

# The ICHS project at Durham University: Inter-seasonal storage of waste data centre heat

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**DiRAC**  
High Performance  
Computing Facility

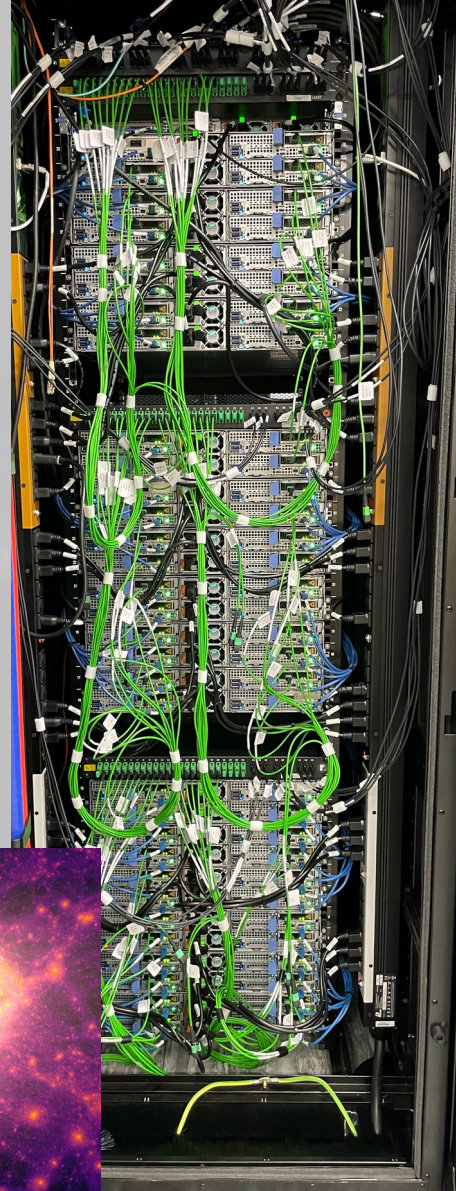
# Introduction

- The COSMA support team
- Day to day operations
- Forward planning
- And more random stuff



# COSMA

- The largest HPC system in the country
  - By x86 core count
  - Providing compute resource for the STFC theory community
    - Via DiRAC
- Established in 2001
- 3 generations in operation: COSMA5, 7, 8
  - With a recent upgrade/replacement of COSMA5
    - In part thanks to the Carbon Fund
- Responsible for some of the largest cosmology simulations worldwide



# DiRAC

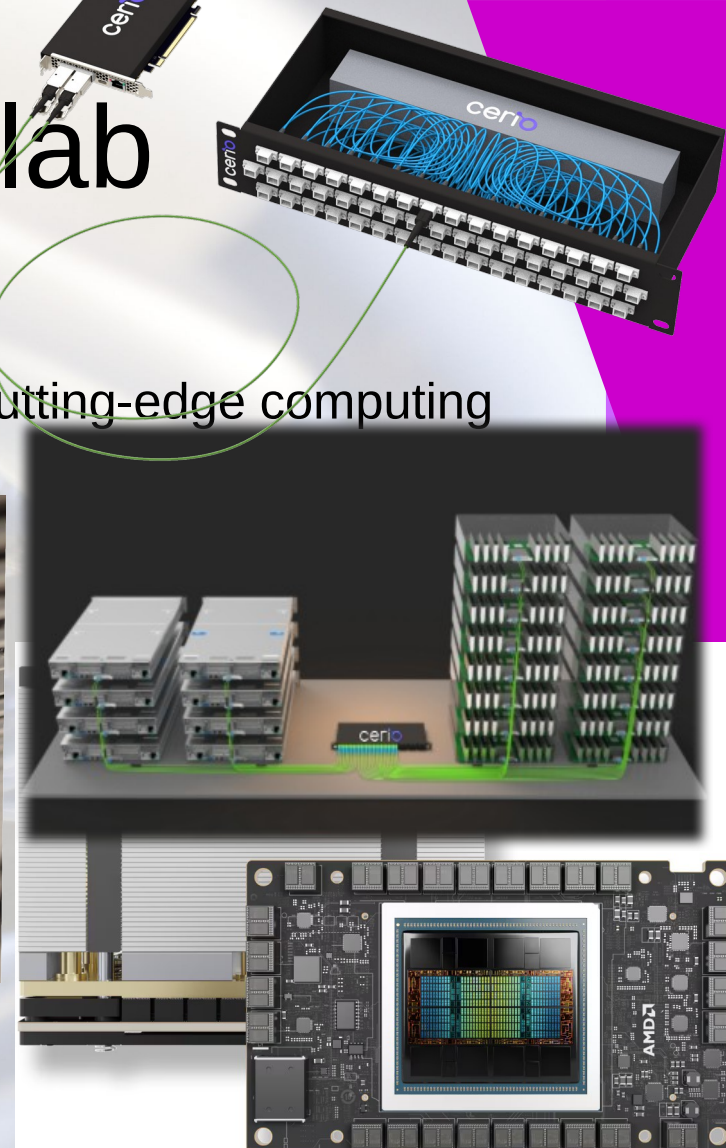
- STFC's compute facility
  - Distributed across 4 locations:
    - Cambridge, Edinburgh, Leicester and Durham
  - Durham hosts the Memory Intensive service
    - COSMA7, 8
    - 500+ nodes with 1TB RAM each
- DiRAC-4 technical case





