The Viking Service Report
November 2023 - June 2025

HPC Management Committee

Introduction

The University of York benefits from state-of-the-art high-performance computation support from our Viking HPC cluster. This facility has been instrumental to much of the University's research and has underpinned over £27.5 million of research in the last year alone.

In 2023 the University of York took the bold decision to relocate the Viking service to the EcoDataCenter in Falun, Sweden during its hardware refresh cycle. This decision was taken to mitigate the untenable rise in UK electricity prices and to also take advantage of EcoDataCenters sustainability practices. This move has allowed the service to benefit from a much more manageable energy costing landscape as well as to utilise novel cooling solutions not available in traditional data centres.

Data centres are responsible for around 1.5% of global energy consumption, and this could rise to 8% by 2030. Taking this approach we have slashed our carbon budget by over 90% and have received positive feedback from funders who are impressed with our focus on sustainable research IT practises. We have been one of the first Universities to take this bold step, leading the field in sustainable Compute.

A sustainable approach to Research IT

Figure 1. EcoDataCenter in Falun Sweden. The Datacenter where Viking 2 is located sits in the foreground of the image. The sawdust mill is located in the back of the image. Heat produced by Viking 2 is piped into the sawdust mill to dry wood and create pellets for renewable energy generation.

After an extensive search it was decided to house Viking 2 in Sweden in the EcoDataCenter. Everything about EcoDataCenter is designed to reduce the CO2 footprint. It is the world's first data centre to be made from wood and runs on 100% renewable energy; 75% from hydropower and 25% from wind power.

The data centre uses the heat created by the hosted compute clusters to dry wood and create pellets which are a renewable energy source. EcoDataCenter is dedicated to building data centers in the most sustainable way possible to support the world's increased need for digitalisation and sustainability. This means our research computing is not only net-zero but has minimal environmental impact as most of the heat is re-used.

To help in the transition from our previous HPC facility to EcoDataCenter, we purchased time on a small data centre from start-up Deep Green. The excess heat created by the data centre is used to heat a public swimming pool.

The University also received an Sustainable Digital Project or Initiative Award at the prestigious Universities and Colleges Information Systems Association (UCISA) awards for this work. Interest has been very high amongst other Higher Education institutions, whereby numerous invited talks and discussions have been had over the past year.

Going Live

In November 2023, we started accepting our first beta users. With the support of the community, we were able to quickly iron out issues before inviting more users to join. It took three weeks to go live, whereas systems like these can take up to six months. This is a testament to the Viking team, Alces and the community support.

Viking Launch event

Figure 2. To celebrate IT Services hosted the Viking 2 Launch event.

The launch event commenced with introductions from Prof. Matt Probert (School of PET) and Tyrrell Basson (Director of IT Services). John Wervnik (CMO of EcoDataCenter) gave a talk on EcoDataCenter, detailing how they have embedded the idea of sustainability throughout all of their operations. John also showcased their plans for the future that includes their other data centres in Sweden, one of which reuses heat to assist in food production.

Following John's presentation, academics showcased their research on Viking 2 in a series of lighting talks. Researchers from YSBL, Language and Linguistics, Physics and Bioarcheolgy discussed topics such as Cryo-electron microscopy (cryo-EM), Ancient DNA analysis in the history of Italian winemaking, and Pipelines as a Service. The aim was to showcase what is possible with Viking and to show the variety of research that can be conducted in the HPC sphere. Our partner, Alces also funded a drinks reception in the ISA building. It was a great success and well attended.

Viking 2 hardware

Figure 3. Image of the Viking 2 cluster in situ. In Falun Sweden.

The new system is significantly more powerful than Viking 1. This would not have been possible if the cluster remained in the UK due to the operating costs (power, hosting and cooling) significantly increasing. With more CPUs and GPUs we have been able to attract further research to Viking. The hardware was purchased from Dell Technologies, Alces set up Viking and maintain the hardware and the majority of the underlying infrastructure. This allows the Viking team to focus on supporting users.

