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# AI Energy Use & Data Center Demand: A Primer

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# AI Use
# A Primer

**Ever since ChatGPT burst onto the scene in November 2022, growth in public use and awareness about the revolutionary power of AI has been explosive. As of March 2024, ChatGPT has over 180.5 million monthly users. Less well known, however, is the massive amount of energy AI consumes and the strains it poses to power grids around the world. This report will explain AI energy use, its relationship to data centers, and the changing nature of data center demand.**

## The digital world we now inhabit runs on computers located in massive facilities known as data centers.

The digital world we now inhabit runs on computers located in massive facilities known as data centers. They are giant warehouse-like buildings filled with orderly racks of servers, routers, storage devices, and other equipment. Almost everything we do with our tech – internet searches, streaming, online shopping, gaming, and the like – depends on data centers.

**180.5 Million**
Monthly ChatGPT Users

Even without AI, the amount of energy needed to power current computing needs is enormous. According to estimates by the International Energy Agency (IEA), data centers consumed 240-340 terawatt hours (TWh), or 1.0 percent to 1.3 percent of total global energy consumption in 2022. (A terawatt hour equals 1 trillion watt hours, or Wh). To put the energy consumption of data centers in perspective, the six states of New England consume 120-125 TWh of energy on average each year; data centers worldwide consume at least two to three times that amount.

## With AI, data centers will consume even more massive amounts of energy.

AI computing requires much more energy. Training the AI is the most energy-intensive. The amount of energy needed for training depends on the AI model being developed. According to research published in 2022, the energy required for training ranged from 2-3 kilowatt hours (one kWh equals 1,000 watt hours) for small natural language processing and computer vision models to 103,500 kWh for a 6 billion-parameter "transformer".

To appreciate how much energy that is, consider this stat. GPT-3, the older version of ChatGPT that came out in 2022, used almost 1,300 MWh (one MWh equals 1,000 kWh) of electricity to power its 175 billion-parameter AI model. That's roughly equal to the annual power consumption of 130 homes in the U.S.

In addition to training AI, a lot of this energy is used for cooling. AI computing is generally done with hotter-running microprocessing chips which requires more energy. About 25% - 40% of energy used by traditional data centers is consumed by HVAC systems and about 50% is consumed by other systems and equipment.

## HYPERSCALE DATA CENTERS ARE THE FUTURE

Given the significant economic implications, tech firms are actively enhancing the energy efficiency of AI data centers, transitioning from those focused on conventional computing to ones increasingly geared toward AI. Accordingly, tech firms are in the process of constructing hyperscale data centers. Hyperscalers take up 1 million to 2 million square feet versus 100,000 square feet for the average cloud data center. In addition to housing more equipment, hyperscalers house more equipment and are more energy efficient by design. 40% of all hyperscalers in the pipeline will be built in the U.S. Google just announced that it is developing a $1 billion data center in Kansas City, Missouri totaling over 1.4 million square feet. Meta, Microsoft,and Amazon as well as Oracle and Akamai have announced similar plans.

Interestingly, Microsoft is considering using nuclear power to run its AI data centers, possibly using an array of small modular reactors. It has also agreed to purchase power from Helion, which is trying to build a fusion power plant.

Although it's difficult to know exactly how these advances in power efficiency will pan out, the relentless and nearly insatiable demand for more efficient energy sources to sustain our growing AI-driven tech industry is undeniable.

## DEMAND FOR AI DATA CENTERS IS GROWING.

Data centers are proliferating as the use and development of AI grows. It is hard to say whether the proliferation of both is going to increase total energy consumption because total net energy consumption can be mitigated with increases in efficiency in data center operations and design. Energy consumption remained stable from 2018 to 2022, according to the IEA, but is expected to double by 2026 to 1,000 TWh – about as much energy as Japan consumes annually today .

This amount of energy use will limit which existing data centers will host AI computing and where data centers specifically designed for AI will be built. Worldwide, our best estimate of how many datacenters there are ranges between 9,000 and 11,000. With the exception of Antarctica, data centers are on every continent. Ranked in order of megawatt usage, here are the top 5 locations where data centers cluster worldwide: Northern Virginia, London, Tokyo, Frankfurt, and Sydney. In the U.S., data center hotspots include Northern Virginia, Silicon Valley, Dallas/Fort Worth and Chicago.

For optimal AI performance, data centers need reliable power grids, dense fiber networks, and proximity to internet "backbone points". Beyond technical specs, data center location depends on government and public approval. Places like the U.S., with streamlined permitting and data-friendly laws, will be magnets for AI facilities. This economic lure extends even to countries traditionally cautious about development, like France, which is actively courting AI data centers.

The London School of Economics reports that "data center activism" is growing around the world. Opposition to further data center construction stems from concerns regarding the massive amount of water used for cooling, general environmental sustainability, overall community benefit, and the use of open space.