# HPC hardware lab

- A lab for all things HPC
- Providing UK researchers with access to novel and cutting-edge computing hardware
  - Latest GPUs
  - Composable hardware
  - Networking
  - Storage technologies
  - Net-zero component
  - Visitors welcome

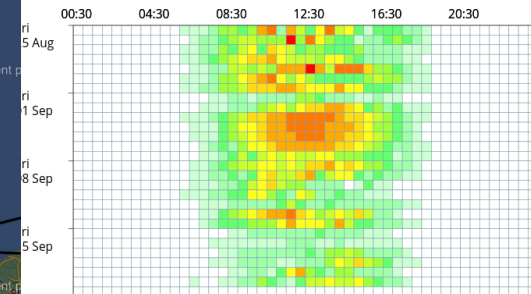


# Net-zero

- ~£1m solar panel installation
  - STFC/DiRAC-funded
- First UK site providing energy monitoring data back to users
- Energy efficient cooling
- Underground heat storage
- Pushing for heat reuse



Electricity Footprint Report





# A (brief) history of cooling on COSMA

- Early 2000s – hot air
  - Moved by fans
- Mid-late 2000s – rear door heat exchangers
  - Cooling water flowing through radiator grills
- Early-mid 2010s – active rear doors
  - Comes with fans!
- Early 2020s – Direct liquid cooling
  - Piping water onto the CPU heat exchangers (what could possibly go wrong?)
- Mid 2020s – Immersion cooling

# Immersion cooling

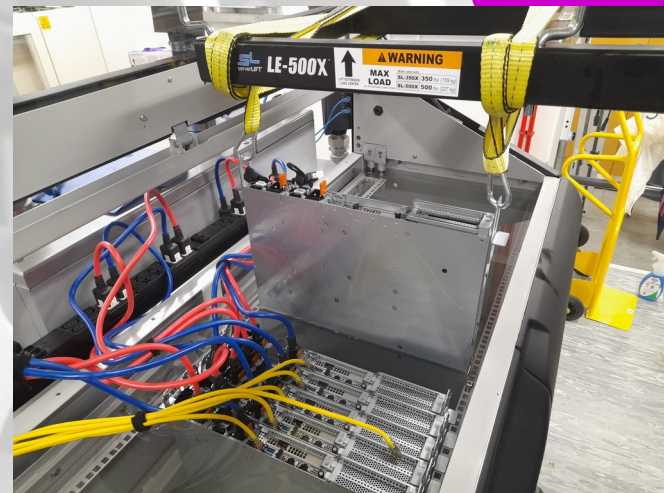
- Servers immersed in oil
  - No fans required
  - Complete heat capture
- Funded as part of the ICHS project
- Higher output temperature
  - Heat is easier to dispose of
  - And easier to reuse



