iris Carbon Mapping Project

Alex Owen (QMUL)
Jon Hays (QMUL)
Daohai Li (QMUL)
Alex Dlbbo (STFC)

Motivation: How should IRIS work towards NetZero DRI?
How do we know we got there?

Models and Tools

Outline Delivery Roadmap

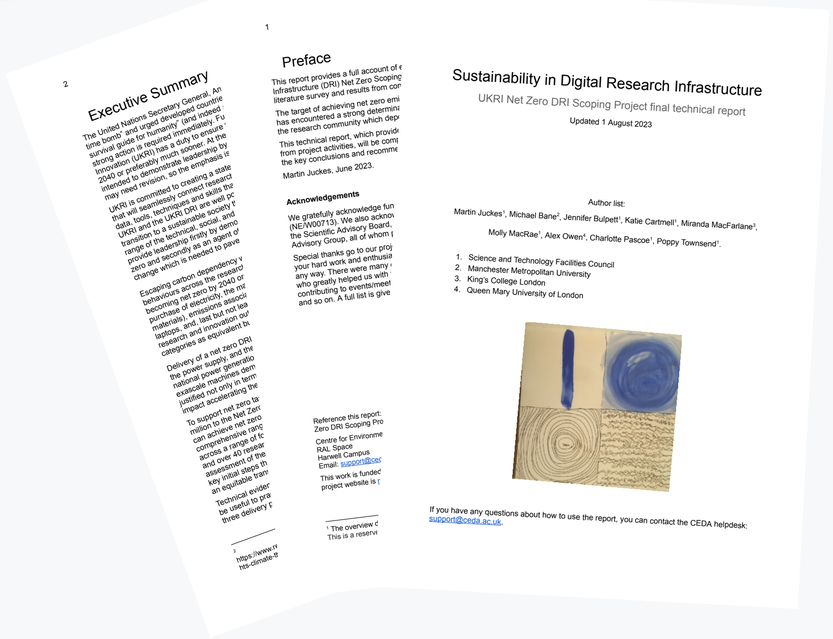
What do you need?

Speaker: Dr Alex Owen r.a.owen@qmul.ac.uk

Queen Mary University of London

UKRI Net Zero DRI Scoping Project

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



Sustainability in Digital Research Infrastructure

UKRI Net Zero DRI Scoping Project final technical report

Updated 1 August 2023

Author list:

Martin Juckes[1], Michael Bane[2], Jennifer Bulpett[1], Katie Cartmell[1], Miranda MacFarlane[3], Molly MacRae[1], Alex Owen[4], Charlotte Pascoe[1], Poppy Townsend[1].

1. Science and Technology Facilities Council
2. Manchester Metropolitan University
3. King's College London
4. Queen Mary University of London

Martin Juckes(STFC)
Michael Bane(MMU)
Jennifer Bulpett(STFC)
Katie Cartmell(STFC)
Miranda MacFarlane(KCL)

Molly MacRae(STFC)
Alex Owen(QMUL)
Charlotte Pascoe(STFC)
Poppy Townsend(STFC).

The IRISCAST Project

Audit of Carbon Costs

Measuring Carbon

Jon Hays (QMUL)
Nic Walton (Cambridge)
Adrian Jackson (Edinburgh)
Alison Packer (STFC)

Alex Owen (QMUL)
Alex Ogden (Cambridge)
Anish Mudaraddi (STFC)

Dan Traynor (QMUL)
Derek Ross (STFC)
Alexander Dibbo (STFC)
Jon Roddom (STFC)
Martin Summers (STFC)
Jacob Ward (STFC)
Dan Whitehouse (Imperial)
Alastair Basden (Durham)

6 Month Project Funded within UKRI Net Zero DRI Scoping Project

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

IRISCAST Proposes

High Level Feedback

Carbon Equivalent per month

Low Level Feedback

Figure of merit per Job → Carbon Equivalent per Job

1. Future DRI procurement to include a score based on embedded carbon costs and equipment energy usage.
2. New computer hardware to include energy measurement capability such as IPMI (or per port PDUs) and require the supplier to provide best estimates of embedded carbon costs.
3. Measure energy used by cooling infrastructure and the computing infrastructure.
4. Facilities to keep an inventory of equipment including embedded carbon cost and idle power draw.
5. Monthly (or other periodic) reporting of carbon usage by facilities based on 3 and 4 above. Roll into standard grant reporting regime.
6. Collect per job (or VM) energy usage by using tools like Slurm (correctly configured). Combined this with embedded carbon from inventory and electricity carbon intensity to feedback job carbon cost to the end user to drive improvements in user code and workflow.
7. Identify user communities and the authors of community codebases so that useful feedback can be given to them to drive the development of more efficient code and workflows.