	Viking 2	**Viking 1**
Compute node only CPU cores	12,864	7,000
Total standard compute nodes	134	170
Compute node generation	AMD EPYC3 7643	Intel Xeon 6138
Memory per compute node	512GB	127 nodes 192GB
		33 nodes 384GB
High memory node	2 x 2TB	2 x 768 GB
High memory node	1 x 4TB	2 x 1.5 TB
GPUs	48 A40	8 V100
	12 H100	
Scratch (PB)	1.5	2.5
Warm storage (PB)	2.0	
Usable NVME storage (TB)	215	48
Interconnect type	100Gb OPA	100Gb Mellanox

Table 1. Comparison of Viking 1 and Viking 2 hardware.

Sustainability

An important aspect of the Viking 2 project was concerned with seeking more sustainable ways to power and cool the HPC facility. Viking 2 is housed in the EcoDataCenter in Sweden. Each month EcoDataCenter provides a report showing emissions and water usage for both Viking 2 and the data centre itself. Tables 2 and 3 give a breakdown of the carbon emissions for all scopes from the Data centre and Viking 2. By re-using heat produced from Viking 2 we were able to avoid 109 kg CO2e within the last 12 months of operation.

Category	**12 Months 03/24-03/25**	**Comments**
Customer's Scope 3 GHG emissions (kg CO2e)	410	These are EcoDataCenter's scope 1 and 2 emissions. These emissions should be reported as your Scope 3, category 8. Upstream leased assets' emissions according to CSRD.
Customer's Scope 4 Avoided emissions (kg CO2e)	109	Avoided emissions from waste heat sold to third party. The avoided emissions are from waste heat sold to parties outside of our system boundaries and might be accounted by others too. The waste heat is replacing need of district heating

Table 2. Provides the total Scope 3 emissions over the last 12 months. The Scope 4 avoided emissions are due to heat re-use from the Viking cluster.

Category	12 Months 03/24-03/25
EcoDataCenter's Scope 1 emissions	410
GHG Emissions From Fuels (kg CO2e)	410
Refrigerant leaks (kg CO2e)	0
EcoDataCenter's Scope 2 emissions	0
Hydro Power 75% (generation)	0
Hydro Power 25% (generation)	0
EcoDataCenter's Scope 3 emissions	13573
Purchased goods and services – construction materials (kg CO2e)	307
Capital goods – datacenter installations (kg CO2e)	3028
Upstream emissions of purchased fuels (kg CO2e)	430
Upstream emissions of purchased electricity (life cycle) (kg CO2e)	8299
Transmission and distribution losses (kg CO2e)	415
Upstream transportation and distribution (kg CO2e)	89
Emissions from waste generated in operations (kg CO2e)	342
Business travel (kg CO2e)	229
Employee commuting (kg CO2e)	434
Allocated water use for cooling - rolling 12 months (m3)	124

Table 3. A detailed breakdown on the emissions produced by the datacentre housing the Viking cluster. The detail is impressive, and shows the dedication and ambition EcoDataCenter have towards creating sustainable datacentres.

In addition to this, the following graphs show energy and water usage over the past year. Figure 2 shows the renewable energy mix used by Viking 2. This is now at 100%, due to the phasing out of diesel in EcoDataCenters back-up generators by switching to Hydrotreated vegetable oil (HVO). Figure 2 also shows this reduction. Figure 3 also shows an increase in avoided emissions during colder periods, which correlates with the reuse of heat from Viking 2 for district heat generation.