# Immersion cooling



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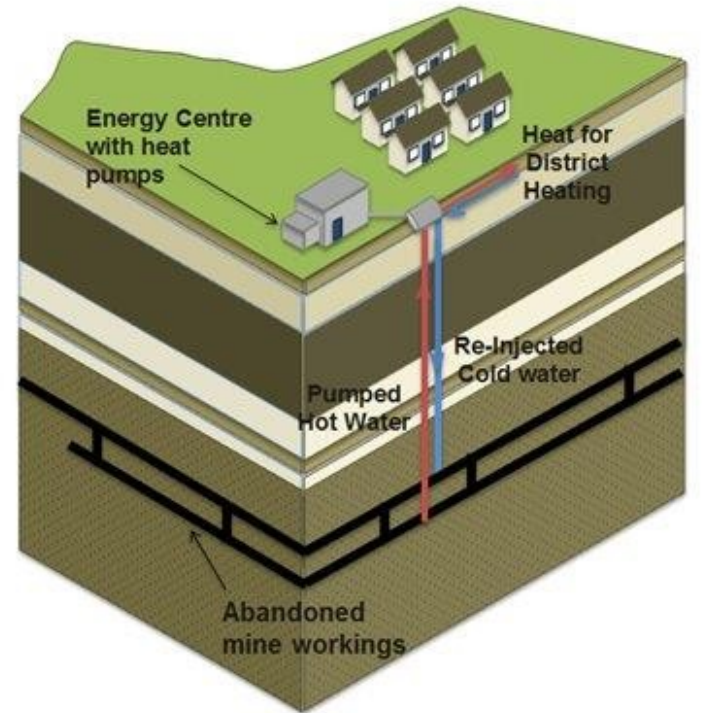
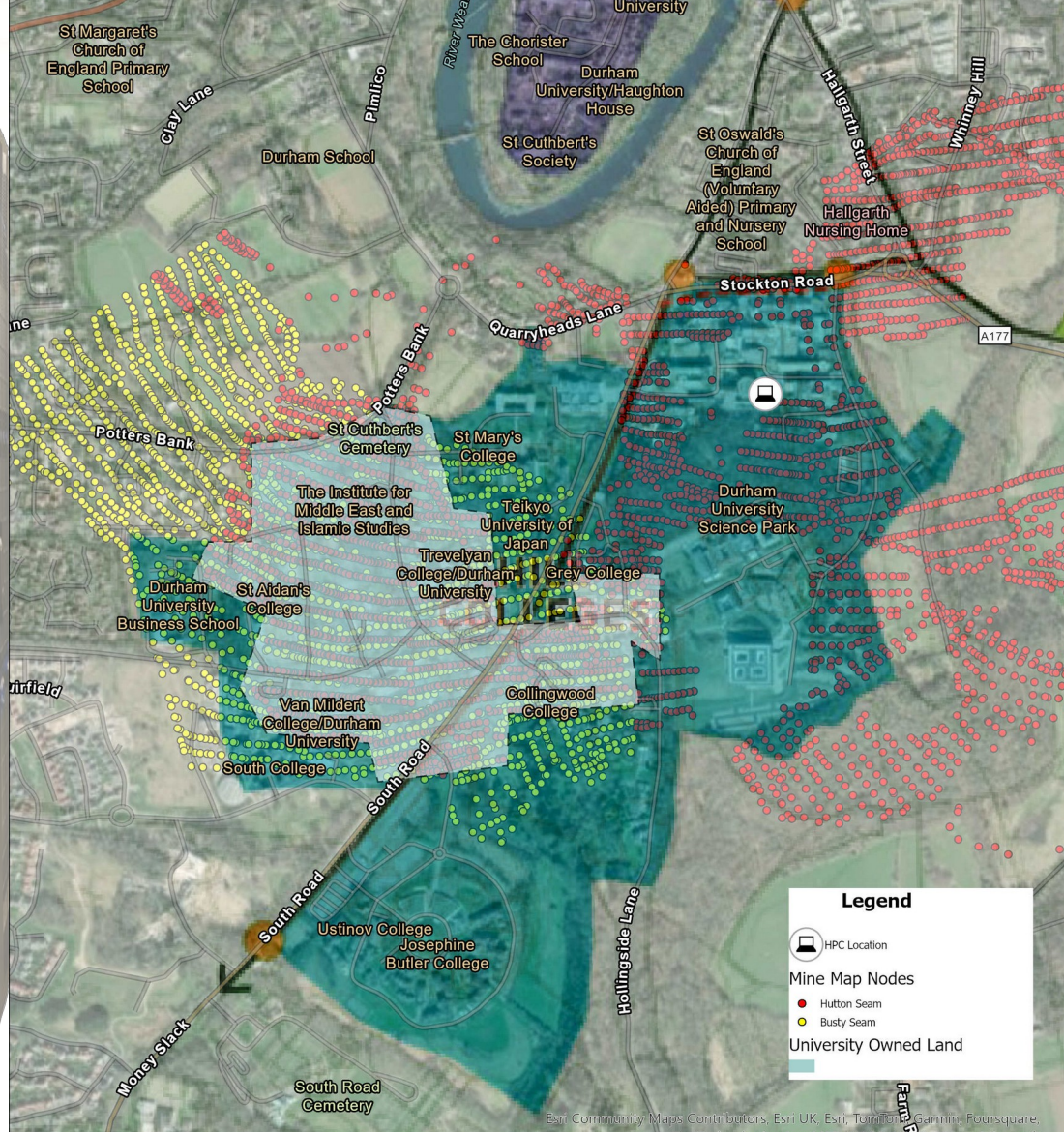




