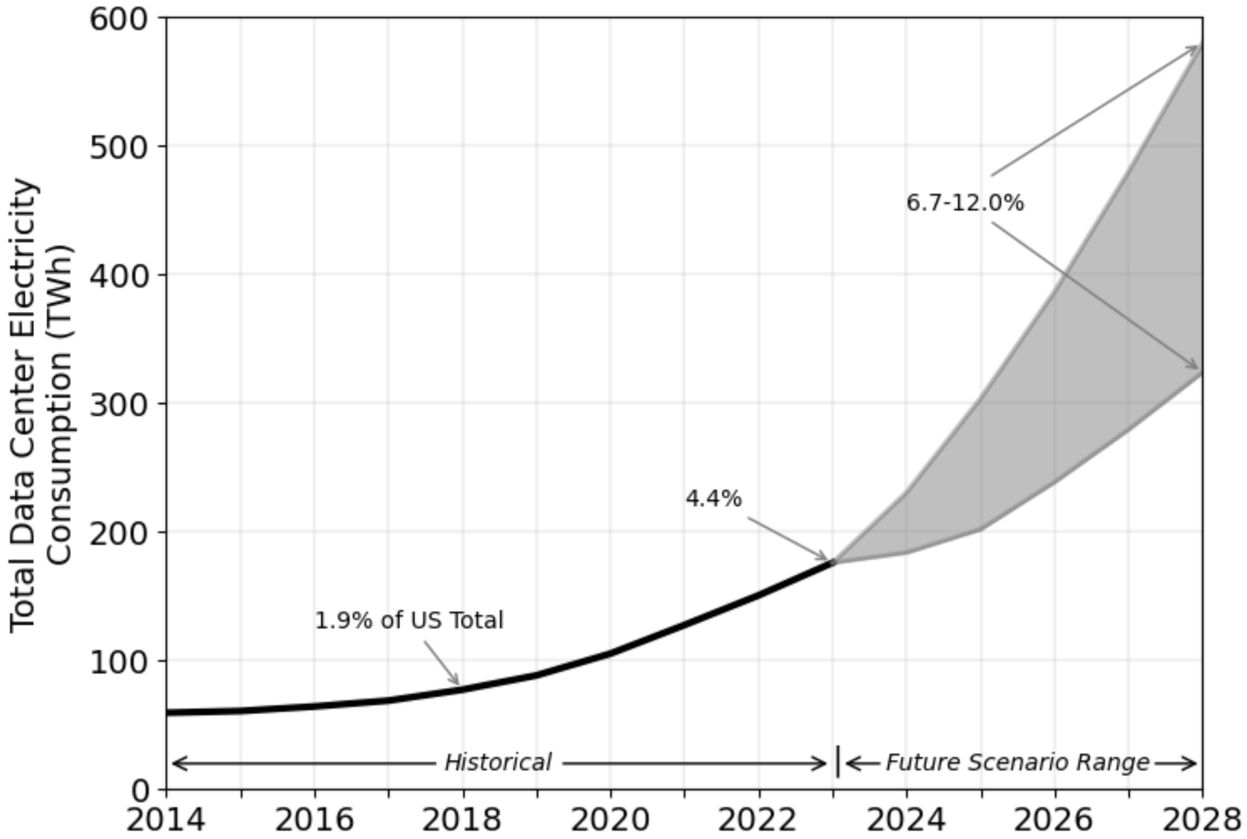
The *Uneven* Distribution of AI's Environmental and Public Health Costs

Shaolei Ren

UC RIVERSIDE

AI’s growing appetite for energy



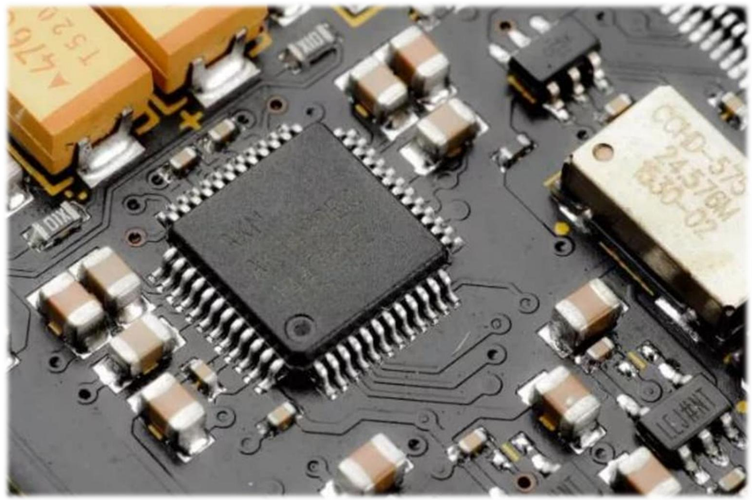
The U.S. data centers, almost entirely driven by AI, will consume up to ~600 TWh electricity in 2028, accounting for **6.7 – 12.0%** of the national electricity demand.