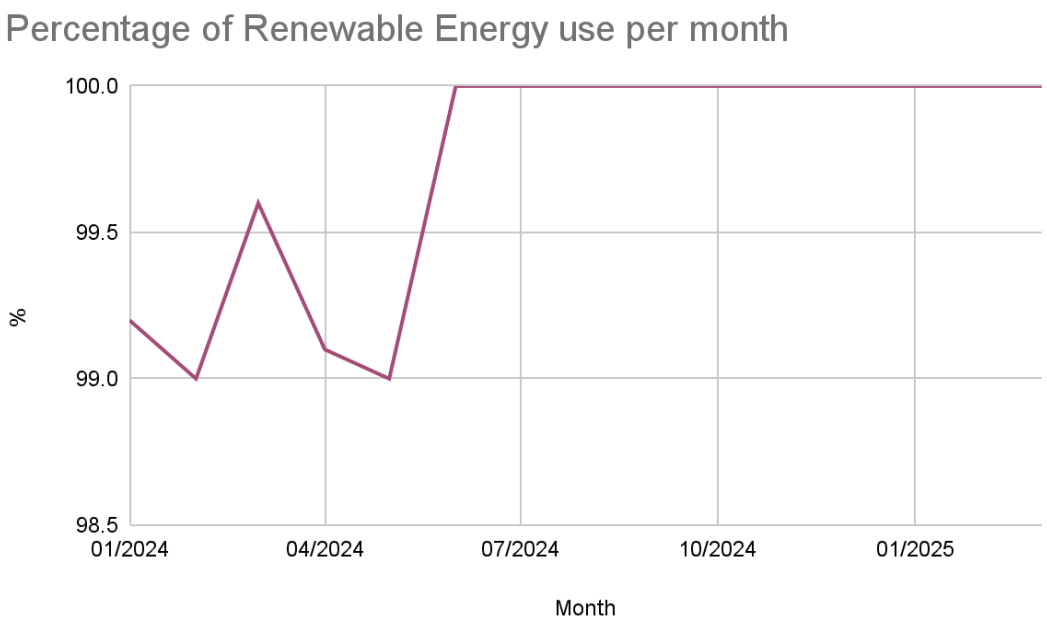

Figure 4. The percentage of Renewable Energy Usage per month at EcoDataCenter. The increase in May is due to the phasing out of diesel in EcoDataCenter's back-up generators by switching to Hydrotreated vegetable oil (HVO)

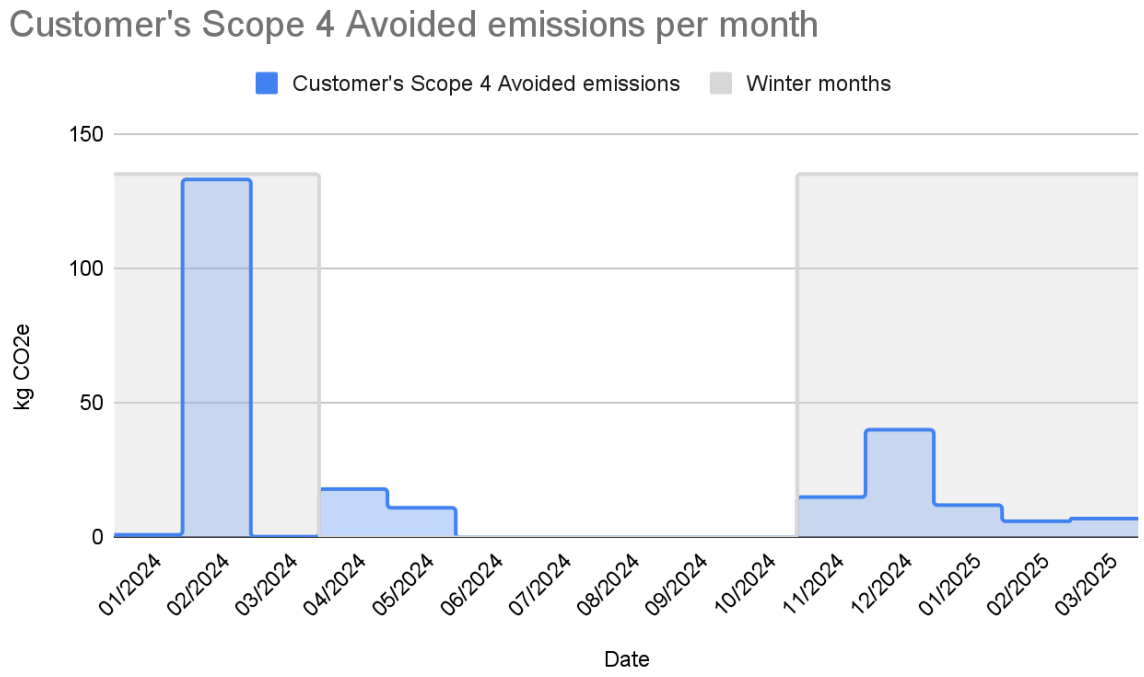

Figure 5. This graph shows the avoided emissions from Viking 2 due to heat reuse. As expected, in the cooler months more heat is used for district heating compared to warmer months.