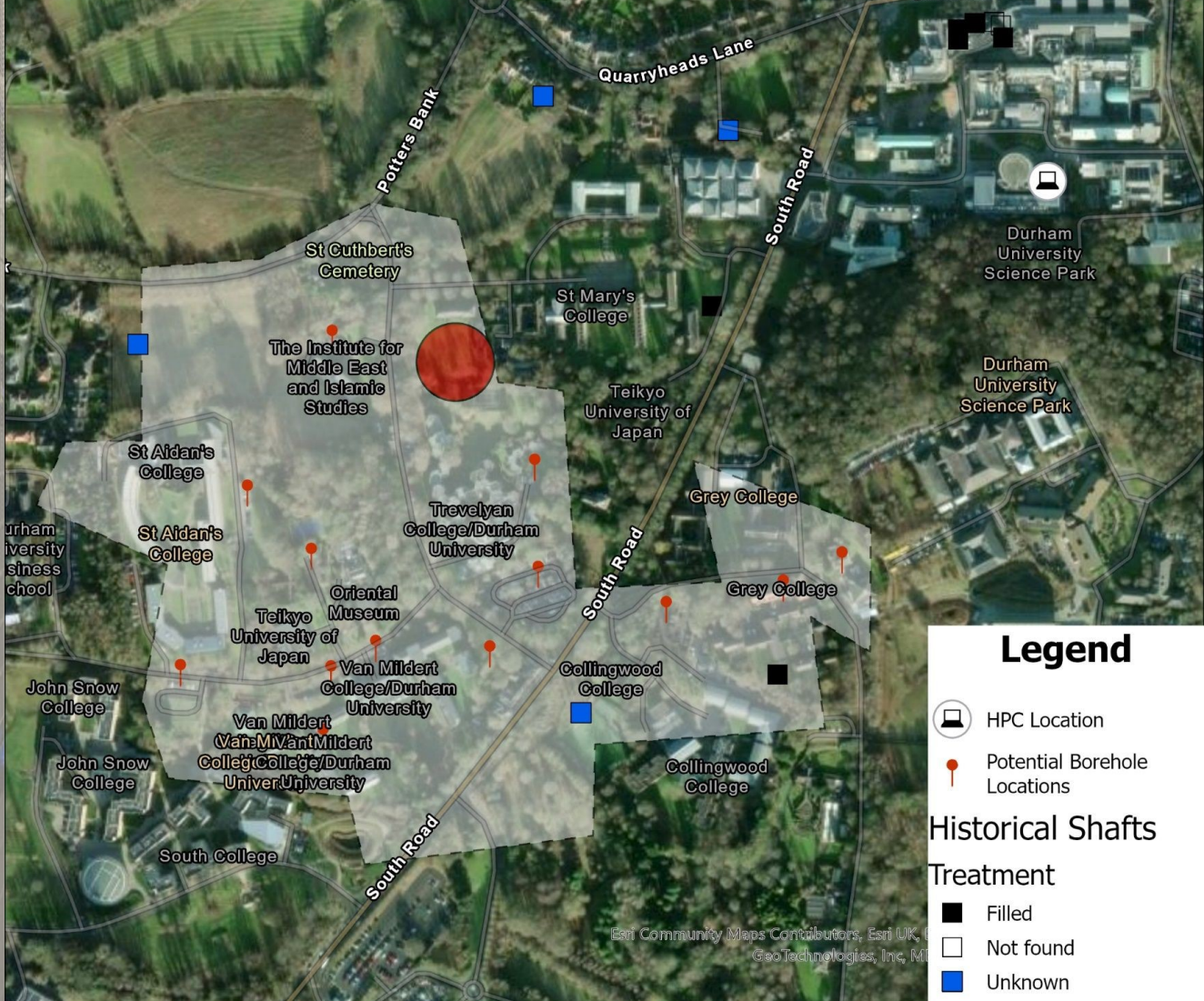
# The ICHS project

- Immersion Cooling and Heat Storage
  - UKRI funded
- We don't yet make use of waste heat from COSMA
  - Heating the Arthur Holmes building would be a start
  - But what can we do with the heat in the summer months?
    - Store it underground
      - In flooded abandoned mine workings











# Heat storage

- Pump warmer water into lower mine level
- Extract cooler water from upper mine level
  - Water will flow between the 2 levels providing a large thermal battery
- Reverse the flow to extract the heat
  - And use heat pumps to transfer it into the proposed campus heat network
  - Essentially recharging the heat source for a ground source heat pump
- Ambitious – but we have to start somewhere
  - Investigate the feasibility

# Summary

- Running a large HPC facility is more than computing support
  - Forward planning
  - Prototyping and research
  - Efficiency
  - Net-zero
  - And some quantum
  - And AI