IL PESO INVISIBILE DEL DIGITALE

Francesco Cara per Webinar RIDEF 2.0
POLIMI, 17 Febbraio 2025

CONSUMO ELETTRICO, IEA 2022

240 - 340 TWh

Consumo di elettricità dei **CENTRI DI CALCOLO** nel 2022, pari a 1 - 1,3% della domanda globale.

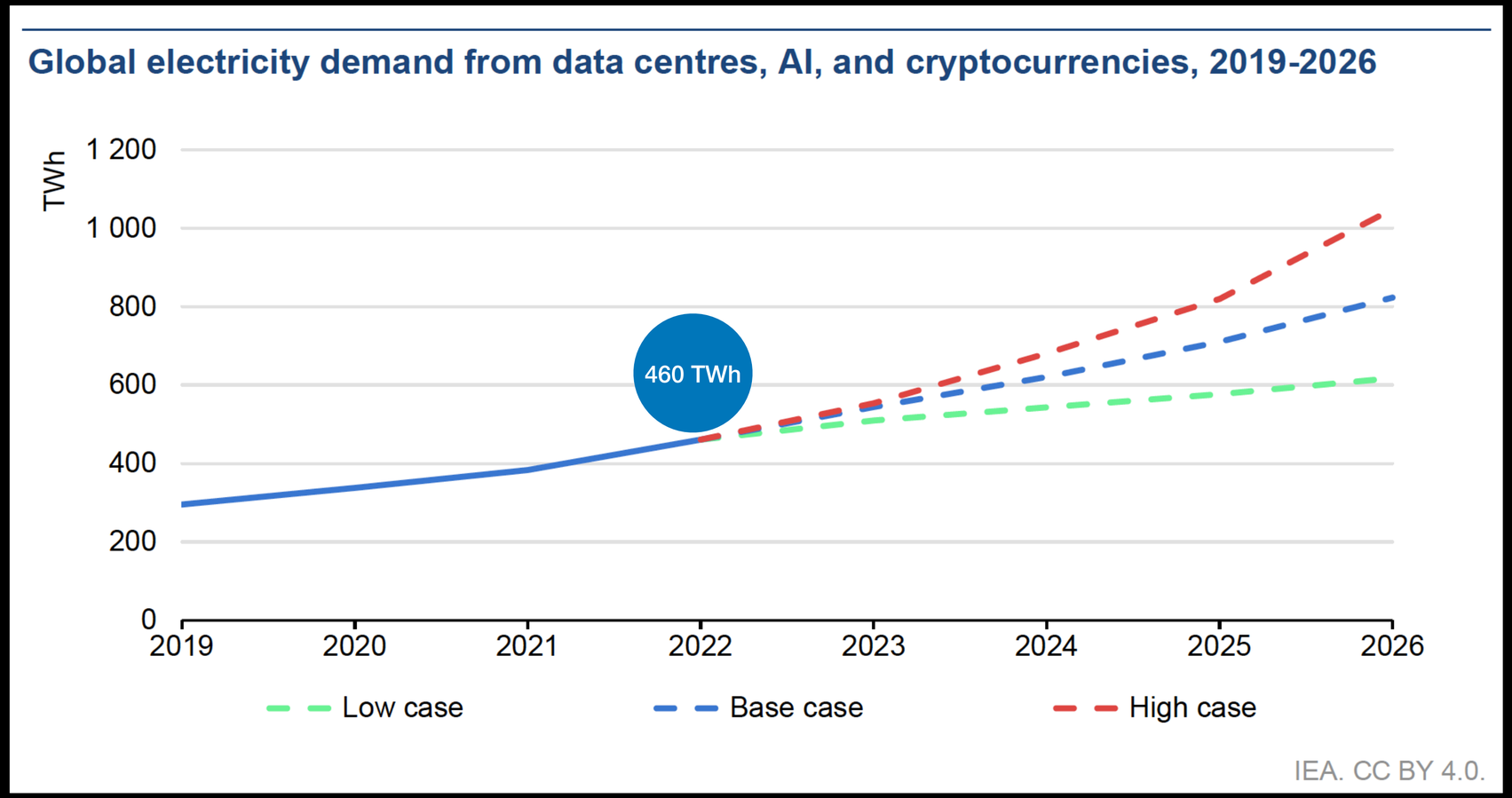
IEA,https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks

260 - 360 TWh

Consumo di elettricità delle **RETI DI TRASMISSIONE DATI** nel 2022, 1 - 1,5% della domanda globale, di cui 2/3 da reti mobili.