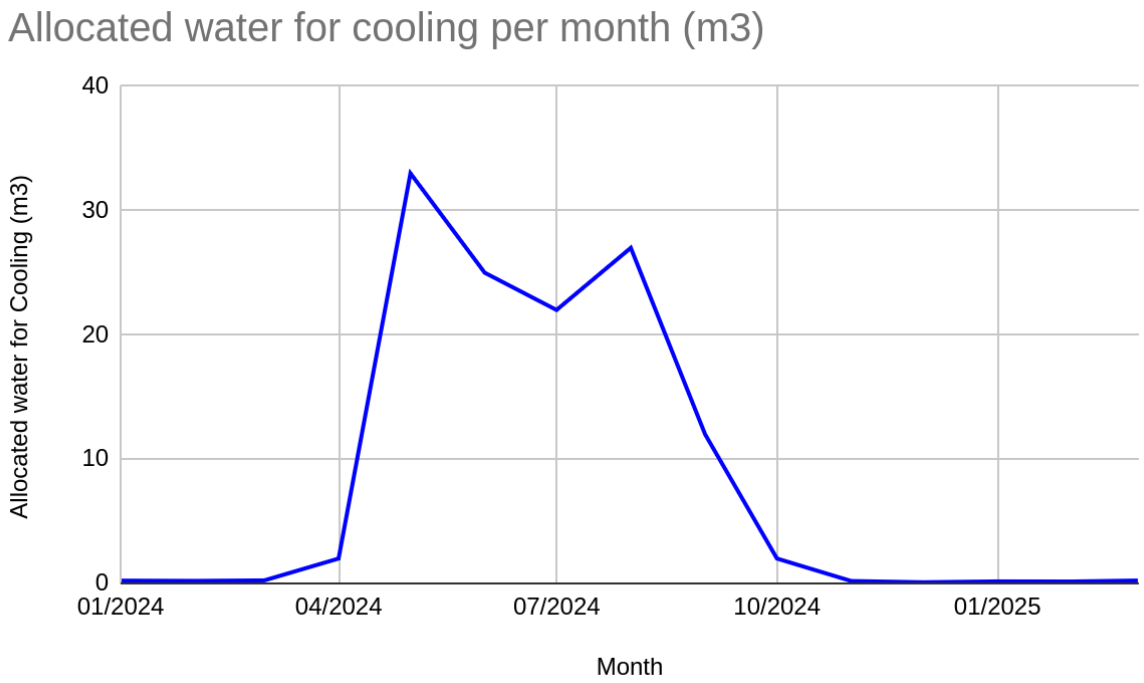

Figure 6. shows the increase in water usage during the summer months used to cool the Viking cluster.

EcoDataCenter continues to make improvements to reduce their carbon consumption. If we had located Viking 2 in our data centre on campus, based on the quoted Scope 2 emissions carbon factor of 0.207 kg/kWh, during a 12 month period we would have produced 192 Tonnes CO2e. At EcoDataCentre the total carbon emissions (scope 1, 2 and 3 combined) comes to 14 Tonnes CO2e. Therefore the university saved 14 Tonnes CO2e from Scope 3 emissions. However, if we had situated Viking 2 on campus we would have generated 192 Tonnes CO2e to the environment, we reduced this by 93% moving to Sweden.

Year Overview

Viking has continued to provide a valuable research facility for staff and students across the university. In addition to research, Viking is also used for three undergraduate modules, two based in the School of Physics, Engineering, and Technology (PET) and one based in Computer Science.

