ABSTRACT

Computing based services are everywhere today. Digitalization but, became a concern for the Energy national agencies when technologies like AI or cryptocurrencies became popular in the last decade. The IEA states that over 1% of the global energy demand comes from data centers; Ireland reported that from the total electricity consumption, data centers share went from 5% in 2015 to 21% in 2023 ; 3 big tech companies (Microsoft, Amazon, Alphabet) have signed agreements to nuclear power their data centers. Those are just few of the latest figures of an industry with sustained energy consumption growth forecast.

But this is not new. The long run evolution shows an increase over the years on total energy demand to operate those machines. But it also shows a substantial improvement in efficiency – measured as computations made by kilowatt-hour. Both parallel phenomena took place while computing price was decreasing. How then, if ability to compute was sustainably growing while the electric efficiency improved, the global electricity demand grows? Interestingly, this parallel growing evolution of both energy efficiency and aggregated energy demand suggests that computing might show Jevon's Paradox.

In order to check this hypothesis, it is vital to understand long-term trends throughout computing's development trends – many tech milestones had to be archived to make today's user adoption possible, together with drivers that pushed the energy demand.

The presentation will navigate the complexity of the computing powered systems by providing answers that are just parts of the puzzle we need to fit together until reaching the full picture, and being able to answer the multiple questions arised regarding how computing's energetic requirements have exploded; this is vital to better understand what we can expect in the future energy demands. First, we will explore the state of the art of historical long run studies, and identify (some) technical milestones that made modern computing possible. Then, we will analyze the impact of those milestones on the drivers that have had a multiplier effect on computing's energy demand.

Even the absence of reliable datasets today, the complexity of the topic will allow also discussing other aspects related to the energy requirements like the life cycle considerations as the hardware is impacted heavily by the manufacturing process, the Information and Communication Technology industry as a whole and not only focusing on the data centers or if this energy consumption is socially relevant (with the paradigmatic example of cryptocurrencies)