AI’s dirty secret

Addressing the hidden environmental cost of AI hardware manufacturing

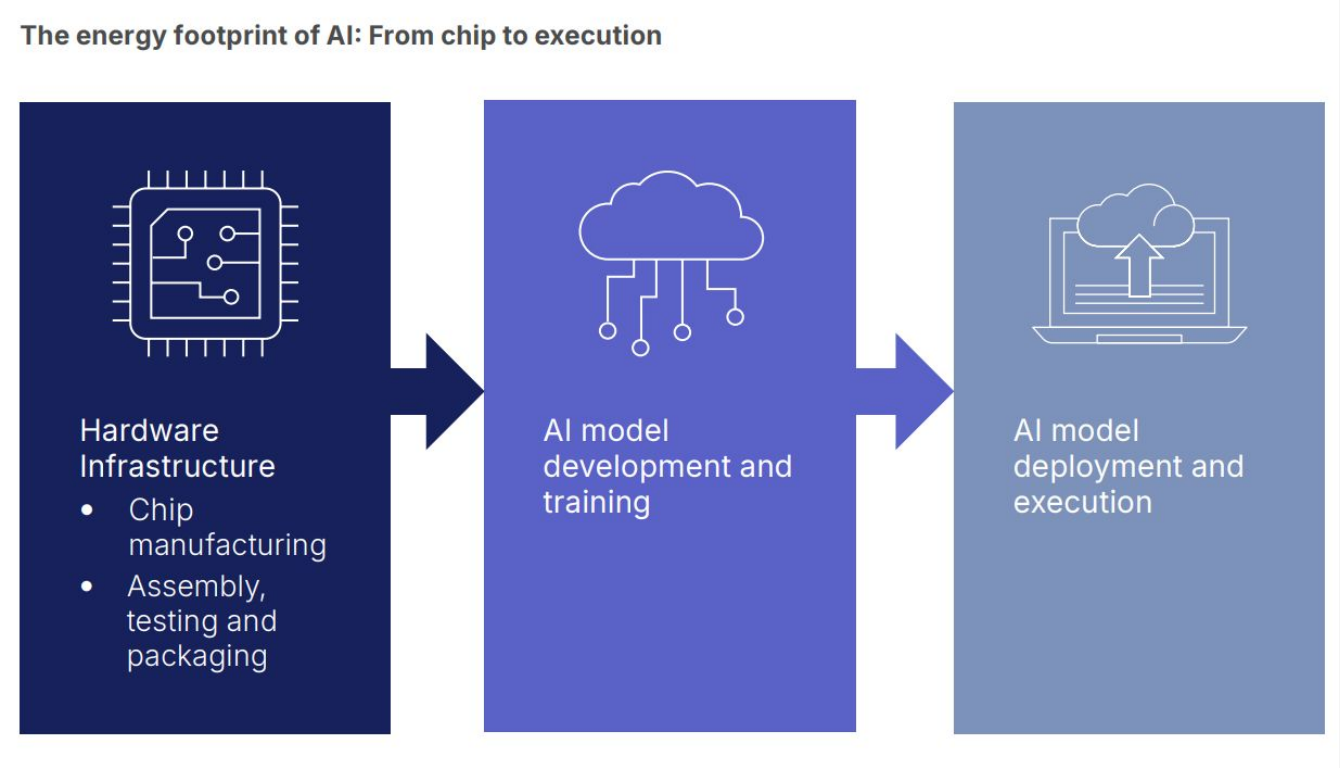
Provided by Digiconomist
Alex de Vries-Gao in collaboration
with Greenpeace East Asia

The Growing AI Industry

Current discussions have largely centered on the electricity demand of data centers. These facilities, which support the AI training and inference processes, are placing increasing stress on electricity grids and sustainability due to their surging electricity capacity demand.

