Sustainable Computing

Prof Jonathan Hays

NetDRIVE Meeting

Queen Mary University of London, 18th February 2025

Sustainable, adj.
Capable of being maintained or continued at a certain level or rate

Computing, n.
The action or practice of using computers, esp, as a professional or expert; the activity operation of an electronic computer

Source: Oxford English Dictionary

Sustainable, adj.

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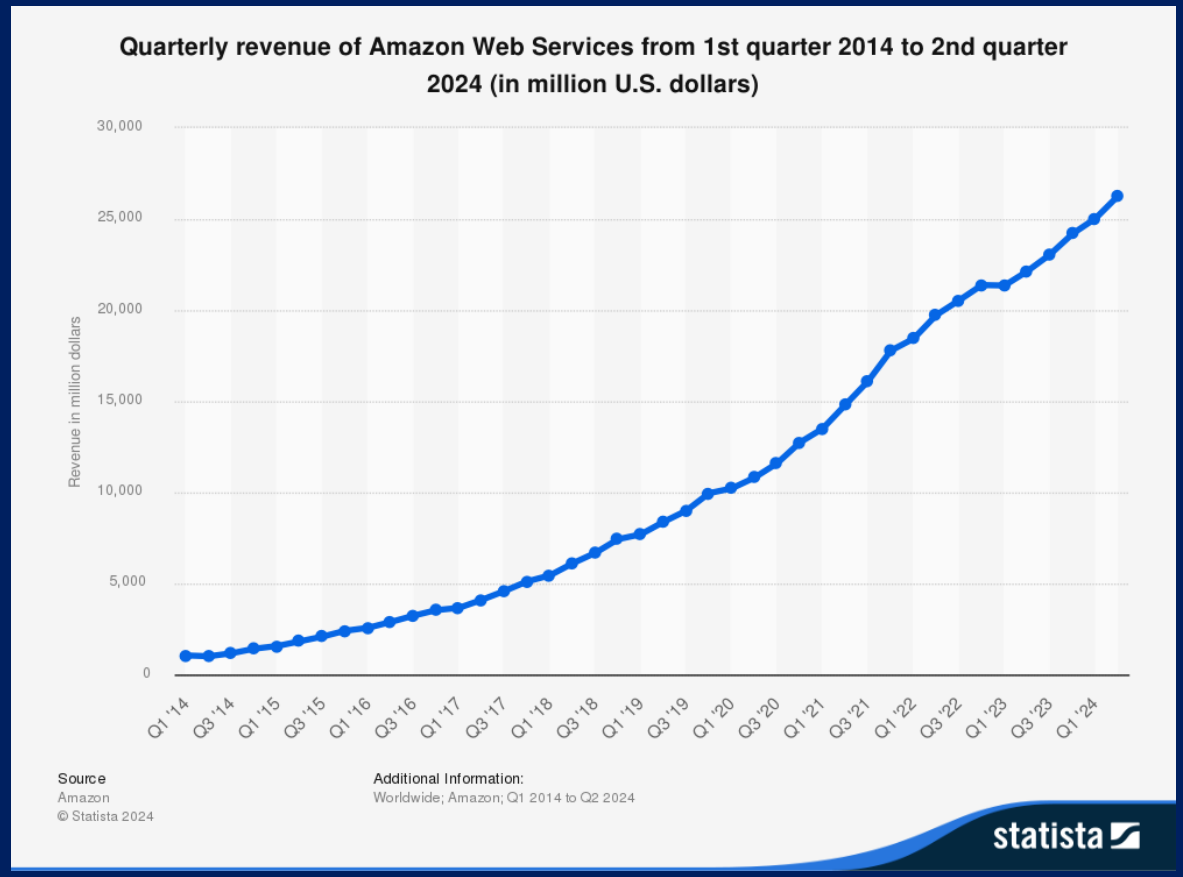

