£1.2 billion for the world's most powerful weather and climate supercomputer

- £1.2 billion investment confirmed for state-of-the-art supercomputer to improve severe weather and climate forecasting
- the latest supercomputing technology will unleash the full potential of weather and climate data for the UK
- data from the supercomputer will be used to inform government policy as part of leading the global fight against climate change and meeting net zero emission targets

Predicting severe weather and the impacts of climate change will be faster and more accurate than ever before, thanks to confirmation of £1.2 billion government funding to develop a state-of-the-art supercomputer, Business and Energy Secretary and COP26 President Alok Sharma announced today (17 February 2020).

Data from this new supercomputer – expected to be the world's most advanced dedicated to weather and climate – will be used to help more accurately predict storms, select the most suitable locations for flood defences and predict changes to the global climate.

The new supercomputer, to be managed by the Met Office, will also be used to help ensure communities can be better prepared for weather disruption, including through:

- More sophisticated rainfall predictions, helping the Environment Agency rapidly deploy mobile flood defences
- Better forecasting at airports so they can plan for potential disruption; and
- More detailed information for the energy sector to help them mitigate against potential energy blackouts and surges

With the government announcing its Year of Climate Action, the news further demonstrates the UK is leading by example ahead of hosting UN climate conference COP26, where the world will meet to agree more ambitious action.

Business and Energy Secretary and COP26 President Alok Sharma said:

> Over the last 30 years, new technologies have meant more accurate weather forecasting, with storms being predicted up to five days in advance.
>
> Come rain or shine, our significant investment for a new supercomputer will further speed up weather predictions, helping people be more prepared for weather disruption from planning travel journeys to deploying flood defences.

The new supercomputer will also strengthen the UK's supercomputing and data technology capabilities, driving forward innovation and growing world-class skills across supercomputing, data science, machine learning and artificial intelligence.

Professor Penny Endersby, Met Office Chief Executive said:

> This investment will ultimately provide earlier more accurate warning of severe weather, the information needed to build a more resilient world in a changing climate and help support the transition to a low carbon economy across the UK.
>
> It will help the UK to continue to lead the field in weather and climate science and services, working collaboratively to ensure that the benefits of our work help government, the public and industry make better decisions to stay safe and thrive.
>
> We welcome this planned investment from UK Government.

Chair of the Science Review Group Professor Ted Shepherd said:

> The agreement to upgrade the Met Office high performance computer is welcome news. The improved processing power will deliver a step-change in weather forecasting and climate modelling capability for the UK, such as the further development of the Earth Systems Model, which involves collaboration with the many UKRI-NERC funded research centres.
>
> Improved daily to seasonal forecasts and longer-term climate projections will equip society with a greater ability to proactively protect itself against the adverse impacts of climate change.

The Met Office is at the forefront of supercomputing, using its current technology to drive advances in environmental forecasting.

As a result, detailed weather predictions for the UK now take place every hour instead of every three hours, providing crucial and timely updates when extreme weather is approaching.

The benefit of this has been felt recently: major storms Ciara and Dennis, and the 'Beast from the East' in 2018, were forecast five days in advance, enabling local councils and emergency services to prepare and instigate resilience plans. Similarly, the Environment Agency has used the Met Office's latest UK climate projections set out potential future flooding scenarios and how funding can be best allocated.

UK supercomputer breakthroughs

Today, the government also announced £30 million investment for advanced supercomputing services, providing researchers with access to the latest technology and expert software engineers. It will also help them speed up scientific breakthroughs like developing ‘food fingerprinting’ to detect chemical contaminants in food and improving drug design.

The funding will support seven High Performance Computing (HPC) services run by universities from across the UK, including Queen’s University Belfast, the University of Edinburgh, and Durham University. The services will provide researchers with invaluable access to powerful systems to support ground-breaking work in areas from Artificial Intelligence, energy storage and supply, and therapeutic drug design, as well as boosting the skills of UK scientists.

UK Government Minister for Scotland Douglas Ross said:

> The UK Government £30 million investment in Edinburgh’s supercomputers helps keep our capital at the forefront of cutting edge technology.
>
> The University of Edinburgh facility will benefit scientists from across the UK as they are given the opportunity to use this new technology. This additional funding builds on the work of the Edinburgh and South East Scotland City Region Deal which is creating world-leading hubs for AI research.
>
> The UK Government is committed to combatting the impact of climate change on top of creating thousands of high-earning jobs and ensuring businesses and public services in the UK are the first to benefit from the latest innovations.

Notes to editors

The government investment will replace Met Office supercomputing capabilities over a 10-year period from 2022 to 2032.

