EPCC
A UK HPC CENTRE

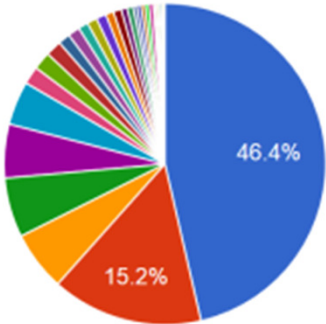http://www.epcc.ed.ac.uk

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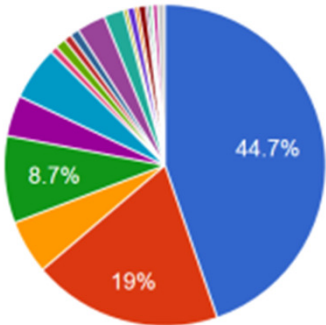
Research Architect

International Aspect

Countries System Share

- United States 46.4%
- China 15.2%
- United Kingdom
- Japan
- France
- Germany
- Canada

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Countries Performance Share

- United States 44.7%
- China 19%
- United Kingdom
- Japan 8.7%
- France
- Germany
- Canada

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EPCC

- Edinburgh Parallel Computing Centre
  - founded in 1990 at the University of Edinburgh
- Originated from Physics HPC machines and *Edinburgh Concurrent Supercomputer Project*
- Institute within the School of Physics and Astronomy

James Clerk Maxwell Building, The King's Buildings
© Visual Resources, The University of Edinburgh

EPCC

- 24 years old – 80 staff

- Fully self-sustaining

- Turn over ~£5million

- Main UK National HPC Service provider
  - ARCHER – Cray XC30 ~70,000 cores (soon to be 120,000 cores)
  - DiRAC – 6 frame BG/Q

- Wide range of work from HPC to Data Analytics and Cloud

- Work with academia and industry
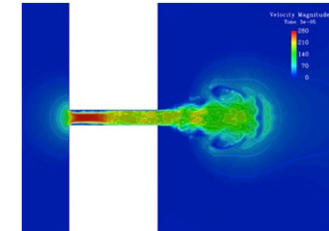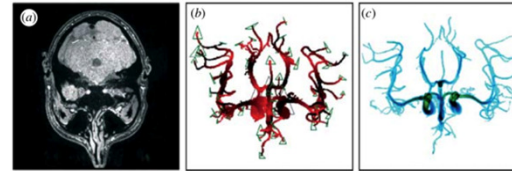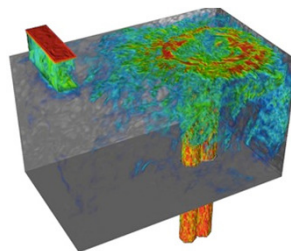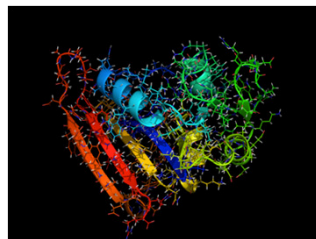
- Project highlights:
  - IPCC – EPCC is funded by Intel to optimise codes for Xeon Phi
  - CRESTA – we lead only Exascale software co-design project
  - PRACE – we lead the UK's involvement in Europe's HPC research infrastructure
  - FORTISSIMO – lead this flagship project bringing HPC to SMEs across Europe
  - EPiGRAM – combining and improving MPI and PGAS for Exascale
  - SSI – Software Sustainability Institute
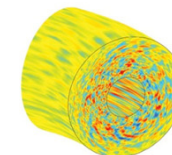
EPCC Activities
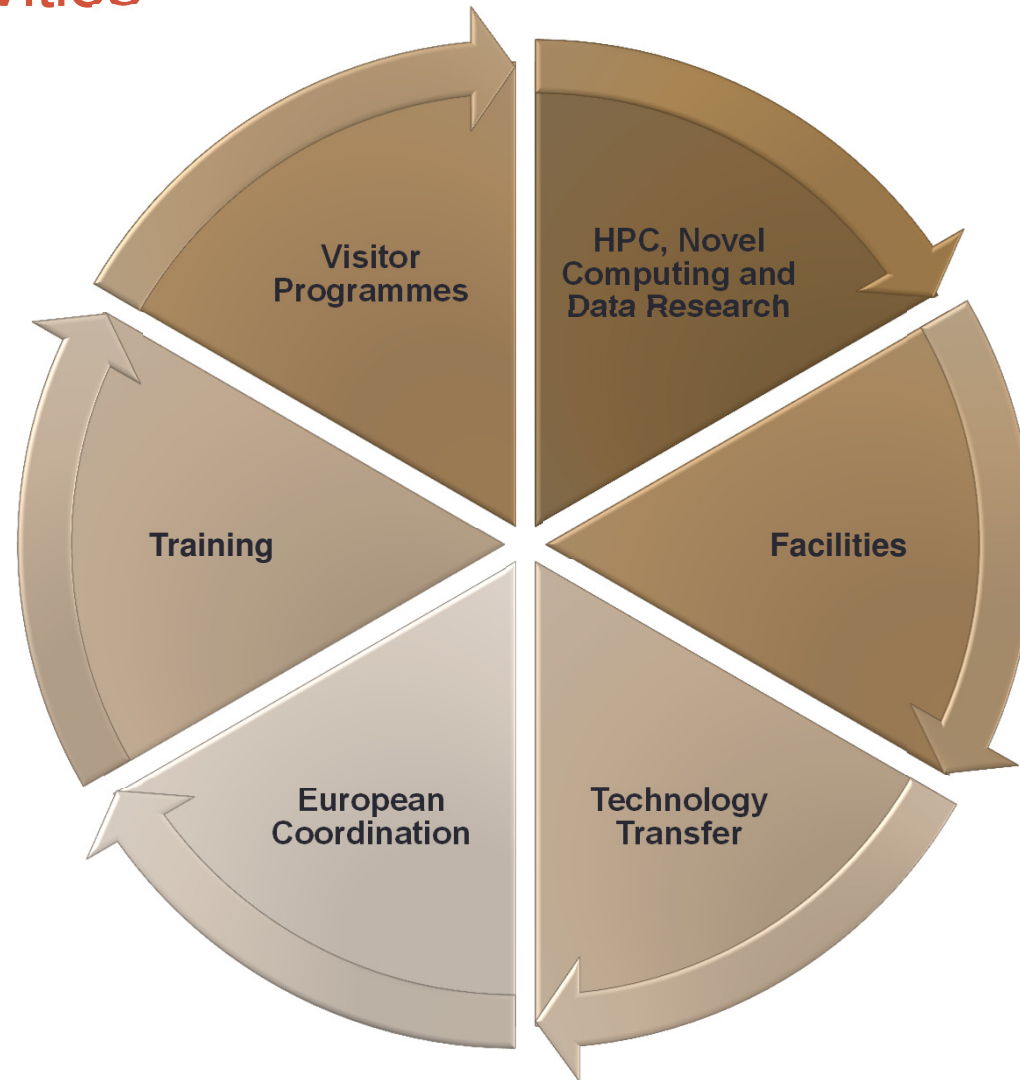
Software, services and research