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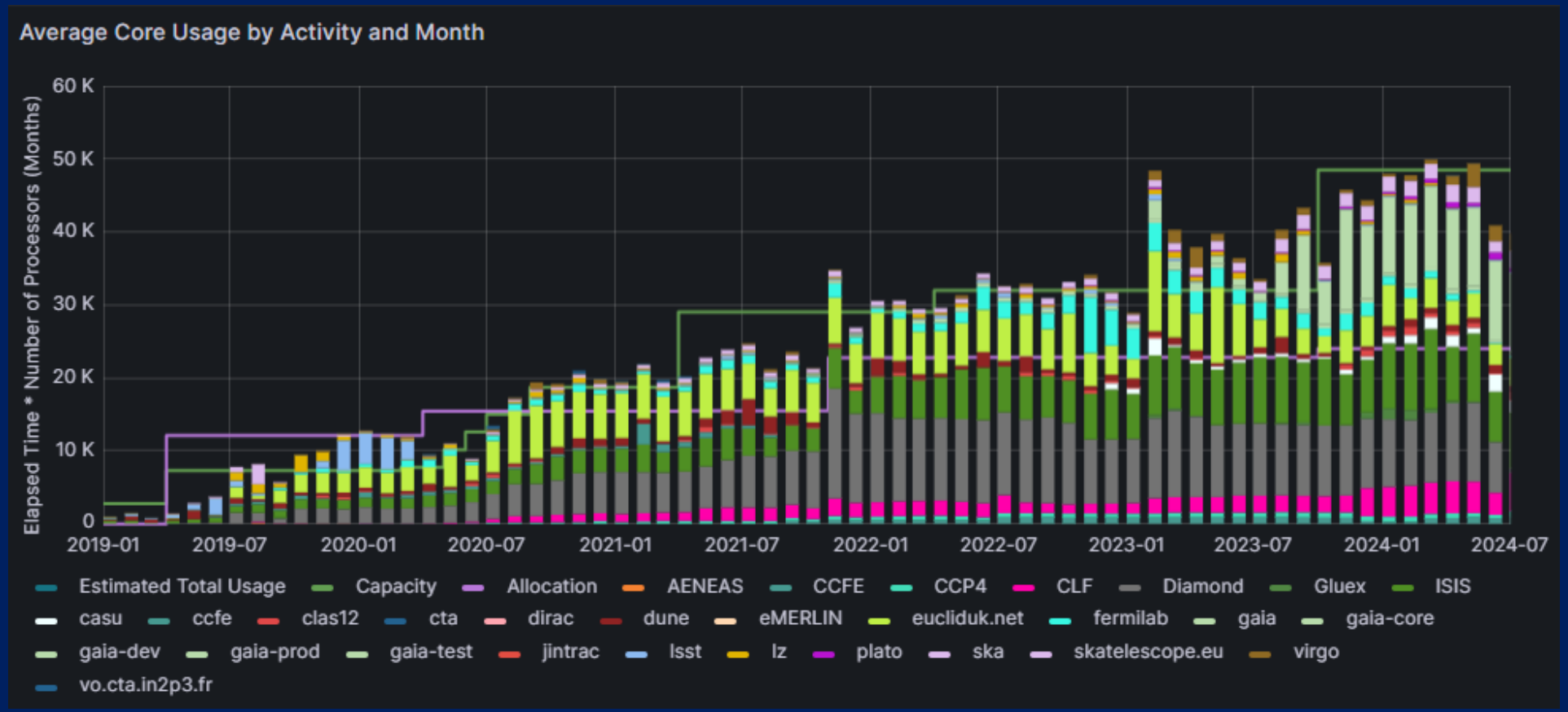

STFC IRIS CPU Usage 2019-2024

Sustainable, adj.

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Technology

Data centres as vital as NHS and power grid, government says

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AI experts warn electricity costs may stunt growth

