Briefing Note

Breakout Aims

We have three breakout sessions scheduled over two days. The first should be used to collect and clarify ideas. Some views expressed within the group may be contradictory: to aim here is to record these areas of contradictory views rather clearly than trying to resolve them. In the 2nd breakout the main areas of agreement and contention should be identified in order to begin organising the range of views expressed in the first breakout.

The final breakout should be used to set out recommendations and guidance for UKRI and the community.

Each group should seek to address the three questions listed below and assign discussion points to the four project themes (also listed below). Moderators will try to ensure that all themes are covered.

Three Questions

Q1: **How can we maintain competitive computing capability when we have net zero challenges and a 10-fold increase per decade in the price of a top-end machine?**

Context: Performance per dollar has increased approximately 100-fold per decade since 1940; performance of the top machine has gone up 1000-fold per decade. Claiming progress significantly above past performance trends, Cerebras have announced the capability to build a 250-exaflop machine[1], but the (undisclosed) price will probably be in the range of $50billion. This hyperinflation is reflected in the 3-fold price increase of the machine topping the TOP 500 list from $200m for Summit in 2019 to $600m for El Capitan in 2024.

- ★ What is a realistic ambition for the scale of our research computing resource? Should this be expressed in terms of international ranking or scale of budget?

Q2: **How do we manage ethical issues around culture change and resource usage for our national compute resource and associated data?**

Context: It is widely accepted that net zero targets cannot be achieved in any meaningful way without behaviour change.

[1] https://www.redsharknews.com/nvidia-and-cerebras-highlight-the-crazy-acceleration-in-processing-power

- ★ If behaviour change means, for instance, more preparation before gaining access to large compute resources, how should we ensure that this does not distort fairness of access?
- ★ How do we maintain accessibility while enhancing awareness of negative impacts of resource use? Do we need to ration usage or educate users?

Q3: **How do we develop the new skills needed both for rapidly advancing technology and evolving sustainability targets?**

Context: The commercial software sector is expanding at a rate which academic organisations cannot match. For example, Nvidia claims more than 4 million developers working on their systems through 40,000 partner companies[2]. On the other hand, the Independent Review of The Future of Compute: Final report and recommendations (2022) recognises the severe implications for national security of any gaps in our national skill base.

- ★ Is there a substantial difference between the type of new skills needed now and the skills which were new 10 years ago? Do we need a different approach to skills or is it just a matter of expanding and updating existing courses?
- ★ Do we need different approaches to management and different organisational structures?
- ★ What is motivating early career software engineers and computational scientists today?

Four NetDRIVE Themes

Green Software Engineering

This theme covers a wide spectrum of digitised instructions and knowledge systems, whether a code used or developed by a researcher, or the environment within which such codes run (e.g. schedulers on multi-user machines or use of ChatGPT as a tool). It covers the whole lifecycle of development of software, from gathering requirements, through design, implementation and deployment, and the science of doing so in an efficient manner. Traditionally, Software Engineering has focussed on functionality, reliability, extensibility and how well the software product performs in terms of time, hardware resources and people to maintain it. Green software engineering shifts the focus to sustainable use of resources which can be achieved both through efficient programming and an inclusive approach to project management and development.

Target audience: Research software engineers, computational scientists,

[2] https://www.nvidia.com/en-us/about-nvidia/corporate-timeline/ [accessed 28th Jan 2025]

Topics: Skills and Career Pathways, data workflows, exploiting/taming artificial intelligence, exploiting novel architectures

Objective: Develop and embed the paradigm of green software engineering in the UKRI research culture.

Systematic Change

"*Sustainability - the critical application of creative thinking and technology to secure our future on this small planet*" (Richard Rogers, 1995)1

Increase in computational efficiency over recent decades have been offset by increases in capacity, resulting in a net increase in the carbon footprint for computation. Such gains in efficiency in computation are essential, but to convert efficiencies into emissions reductions, avoid the rebound effect, and remain aligned with the balanced pathway to net zero, we need a paradigm shift in the evaluation of computation and the use of computing in research. We need continuous assessment and focus on the mission of achieving sustainability as well as active measures to counter the risk of enhanced demand negating efficiency gains. Working with peers and suppliers to understand the mutual benefits of a low carbon supply chain is essential. UKRI needs to support the Climate Change Committee's balanced pathway for achieving national sustainability by delivering high levels of innovation while restraining resource usage.

Target audience: Team and institute leaders, strategic planners, policy makers

Topics: System level view, delivering value, block rebound, culture shift, EDI, RRI, open science and data,

Objective: Ensure that the UKRI DRI achieves a clear leadership role in the net zero transition.

Machine Room and Hardware

Amazing gains in computational power and capacity are being delivered through advances in technology which also drive increases in complexity of hardware and associated supply chains. We need to bring sustainability to the forefront of the management of our infrastructure. Full and authoritative life cycle analysis of infrastructure will be needed, including effective measurement and management of impacts during the use phase, clear contracts and conditionalities to develop a low carbon supply chain, and clear end-of-life planning for hardware.

Target audience: Infrastructure funders, machine room operators, infrastructure policy,

Topics: Procurement, lifecycle analysis, sustainable capacity, HPC, cloud

Objective: Deliver platforms for sustainable research computing.

Galvanising Individual Action

Behaviour change is difficult to guide but crucial in the pursuit of DRI Net Zero. All staff (from student to CEO) should be mandated and empowered to take proportionate action to drive change and reduce the environmental impact of their work. Discussions among colleagues, proven to be effective in fostering positive changes, should be encouraged. work must start now with commitment appropriate to the climate emergency while recognising the need for adjustments and learning from experience as we seek a pathway to sustainability.

Topics: Empowerment, motivation, creative thinking.

Target audience: UKRI staff using or managing the DRI.

Objective: Build a sense of individual and community engagement and ownership of the transformation