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

iris Carbon Mapping Project

Carbon Model to apportion carbon costs to payloads. Including tools and measurements needed

Online Delivery Roadmap for Carbon Reporting in IRIS

Needs of Management

Needs of Providers

Needs of Users & User Communities

Help: What are YOUR reporting needs?

iris Carbon Mapping Project

In-person meeting at QMUL Friday 26th January

https://indico.ph.qmul.ac.uk/indico/event/IRIS-CMP-Requirements

Join us to discuss the reporting needs of:
*** Users & User communities**
*** Providers**
*** IRIS Management**

Also there should be some time to explore some of the modelling approaches we are investigating

We have limited funds to pay reasonable travel expenses (eg return rail fare) available on request. (Claimed in arrears via QMUL process).

If you can attend please register this week!

iris Carbon Mapping Project

Reporting Requirements of Users & User Communities

What questions do you want to ask about carbon usage?
What metrics help answer those questions?

Time to science ~ Embedded Carbon for Science (scope 3)
Energy Usage to Science ~ Operational Carbon to Science (scope 2)

What are the key metrics to help make your workloads more carbon efficient ?

Per Payload Carbon:
split by scope 2 and scope 3

Per Project Carbon:
split by scope 2 and scope 3
By month? By week? By day?

iris Carbon Mapping Project

Reporting Requirements of Providers

What questions do you want to ask about carbon usage?
What metrics help answer those questions?

Per User Carbon:
split by scope
What timeframes?

Carbon Cost of Idle time
split by scope 2 and scope 3

How do we estimate Embedded Scope 3 Carbon of equipment and how do we estimate device lifetimes?

Should cost of idle time be attributed to provider or user?
User where resource reserved but left idle.

What is our Monthly Carbon cost?
Is that the right timeframe?

iris Carbon Mapping Project

Reporting Requirements of iris Management Team

(I will be discussing this with IRIS-PA meeting in 2 weeks time)

What questions do you want to ask about carbon usage?
What metrics help answer those questions?

Time to science ~ Embedded Carbon for Science (Scope 3)
Energy Usage to Science ~ Operational Carbon to Science (Scope 2)

Monthly Report of carbon by project.

Idle Carbon costs by Provider and Project?

iris Carbon Mapping Project

DISCUSSION: Users and Communities & Providers

What questions do you want to ask about carbon usage?
What metrics help answer those questions?

Time to science ~ Embedded Carbon for Science (scope 3)
Energy Usage to Science ~ Operational Carbon to Science (scope 2)

Frequency of aggregated reporting?

Idle time allocation?

What are your thoughts?

iris Carbon Mapping Project

In-person meeting at QMUL Friday 26th January

https://indico.ph.qmul.ac.uk/indico/event/IRIS-CMP-Requirements

Join us to discuss the reporting needs of:
*** Users & User communities**
*** Providers**
*** IRIS Management**

Also there should be some time to explore some of the modelling approaches we are investigating

We have limited funds to pay reasonable travel expenses (eg return rail fare) available on request. (Claimed in arrears via QMUL process).

If you can attend please register this week!

Backup Slides
&
Background Information

UKRI DRI Net Zero Scoping Outputs

ROADMAP:
Milestones on the journey to net zero, organised into three delivery pathways

TOOLKIT:
A comprehensive suite of options, based on detailed technical recommendations, which can help us on the journey to net zero, collected into six thematic areas.