Source: 2024 United States Data Center Energy Usage Report

AI's carbon footprint

Scope 1

Scope 2



Scope 3

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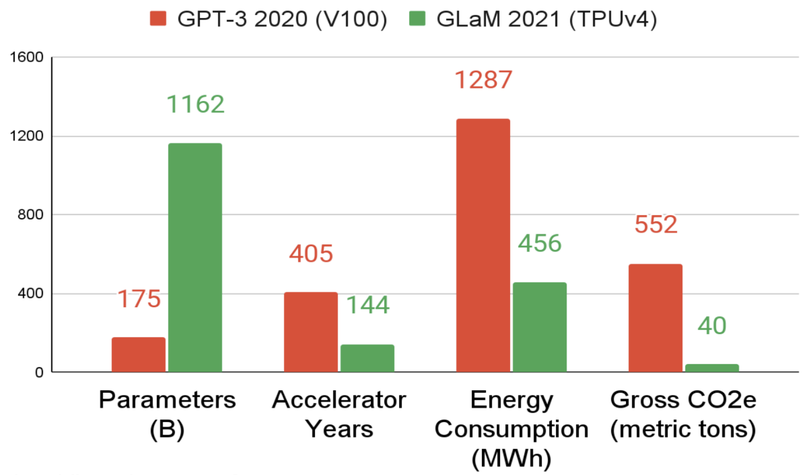
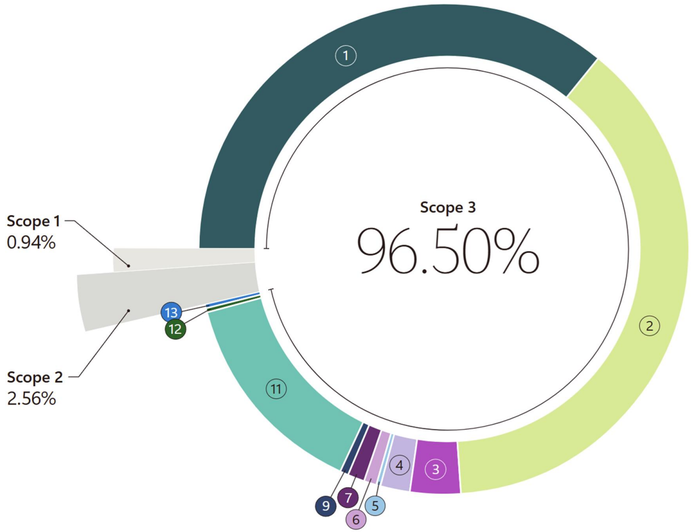
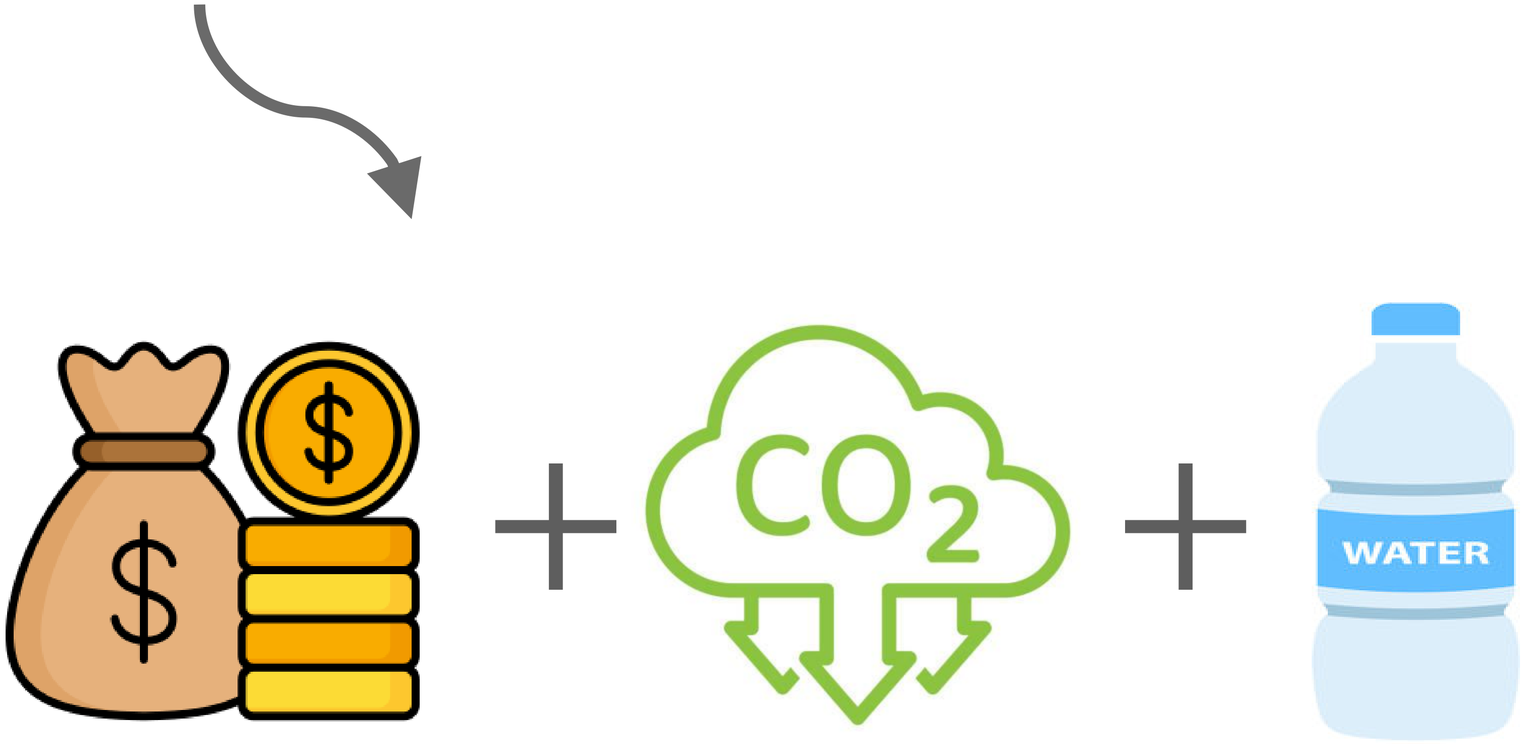