IEA,https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks

CONSUMO ELETTRICO, IEA 2024



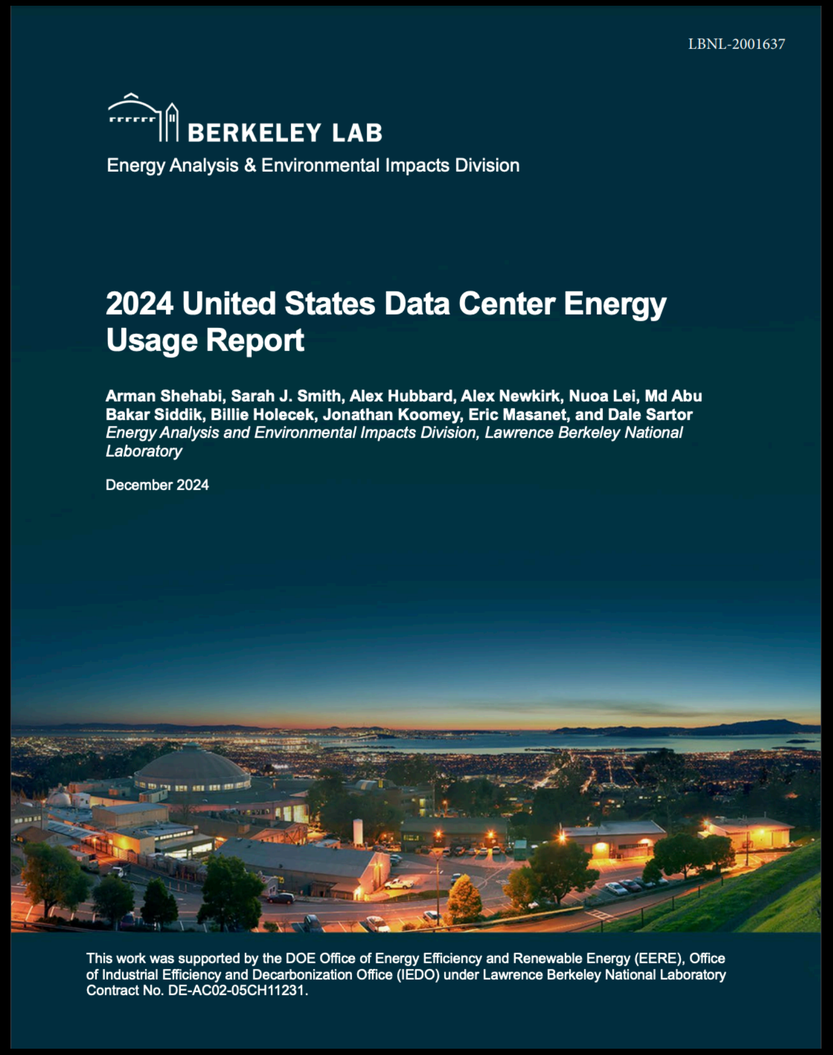
IEA https://www.iea.org/reports/electricity-2024

In funzione della rapidità di sviluppo e d'adozione dell'IA, IEA prevede che il consumo d'elettricità nei **CENTRI DI CALCOLO** arrivi a 620 - 1050 TWh nel 2026, pari a 160 - 590 TWh in più, come aggiungere il consulo di una Svezia (ipotesi bassa) o di una Germania (ipotesi alta).

