 70% of the world's total toxic waste. In 2020, only 17% of this waste was recovered and recycled, leaving about 40 million tons of E-Waste to accumulate in nature year after year, with an estimated increase in the amount of this type of waste in the world of 8% per year.

5) Fifth, according to Tech Target (a US company providing marketing services to various technology companies), about 90% of data is no longer used 3 months after it is backed up. In 2018, 91% of all sites on Google were never visited. According to technology specialist Lucidworks, companies only use an average of 10% of the data they get. All of these are examples of the immense amount of sometimes useless data that is not only not used but also consumes energy while being saved. Now the problem is such that just to deal with the pollution caused by spam, it would be necessary to plant 1.6 trillion trees.

6) Finally, as mentioned before, only some data centers have a PUE of around 1.2. This is because most centers have traditionally tried to make the cooling technique that has always been used (ventilation) more efficient. However, maintaining a stable and adequate temperature can account for up to 40% of the total energy demand of the center, which is why inefficient cooling systems such as this are a huge waste of energy. The problem is becoming more and more serious with the development of much more efficient and therefore more energy consuming components, because of which fan cooling will reach its limits, only being able to cool up to 30-35kW per shelf, a capacity at which they are no longer efficient.

UN TREATIES AND MAJOR EVENTS

12/12/2015

PARIS AGREEMENT

Entering into force on November 4, 2016, this international climate treaty was ratified by all EU member states as well as 174 other states at COP 21 and mainly aims to limit global warming to below 2 degrees Celsius, preferably 1.5 degrees, and to significantly reduce greenhouse gas emission rates by the year 2050. This goal would help to achieve MDG 13 on measures to combat climate change.

2015

ODD 7

This UN Sustainable Development Goal is one of the 17 adopted by the UN General Assembly in 2015, and it consists of "Ensuring access to reliable, sustainable and modern energy services for all at an affordable cost". To achieve this, three of the main targets of this goal are to significantly increase the amount of renewable energy consumed and produced in the world by

2030, to promote access to more environmentally friendly fossil fuel, renewable energy and energy efficiency science and technologies, and finally to double the global rate of energy efficiency improvement.

19/09/2019

« The Climate Pledge »

Founded in 2019 by Amazon and Global Optimism, The Climate Pledge is a cross-sector community of companies and organizations cooperating to ideally achieve a carbon-free economy by 2040. It encourages its 319 signatories such as Microsoft and Mercedes to work collectively to achieve this goal.

POSSIBLE SOLUTIONS

Different solutions exist depending on the distinct parts of the problem:

1) Possessing a lower PUE than other data centers by allowing a better distribution of work among the servers and an optimized airflow (thus limiting the amount of heat produced): favoring the use and creation of hyperscale data centers would largely decrease the amount of current energy waste.

2) It would be possible to promote the installation of data centers near renewable energy sources, as Microsoft is doing with its Natpick Project, aiming to create underwater data centers powered by wind turbines, solar panels and marine turbines. We could also promote the purchase of verified renewable energy through documents such as Guarantees of Origin or RECs as Google is doing, and the production of renewable energy through initiatives such as GO2 that finance this production through the purchase of renewable energy by different companies. Thus, the environmental impact of energy that is not used efficiently or not used at all would be reduced.

3) According to Forbes, in order to reduce the energy consumption of servers, it is possible to install new electronic components that would increase the performance of the center without increasing its energy consumption. Similarly, older server models could be replaced with newer models. In addition, companies such as Google have shown the effectiveness of using machine learning (the use of artificial intelligence) to deduce how to optimize the performance of the center as well as its energy efficiency.

4) In order to limit the amount of E-Waste (Electrical and Electronic Waste) created by data centers, and to reduce the consumption of raw materials for the creation of electronic components, companies can hire an IT asset disposal operator who would take care of the management of electronic components at the end of their life for use, resale, repair or recycling.