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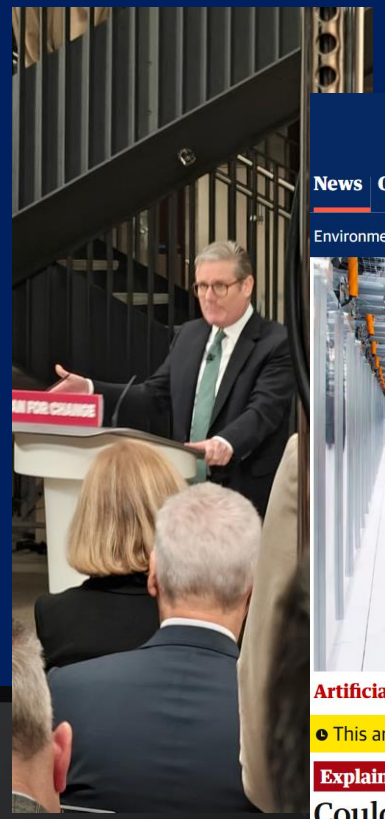
Data centre electricity needs are forecast to grow as more artificial intelligence hubs are

FINANCIAL TIMES

UK economy + Add to myFT

English village becomes flashpoint for Labour's data centres push

Plans for facility on greenbelt land stokes tensions among local community



ANNOUNCEMENT

Nscale invests £2 billion in the UK data centre industry

The Guardian

News | Opinion | Sport | Culture | Lifestyle

Environment | Climate crisis | Wildlife | Energy | Pollution

Artificial intelligence (AI)

This article is more than 1 month old

Explainer

Could Keir Starmer's AI dream derail his own green energy promise?

Sustainable?

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Accelerating demand for compute creates challenges

Cost

Skills

Power

Water Usage

Waste

Carbon emissions

Accelerating demand for compute creates challenges

Rising demand for compute to achieve science goals

Diminishing improvements in raw compute power over time

£

Cost

More efficient use of resources – federation, pooling, mixed-access models, heterogeneous infrastructure

Improved financial modelling and planning

Joined-up approach to funding assessment, award, and oversight

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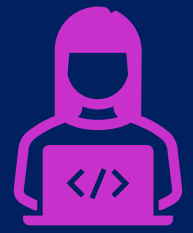
Accelerating demand for compute creates challenges

New technologies

Increasing scale of deployments

New techniques and algorithms



Skills

Larger pool of skilled people

Improved incentives and recognition

More training opportunities

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Accelerating demand for compute creates challenges

More compute

More cooling

Power

Increased grid capacity

Grid improvements

Hardware improvements

Renewables

Smart scheduling

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Accelerating demand for compute creates challenges

Increased cooling requirements

Water abstraction and waste

Water Usage

Data centre improvements

Data centre siting

Tightened environmental requirements

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Accelerating demand for compute creates challenges

Reuse and recycling of systems and components

Increased lifecycles

Waste

Reuse and recycling of systems and components

Increased lifecycles

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Accelerating demand for compute creates challenges