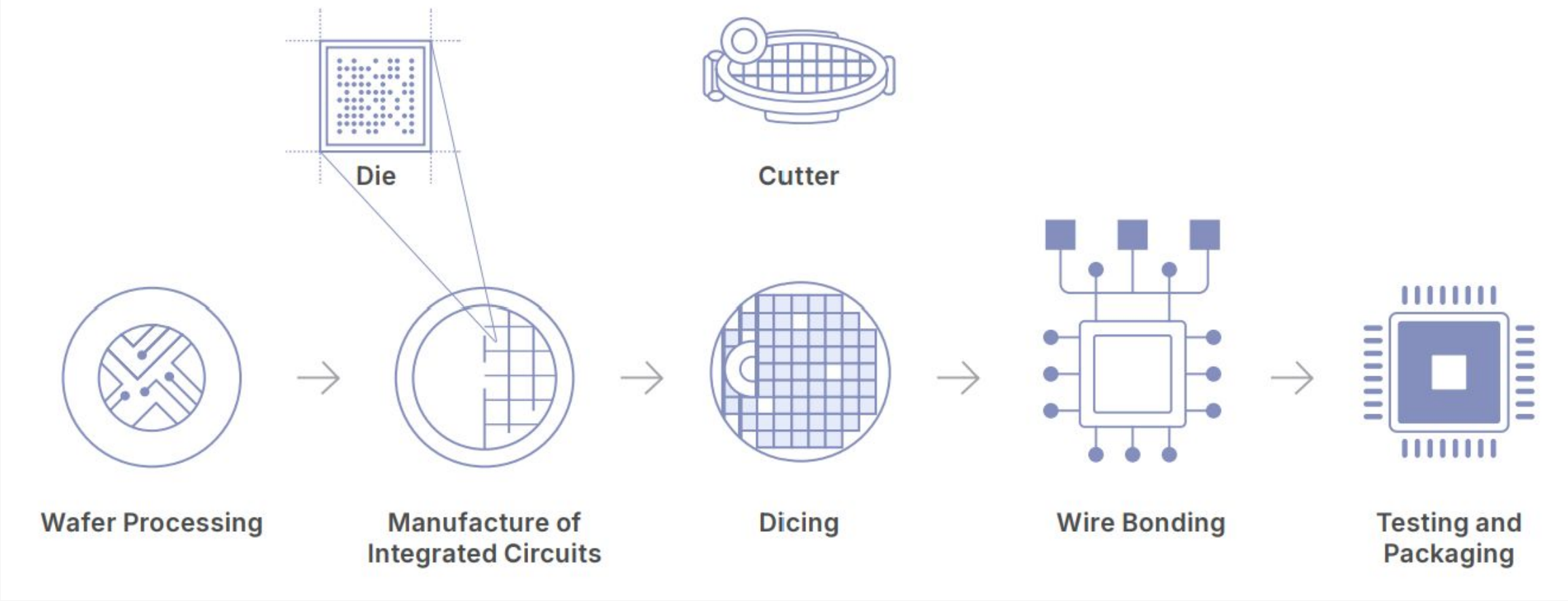
AI is the main driver of data center expansion (IEA, 2025), with AI already being responsible for 20% of global data center power demand at the end of 2024, while this share may increase to half of data center power demand by the end of this year (de Vries-Gao, 2025).

However, the assessment of AI energy consumption should extend beyond data centers to encompass the broader landscape of the AI industry, notably the energy-intensive process of upstream chip manufacturing.



Energy Demand from AI Chipmaking

The exact energy demand from AI chipmaking is not disclosed, but it is possible to make an assessment by considering the chip manufacturing process and the available capacity for packaging AI chips, which has been a key bottleneck for AI hardware manufacturing in recent years.