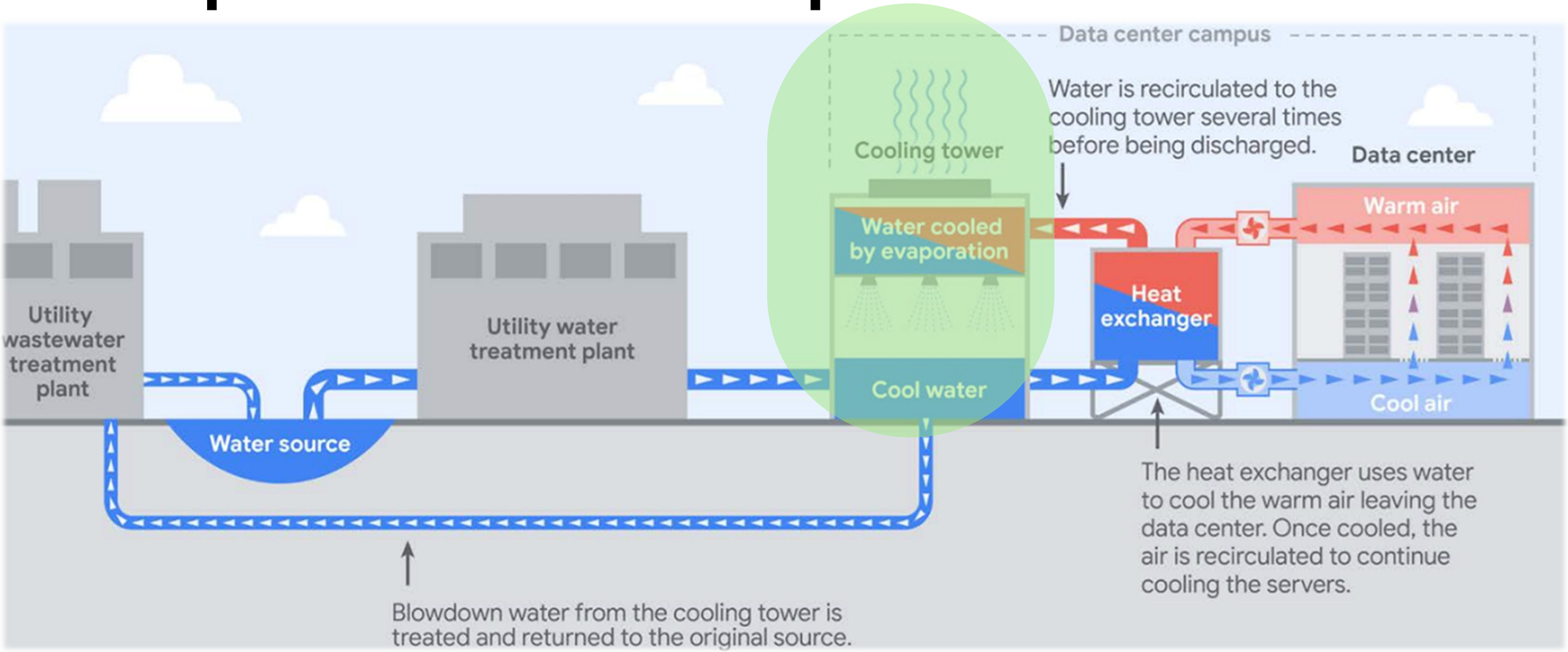


Source: "The Carbon Footprint of Machine Learning Training Will Plateau, Then Shrink", and Microsoft ESG 2024

Cost of energy



Scope 1 water consumption



~80-90% water consumption is drinking water

Source: Google

Source: Google

Scope 1 water consumption

- **Water consumption = Withdrawal – Discharge**
  - Evaporated portion of water withdrawal, or water in products (e.g., beverage)
  - “The portion of water **permanently** lost” according to one big tech’s ESG
- **One tech company can consume billions of liters each year**
- Double-digit growth per year
- Driven by “**the expansion of AI products and services**”