The current Met Office Cray supercomputers reach their end of life in late 2022.

The first phase of the new supercomputer will increase the Met Office computing capacity by 6-fold alone. The Met Office will look to deliver at least a further three times increase in supercomputing capacity for years 6-10.

£1.2 billion refers to the total expected investment from Government. The expected contractual value for the supercomputing capability is £854 million. Other costs include investment in the Observations Network, exploiting the capabilities of the supercomputer and the programme office costs.

2020 marks the 30th Anniversary of the establishment of the Met Office Hadley Centre for Climate Science, working at the forefront of climate science and pioneering research.

Met Office Supercomputer Case studies

Case study 1: The Met Office supported the response to the Toddbrook Reservoir incident and the protection of residents of Whaley Bridge. It worked directly with the emergency services and organisations involved in the emergency response advising on short-term and long-term weather forecast conditions. This was critical as further rainfall would impact the water level in the Dam's reservoir.

Case study 2: In a global first, the government brought together the Met Office, the University of West Virginia, the University of Maryland and NASA to help save lives by accurately predicting cholera hotspots. The Met Office provided guidance on forecasted rainfall in the country for 14 days in advance, to help UNICEF and Oxfam target their on the ground efforts to prevent large outbreaks of cholera.

Case study 3: Africa is one of the world's most vulnerable regions to climate change with millions of people relying on rainfall for agriculture. As part of the UK aid funded IMPALA programme, the Met Office led the development of the first pan-African convection-permitting model CP4-Africa. This ground-breaking research developed high-resolution climate projections that provided a glimpse into future weather and climate extremes across Africa, which were more severe than previously thought. The information will help decision-makers reduce climate-related risks.

Case Study 4: UK Climate Projections (UKCP) provides the most detailed picture yet of future climate in the UK. As part of this, UKCP Local (2.2km) provides the most realistic set of projections of future climate extremes like soaring temperatures during the summer and hourly summer rainfall for local areas in the coming decades. This enhanced detail could help inform future risk assessments and local decision-making on the future of climate change. The UKCP toolkit will be used to inform the next Climate Change Risk Assessment, due in 2022, and is being widely used by local authorities, industry and academia to help inform plans to manage future climate risks and enhance resilience.

High Performance Computing case studies

The Materials and Molecular Modelling Hub

Led by: UCL

Partners: Queen Mary University of London, Queen's University Belfast, Brunel University, Imperial College London, King's College London, Universities of Cambridge, Lincoln, Kent, Reading, Southampton and York

EPSRC support: £4.5 million

Materials are at the heart of almost every modern technology, including energy generation, storage and supply, transportation, electronic devices, defence and security, healthcare, and the environment. It is materials that place practical limits on efficiency, reliability and cost. The MMM Hub provides high performance computing capacity for researchers to carry out ground-breaking research on the properties of new and existing materials, and this funding will build on the hub's capability.

These include understanding and preventing surface degradation, such as corrosion and wear, on a range of different materials; researching how changes to the recycling of metals can reduce the environmental damage caused by metal extraction; and developing the next generation of materials for solar energy generation.

GW4 Tier-2 HPC Centre for Advanced Architectures (Isambard 2)

Led by: The GW4 Alliance of the Universities of Bath, Bristol, Cardiff and Exeter, and hosted by the Met Office

EPSRC support: £4.1 million

The Isambard 2 service will use the very latest technology from the UK-based Arm Holdings to provide scientists with a world-class High Performance Computing service. The same technology is expected to be used in some of the first supercomputers capable of a billion billion calculations per second, called Exascale supercomputers. This technological step change will require scientists to adapt their codes in order to run as quickly and efficiently as possible and thus accelerate scientific discovery. Isambard 2 will succeed the current Isambard system and will help enable British researchers to prepare their codes for the widespread use of Exascale systems.

Isambard has already been used to investigate potential drugs to treat osteoporosis and simulate Parkinson's disease at the molecular level. Isambard 2 will enable researchers to expand this further with the potential for scientific breakthroughs.

Kelvin-2

Led by: Queen's University Belfast and Ulster University

EPSRC support: £2.1 million

The Kelvin-2 service will provide access to an enhanced computing facility focused on artificial intelligence-based research. The project will initially focus on accelerating research in six specialist areas which are economically and socially important to the UK. This includes neurotechnology and computational neuroscience, including work on brain-computer interfaces and heterogeneous catalysis, such as modelling chemical processes which contribute to the production of items used in everyday life.