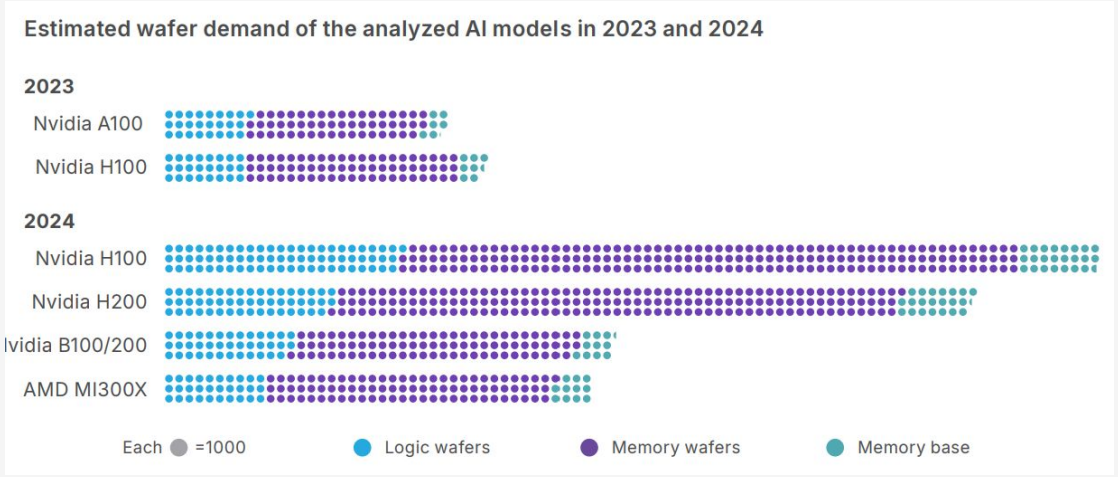


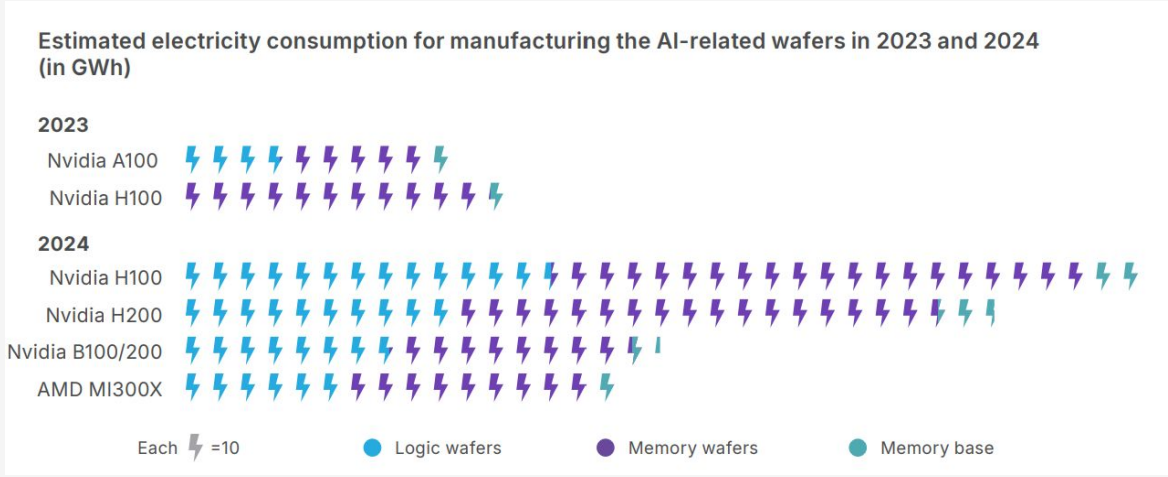
Estimating wafer and energy demand

Using the specifications of AI chip components, with the consideration of production yields, market share and packaging capacity data, we estimated the wafer demand related to device production. Based on our estimated wafer demand of AI hardware, we calculated the electricity demand for the wafer production and found the energy needs increased significantly from 218 GWh in 2023 to 983.9 GWh in 2024, representing a 351% rise.

Note: Over the past two years, Nvidia's market dominance in the data-center GPU sector and its H100 alone occupied a significant share in both 2023 and 2024.

Some tech companies, such as Google, are developing their own AI chips, but these chips are typically not commercially available. Consequently, obtaining product specifications and production data for these accelerators is not feasible.