Whilst computing facilities of this nature tend to be science-focused, Viking has managed to capture a user base across 20 academic schools and departments. This is comparable to Viking 1 which at the end of its lifespan had projects from 20 academic schools and departments.

Faculty of Sciences	Faculty of Social Sciences	Faculty of Arts and Humanities
Biology	**Centre for Health Economics**	**Archaeology**
Chemistry	**Economics and Related Studies**	**Language and Linguistic Science**
Computer Science	**Education**	**School of Arts and Creative Technologies**
Environment and Geography	**Politics and International Relations**	
Health Sciences	**School for Business and Society**	
Hull York Medical School		
Institute for Safe Autonomy		
Mathematics		
Psychology		
School of Natural Sciences		
School of Physics, Engineering and Technology		
York Health Economics Consortium		

Figure 7: Departments with registered Viking projects

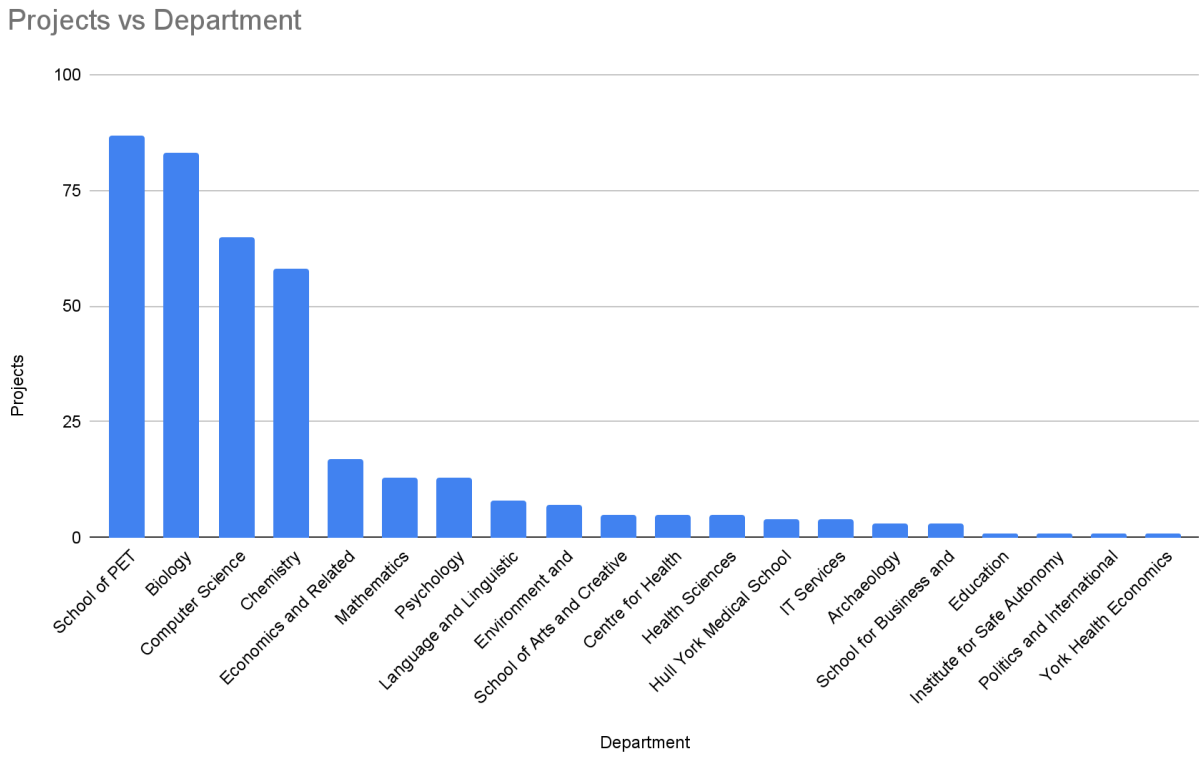

Figure 8: Viking 2 project applications per department.