Delivery pathways

POLICY AND GOVERNANCE

COMPETITIVE FUNDING

DELIVERY PARTNERSHIP

Strategic themes

MISSION FOCUS

ACTION BASED RESEARCH

SHARED RESPONSIBILITY

WORKING WITH PEERS & SUPPLIERS

KNOWLEDGE HUB

GREEN SOFTWARE ENGINEERING

Actions

Recommendations

Evidence

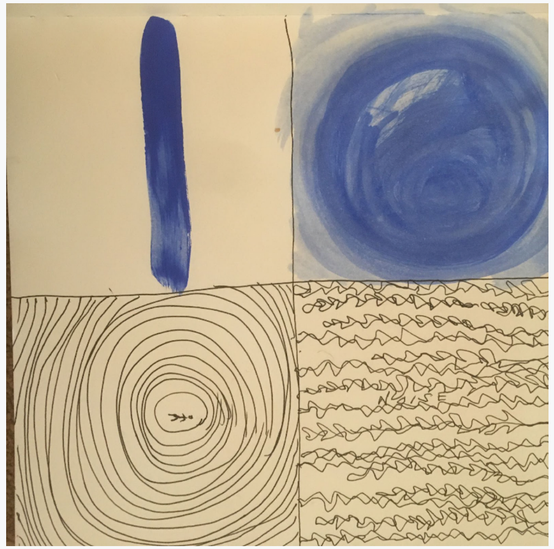
https://doi.org/10.5281/zenodo.8199984

UKRI DRI Net Zero Scoping Roadmap

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

	Policy and Governance	Delivery Partnership	Competitive Funding
2024	• Review policy areas across UKRI and integrate net zero principles • Create net zero action plans for DRI facilities • Develop a timeline for the elimination of onsite fossil fuels	• Establish net zero DRI task-force from within research community • Formalise a map of DRI resources and their environmental impact profile	• Run funding calls and research fellowships with a sustainable DRI focus • Fund research into the influence of usage patterns, hardware and software on Carbon intensity • Fund research into carbon accounting tools • Fund research into behaviour change strategies at all levels of the DRI
2028	• Implement UKRI policy on use of contracts and conditionalities to reduce emissions • Implement UKRI policy requiring re-use of waste heat and recycling of hardware. • Establish a financial and legal framework to facilitate multi-institution collaborations	• Provide training in low-carbon DRI use to key stakeholder groups • Develop technical standards for monitoring, evaluation and accreditation for DRI hardware and usage • Adopt standards for Open Science principles and apply across the DRI	
2030	• Mandate carbon reporting and sustainable accreditation across UKRI-DRI operations • Integrate sustainable computing within DRI career development pathways	• Adopt standards for research practice using DRI • Ensure training in best practices for low-carbon DRI use • Establish a centraliesd net zero DRI hub	• Resource and develop carbon emissions tracking capability
2040	• Implement a procurement framework that guarantees a sustainable supply chain		• Develop a single DRI interface reporting energy use and environmental footprint per job • Develop and deploy green schedulers

UKRI DRI Net Zero Scoping Toolkit



Box 2.1.A: Six Strategic Themes that make up the toolkit

1. **Mission Focus**: continuous assessment and focus on the mission of achieving sustainability; active measures to counter the risk of enhanced demand negating efficiency gains.
2. **Recognition of shared responsibility**: mandate and empower all staff (from student to CEO) to take proportionate action to drive change and reduce the environmental impact of their work; community building; encourage discussion among colleagues and learn from others to foster positive changes in behaviour.
3. **Action-based-research**: work must start now with commitment appropriate to the climate emergency while recognising that there will be a need for regular checks and adjustments; focus on progress not perfection; small steps; learn from experience.
4. **Work with peers and suppliers**: through contracts, conditionalities, and understanding mutual benefits, to develop a low carbon supply chain [essential in the longer term]
5. **Build and Share Knowledge**: providing leadership, support and advice for business cases and large procurements feeding into reporting; central hub for information and institutional knowledge [also likely to create short term results]
6. **Green Software Engineering**: creating a body of expertise around green software engineering, providing training, developing tools, metrics, expert assessment, and standards to transform current approaches to writing code, and supporting codes running in data centres, such that GSE becomes the norm rather than an optional extra.

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