24 billion liters

one big tech’s scope-1 water consumption in 2023

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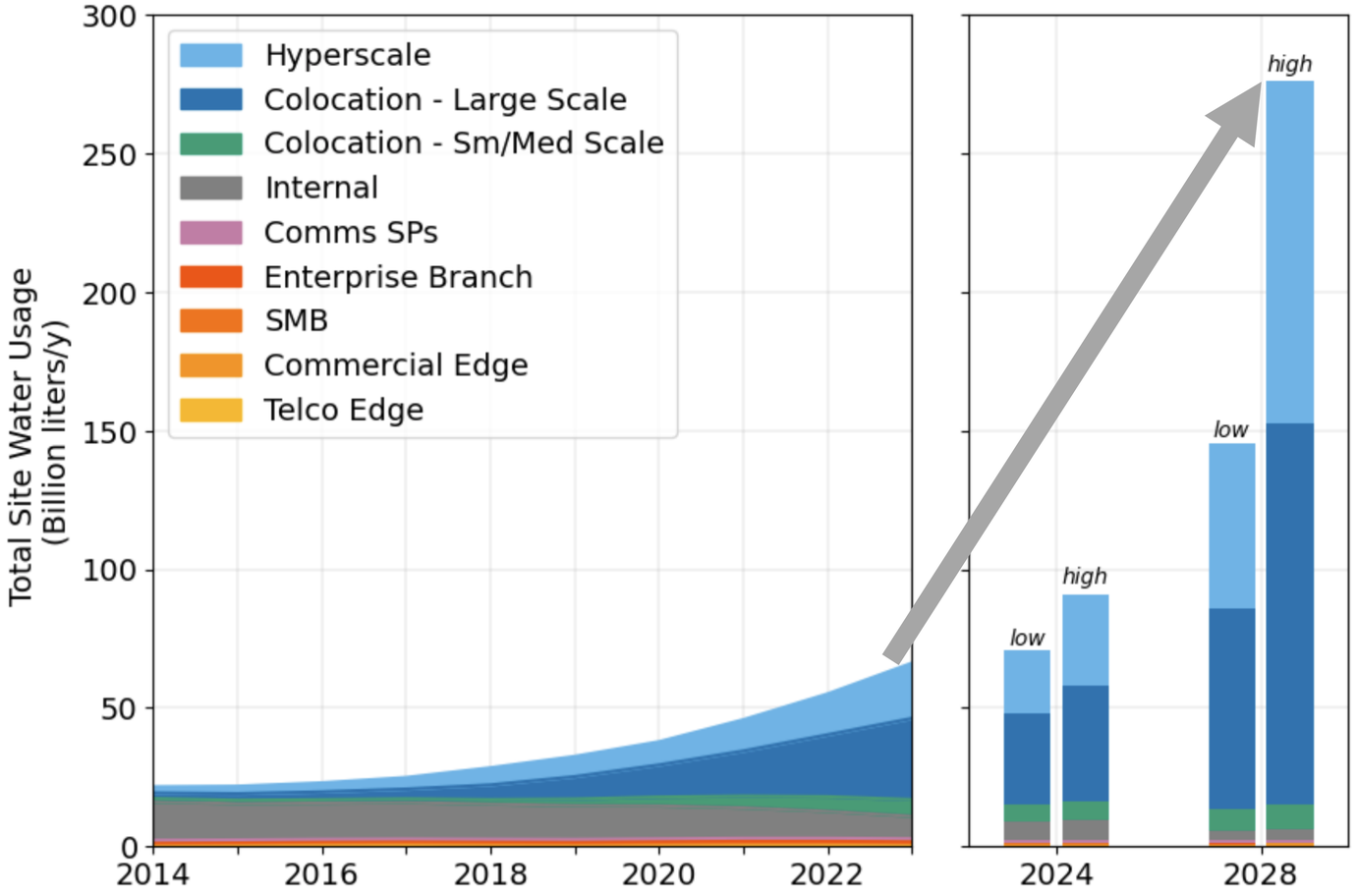
Annual scope-1 water consumption of a major beverage company

