

Developing sustainable supercomputers with digital twin technology

STFC Hartree® Centre built a digital twin model of our new supercomputer to improve its energy efficiency, supporting the wider drive toward sustainability and innovation in IT infrastructure.

Challenge

Data centres are critical to the digital economy but are increasingly under pressure to reduce their energy consumption. Managing energy use across complex systems of computing hardware, power infrastructure and environmental controls is a significant challenge. Traditional energy optimisation methods often lack the agility and granularity needed to respond to dynamic workloads and environmental conditions. The goal of this project was to create a proof-of-concept of a digital twin that could simulate and improve energy efficiency in real time, offering both environmental and commercial advantages across the data centre lifecycle.

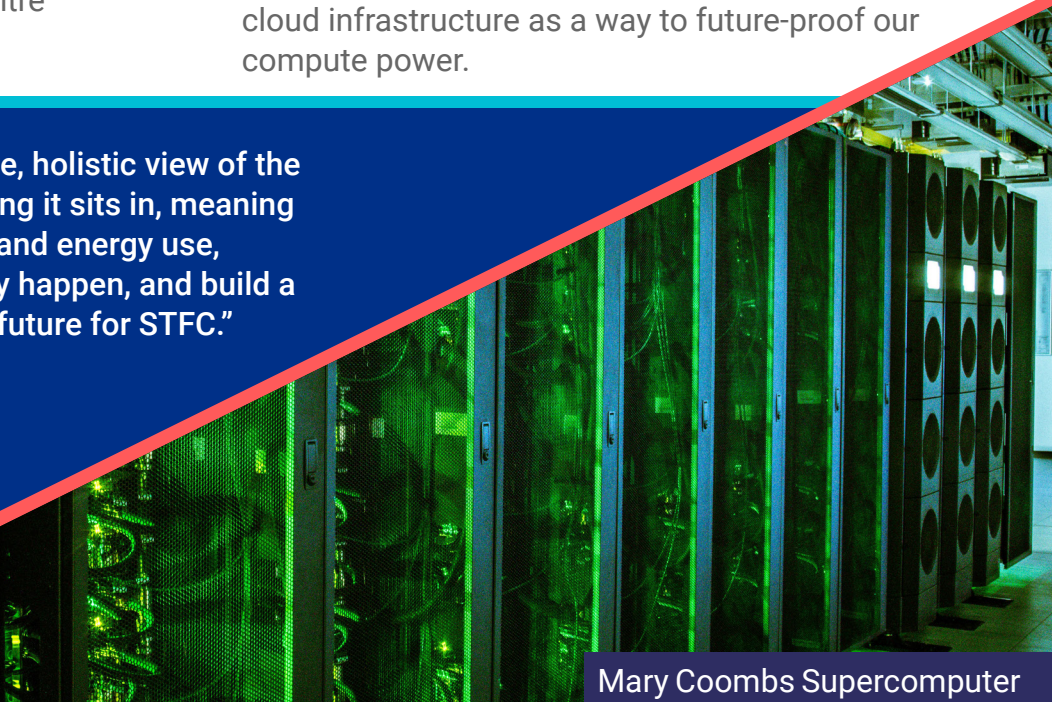
Approach

Using a combination of environmental data, physical plant information and IT infrastructure inputs, we developed a proof-of-concept digital twin model of a data centre. This model will allow near real-time optimisation by generating customised software and hardware configurations for each workload. We developed the model in NVIDIA Omniverse, which is purpose built for digital twins and enables multiuser collaboration, streaming applications directly to users through a webpage. We are also building a monitoring test system for live data, working towards predictive maintenance and a holistic view of the supercomputer and its building, to support a wider STFC asset for more sustainable computing infrastructure. These new capabilities will be integrated into our centres computing and cloud infrastructure as a way to future-proof our compute power.

“Our digital twin gives us a live, holistic view of the supercomputer and the building it sits in, meaning we can tune its performance and energy use, spotting problems before they happen, and build a more sustainable computing future for STFC.”

Charles Crooks

Visualisation Software
Engineer



Mary Coombs Supercomputer

Benefits

This project lays the groundwork for transformative innovation in sustainable computing infrastructure. By enabling dynamic energy efficiency optimisations, the digital twin model can help technology and manufacturing organisations reduce costs, lower emissions and future-proof their infrastructure. It also positions the Hartree Centre as a leader in applying digital twin methodologies to HPC operations. Beyond environmental impact, the solution presents a compelling case for green technology markets where energy efficiency and carbon reduction are strategic priorities.

At a glance

- Developing a digital twin model to monitor and optimise energy use in supercomputers and data centres
- The digital twin will enable near real-time energy efficiency across software and hardware systems
- Supporting sustainability and reducing environmental impact of multiple supercomputer nodes
- Improving lifecycle performance of HPCs including reliability and availability

Who we are

The Hartree Centre was created by UK Government to help businesses and public sector organisations accelerate the adoption of high performance computing (HPC), big data analytics, artificial intelligence (AI) and quantum technologies. We play a key role in realising UK Government's Industrial Strategy by stimulating applied digital research and innovation, creating value for the organisations we work with and generating economic and societal impact for the UK. We are proud to be part of UK Research and Innovation.

What we do

- Boost productivity and innovation for industry
- Offer training and skills development
- Provide insights into future technologies
- Give tailored business development support
- Build bespoke small teams around your project