ALTRE ANALISI D'IMPATTO DEL DIGITALE

https://www.greenit.fr/etude-empreinte-environnementale-du-numerique-mondial/

https://unctad.org/publication/digital-economy-report-2024



https://eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report.pdf

CONSUMO DEI DATA CENTRES USA

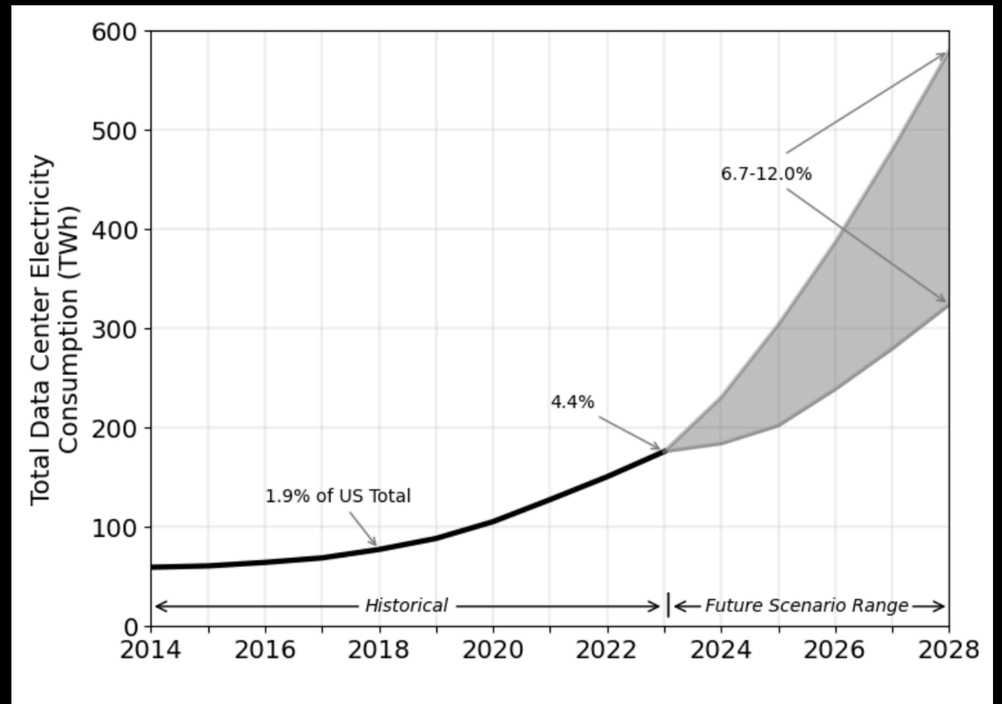


Figure ES-1. Total U.S. data center electricity use from 2014 through 2028.

2024 United States Data Center Energy Usage Report
https://eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report.pdf

2014 – 2016, il consumo annuale dei data center statunitensi è relativamente stabile intorno a 60 TWh.

Nel 2017, con l'aumento del numero di server installati e l'introduzione di server accelerati da GPU, il consumo di elettricità cresce e nel 2018 arriva a circa 76 TWh, pari a 1.9% del consumo complessivo di elettricità negli Stati Uniti.

Nel 2023, il consumo d'elettricità cresce ulteriormente ed arriva a 176 TWh, pari al 4.4% del consumo totale di elettricità negli Stati Uniti.

Dal 2023 al 2028, gli analisti del Lawrence Berkeley National Laboratory prevedono una crescita annuale tra il 13% ed il 27%.