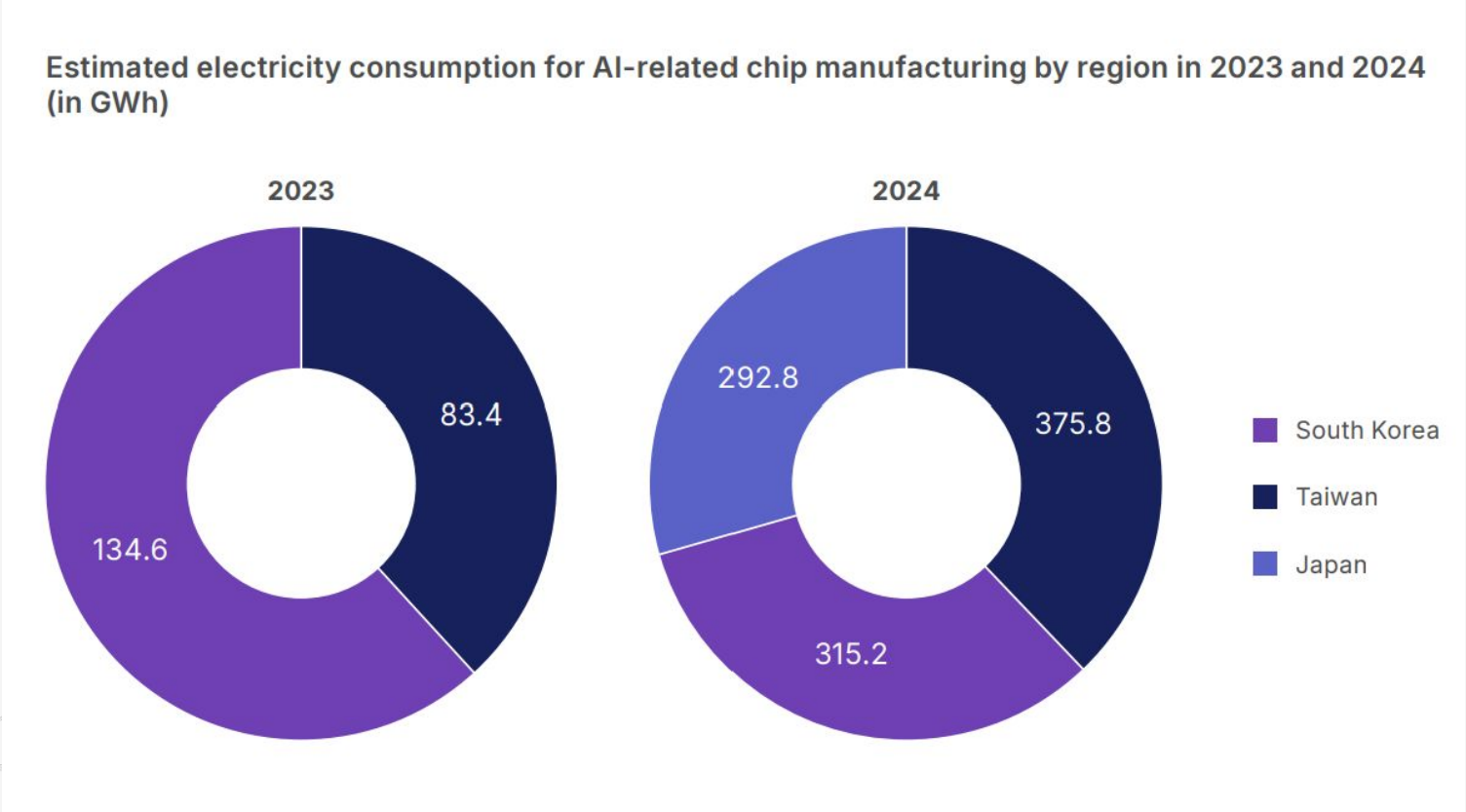




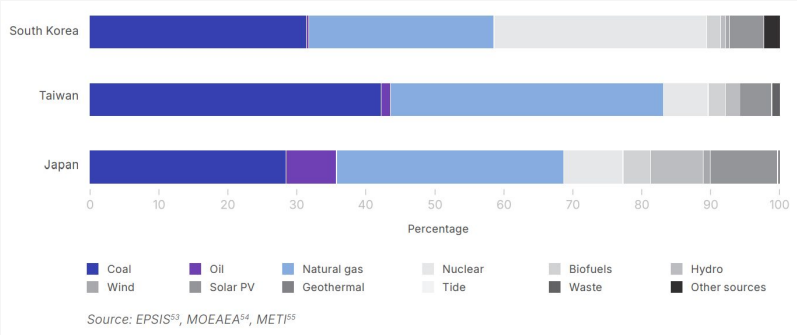
Estimated electricity consumption for AI-related chip manufacturing by region