- EPCC – what we do
  - Facilities access – for academia and industry
  - Performance optimisation
  - Accelerator computing
  - Software engineering
  - Project management
  - Visitor programmes and training
  - Data integration and data mining
  - Numerical modelling and simulation
  - Future Internet
  - Cloud and distributed computing
  - Parallel application consultancy and design services
  - Broad HPC research programme
  - Standards and Committees (OpenMP, OpenACC, MPI, etc…)

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BUSINESS TRANSFORMATION
FROM TECHNOLOGICAL INNOVATION

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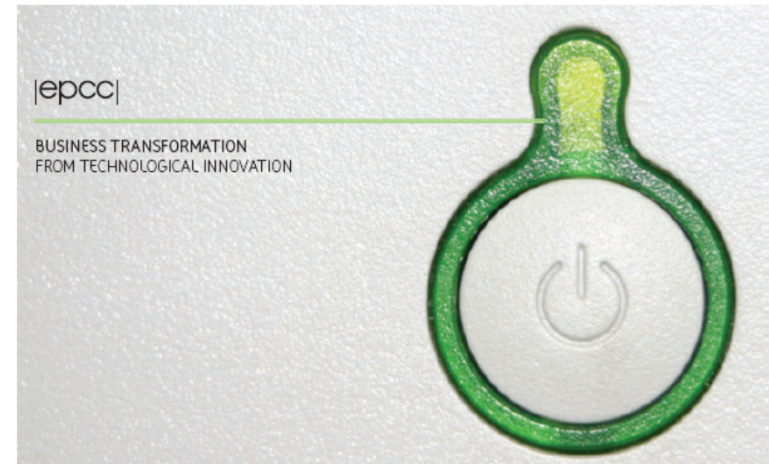
Training

- PRACE Advanced Training Centre

- ARCHER Training co-ordinator

- MSc in HPC
  - ~30 students annually

- Around 600 people trained in past 12 months
  - ~10% from industry

- Develop and teach bespoke courses for industry, e.g.
  - Aerospace
  - Games industry

Industry projects

- Worked with over 750 companies in past 15 years

- Around 50% SMEs

- SME projects tend to be small – 3 to 6 months duration

- Predominately software development and consultancy

- Two current key projects:

SUPERCOMPUTING
SCOTLAND
BUSINESS INNOVATION THROUGH HIGH PERFORMANCE COMPUTING

ff FORTISSIMO

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Advanced Computing Facility

- The 'ACF'
- Opened 2005
- Purpose built, secure, world-class facility
- Houses wide variety of leading-edge systems and infrastructures
  - National services
    - DiRAC (IBM BlueGene/Q)
    - ARCHER
  - Local services
    - ECDF (provide hosting)
    - INDY – industry machine
    - EDIM1 – DIR machine
- Major expansion built: 6MW, 850m^2 plant room, 550m^2 machine
- ARCHER PUE < 1.1

ACF - proposed extension for ARCHER

UK Academic Funding Landscape

- Funding councils for particular subject areas - £3bn
  - RCUK – Represents funding councils
    - EPSRC – Engineering and Physics Sciences
    - NERC – Natural Environment
    - BBSRC – Biotechnology and Biological Scienes
    - MRC - Medical
    - AHRC – Arts and Humanities
    - ESRC – Economic and Social
    - STFC – Science and Technologies Facilities (national labs)
      - Lasers
      - Accelerators
      - Neutron and Muon Sources
      - Synchrotron light sources & Free Electron Lasers (Diamond Light)
      - Atmospheric and Space Science
      - Scientific Computing (Hartree Centre)
- No other national laboratories
  - National organisations (CCFE, UKAEA, AWE, Met Office, etc…)

Large HPC contributors

- EPSRC
  - Fund national service
    - ARCHER
  - Fund some regional services
    - Money was available for regional consortium
  - Fund code development and software research
  - Software fellowships

- NERC
  - Fund national service
    - ARCHER
  - Fund code development

- STFC
  - Fund some national resources
    - DiRAC
  - Fund national lab
    - Hartree

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UK HPC Ecosystem – Local services

- Many Universities have their own clusters
  - i.e. University of Edinburgh
    - Edinburgh Compute and Data Facility
    - 2912 cores available for Edinburgh staff and students
    - Charged to departments on a fixed amount, can by extra priority
    - Biggest job 128 cores, lots of 1 core jobs run on them

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UK HPC Ecosystem – National Services

- ## National service
  - ### ARCHER
    - Funded by EPSRC and NERC
    - Time awarded through grant application
    - Also funds software development
      - eCSE (embedded computational science and engineering projects)

- ## Science based services
  - ### DiRAC
    - Funded by STFC
    - Collection of machines around the country for particle physics simulations
    - Looking likely to have large KNL upgrade in 2015/2016
  - ### Met Office
    - Dedicate HPC system for weather simulation
  - ### Hartree BG/Q
    - Funded by STFC for industry and other collaborations
  - ### Closed/secret services
    - AWE, GCHQ, etc…

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UK HPC Ecosystem – Regional Services

- Five regional consortiums, Six machines
  - Funded by EPSRC with spare money from government
  - Only funded hardware
  - No common model for access or usage
  - Science and Engineering South
    - Emerald: 372 NVIDIA Tesla GPUs: 119 TFlop/s
    - Idris: 12,000 core Intel Westmere CPU system: 108 TFlop/s
  - ARCHIE-WeSt
    - 3,500 core Intel Westmere CPU system: 38 TFlop/s
  - HPC Midlands
    - 3,000 core Intel Sandy Bridge system: 48 TFlop/s
  - N8 HPC
    - Polaris: 5,000 core Intel Sandy Bridge System: 110 TFlop/s
  - MidPlus
    - Minerva: 6,000 core Intel

UK HPC Funding Opportunities

- Full research projects
  - Apply direct to council as any other project does
  - Software development very hard to fund this way

- Small part of someone's research project
  - Addition to grant to do some software optimisation or development

- Tailored funding calls
  - i.e. Software for the future

- ARCHER eCSE funding

- Commercial funding

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Surviving in this funding environment

- 80 staff – fully self sufficient
  - Continual process of bringing in new project to sustain staff levels
  - Staff generally work across projects
    - Not academic approach, more like industry project management
  - International collaborations
    - Nu-FuSE, eXtasy, etc…
  - Large European projects
    - Co-ordinate and research partners
  - Large UK research project
    - Hosting UK national facility
    - Software Sustainability Institute
  - Small UK projects
    - Collaborate with academics on proposals
    - Work with industry on their codes
  - Small University projects
    - Collaborate within the University on HPC research
  - Training and teaching
    - MSc, PhD students, national and international training (i.e. ARCHER and PRACE training)

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Surviving in this funding environment

- ## Selling HPC resource to industry

  - ### New machine recently purchased

    - Indy: 1536 cores, infiniband machine
    - Ultra: UV2000, 512 cores, 8 TB shared memory

  - ### Provide bespoke access and setup

    - Windows dual-boot possible

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Summary

- EPCC is an institute in the University of Edinburgh

- We are funded through project work

- UK has a number of large HPC funders
  - No joined up funding of HPC resources or joined up HPC services
    - Two major services: ARCHER and DiRAC, no transfer between them
    - No way to transfer between these and the regional consortium

- PRACE also an important resource for UK researchers

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HPC Usage