CONSUMO DEI SERVERS NEGLI USA

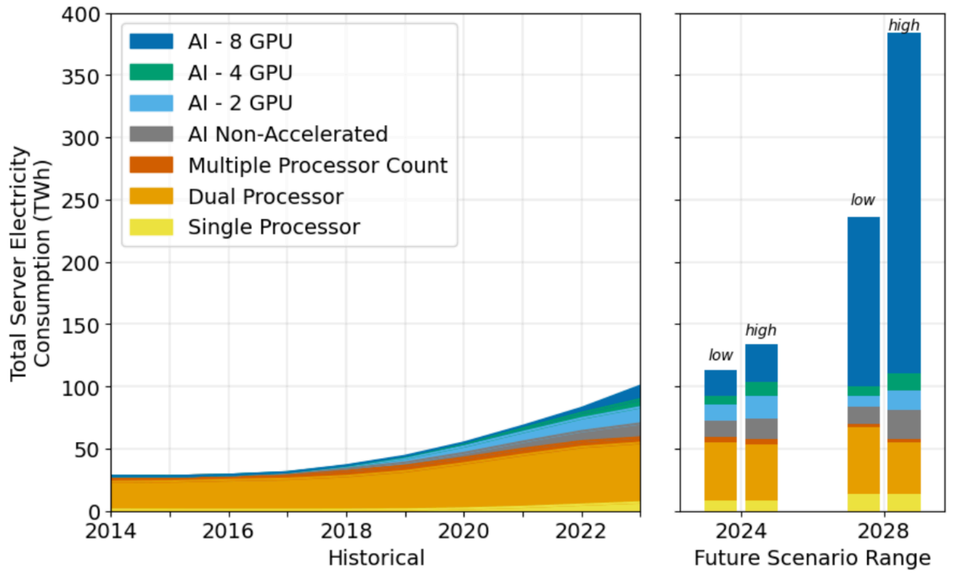


Figure 5.1. Server annual electricity usage by type.

2024 United States Data Center Energy Usage Report
https://eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report.pdf

2014 – 2023, il consumo annuale dei server è aumentato di oltre il 300%, passando da circa 30 TWh a quasi 100 TWh.

Sono in gran parte i servers AI accelerati da GPU che causano questo incremento. Il loro consumo è passato da meno di 2 TWh nel 2017 a più di 40 TWh nel 2023. Più lentamente, ma anche il consumo dei server tradizionali cresce passando da 30 a quasi 60 TWh.

CONSUMO DIRETTO DI ACQUA

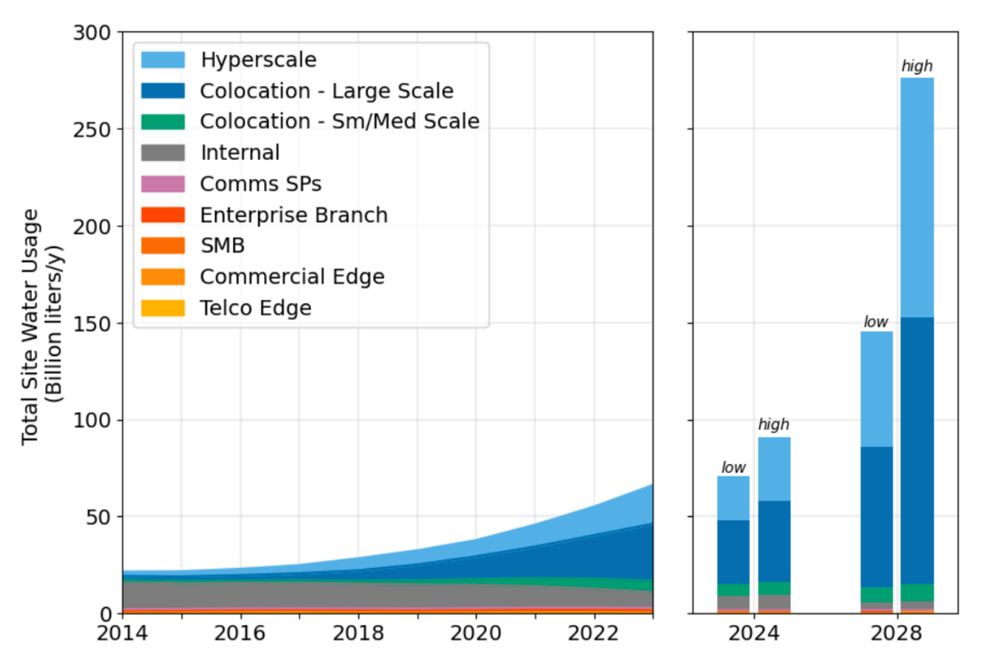


Figure 5.9. Direct water consumption by data center type.

2024 United States Data Center Energy Usage Report
https://eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report.pdf

2014 – 2023, il consumo diretto annuale di acqua dei data center statunitensi passa da 21.2 miliardi di litri nel 2014 a 66 miliardi di litri nel 2023.

