NATIONAL SUPERCOMPUTING

Exascale, Quantum Computing and AI

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Dean of Research Computing

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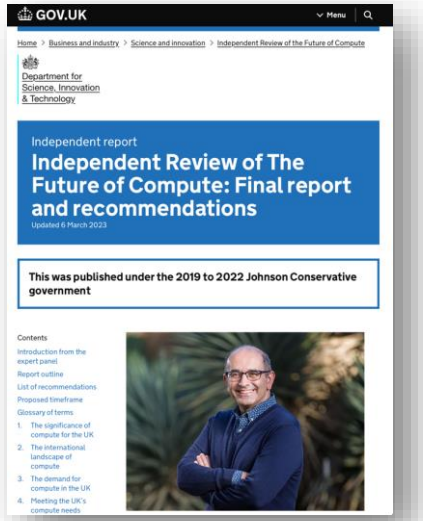
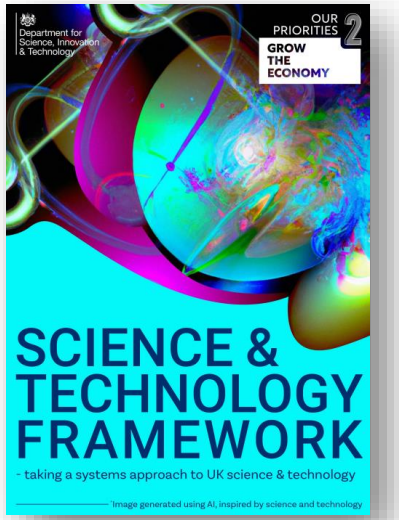
We have a surfeit of plans …