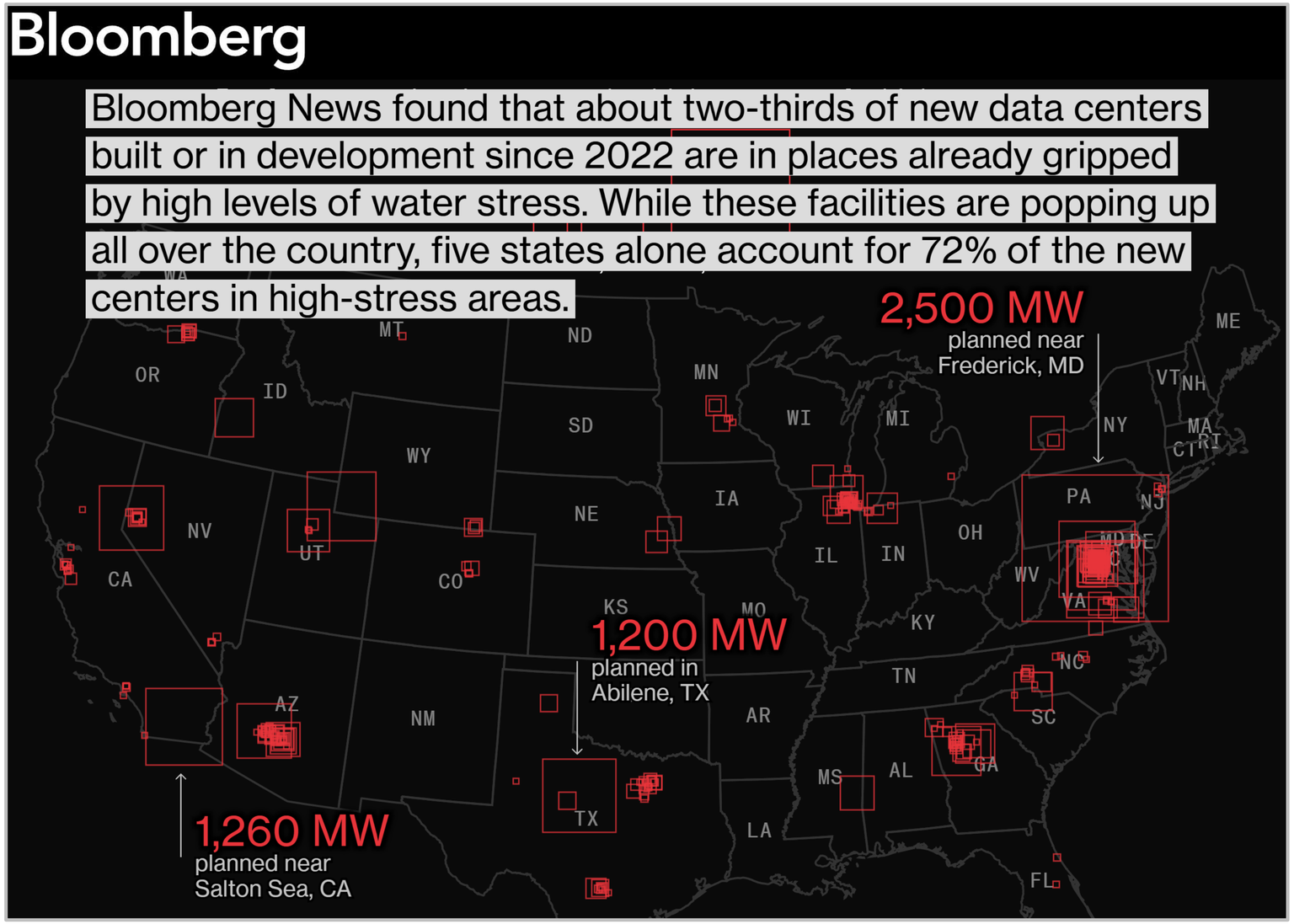
The growing thirst for water

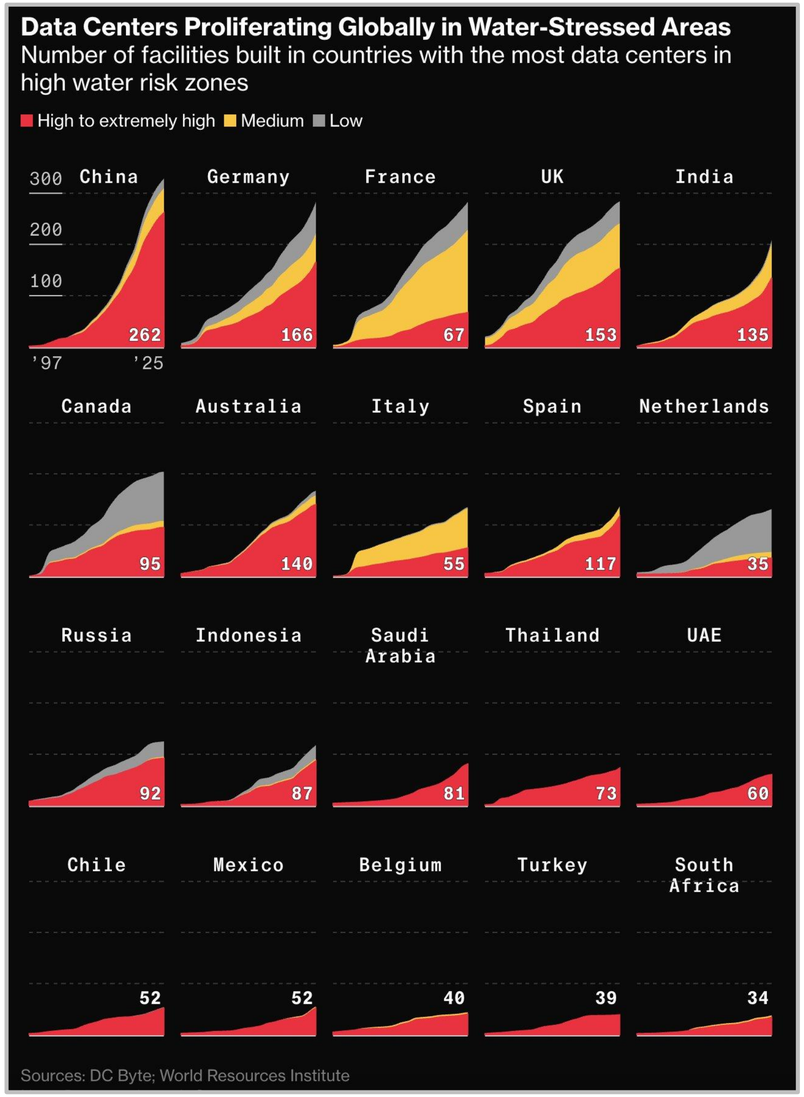


The U.S. data center water consumption in 2028, almost entirely driven by AI, will exceed **2 – 4x** the 2023 level

Source: 2024 United States Data Center Energy Usage Report

“AI is draining water from areas that need it most.”