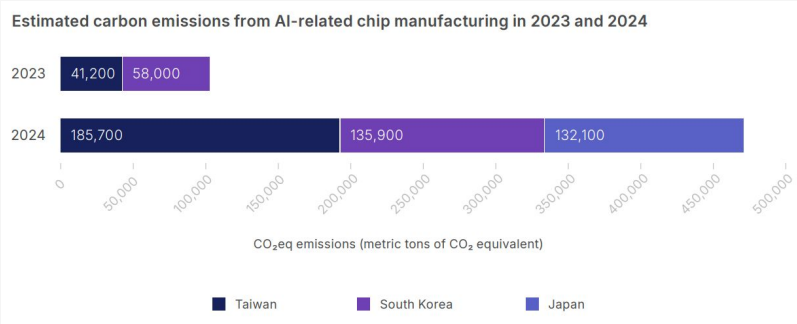
By assessing which manufacturers are responsible for producing the various AI-chip components and their primary production locations for these components, the estimated electricity consumption can be attributed to the location of the manufacturing facilities.

Although detailed information regarding the proportion of production capacity dedicated to AI-related hardware remains unavailable, the analysis of GPU and memory chip suppliers suggests that the relevant manufacturing facilities are concentrated in the East Asia region.



Electricity mix and carbon emissions





Electricity grid in East Asia is mainly powered by fossil fuels, which leads to AI chips that are mainly manufactured by coal, oil and gas, with 2023 figures showing 83.1% reliance in Taiwan, 68.6% in Japan, and 58.5% in South Korea.

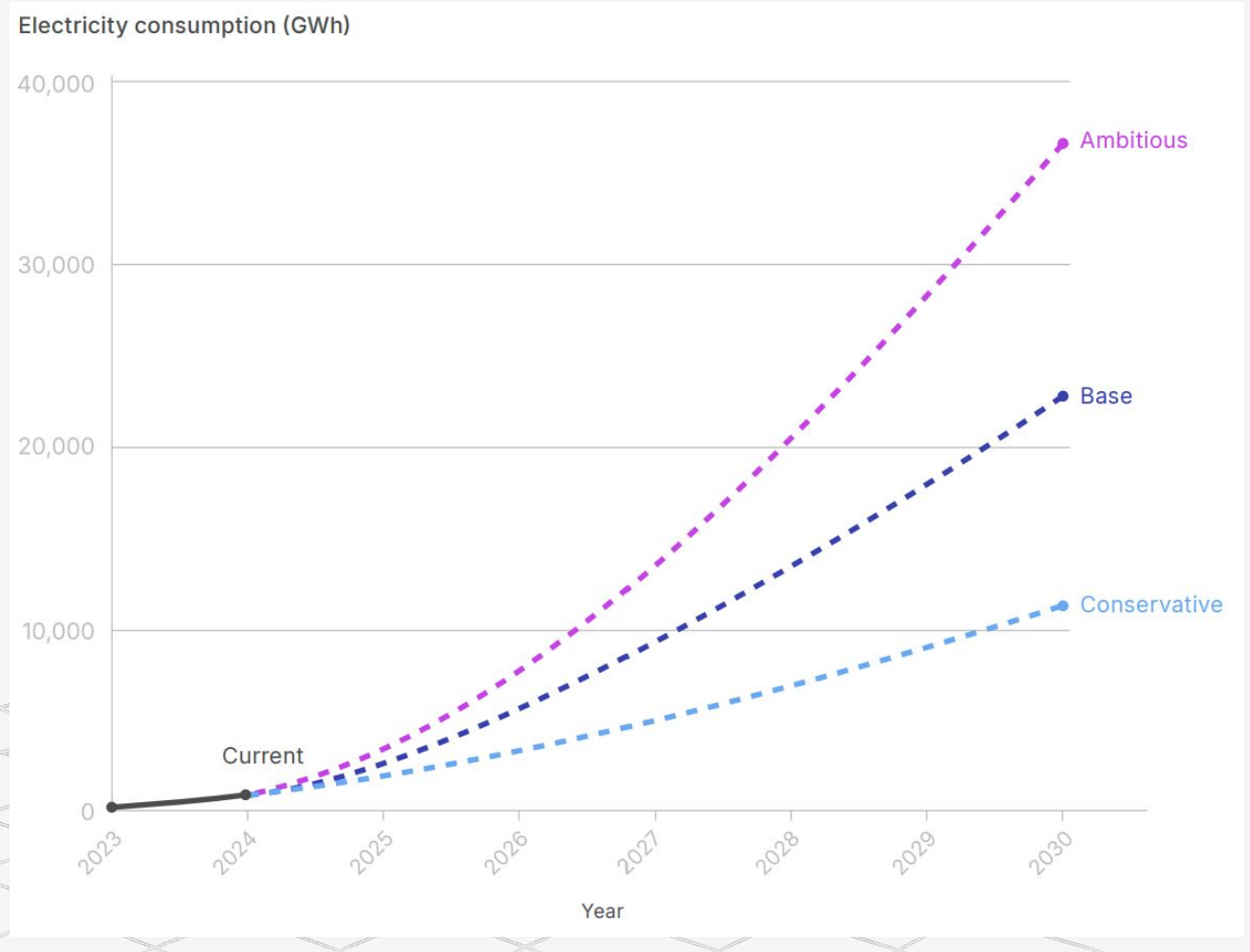
In 2023, electricity consumption in AI chip manufacturing generated 99,200 metric tons of CO2 equivalent in East Asia, and the number increased more than 4.5 times in 2024, accounting for more than 453,600 metric tons of emissions.