Lord Vallance initiated

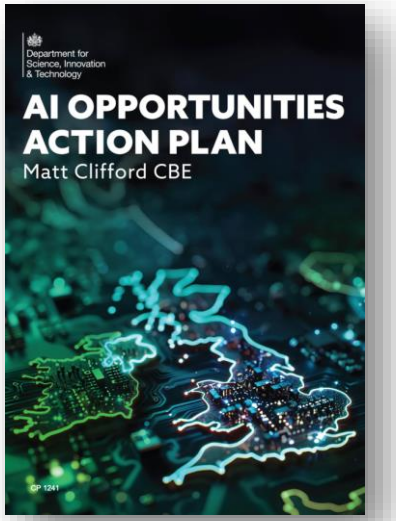
September 2021

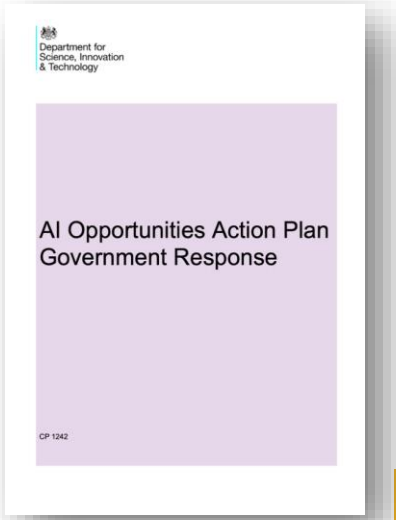




March 2023

March 2023





January 2025

January 2025

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CRESTA Project

2011 - 2014

EPCC's first EU-funded Exascale project

EuroHPC established

March 2017

Subsequently UK decides not to participate

Exascale Project Working Group

March 2019

EPWG starts work on business case to Government

Exascale Project Working Group

August 2019

First business case draft completed

Large-scale Computing Review

September 2021

Government Office of Science publishes report

2011 — 2017 — 2019 — 2021

… and a timeline that is far too long

Future of Compute Review

March 2023

Review published recommends Exascale

Future of Compute Review

June 2022

Review announced by Government

ARCHER2 opening

February 2022

Prime Minister Johnson opens ARCHER2

2023 — 2022

Budget 2023

March 2023

Chancellor announces £900m investment in Exascale and AI

UKRI formal approvals begin

March 2023

Business Case revision and procurement preparations

Exascale hosting site

October 2023

Edinburgh confirmed as hosting site. CR4 grant application submitted

BBC announces Exascale shelved

August 2024

UK Government "shelves" UK Exascale

Project stalled

Today

High risk of no UK National Supercomputer Service after Nov 2026

2023 — 2024 — 2025

Exascale supercomputing worldwide

The world's first Exascale supercomputer

Country or Region	Timescale	Detail
Japan	2020	Fugaku – based on Fujitsu A64FX Arm [illegible]
China	2021	Two systems in operation - next ge[illegible]ration Sunway and Tianhe 3 system. Believed to have 5 or m[illegible]re systems now.
USA	2022 2024 2024	**Frontier – Oak Ridge National Lab – 1.35EF** Aurora – Argonne National Lab – 1.01EF El Capitan – Lawrence Livermore National Lab – 1.74EF
Europe	2022/3 2025 2026	Pre-Exascale systems in Finland, Italy and Spain – ~0.3EF Jupiter system in Germany Summer 2025 – 1.0EF Alice Recoque system in France – 1.0EF + 13 AI Factories

EuroHPC will have invested **€10 billion by 2027**. **Finland**'s new project has just received **€612m** – UK GDP is 11 times that of Finland…

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What next for National Supercomputing?

- Government has ar[illegible] extension 2026
- Currently no news [illegible] – now calling it [illegible] National Supercom[illegible] **post-Exasc[illegible]**
- Technology is moving on at pace. By early 2027 new GPUs will be available with different (complex) characteristics
- We'd expect to be able to get 1EF with between 8,000 – 12,000 GPUs – a huge increase in performance (but a reduction in memory and scale of computation)
- … suggests to me **we should set our target at 2EF+ to ensure scientific throughput is maintained**