More hardware

More electricity

More cooling

Carbon emissions

Green procurement

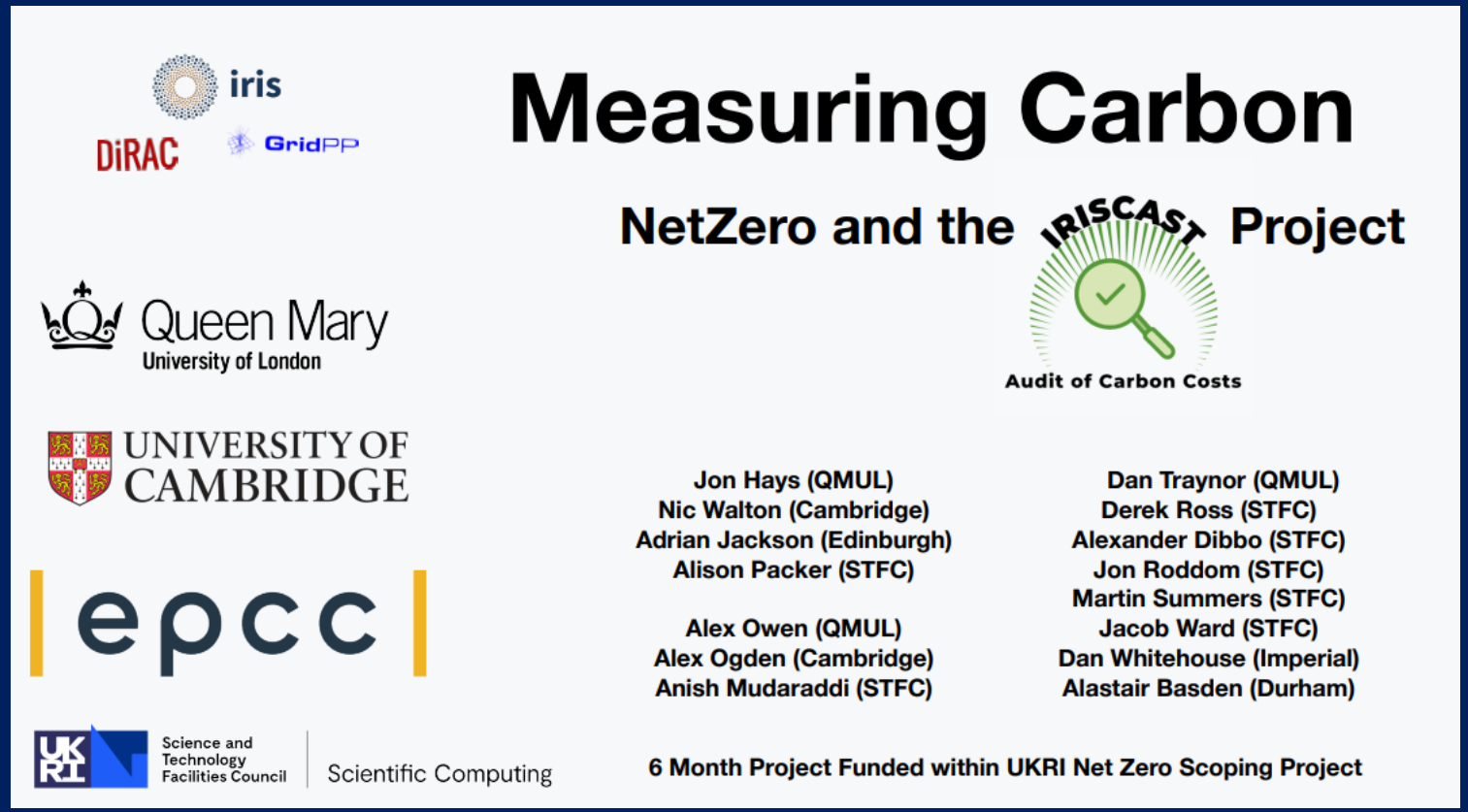
Renewable energy

Efficient usage

Improved algorithms

Improved architectures

UKRI DRI NetZero: IRISCAST



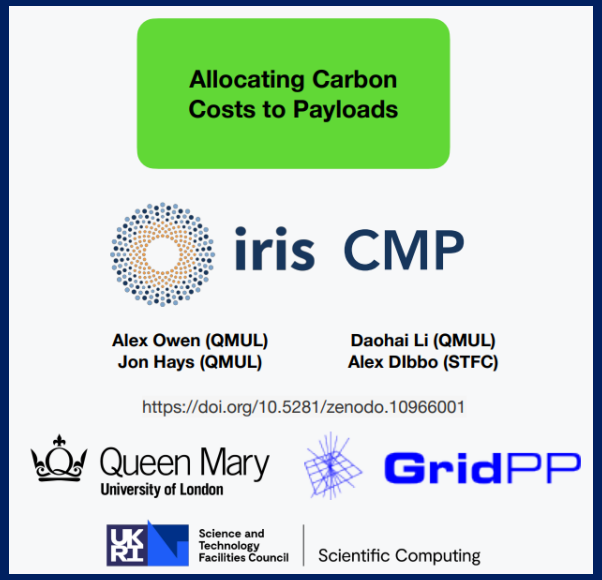
Attempt to build a picture of carbon "costs" across a distributed set of heterogenous infrastructures