The School of Physics, Engineering and Technology has submitted the largest number of project applications on Viking, with a similar number in Biology, Chemistry and Computer Science . We have also seen some growth in the number of users from the Faculties of Arts and Humanities and Social Sciences. The Faculty of Social Sciences now abouts for 8% of projects applications with the Faculty of Arts and Humanities accounting for 5%. Compared to the last annual report for Viking 1, the Faculty of Social Sciences has remained steady at 8% but we have seen an increase of 1% for the Faculty of Arts and Humanities.

Research Outputs

Using the University Research Database (Pure) and user surveys, we have recorded a total of 74 research outputs (papers, articles, datasets, software etc.) since December 2024 that have been produced using Viking 2. This is remarkable, given that it has only been operational since November 2023.

The split of outputs by department roughly reflects the departmental split of researchers on Viking.

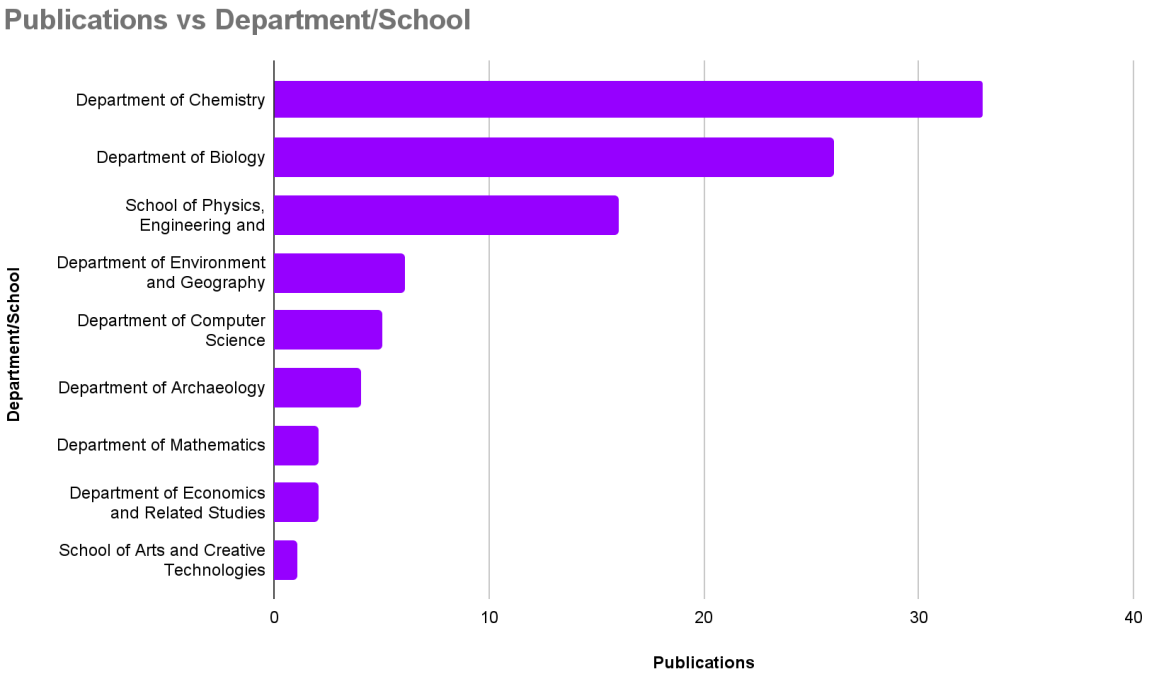

Figure 9: Research outputs which made use of Viking 2, counts by department. Data generated from user submissions and Pure data.

Although STEM are still dominant, we are seeing increased usage from other faculties. Of course, there is always a lag between usage and research outputs.

Support

Research Software Engineering Team

The team of Research Software Engineers (RSEs) in IT Services has continued providing specialist software development support across all Faculties at the University. The options for career progression for RSEs in the team have grown with the creation of a new Senior RSE role which 2 team members have moved into. The team has also expanded to include a second RSE team leader and two more RSEs to meet capacity.