Nel 2028, la previsione è che i data centres consumeranno tra 150 e 280 miliardi di litri di acqua. In un anno, una metropoli come New York consuma circa 140 miliardi di litri d'acqua (2023).

IMPATTO EMISSIVO DELLA GENAI

Meta

2024 Sustainability Report

Environmental footprint[1,2,3,4,5,6]

1.1 GHG emissions

Total GHG emissions

Market-based (in metric tons CO_2e)

	2019	2020	2021	2022	2023
Net total	4,330,000	4,984,000	5,740,244	8,453,471	7,443,182
Carbon removal (carbon credits applied)	-	145,000	90,000	80,000	53,050
Total	4,330,000	5,129,000	5,830,244	8,533,471	7,496,232
Scope 1	44,000	29,000	55,173	66,934	48,952
Scope 2	208,000	9,000	2,487	273	1,658
Scope 3	4,078,000	5,091,000	5,772,583	8,466,264	7,445,621

Location-based (in metric tons CO_2e)

	2019	2020	2021	2022	2023
Total	6,295,000	8,559,000	10,163,476	14,007,222	14,067,104

1.1 GHG emissions

Market-based vs. location-based

Scope 2 emissions (in metric tons CO_2e)

	2019		2020		2021		2022		2023	
	Market-based	Location-based	Market-based	Location-based	Market-based	Location-based	Market-based	Location-based	Market-based	Location-based
Total facilities GHG emissions	205,000	1,885,000	9,000	2,718,000	2,487	3,080,194	273	3,921,611	1,658	5,141,350
Data centers total	197,000	1,813,000	2,000	2,650,000	2,487	2,987,964	273	3,821,450	733	5,036,131

Meta 2024 Sustainability Report: https://sustainability.atmeta.com/2024-sustainability-report/

1.1 Greenhouse gas (GHG) emissions

Microsoft

Table 1A – GHG emissions by scope ($mtCO_2e$)

	FY20	FY21	FY22	FY23
Scope 1	118,100	123,704	139,413	**144,960**
Scope 2				
Location-based	4,328,916	5,010,667	6,381,250	**8,077,403**
Market-based	456,119	429,405	288,029	**393,134**
Subtotal emissions (Scope 1 + 2 market-based)	574,219	553,109	427,442	**538,094**
Scope 3[1]				
Category 1 – Purchased Goods & Services[2]	4,415,000	4,930,000	5,780,000	**5,564,000**
Category 2 – Capital Goods	2,962,000	4,179,000	4,026,000	**5,872,000**
Category 3 – Fuel- and Energy-Related Activities	300,000	350,000	450,000	**521,000**
Category 4 – Upstream Transportation[3]	243,000	225,000	371,000	**318,000**
Category 5 – Waste	9,500	5,700	8,000	**8,000**
Category 6 – Business Travel	329,356	21,901	139,000	**133,000**
Category 7 – Employee Commuting	317,000	80,000	141,000	**187,000**
Category 9 – Downstream Transportation	65,000	69,000	69,000	**69,000**
Category 11 – Use of Sold Products	2,983,000	3,950,000	5,101,000	**3,941,000**
Category 12 – End-of-Life of Sold Products	17,000	19,000	18,000	**4,000**
Category 13 – Downstream Leased Assets	11,800	9,600	8,000	**7,000**
Subtotal emissions[4]	[illegible]	13,839,000	16,111,000	[illegible]
Total emissions (Scope 1 + 2 + 3)[4]	12,227,000	14,392,000	16,538,000	**17,162,000**

Notice: Microsoft 2023 total emissions include Market-based Scope 2 emissions, and not the more realistic location-based emissions that would add 7,648,269 tons of CO2e, for a grand total of 24,846,269 tons of CO2e, roughly equivalent to Croatia's 2022 emissions, a country of 4M people.