Exascale design in 2024 had 6,000 nodes and 24,000 GPUs

This represents a considerable challenge …

Implications of AI, Quantum Computing and Net Zero

AI

- An application of supercomputing
- Uses the same computing technologies

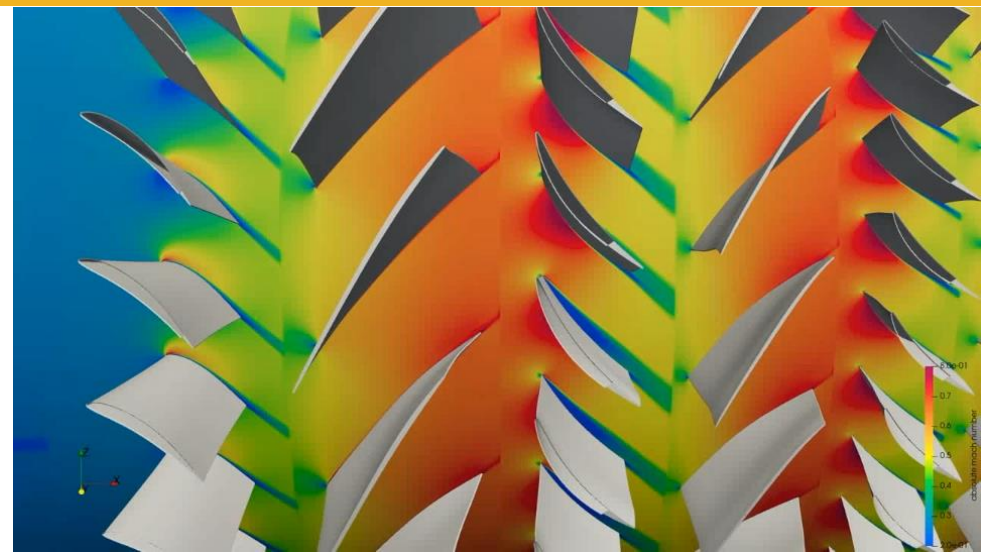
QC

- 10 years until large-scale QC arrives
- Supercomputing critical to delivering

NZ

- ARCHER2 is operationally Net Zero today
- Exascale has plans to be better

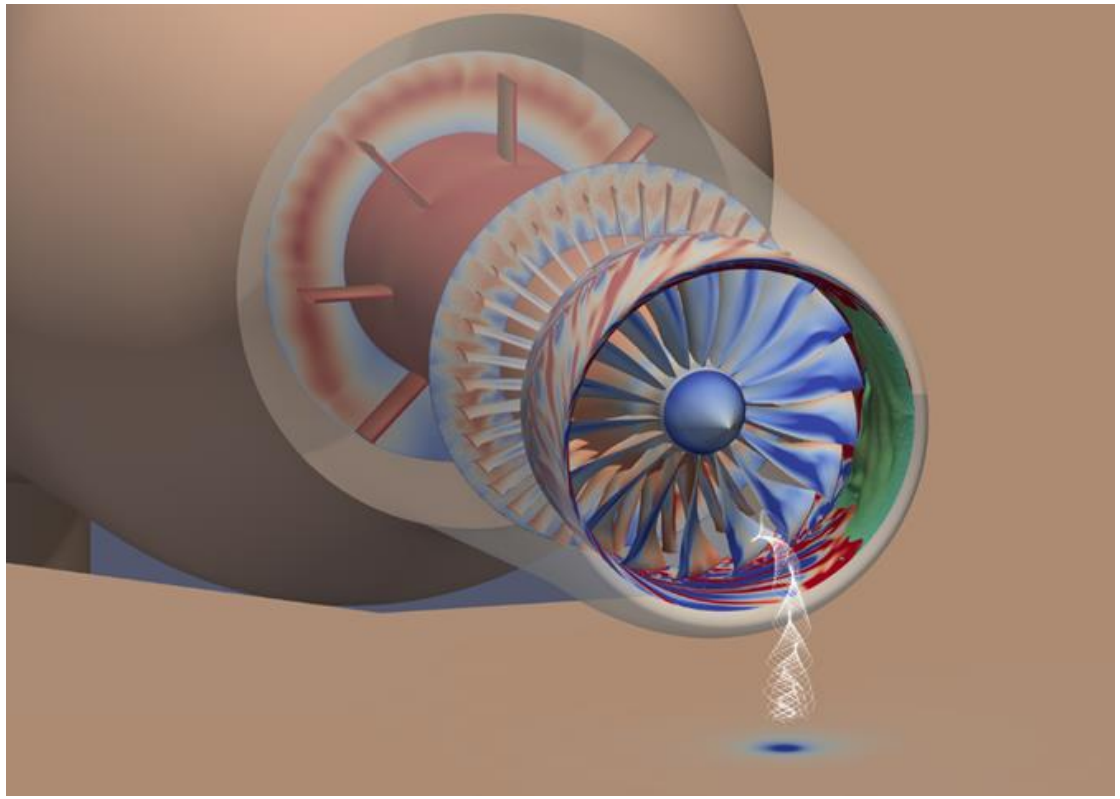
ASIMOV Project with Rolls Royce



- 5 year programme (10 years in total)
- World's first high-fidelity simulation of a gas turbine engine in operation
- Structure / Thermodynamics / Fluid dynamics / Electromagnetics
- A **TRILLION** degrees of freedom
- An engineering challenge for the Exascale era … now on ARCHER2
- EPSRC Prosperity Partnership with
  - **Rolls Royce**, **Edinburgh**, Warwick, Oxford, Cambridge, Bristol, Zenotech and CFMS

Whole Engine Virtual Certification is the goal

- Large bird strike **certification took 10 years** to obtain FAA approval
- Whole engine virtual certification is a key technology needed to reach TRL 6 in the **2025-2030 timeframe**
- High resolution multi-physics models from **10-100M** cells today **to trillions** of cells



ASiMoV results already in production use

Be bold — We are post-Exascale – the UK should aim for at least **2 Exaflops**

Plan — **Plan for 2035 now** – make an irrefutable case and start immediately on next system

Compete — Push the boundaries – be mission / grand challenge driven – **compete on world stage**