Source: Bloomberg

Scope 2 water consumption

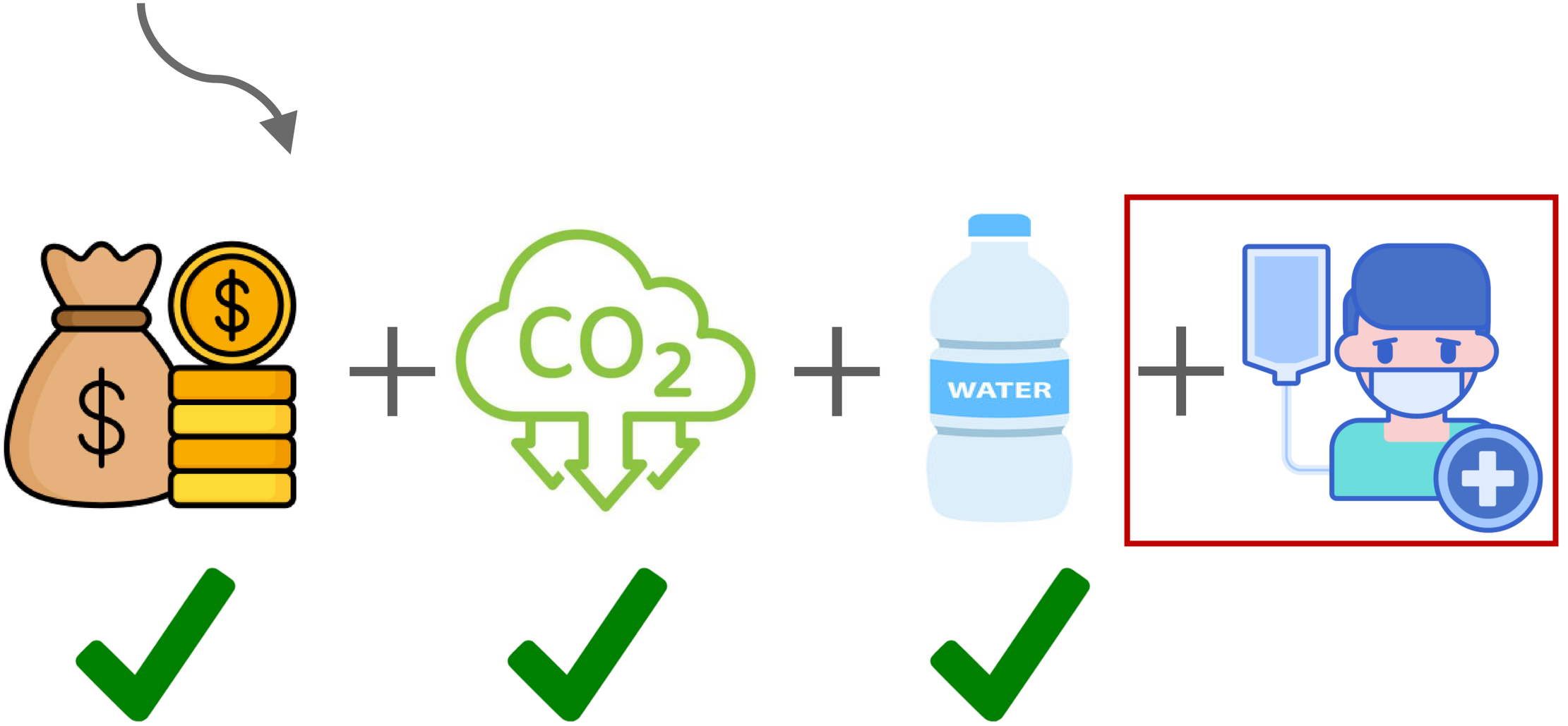
Source: Talen Energy

Scope 3 water consumption

Apple says that the supply-chain water consumption takes up ~99% of its overall water footprint!

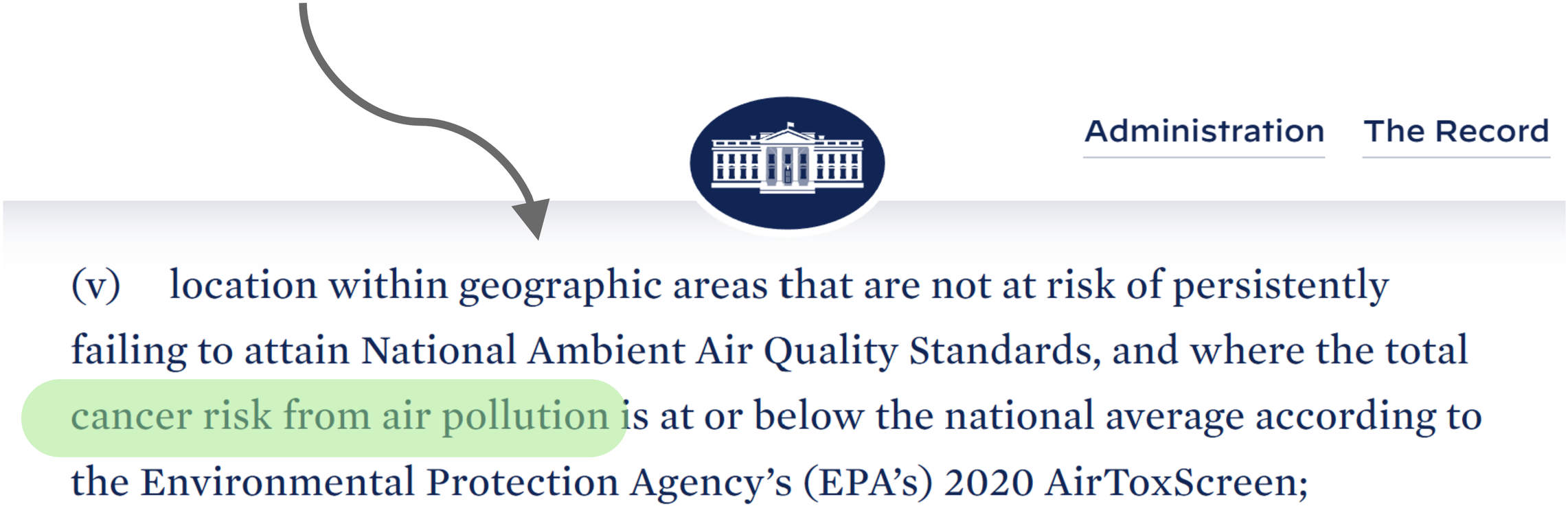
Source: Apple ESG 2024

Cost of energy



AI data centers worsen cancer rates?

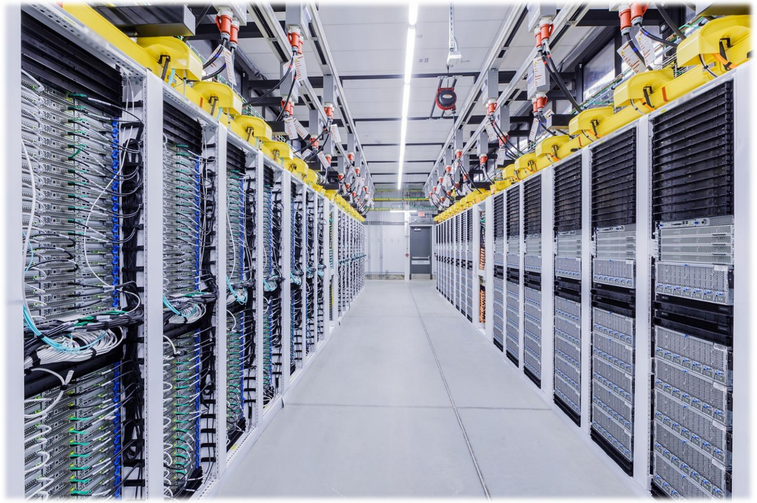
EO 14141 “Advancing United States Leadership in AI Infrastructure” prioritizes data centers in



Source: Executive Order 14141 of January 14, 2025 Advancing United States Leadership in Artificial Intelligence Infrastructure (not rescinded as of 02/11/2025)

Emission of criteria air pollutants

PM2.5, SO2, NO2, VOC, etc.