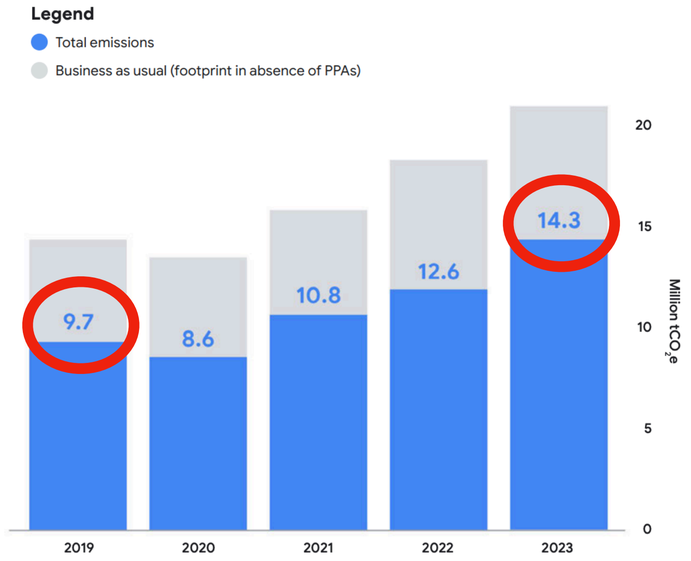
Microsoft Environmental Sustainability Report 2024: https://www.microsoft.com/en-us/corporate-responsibility/sustainability/report

IMPATTO EMISSIVO DELLA GENAI

2023 PROGRESS

Emissions reductions: Total GHG emissions were 14.3 million tCO_2e, representing a 48% increase compared to 2019

Residual emissions: Signed offtake deals for approximately 62,500 tCO_2e of removal credits



TREND

Emissions reductions: In 2023, our total GHG emissions increased 13% year-over-year, partially driven by a 37% year-over-year increase in our Scope 2 (market-based) emissions. Our total GHG emissions increased at a slower rate compared to the previous two years. For trend details for each scope, see the Scope 1 emissions, Scope 2 emissions, and Scope 3 emissions sections.

Residual emissions: 2023 marks the first year of implementation of our carbon removals strategy, and while we have a long way to go to meet our 2030 target, we've begun establishing impactful partnerships and have started contracting for carbon removal credits. For more detail, see the Managing residual emissions section.

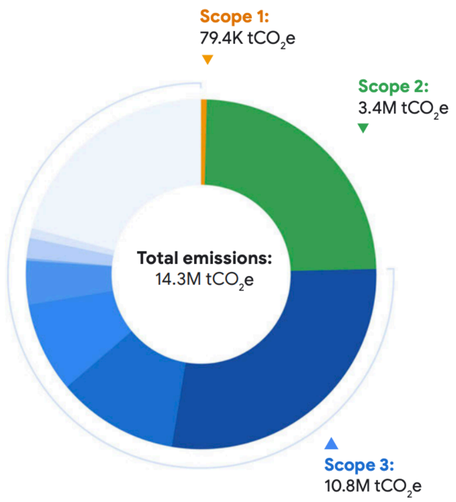
DETAILS

Emissions reductions: All Scope 1, 2 (market-based), and 3 absolute emissions across our operations and value chain, including our data center and office operations, supply chain, and consumer hardware devices.

Residual emissions: Carbon removal credits to neutralize our residual emissions by 2030.

Google 2024 Environmental Report: https://sustainability.google/reports/google-2024-environmental-report/

FIGURE 16 **Our 2023 carbon footprint**



Scope	tCO_2e	%
Scope 1	79,400	1%
Scope 2 (market-based)	3,423,400	24%
Scope 3: (1) Purchased goods and services	4,038,000	28%
Scope 3: (2) Capital goods	1,605,000	11%
Scope 3: (3) Fuel- and energy-related activities (not included in Scope 1 or 2)	1,186,000	8%
Scope 3: (4) Upstream transportation	584,000	4%
Scope 3: (5) Waste generated in operations	10,000	<1%
Scope 3: (6) Business travel	283,000	2%
Scope 3: (7) Employee commuting (including teleworking)	113,000	<1%
Scope 3: Other categories	2,993,000	21%
Scope 3 (total)	10,812,000	75%
Total emissions	**14,314,800**	**100%**

"Le nostre emissioni totali di GES sono state pari a 14.3 Mt CO2e, in crescita del 13% in un anno e del 48% rispetto all'anno di riferimento 2019, principalemente a cause di un aumento del consumo energetico dei data centres e delle emissioni della supply chain".

