

# Beyond Performance: Software Approaches for Energy-Efficient HPC

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## Abstract

Energy-efficient computing is a major challenge for exascale computing. Power constraints, rising electricity costs, and the diminishing efficiency benefits of Moore's Law have exacerbated this challenge and increased the need for energy-efficient technologies. This talk will present state-of-the-art software approaches aimed at minimizing the energy consumption of HPC applications. We will discuss some common misconceptions about energy optimization and provide insights into understanding when optimizing for energy differs from optimizing for performance. We will see how different approaches in HPC can target energy optimization from different perspectives, such as job schedulers, compilers, and operating systems. We will see how recent research targets fine-grained solutions that span the software stack (SYnergy [SC23]), including programming models, compilers, runtime systems, and extensions to phase-based approaches [IPDPS25]. Finally, the talks conclude with an overview of emerging trends in fields including carbon-efficient computing.

## Short bio

Biagio Cosenza is an associate professor at the University of Salerno, Italy. From 2015 to 2019, he was a senior researcher at the TU Berlin, Germany, where he was the principal investigator of the DFG project Celerity. From 2011 to 2015, he was a postdoctoral researcher at the University of Innsbruck, Austria, where he contributed to the Insieme compiler and the DK-Plus multidisciplinary platform. Cosenza's research focuses on high-performance computing and programming models; he is a member of the Khronos SYCL Working Group and the UXL Foundation. His research is currently funded by the EuroHPC Joint Undertaking (LIGATE project), the Italian Ministry of Research (LibreRT project), and several industrial projects.

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## Declaration on Generative AI

The author has not employed any Generative AI tools.

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