

# The value of Exascale

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## 1. Introduction

What are Exascale systems? What are they for, and why should a non-physicist care?

As we approach the era when the supercomputing community is talking more vocally about Exascale systems, with teams around the world making concrete plans for the implementation of systems within the next years, we consider why it makes sense to put resources into what appears at first sight a hubristic goal. We then review what it is that constitutes an Exascale system, looking at challenges and innovations that will be required.

## 2. Uses

We review the guiding motivation for building this type of system – what new science will be possible, and what the realisation of that science will mean not just for the science teams involved, but for the wider community. Exascale systems are expected to form the underpinning capability of our fundamental science and technology base for decades to come. As such, they will be an important economic driver for industrialised societies.

We will focus primarily on their impact on life sciences, but touch also on the impact they will have on the Earth and Earth sciences, energy and decarbonisation. We will outline each science problem as it is dealt with today, then consider how the problem scales, and show what could be achieved if we had systems with Exascale capability.

## 3. Technology

Next, we give an overview of the hardware challenges associated with Exascale, looking at the constraints and drivers – how these systems will be similar to, and more importantly different from, HPC systems of today.

Changes to hardware will necessitate a change to how data is managed and the software stack. We know that with the current state of technology, compute capability is growing at a faster rate than storage systems, both in capacity and performance. We will therefore consider strategies for changing the balance of workflow.

## 4. Conclusion

Exascale systems will be critical to the industrial base of advanced societies in the years and decades to come. In order to achieve these advances, societies will need to create an ecosystem

to back up their scientists with a wide range of expertise in applications scalability, tooling & libraries, storage & data handling, and systems management.