5) Taking into account the huge amount of data that is not used but consumes energy, it would be possible to implement solutions such as "data rescue" (transferring data directly to a user for use without copying it) within the framework of organizations such as the WMO, thus allowing the sharing of information by preventing the creation of unnecessary copies.

6) Installing more efficient cooling systems would limit energy waste in data centers by reducing the PUE. The most efficient alternative to fan cooling would be liquid immersion cooling, which depending on the system (two-phase liquid immersion cooling) would even allow the reuse of server heat for district heating, water, etc.

However, all these solutions are expensive and not always suitable for smaller companies, so it's up to you to find out how to make them more accessible and easy to implement.

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a) Reports :

1) Greenpeace report (2010) on the impact of ICTs and data centers → https://archivo-es.greenpeace.org/espana/Global/espana/report/cambio_climatico/dirty-data-report-greenpeace.pdf

2) Supermicro report on the environmental impact of data centers → https://www.supermicro.com/wekeepitgreen/Data_Centers_and_the_Environment_Dec2018_Final.pdf

3) Environmental Protection Agency (EPA) report on server and data center energy efficiency → https://www.energystar.gov/ia/partners/prod_development/downloads/EPA_Report_Exec_Summary_Final.pdf

4) United Nations University Report on Global E-Waste → http://collections.unu.edu/eserv/UNU:6341/Global-E-waste_Monitor_2017__electronic_single_pages_.pdf

b) Websites :

1) Of organizations :

1.1-ECOHZ Website: https://www.ecohz.com/facts/un-sustainable-development-goals-sdgs (site parlant de la SDG 7)

1.2-ECOHZ Website explaining the GO² initiative : https://www.ecohz.com/go2

1.3-UNFCCC (United Nations Framework Convention on Climate Change) Website about the Paris Agreement: https://unfccc.int/fr/processus-et-reunions/l-accord-de-paris/l-accord-de-paris#:~:text=Qu%27est%2 Dce%20que%20l,vigueur%20le%204%20 novembre%202016

1.4-United Nations website explaining SDG 7: https://www.un.org/sustainabledevelopment/energy/

1.5-"The Climate Pledge" website: https://www.theclimatepledge.com/

2) Of authors:

2.1 – Website of the author of *Worldwide Waste*: (explains the environmental impact of technology): https//gerry mcgovern.com/books/world-wide-waste/

3) Of sellers:

3.1- GRC (Green Revolution cooling) website talking about ways to reduce the amount of E-Waste produced by data centers

https://www.grcooling.com/blog/3-ways-to-manage-e-waste-from-data-centers/

3.2-GRC site showing the advantages of liquid immersion cooling versus fan cooling: https://www.grcooling.com/air-based-cooling-vs-liquid-based-cooling/ (certaines donnees notamment les chiffres sont possiblement exageres)

c) Articles :

1) Article published by DW (German international broadcaster) in 2022 talking about electricity use by data centers: (https://www.dw.com/en/data-centers-energy-consumption-steady-despite-big-growth-because-of-increasing-efficiency/a-60444548)

2) Article explaining many aspects of the problems with data centers in an understandable way: https://energypost.eu/the-nexus-between-data-centres-efficiency-and-renewables-a-role-model-for-the-energy-transition/

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5) Article talking about solutions to problems caused by underused electronic components: https://www.forbes.com/sites/forbestechcouncil/2021/05/03/renewable-energy-alone-cant-address-data-centers-adverse-environmental-impact/?sh=66ad47105ddc

6) Article talking about ways to reduce the amount of E-Waste produced by data centers (mainly recycling, reuse of components...): https://www.simslifecycle.com/resources/white-paper-data-center/

7) General information on the environmental risks of E-Waste: https://www.genevaenvironmentnetwork.org/fr/ressources/nouvelles/the-growing-environmental-risks-of-e-waste/

8) Article explaining the different types of server cooling systems: https://datacentremagazine.com/critical-environments/which-cooling-system-best-your-data-centre

9) Article comparing the two types of liquid immersion cooling: https://www.akcp.com/articles/different-approaches-to-immersion-cooling/