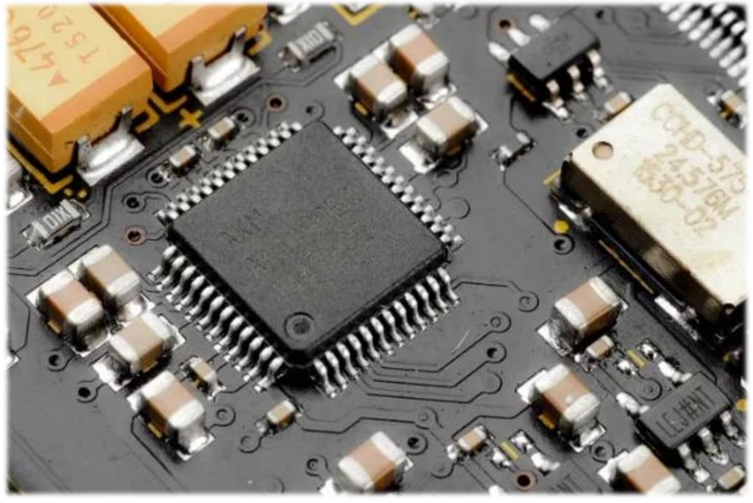


Scope 1

Backup generator

Scope 2

Fossil fuel



Scope 3

Supply chain

One fab: $25-37 million/year
(will be $92-146 million/year if in Ohio)

PM2.5, NO2, SO2, etc.

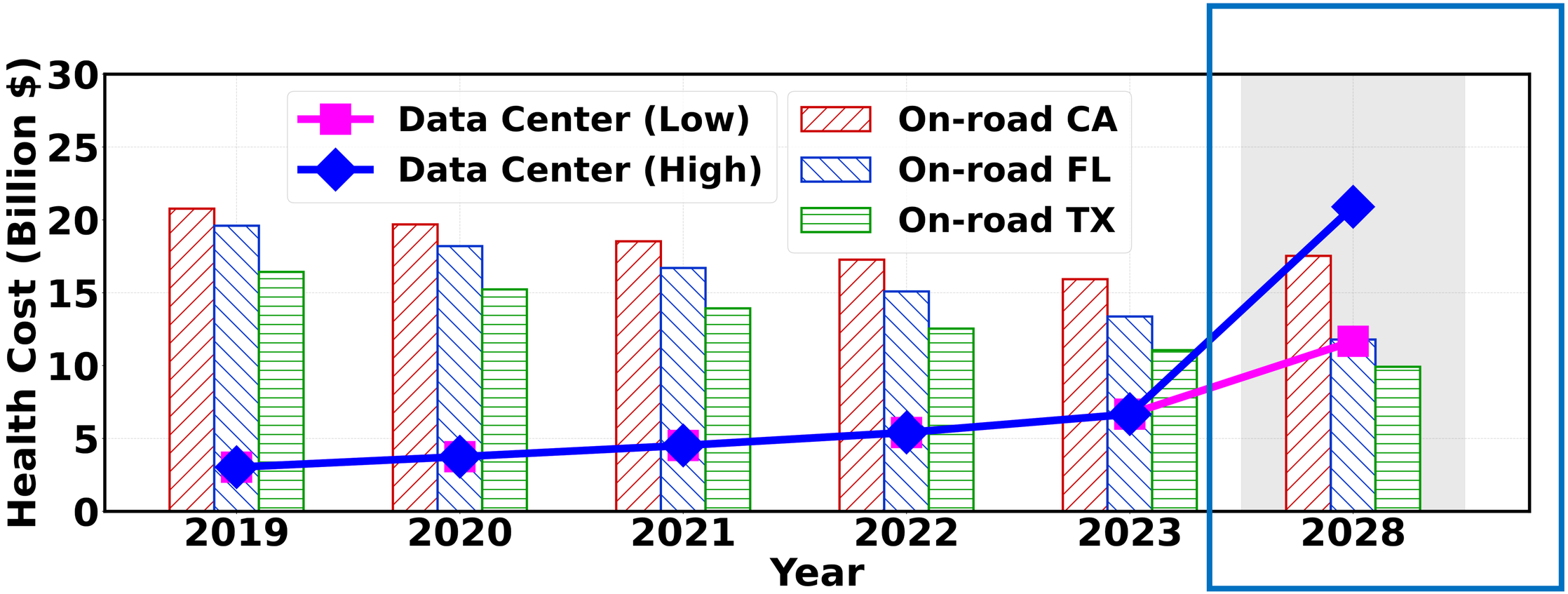
Public health impact of the power sector

Europe

"The analysis shows that just a small fraction of the most polluting facilities — **many of them coal power plants** — causes **half of the total damage**."