Learn by doing

Document the challenges and gaps to generate requirements and recommendations

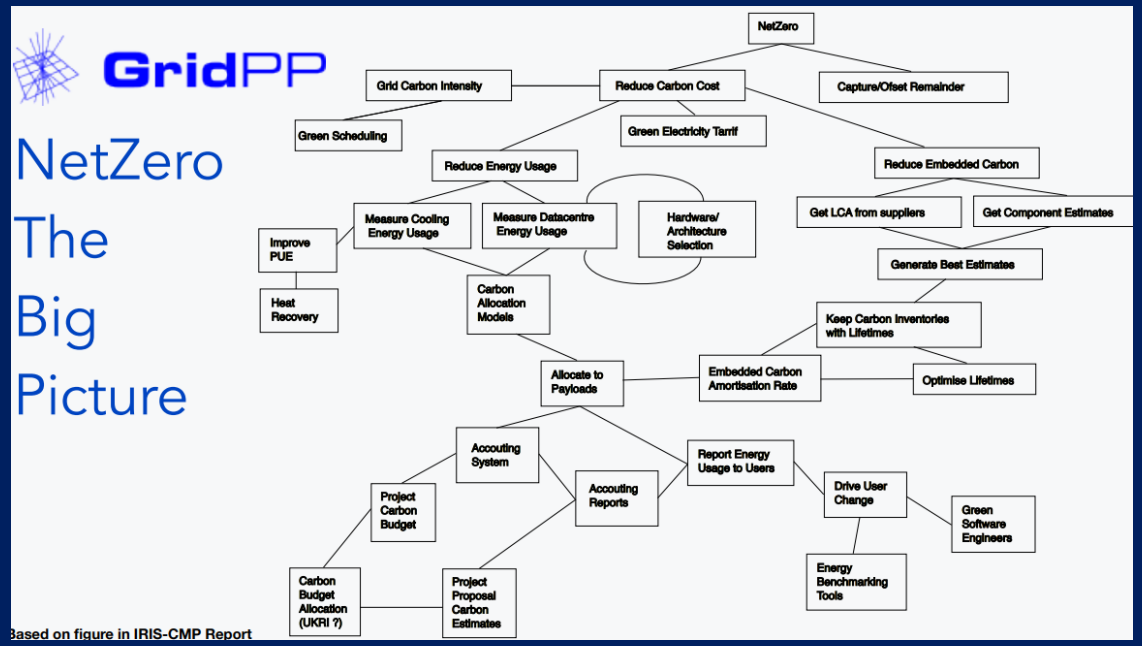
https://doi.org/10.5281/zenodo.7692451
https://doi.org/10.5281/zenodo.8199984

IRIS: IRIS-CMP



Take job level measurements on live systems

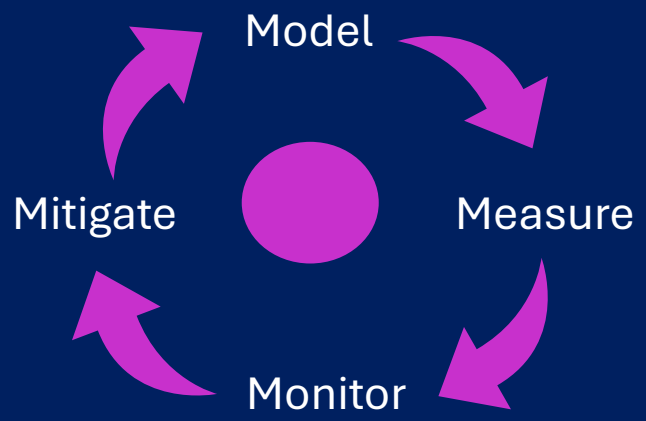
Develop and evaluate two simple models of carbon accounting suitable for both grid computing and cloud infrastructures



Key conclusions

Keep it simple
Gather widely – use wisely
Think like an accountant not a scientist!