The areas also include innovative drug delivery for improving drug-based therapies and for use in diagnostics, as well as a focus on precision medicine where automated tools will be created to analyse data and identify

indicators for health conditions. There will also be a focus on food fingerprinting, including techniques for detecting chemical contaminants in food; and hydrogen deflagration to assist with developing accident prevention and mitigation for hydrogen tanks.

JADE: Joint Academic Data Science Endeavour – 2 (JADE 2)

Led by: University of Oxford

EPSRC support: £5.5 million

Partners: Universities of Bath, Bristol, Cambridge, Exeter, Lancaster, Leeds, Loughborough, Sheffield, Southampton, Surrey, Sussex, Warwick and York, Queen Mary University of London, King's College London, Imperial College London, UCL, Newcastle University, The Alan Turing Institute, Hartree Centre. The JADE 2 service, hosted at STFC's Hartree Centre, will be a unique national resource providing a state-of-the-art GPU (Graphics Processing Unit) computing facility for research into Artificial Intelligence (AI)/Machine Learning and Molecular Dynamics, a computer simulation method for analysing the physical movements of particles that make up molecules.

The AI techniques developed using the service will have impact in a range of sectors including financial services, manufacturing, energy and healthcare. The Molecular Dynamics research conducted on JADE 2 will advance understanding of the structure and function of large biological molecules, many of which are targets for therapeutic agents for a large variety of health conditions. The service will provide a valuable computing resource to the new UKRI Artificial Intelligence Centres for Doctoral training, and thus provide a critical computational capacity needed to develop the next generation of experts in AI.

Cirrus Phase II: Preparing for Heterogeneity at Exascale

Led by: The Edinburgh Parallel Computing Centre at the University of Edinburgh

EPSRC support: £3.5 million

Cirrus Phase II will expand the capabilities of the Cirrus service by adding specialized GPUs to the current system. GPUs are commonly used as graphics/video cards in mobile phones, personal computers and games consoles. However, specialized GPUs can be also be used in supercomputers as accelerators enabling them to run numerical calculations more quickly. The technology used in Cirrus is expected to be used in some of the first Exascale supercomputers and will allow scientists to test and adapt their code for modelling and simulation to be ready to advance discovery and innovation as soon as Exascale systems become available. It will help to ensure the UK has a supply of individuals trained with these specialised skills and could lead to far more rapid and detailed discoveries in new areas and the projects Cirrus has already supported, such as modelling protein shape for better drug design and simulating tidal flows to optimise turbine installations and their effects on sea beds. The new GPUs will also provide a

high-performance platform for AI training and research, a critical and rapidly growing area.

Northern Intensive Computing Environment (NICE)

Led by: Durham University as part of the N8 Research Partnership (Durham and Newcastle Universities, Universities of Lancaster, Leeds, Liverpool, Manchester, Sheffield and York)

EPSRC support: £3.1 million

The new NICE service will use the same technology as that used in the current leading supercomputers in the world, extending the capability of accelerated computing. The technology has been chosen with the aim of combining experimental, modelling and machine learning approaches, bringing these communities together to address new challenges.

This will mean that machine learning can be used alongside modelling and simulation to better understand the vast data sets now being generated by experimentalists through, for example, national facilities such as Diamond and the Henry Royce Institute and international facilities such as the European Synchrotron Radiation Facility. This approach will enable scientists to, for example, advance the imaging techniques necessary to produce the next generation of X-ray instruments and develop future students working with deep learning techniques at the interface of algorithms and High Performance Computing.

Cambridge Service for Data Driven Discovery (CSD3) – A National Data Intensive Science Cloud for Converged Simulation, AI and Analytics

Led by: University of Cambridge

Partners: Cardiff University, King’s College London, Universities of Edinburgh, Leicester, Oxford and Southampton

EPSRC support: £4 million

The Cambridge Service for Data Driven Discovery is a £10M investment, creating one of the most powerful academic supercomputers in the UK specially designed to combine large scale data intensive simulation and AI science within a single computer system.

This breakthrough supercomputer was developed via a unique Co-design partnership between the University of Cambridge, Dell, Intel, NVIDIA, Mellanox Technologies and StackHPC a leading UK SME developing ground breaking HPC system software. It will accelerate research across a wide range of engineering and physical science themes, including materials science and computational chemistry, health informatics, medical imaging and bio-simulation, and AI and machine learning. The proposal has stimulated significant industrial investment from Dell, Intel and Cambridge to form the Cambridge Open Exascale Lab, providing a large critical mass of people and technology focused on driving UK competitiveness in the rapidly emerging exascale computing landscape.

This service will also be supported by an additional £3 million investment from the Science and Technology Facilities Council, Medical Research Council and UK Atomic Energy Authority (Culham Centre for Fusion Energy).