The public health cost of U.S. data centers

2028 prediction (based on the LBNL report)

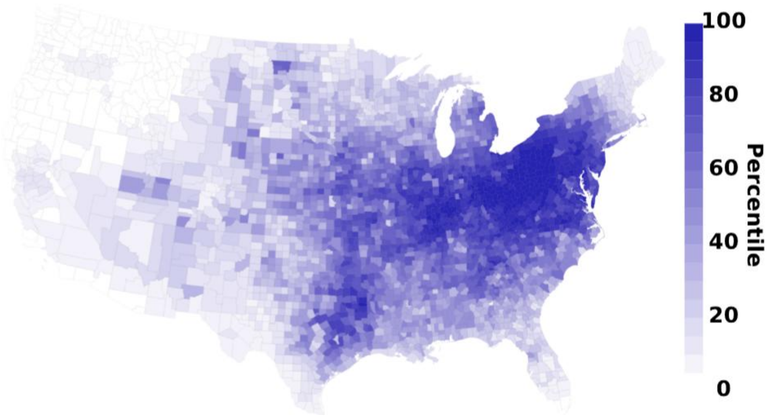


Rivals that of on-road emissions of the largest states.

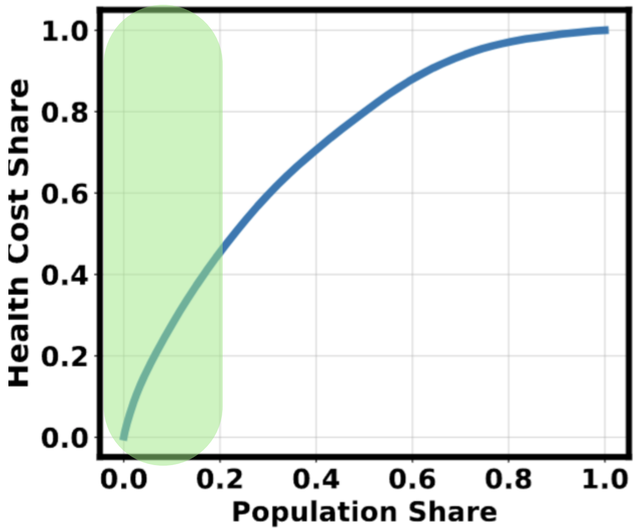
Source: Yuelin Han, Zhifeng Wu, Pengfei Li, Adam Wierman, Shaolei Ren, “The Unpaid Toll: Quantifying the Public Health Impact of AI,” arXiv, 2024.

The public health cost of U.S. data centers

From 2019 to 2023



State	County	Per-household Health Cost ($)	County-to-nation Income Ratio
WV	Marion	**1218.3** (978.0, 1458.5)	0.80
WV	Mason	**1139.0** (897.6, 1380.4)	0.71
OH	Meigs	**1123.1** (840.8, 1405.5)	0.62
OH	Gallia	**1107.6** (828.1, 1387.2)	0.74
WV	Marshall	**1083.8** (831.2, 1336.5)	0.77
WV	Taylor	**1052.5** (853.1, 1252.0)	0.70
PA	Fayette	**992.6** (782.0, 1203.3)	0.74
PA	Greene	**944.9** (770.3, 1119.5)	0.88
WV	Brooke	**918.8** (693.2, 1144.4)	0.69
WV	Jackson	**871.9** (703.8, 1039.9)	0.73



Per-household health cost **Top 10 counties** **Lorenz curve**

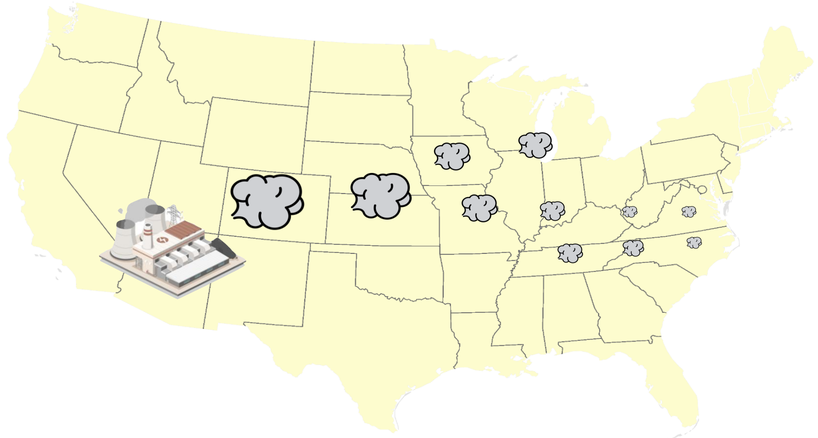
20% of the population took ~50% of the public health burden!

Source: Yuelin Han, Zhifeng Wu, Pengfei Li, Adam Wierman, Shaolei Ren, “The Unpaid Toll: Quantifying the Public Health Impact of AI,” arXiv, 2024.

Why should we focus on AI data centers?

Large and flexible.

The data center locations we choose today will impact the public health for many years to come.



Source: Meta’s 2024 ESG

The benefits of AI

Edge computing and IoT

- AI model selection in edge devices with battery constraints.
- Edge server management

Scientific discovery

Advanced manufacturing

Knowledge reduces fear, and actions build better futures.

Harvard Business Review

Climate Change | The Uneven Distribution of AI's Environmental Impacts

The Uneven Distribution of AI's Environmental Impacts

by Shaolei Ren and Adam Wierman

July 15, 2024

POLITICO

'How come I can't breathe?': Musk's data company draws a backlash in Memphis

The company's turbines — enough to power 280,000 homes — run without emission controls in an area that leads Tennessee in asthma hospitalizations.

An aerial view of the xAI data center. | Steve Jones/Flight by Southwings for SELC

Country suffering its worst drought in 74 years, with government even mixing saltwater into drinking supply

People take part in a protest amid a shortage of drinking water reserves in Montevideo on 31 May 2023. Photograph: Eitan Abramovich/AFP/Getty Images