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Machine Learning and Scheduling Strategies for Sustainable Computing at PIC

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This work addresses the optimisation of energy use, electricity costs, and CO₂ emissions at the PIC WLCG Tier-1 site. With data centre energy demand expected to increase, aligning with WLCG sustainability goals is critical.

Two main studies were conducted. First, simulated natural job drainages, applied to 2023–2024 PIC utilisation data (HTCondor logs), evaluated halting job acceptance during periods of high electricity prices or emissions. The approach yielded modest savings but significant computational losses, mainly due to non-energy-aware HTCondor scheduling, hardware characteristics, and hyperthreading. More promising strategies include selectively shutting down inefficient nodes or adjusting CPU frequencies at compute nodes.

Second, an XGBoost model was developed to predict CPU-core reduction after real-time drainage events, using only decision-time features. Using two years of HTCondor information at the site, the model accurately forecast core drops, especially 8–40 h post-drainage, enabling the design of a dynamic CPU resource management system responsive to price and environmental signals.

These results provide actionable insights for sustainable computing operations at PIC and within the broader WLCG framework.

Desired slot length

Speaker release

Yes

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