Urban Sciences Building

A flagship development for computing and urban sustainability
Introduction

The Urban Sciences Building (USB) is an exemplar of world class research and education in computing, digital technology and engineering. It is demonstrating best practice for 'digitally enabled urban sustainability'. Situated on a site that was once a colliery and later the Scottish & Newcastle Brewery, it is transforming this area in the heart of Newcastle into a thriving quarter for research, business and innovation. Newcastle University has brought together cutting edge areas of research and education in computing, energy, water, digital urban sensing and infrastructure to discover solutions for global challenges. It is producing the next generation of leaders for the digital age.

Completed in summer 2017, the USB is driving critical programmes of research and innovation working with stakeholders in government, business, industry and communities. It is revolutionising how cities will look, behave and interact within their environment to improve life for communities and create opportunities for sustainable economic growth.

The USB contains one of the world’s leading schools of computing alongside a series of innovative research labs to inform urban infrastructure, industry and policy, and provides an evidence base to be used by city planners and future developers. No other building in the world draws together these types of facilities in an integrated way.

The building itself is a lab for innovative research that has wide applications for business, industry and urban communities. Containing over 4,000 digital sensors, computing technology is embedded throughout the structure, making it one of the most monitored and high-performance buildings in the country.

The USB and surrounding area underpins research to make urban centres more sustainable for future generations. The building is designed for teaching, laboratory research, events and testing real-time smart technologies for urban sustainability.

Research at the USB is working with stakeholder partners to address global challenges for cities including:

- environmental sustainability
- quality of life
- security
- sustainable economy
Key Facts
• The USB houses 1,200 students, 55 academic staff, 120 post-doctoral researchers from the School of Computing, including two national Centres for Doctoral Training.
• Total cost: £58 million. Size: 12,800sqm.
• Top university in the UK for research impact in computer science and informatics.
• 60 year legacy of educational and research excellence in computing.
• 94% of computing graduates in employment within 6 months after their course.
• PV-T array projected to generate 33,000 kWh/year of electrical and thermal energy. Projected CO2 savings: 19,798 kg/year. 48v DC office microgrid.
• Biodome using waste CO2 and heat from the building.
• 560m² wild flower meadow green roof.
• 99.2% of construction waste from the project was recycled.
• Recipient of the BREEAM Innovation Credit that is awarded to buildings going beyond best practice in sustainability.
• Awarded the Newcastle Lord Mayor’s Design Award for Sustainability.
• Awarded an outstanding CEEQUAL Award for best practice in sustainable drainage.

Digitally Enabled Urban Sustainability
• Better understand cities through observation, analysis, collaboration and full-scale demonstration.
• Accelerate innovation and enable urban areas around the world to become more productive, liveable, resilient and sustainable in the digital era.
• Develop radical, digitally-led, interdisciplinary and collaborative approaches to tackling global challenges for cities and produce evidence for change.
• Use large-scale observation and experimentation in the city to investigate and demonstrate solutions.
• Provide the curriculum for new teaching programmes that will produce leaders at the forefront of the ‘smart’ or digitally enabled urban revolution with the skills to make it a global success.
A World-leading School of Computing

The USB is home to Newcastle University’s world-leading School of Computing. Newcastle University is ranked in the Top 100 in the world for Computer Science*. Our School of Computing is at the forefront of research in:

- bio & neurocomputing
- cloud computing
- cyber-physical systems
- cyber security
- data science
- data visualisation
- digital civics
- games engineering
- scalable computing

The School of Computing is making advancements on the knowledge that founded the modern digital age. Our research is driven towards a particular end – to improve conditions for humanity and the planet. We undertake rigorous research with social, economic and environmental benefits articulated to the needs of stakeholders.

Training computing and digital experts of the future

The School of Computing is one of the longest-established active schools in the UK, awarding degrees in computing since the mid-1960s. As part of degrees from BSc to PhD, the school delivers specialist training in areas including cyber security, software engineering, biocomputing and human-computer interaction, with graduates going on to a huge variety of careers. The School’s distinctive programmes in games engineering have seen students go on to work in games studios around the world and working on some of the most popular games in the industry.

*Source: Times Higher Education, World University Rankings 2018
The USB and the wider city

Meeting the global challenges of today and creating solutions for tomorrow

A city is only as advanced as its ability to serve society.

The USB is an urban test bed for demonstrating how to transform cities into places that are not merely habitable, but innovative, integral and life-sustaining for multiple generations.

The line between research at the USB and the city is seamless, providing insights into how people interact with their immediate environment, and improve upon it in real-time.

It does this through discovery of practical and solutions-based research – addressing the global challenges of today by building an equitable future for all. The digital era opens up a wide array of opportunities for cities to be more productive, liveable, resilient and sustainable.

The USB is harnessing interdisciplinary research at Newcastle University and building strong partnerships with industry, business, governance and communities, to turn cities from places where people live and survive to places where people thrive.