GridPP: The 4 ‘M’s



Data centre digital twinning

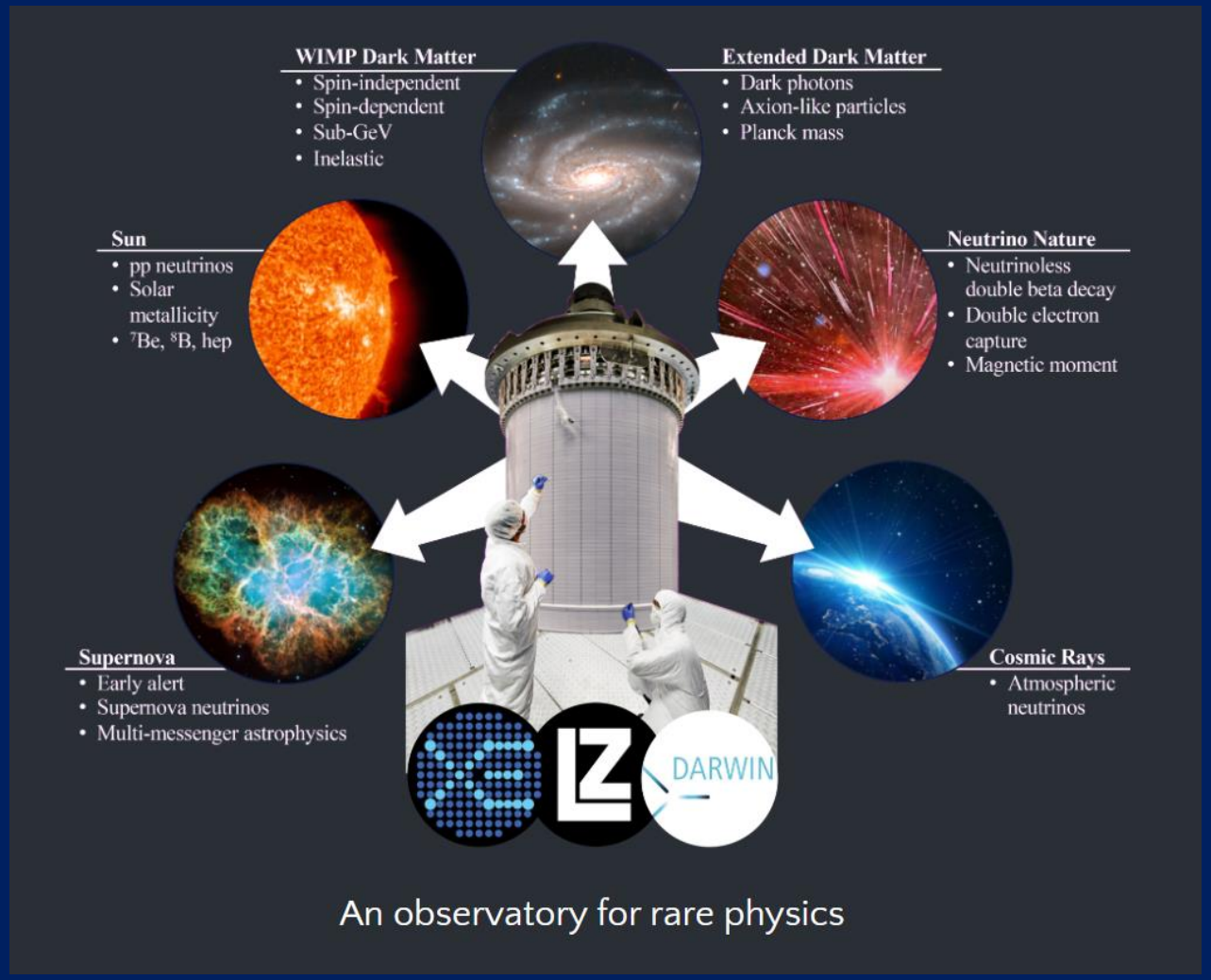
Carbon accounting

Carbon reporting

Alternative architectures

https://indico.cern.ch/event/1297834/contributions/5509064/
https://indico.cern.ch/event/1377701/contributions/5902267/