Among all the key AI chip manufacturing locations, the emissions of AI chip manufacturing in Taiwan had the biggest surge from 41,200 metric tons in 2023 to 185,700 metric tons in 2024, which is more than a four-fold increase. In South Korea, the emissions related to AI chipmaking more than doubled, from 58,000 metric tons to 135,900 metric tons in 2024

Projected electricity consumption for AI-related chip manufacturing

The demand for AI hardware is expected to continue expanding through 2030. According to McKinsey's estimates, the projected growth in demand for AI-related chips will necessitate the production of an additional 1.2 to 3.6 million logic wafers, 4.5 to 21 million dynamic random-access memory (DRAM) wafers, and 1.7 to 7.9 million NAND flash memory Wafers.

Combining this projection with current electricity demand estimates suggests that to meet such a demand, the electricity consumption would be expected to increase to between 11,550 GWh and 37,238 GWh, up to 170 times more than the demand in 2023, which would exceed Ireland's current consumption by 2030.



Moving forward in a sustainable manner: cleaning up the supply chain

Leading tech companies and AI chip design companies, such as Nvidia and AMD, need to target 100% renewable energy across the supply chain by 2030.
AI players must design a clear pathway for supply chain emissions reduction. The majority of emissions are from electricity consumption; therefore it is essential that chipmakers and other AI suppliers adopt renewable energy. Companies must set up a 100% renewable energy target across the supply chain by 2030.

Leading tech companies and AI chip design companies should actively engage with suppliers on renewable energy procurement and strategies to reduce emissions.
Active engagement with suppliers is imperative to drive the renewable energy transition and achieve Scope 3 emissions reduction goals. Companies should provide financial support and incentives to their suppliers, engage meaningfully through training and reporting, and actively require key suppliers to set their own renewable energy and emissions reduction targets.

Companies need to choose high-impact sourcing methods when it comes to renewable energy procurement.
High-impact renewable energy sourcing options, such as power purchase agreements (PPAs), renewable energy investment, and onsite generation should be the primary options for a company to achieve renewable energy targets because these methods have clear additionality and trackability. ***Consumers can become prosumers.*** Renewable energy certificates can be an additional choice for companies to meet their targets. When companies set the renewable energy targets for the supply chain, high impact sourcing methods need to be clearly stated.

Q&A

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