# Energy Consumption of LUMI

Simulation and Modelling in Astrophysics (AMUSE) - Assignment 1

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September 13, 2022

## 1 Introduction

LUMI (Large Unified Modern Infrastructure) is a supercomputer located in Kajaani, Finland. It is the 3rd fastest supercomputer in the world and the fastest in Europe as of June, 2022; it finds its place in the list of the 500 fastest supercomputers in the world - the TOP500 project [3]. LUMI is a pan-European undertaking and is hosted by the LUMI Consortium [2]. It was developed to be utilized for advancing scientific research in fields such as climate change, quantum computing, artificial intelligence and medicine.

## 2 Specifications and Power Consumption

LUMI is capable of theoretically performing a maximum of 550 petaFLOPS [1] and has a sustained computing power of 375 petaFLOPS [2]. According to the TOP500 project [3], it consumes a power of 2941.13 kiloWatts (kW). A reasonable way of computing the energy efficiency is to compute the number of operations done per unit amount of energy consumed. Thus, if one is interested in computing the efficiency of LUMI in gigaFLOPS per Watt consumed (GFLOPS/Watt), it is seen that LUMI has a theoretical efficiency of $\frac{550\times10^6}{2941.13\times10^3} = 187.003$ GFLOPS/Watt and a reaistic estimate of the efficiency given by $\frac{375\times10^6}{2941.13\times10^3} = 127.502$ GFLOPS/Watt. This makes it one of the most efficient supercomputers and since it performs many operations for a small amount of power consumption, it is considered a green supercomputer. The LUMI supercomputer ranks 3rd in the list of the 500 best green supercomputers, known as GREEN500 [1].

## 3 Nature of Power Generation

What makes LUMI actually green is the fact that 100% of the power generated for running LUMI comes from hydroelectric energy [2], and the residual heat arising out of LUMI is used to power 20% of the energy needs of the district of Kajaani in Finland [4]. This process significantly reduces the carbon footprint of the district and also makes LUMI one of the cleanest supercomputers.

## References

[1] : *GREEN500.* – URL https://www.top500.org/lists/green500/2022/06/

[2] : *Large Unified Modern Infrastructure.* – URL https://www.lumi-supercomputer.eu

[3] : *TOP500.* – URL https://www.top500.org

[4] : *Waste Energy of LUMI*

[1] Flop stands for Floating-point operations per second, which is predominantly used as a measure of performance of a supercomputer. Peta- is 1 followed by 15 zeros, i.e. $10^{15}$.