XLZD : Sustainable Dark Matter



UKRI Infrastructure fund preliminary activity

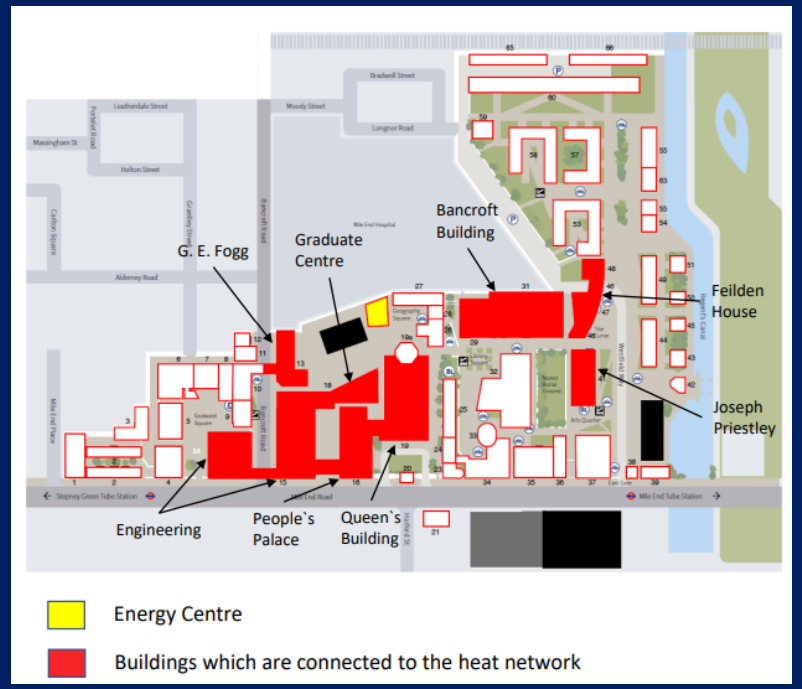
WP8: Environmental Sustainability

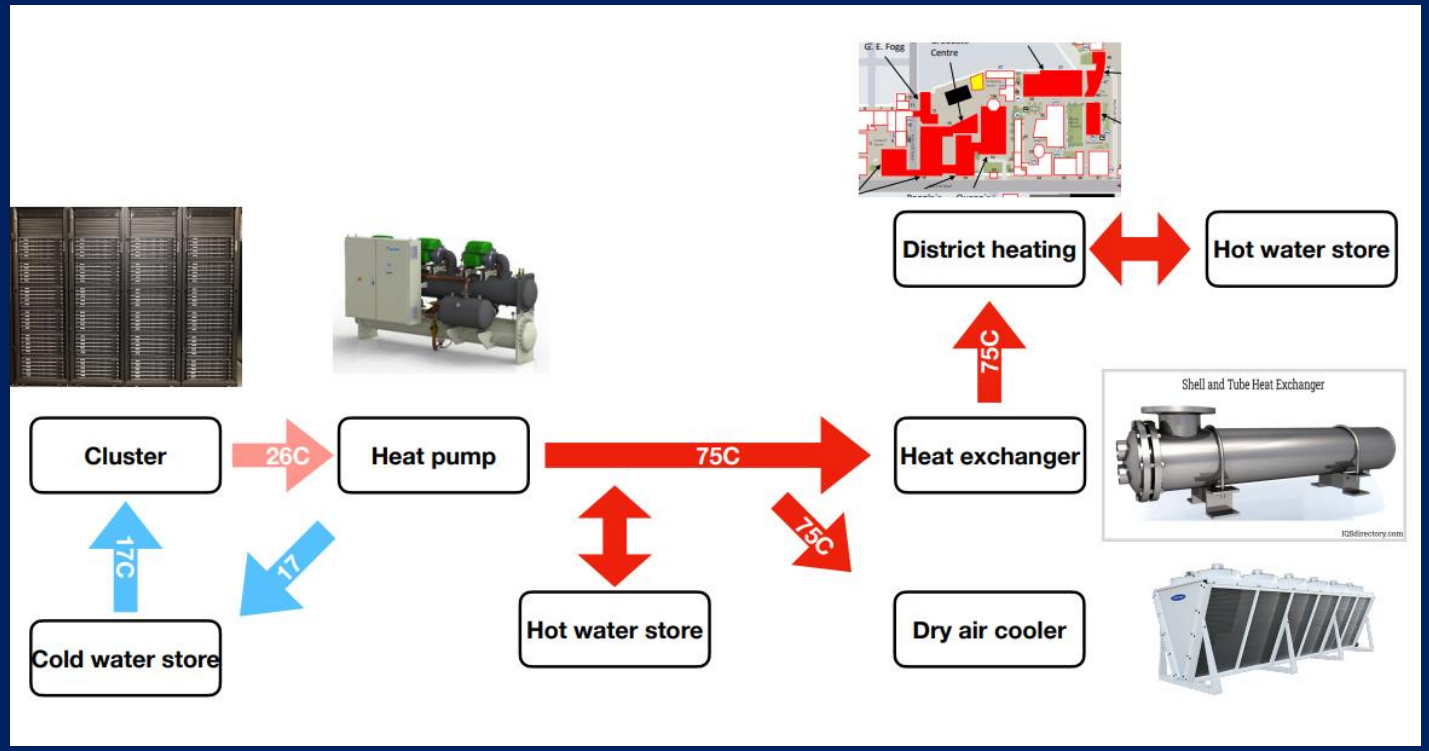
Most sustainable experiment possible while achieving our scientific goals