Building-as-a-lab

The USB is a demonstrator for understanding the relationship between buildings and their wider environment. The thousands of sensors located in the building make it possible to not only understand its performance, but also how it interfaces with the energy, water, internet and other networks it is connected to. By co-locating computer scientists with engineers, we are leading new research that explores the crucial dependencies much of our infrastructures have on digital technology e.g. cyber security of buildings.

Building-as-a-lab makes it possible to do leading, innovative research on the built environment and test potential solutions to global challenges in water, food, energy and infrastructure. It also has implications for assisting the world in achieving the UN Sustainable Development Goals by helping to make our cities resource smart, resilient, secure, low-carbon and green, with improved health, livelihood and quality of life for residents.
World-leading research facilities

The USB encompasses a wide range of research areas, centres, labs and facilities co-located with the aim of generating ground-breaking interdisciplinary research. Our facilities provide opportunities for any discipline to apply their expertise and methods to global sustainability challenges. The USB is a platform for developing solutions by engaging with local, national and international academic, business, community, industrial and government stakeholders.

National Green Infrastructure Facility
ncl.ac.uk/sage/collaboration/wg

The National Green Infrastructure Facility is a ‘living lab’ for pioneering solutions to global challenges in water and sub-surface behaviour for urban sustainability. It is generating real world insights into sustainable drainage systems, developing novel approaches and technologies for improved surface water management, and increasing our understanding of the interaction between the climate and the urban landscape.

“Northumbrian Water Group is proud to be working with the National Green Infrastructure Facility to undertake transformative research in blue-green infrastructure, and demonstrate sustainable drainage systems for mitigating flooding and adapting cities to climate change”.

Chris Jones, Research and Development Manager, Northumbrian Water Group

National Centre for Energy Systems Integration (CESI)
cesienergy.org.uk

CESI’s researchers are taking a whole energy systems approach to the UK’s energy future. Incorporating heat, transport and electricity, they are exploring the many possible and potential scenarios. Our aim is to establish the value proposition of providing energy system flexibility and efficiency that tackles the challenges of cost, resilience and carbon.
The dots and lines across the glazed south elevation of the USB are in a sense a self-portrait of Newcastle University. They are the result of an artistic and technical collaboration between the University, the architects Hawkins\Brown and Martyn Dade-Robertson, a member of the School of Architecture, Planning & Landscape, and alumnus of the School of Computing.

The image, which provides solar shading, colour and depth to the central forum space and Science Square, is based on a data mining exercise. The lines, dots and circles represent the information resources in the University’s websites, and their myriad networks and layers of connections. It is a digital look in the mirror.
**Digital Economy Research Centre (DERC)**

The Digital Economy Research Centre (DERC) is theorising, designing, developing, and evaluating new digitally mediated models of citizen participation that engage communities, the voluntary sector, local government and the commercial digital economy in developing the future of local service provision and local democracy.

**Cyber-Physical Lab**

research.ncl.ac.uk/cplab

The Cyber-Physical Lab focuses on systems that combine hardware, software, networking and control. The research enables design models to be co-developed and co-simulated by joining them together to enhance product performance and optimisation. The lab is developing integrated systems for transport, robotics, agriculture, building infrastructure, smart grids and many other exciting areas of cyber-physical innovation.

“Siemens is excited to be basing some of its most innovative people and projects in the Urban Sciences Building at Newcastle University. We believe this is the perfect environment for accelerating digitalisation, technology and knowledge exchange together with our business and academic partners”.

Dr Adam Cartwright, Head of Open Innovation, Siemens UK

**MindSphere Lab**

MindSphere is the cloud-based, open, collaborative IoT operating system from Siemens. Newcastle University is connecting its assets from across the campus into MindSphere, enabling students and researchers – alongside Siemens staff and industry partners – to harness the value of data.
Whole Energy Systems Lab

The Whole Energy Systems Lab is exploring the use, optimisation and management of conventional and renewable energy technologies in industrial, commercial and domestic settings. Heating, cooling, power generation, energy efficiency, demand reduction, transport, waste heat recovery, electrical and thermal storage, and human behaviour are all addressed together.

Games Engineering

The School of Computing works collaboratively with leading partners from the video games industry to deliver world-class teaching and research. Newcastle University has the only industry-focussed video games laboratory in the Russell Group and is well-known for translating its research into real-world video game technologies. The MSc in Computer Game Engineering has high success rates for putting students directly into world-leading video games' studios, often before studies have finished. By combining teaching and research we provide future leaders to the global video games industry.

Energy Storage Test Bed Facility

Supported by the EPSRC, Siemens and Northern Powergrid, the energy storage test bed is a unique grid-connected facility open to industry and academia for use in investigating and testing emerging storage tools, techniques and materials. It is highly flexible and capable of integrating a multitude of electrical energy storage systems. The test bed is available to the world’s leading innovators in energy storage technology to evaluate their own technologies in real-time and understand what impact they have on the distribution network.

