# Sustainable Artificial Intelligence for the Support of Humanity and the Development of Human Potential

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**Abstract**

In a recent Biological Physics and Meaning Mini Conference (December 2024), I presented an overview of the achievements and challenges to intelligent systems today, outlining crucial insights from brain studies and also introducing brain-inspired system designs, combing the benefits of advanced AI/AGI and neuromorphic technologies. It is emphasized that the main objective of the research into artificially intelligent techniques is to support human quality of life and help humanity, and to develop harmony of biological and machine intelligence.

## The Need for Sustainable AI

The spectacular development of AI in recent years has brought many results that have increased the quality of life of all people. AI is everywhere. It is in our homes, on the road, at work, in hospitals and healthcare, banks and financial institutions, communications, and industry. It has helped us in many ways and contributed to increasing our quality of life. All these results are excellent, however, there are some warning signs pointing to problems ahead (Goertzel, 2023) (Aschenbrenner, 2024).

It is important to address several key challenges to make a sustainable future. Cutting-edge AI, AGI, ChatGPT and other intelligent computational technologies, demonstrate outstanding performance in many important tasks requiring intelligent data processing under well-known conditions, supported by massive computational resources and big data. At the same time, the performance of these systems may drastically deteriorate when the data are perturbed, or the environment dynamically changes, either due to natural effects or caused by man-made

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disturbances and adversarial effects, possibly due to malicious actors (Kozma, Alippi, Choe, & Morabito, 2023).

Advanced AI technologies require a huge amount of resources, including data, computational power, and electrical energy. Until recently, such limited resources did not pose a real constraint on creating new technologies. In recent years, however, the exponentially developing AI computer systems have used up practically all data and knowledge resources available on the internet. Moreover, even with the more advanced computer technology, it is becoming hard to complete the computations required for the creation of the next generation of AI. There is also a problem with the energy need of AI. According to some estimations, advanced data centers use now about 5% of the available electrical energy (Alibour & Wilson, 2024). It is a possible scenario that by 2030 there will not be sufficient energy to satisfy all the needs of the AI and human consumption. AI often implements wasteful use of the available resources. At the same time, our brains are very efficient systems.

## Brain-Inspired Approaches to Sustainable AI

What can we learn from the energy management of the brain? A neuromorphic perspective can provide crucial support under such demanding conditions. Human brains are efficient devices using 10W power (just like a light bulb!), which is many orders of magnitudes (OOM) less than the power consumption of today's supercomputers, requiring MWs of power to solve specific learning tasks in an innovative way. This means there is a million times less power consumption in brains than in today's supercomputer clouds.

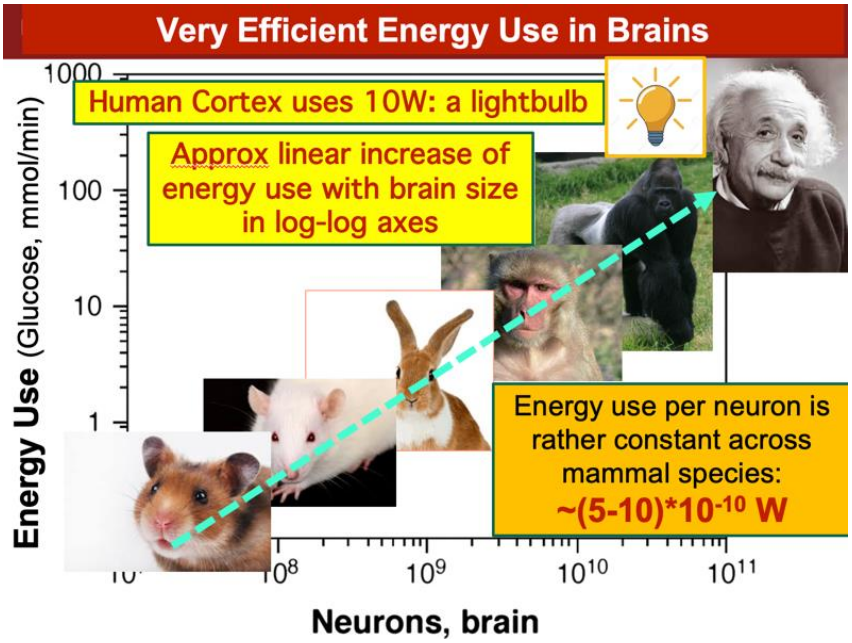


Figure 1. Illustration of the scaling of energy use on mammalian brains versus the size of the brain. The size of the brain drastically varies across species, from gerbils, rats, rabbits, monkeys, gorillas, to humans. At the same time, the ratio of brain size and energy use follows a linear law, shown here in log-log coordinates.

An analysis across mammals shows that clearly the size of the brain drastically varies across species, from gerbils, rats, rabbits, monkeys, gorillas, to humans. At the same time, the ratio of brain size and energy use follows a linear law, shown here in log-log coordinates. So, there is a very efficient energy management that takes place in a wide range of species (Kozma & Freeman, 2016).

Brains use spiking interaction between brain cells, and human brains have about 20 billion neurons. In order to simulate so many neurons on a supercomputer, like the top K computer, one needs 120 Mega Watts power, that is a million times more than humans need. Advanced neuromorphic chips can drastically cut the energy demand, still, brains are 1000 times more efficient than the most advanced neuromorphic chips.

## Embodiment and a Situated Intelligence for Sustainable AI

The brain's energy management is the ultimate manifestation of embodiment and situated intelligence (Dreyfus, 2007). Analyzing spatio-temporal cortical oscillations, serving as the basis of pattern-based computing in the brain, can help developing novel computational and hardware implementations with drastic improvement in using resources, including energy, data, and computing, in the style of the brains (Kozma R., 2024). These efforts aim at establishing a path towards sustainable AI.

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