COME RENDERE VISIBILE IL PESO DEL DIGITALE

COMMISSION DELEGATED REGULATION (EU) 2023/1669 of 16 June 2023 supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council with regard to the energy labelling of smartphones and slate tablets, 20.06.25

Energy labels are coming, covering durability too

Battery endurance per cycle

The time a phone or tablet can operate running a defined test scenario from a fully charged battery until the device shuts off due to a drained battery. Measured in hours.

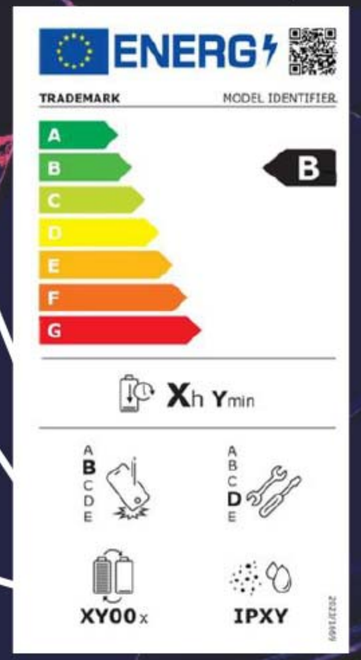
Free fall reliability class

Phones must withstand a minimum of 45 accidental drops without functional defects. Categorization is based on up to 270 drops from one meter onto a hard surface.

Battery endurance in cycles

The number of full cycles of charge (100% to 0%) a battery can withstand until its electrical capacity has reached 80% of its rated capacity. Measured in cycles.

New EU labels for smartphones



Energy efficiency index

The ratio between battery endurance per cycle and the nominal voltage of the battery multiplied by the rated capacity of the battery.

Repairability index class

Score based on disassembly complexity, fasteners used, tools required, software updates, spare part availability and provision of repair info for key components.

Ingress protection rating

Measures how well protected a device is against water and dust. The first number reflects dust resistance (0 to 6). The second reflects water resistance (0 to 9).

Source: Energy Efficient Products, Smartphones and Tablets, European Commission, September 2024

canalys

https://www.canalys.com/insights/ecodesign-laws-transform-smartphones-2025
https://energy-efficient-products.ec.europa.eu/product-list/smartphones-and-tablets_en

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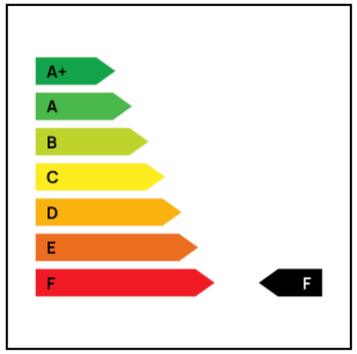
Internet consuma molta elettricità: circa 416,2 TWh all'anno per essere precisi.
Più di quella consumata dall'Italia che è di 321,4 TWh/anno.
Dai data center alle infrastrutture di rete, fino ai pc e smartphone che usiamo quotidianamente, tutto questo sistema consuma elettricità e produce emissioni di carbonio.

pianod

https://www.sitigreen.it/



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https://www.polimi.it/

EFFICIENZA ENERGETICA NEL WEB

FORMAƒANTASMA

STUDIO WORKS UPCOMING

PREFACE

Formafantasma is a research-based design studio investigating the ecological, historical, political and social forces shaping the discipline of design today. Whether designing for a client or developing self – initiated projects, the studio applies the same rigorous attention to context, processes and details. Formafantasma's analytical nature translates in meticulous visual outcomes, products and strategies.

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https://formafantasma.com/

EFFICIENZA ENERGETICA NEL WEB

Alta intensità carbonio

https://branch.climateaction.tech/

Intensità carbonio media

Intensità carbonio bassa