The types of projects undertaken have expanded with particular interest in mobile apps, which have accounted for three new projects - SAFFIRE (a collaboration with the BBC Singers), Breathing for Speech - Breathappy (a collaboration with Speech & Language Therapists at York Hospital) and BabblePlay (an app for encouraging babies to babble). Members of the team have also been heavily involved in the University funded Sparks project, YorVoice, through both the Breathing for Speech app and the YorVoice Catalogue, a curated collection of resources for researchers investigating the human voice. The catalogue builds on work done by our current intern to catalogue and present the entirety of the research outputs from the 5 year multi-institution Turbulent Dynamics of Tokamak Plasmas (TDOTP) project.

Other projects of note have included the development of the instruments and control software within the Wolfson Atmospheric Chemistry Laboratory (WACL) and the Department of Chemistry. Multiple team members have been working on various elements of a satellite payload in the area of quantum communication. Work has also continued on the development of CellPhe, a software tool for analysing and identifying cells.

The IT Services webpages have recently been significantly overhauled including the Research IT pages which signposts researchers to the wide range of facilities and services available to them. This has included an update to the Research Software Engineers page and the creation of a new email address (rse-support@york.ac.uk) for contacting the team directly.

Research Infrastructure Team

The Research Infrastructure Team continues to provide support for users across the university. We have 1 FTE devoted to Viking, we also have 4.4 FTE covering PET, CS, YNIC and YSBL whilst also providing wider support to the University. The new additions in the team has allowed Research IT to provide support with a more joined up approach and to also work on other projects such as EasyBuild, OpenOnDemand and research data management. The infrastructure team has also refreshed the Viking documentation to support users better when accessing VIking.

EasyBuild

Figure 10. Easybuild User Conference 2025

During Viking 1 the University of York adopted EasyBuild as a means to deliver software at scale. Since then, a number of our team have become experts in writing EasyBuild code that has also been pushed upstream to benefit the wider community (both nationally and internationally). We currently have 4139 packages installed on Viking, of which 1131 are unique packages. Jasper Grimm (HPC Systems Engineer) has authored 730 major contributions to the main EasyBuild project. The adoption of EasyBuild has been a real success story for York, and its use has been expanded to other parts of research IT infrastructure. It also highlights how we continue to contribute nationally and internationally to research IT projects.

Regional and National Links

The N8 Centre of Excellence in Computationally Intensive Research (N8CIR) operates the tier-2 “Bede” facility on behalf of EPSRC and the N8. This supercomputer contains a large number of GPUs and offers an upgrade path from Viking2. The University of York is one of the biggest users of the Bede facility. We have also contributed to a number of case studies to N8 CIR. N8 CIR also offers a number of RSE internships each summer, and

provides a lot of training and computational community support activities. You can find more information about N8 CIR and Bede on the N8 CIR website.

The ARCHER2 Service is a world class advanced computing resource for UK researchers. ARCHER2 is provided by UKRI, EPCC, HPE Cray and the University of Edinburgh. Originally funded in 2019, the launch was delayed by COVID and finally went live in July 2021. Since then, the facility has been heavily used, and is currently planned to be in use until November 2026. Viking is a key stepping stone for those researchers that need more computational resources to develop the necessary skills before moving on to ARCHER2. More information about ARCHER2 system can be found on the ARCHER2 website.

A consortium of UK universities (including the University of York) and The Alan Turing Institute, led by the University of Oxford, has been awarded £5 million by the Engineering and Physical Sciences Research Council (EPSRC) to continue the world leading research enabled by the Joint Academic Data science Endeavour service (JADE 2). This forms part of a continued investment by EPSRC in the UK's regional Tier 2 high-performance computing facilities, which aim to bridge the gap between institutional and national resources.

JADE 2 is unique amongst the Tier 2 centres in being designed for the needs of machine learning and related data science applications. The system design exploits the capabilities of NVIDIA's MAXQ Deep Learning System, which has 63 servers, each containing eight of its Tesla V100 GPUs, tightly coupled by its high-speed NVlink interconnect. JADE 2 has supported 36 researchers from York spanning 7 different departments/schools within the Faculty of Science during its 3-4 year lifespan. The Jade 2 service closed in January 2025.

Summary

The Viking facility continues to provide a vital facility for research, but we have also shown UK higher education that it is possible to run these facilities in a sustainable way.