“Through the range of research spaces, comprehensive monitoring, and ‘building-as-a-lab’ concept the USB is not just here to be sustainable, but to challenge what sustainable means”.

Newcastle City Council Lord Mayor’s Design Awards
Open Lab
openlab.ncl.ac.uk

Open Lab is a world-leading interaction design and ubiquitous computing research group in the School of Computing. It focuses on the experience-centred design of digital technology and applied challenges in ubiquitous computing. One of the top three in the world for research papers on Human-Computer Interaction, it includes the Digital Economy Research Centre and EPSRC Centre for Doctoral Training in Digital Civics.

Centres for Doctoral Training in Digital Civics and Cloud Computing for Big Data
digdata-cdt.ac.uk
digitalcivics.io/apply

The EPSRC Centre for Doctoral Training in Cloud Computing for Big Data is creating future leaders in data science by tackling the enormous skills shortage in data analytics in the UK, training them in using big data to solve problems, generate new interdisciplinary research and pioneer new business opportunities.

The EPSRC Centre for Doctoral Training in Digital Civics delivers applied research training for doctoral researchers who do projects in a range of fields including digital public health, digital social care, digital learning and digital democracy.

Scalable Computing
ncl.ac.uk/computing/research/groups/scalable

The School of Computing is creating enabling technologies from microscale to large-scale systems that meet the needs of industry and society, from chemical engineering to health care, medicine, railways and the entertainment industry.

Maker Space

Ambient Kitchen
The School of Computing is recognised by the UK government as an Academic Centre of Excellence in Cyber Security Research. It is creating modern information systems, networks and infrastructures that are dependable and secure.

The Urban Observatory is the largest urban sensing network in the UK. Urban sensors are becoming the eyes and ears of cities – enabling new ways to tackle a range of challenges such as improving air quality, integrating transport and preparing for climate change. Recording millions of observations daily, the Urban Observatory uses urban monitoring to provide insights into how Newcastle works over multiple time frames and sectors.

The Decision Theatre is an interactive 3D facility linked to the Urban Observatory that provides companies, policy makers and researchers with powerful data visualisation for collaborative decision making. It allows real-time data from the city to be analysed and explored, and to solve problems through the sharing of data.

The School of Computing is paving the way for new insights, discoveries and technologies that combine interdisciplinary expertise in computing with the biological sciences. Researchers are developing new tools from computing to resolve complex problems in the life sciences as well as harnessing biology to solve computational problems more efficiently and sustainably.
Computing is everywhere and nowhere simultaneously. ‘Cloud computing’, ‘wireless networks’ and ‘virtual realities’ make it increasingly harder for people to see how ubiquitous digital processes have become. This building was conceived as a space that creates, curates and relies on digital connections.

**PunchcardPast**

Punch cards were first used to control machinery in the early 19th century, and later carried data and instructions for calculating machines and digital computers. The site the USB is built upon has a rich cultural and industrial heritage that goes back even further.

PunchcardPast draws links between digital process and the site’s history. The small dotted pattern that runs around the building represents a punch card carrying the following message, encoded using methods invented in the 1960s:

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GALLOWGATE - NORTH ELSWICK COLLIERY
SCOTTISH & NEWCASTLE BREWERY - SCIENCE CENTRAL
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The dot patterns were designed to be appreciated close-up. As an echo of the history of this site and of early methods of data storage, they reflect the physical beginnings of the digital revolution.

**Limestone Floor**

Irish Blue Limestone has been used in the USB’s ground floor. This rock contains abundant fossils that help define its age, and the environment in which it was deposited. The limestone is around 340 million years old. At this time, the site was occupied by river channels that brought sand down from mountains to the east. The limestone shows that further west, calm coral seas, teeming with life, existed at the same time.
Newcastle helix

The USB is one of the first buildings on the Newcastle helix site, a £350million flagship project bringing together academia, communities, business, industry and the public sector.

A partnership between Newcastle University, Newcastle City Council, and Legal & General, Newcastle helix is taking shape as the UK’s biggest urban development site outside London and is fast-becoming an internationally-renowned innovation centre for sustainable engineering, ageing and data sciences.

“The Newcastle helix is set to be a site of world-leading research and technological advances alongside global businesses that will enable us to write the next chapter in our region’s enviable story of invention and innovation”.

Professor Chris Day, Vice-Chancellor and President, Newcastle University

The site has been transformed through a period of demolition, urban coal mining, groundworks and now construction.

By 2019 the USB will have been joined by the ‘Newcastle Laboratory’, providing facilities and offices for a wide range of companies working in life science and healthcare. By 2020 the National Innovation Centres for Data and Ageing, and Newcastle University’s £29million Learning and Teaching Centre will also have opened.

Image Credit: Render 3D. Subject to planning approval
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