Achieve carbon neutrality in operations

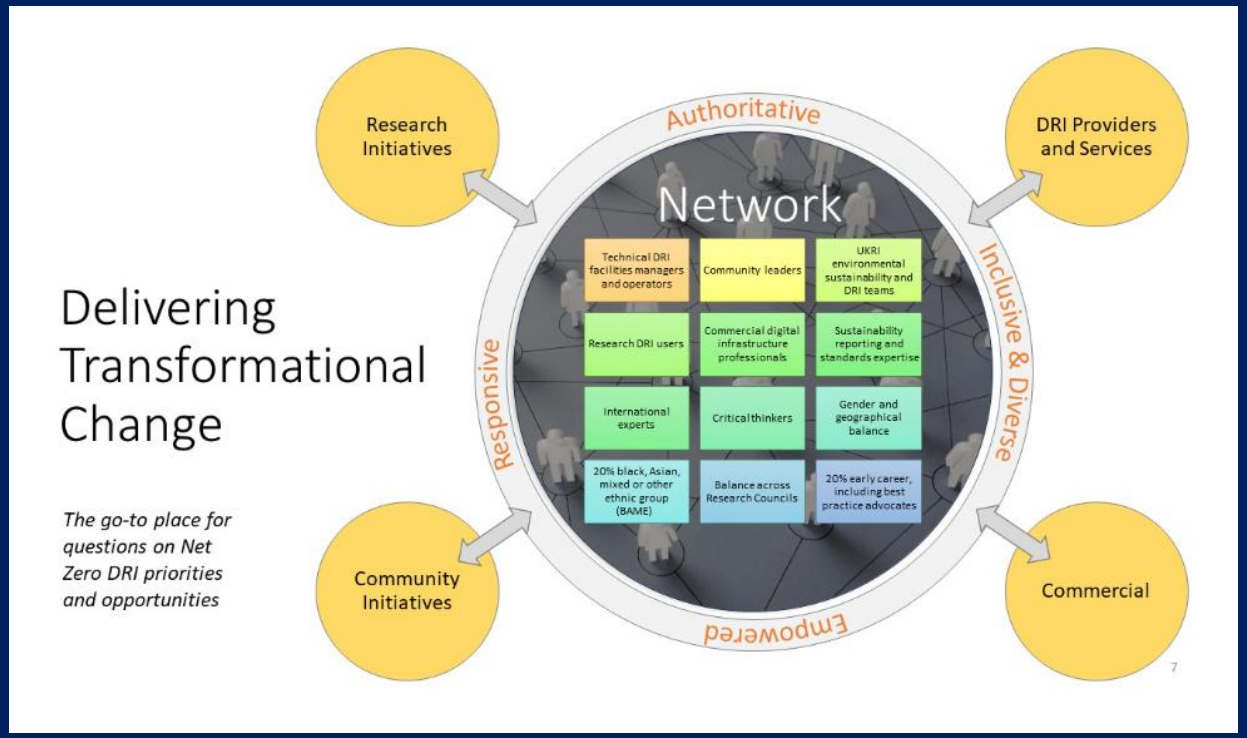
Create a legacy for future experiments

QMUL: Data Centre Upgrade





UKRI DRI NetZero: NetDRIVE

The challenges are tough
Change is hard
There's lots to do

Let's get on with it!