We already have over 1500 registered users across 384 projects, spanning 20 schools and departments. A total grant value of **£27.5 million** has been awarded where Viking 2 was used for research, **£19.3 million** of which was awarded directly to the University. Viking 2 was mentioned explicitly in **£10.5 million** of this research income.

Whilst still predominantly used by the Faculty of Sciences, it has been encouraging to see increased uptake in the Faculties of Social Sciences and Arts and Humanities. The number of research outputs associated with Viking 2 is 74; this increases to 288 with the inclusion of Viking 1, and we still have at least 3 years of operation remaining.

The expansion of GPU provision on Viking 2 has allowed other research avenues to take advantage of the facility. CryoEM and GPU accelerated Bioinformatics workloads have been able to significantly increase their usage of Viking 2 due to the increased GPU resourcing. With the cost savings from powering Viking 2 (comparing electricity pricing in the UK) we have been able to invest in new software such as Globus to support the sharing of data and begin to build better research data management pipelines both internally and externally.

The University also received an Sustainable Digital Project or Initiative Award at the prestigious Universities and Colleges Information Systems Association (UCISA) awards for this work. Interest has been very high amongst other Higher Education institutions, this project has really captured the imagination of other institutions throughout the UK, hopefully housing HPC in sustainable datacentres will continue to become the norm over time.

Statistics

- Over **1500** registered users across **384** projects, spanning **20** schools and departments.
- Total grant value of **£27.5 million** has been awarded where Viking 2.0 was used for research, **£19.3 million** of which was awarded to the University. Viking 2.0 was mentioned explicitly in **£10.5 million** of this research income.
- **74** recorded research outputs relating to Viking 2 use (this increases to 288 with the inclusion of outputs from Viking 1).
- **75 million CPU hours** and **0.38 million GPU hours** of work completed within the last year on Viking 2.
- **1.81 million jobs** have been completed since VIking 2 came online.
- **56%** of Viking users are undergraduate/postgraduate taught students.
- **109 Kg CO2e** avoided in the last 12 months due to heat recycling.
- **14 Tonnes CO2e** scope 3 emissions avoided in the last 12 months.

Talks and Interviews

The University has attracted significant attention with the Viking 2 project, especially the emphasis on sustainable High Performance Computing.

- Sustainable Reality - Leicester Space centre - 25th September 2023 Invited talk (Emma Barnes).
- UCISA DIG2023 - Birmingham - 12-13th October 2023 (Richard Fuller and Emma Barnes).
- HPC - AI - 18th - 19th October 2023 Keynote speaker (Emma Barnes).
- EcoDataCenter breakfast talk - 29th Nov 2023 (Emma Barnes).
- RUGIT Q&A - 21st March 2024 (Emma Barnes).
- Women in HPC at ISC24 Solution Forum Takeover - May 12 - 16, 2024, Hamburg Germany - (Emma Barnes).
- Sustainable Reality - 25th September 2024 Invited talk (Richard Fuller and Emma Barnes).
- Published Success Story - From Sawdust to SuperComputing, (Alces Flight)
- Article in DataCenter Dynamics, (Georgia Butler)
- Article in Computer Weekly, (Caroline Donnelly)
- Article in Energy Advice Hub,
- Numerous discussions with Universities across the UK sector.

The Future

The Viking Service continues to be a valuable resource for research at the university. Going forward, the Viking team plan to continue its push on sustainable and accessible research IT.

There are a number of new features in development for Viking 2. To improve accessibility, the Viking team have deployed OpenOnDemand. OpenOnDemand allows students and staff to access Viking 2 using a web interface, which helps to bridge the gap between non-traditional HPC users and access to the Viking service. We have also purchased a licence for Globus. Globus provides a safe and secure way to share data. This has proved problematic in the past for users when transferring large amounts of data, or sharing data with other institutions. One of the aims is to provide a method for academics to quickly and easily transfer data from their experiments to be processed on Viking. This can also be automated, which has the potential to open up new research and commercial opportunities.

Appendix

Publications & Outputs

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