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Power efficiency gains from GPU optimised workloads with Geant4 based detector simulations

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Improvements in algorithmic efficiency are, in principle, the 'free-est' sources of energy-efficiency gains, as reducing CPU time at a constant power clearly reduces total energy. However, it is not clear a priori that the same applies to porting parts of a code to special purpose accelerators such as GPUs.

We investigated this case for the Celeritas project's GPU offloading for Geant4's EM calorimeter simulation – this particularly relevant as ATLAS currently spends ~40% of its CPU budget in simulation, and ~20% on Geant4 'full-sim'.

We show that, for all cases, both run-time and energy consumption are reduced by moving to GPU. In the best cases, energy use is reduced by 42% and run-time by 54%.

We will discuss how these observations extend to strategic considerations for applications of accelerators to NetZero targets in the HL-LHC regime.

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