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Towards Pioneer Campus 2040

Report to Harwell Science and Innovation Campus

SQW

Contents

Contact:
Donald Ross
Tel: 0161 475 2108
email: dross@sqw.co.uk

Approved by:
Christine Doel
Director
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Executive Summary

1. In spring 2022, **Harwell Science and Innovation Campus** commissioned **SQW** to complete a programme of independent research to inform a debate about the changing nature and role of single-site campuses within global innovation clusters. Specifically, the study considered **what might be learned about '*Pioneer Campus 2040*' from the way campuses around the world have evolved and how they are currently both navigating and shaping key drivers of change.**

2. The research focused on eight case study campuses. These were chosen because they met four criteria: international visibility because of the quality/quantity of research and innovation conducted; an easily identifiable single site; multidisciplinary, with strengths in more than one core discipline; and a 'mixed economy' of public and private sector actors. However there were substantial differences between the sites. Each of the case studies involved a review of relevant literature, and consultations with campus owners/managers and local/regional policy makers.

3. In relation to the current functions of the eight case study campuses, the study drew three main conclusions:

   - **First, the eight campuses are key nodes in the knowledge economy**. While they vary in terms of longevity and science intensity, all contribute to science, research and innovation, and to wider processes of economic growth. They are helping to accelerate processes of enterprise and commercialisation, and many are providing a focus for inward investment.
   - **Second, all eight campuses are international players**. They host and curate international science and innovation, sometimes linked to large scale research facilities; they employ an internationally mobile workforce; and they are – increasingly – financed by investment that is in part international. The policy framework in relation to international research, science, innovation, commercialisation and finance is critically important in shaping their character, performance and prospects.
   - **Third, the form and function of the campuses has evolved – and continues to evolve.** The campuses are responding to – or in some cases precipitating – major changes across the science, innovation and enterprise nexus. This incremental process will need to continue. Local planning authorities and other local partners play a key role. Campuses are national assets which happen to be located in a particular place; however alongside the national landscape, the local context is also important in shaping future evolution.

Pioneer Campus 2040

4. Amongst the eight case study campuses, there is no single form for a successful campus in 2023, and we suspect this will be equally true in 2040. The period to 2040 is a relatively short

time for campuses to look and function in a radically different way. **Through on-going evolution, some/all of the case study campuses could become *Pioneer Campus 2040.*** But equally, emerging campuses (and/or other campuses which are already well developed but were not selected as case studies) may shape the narrative half a generation from now.

5. A core scenario for *Pioneer Campus 2040* is that it will:

- **continue to drive innovation; indeed, that must be its fundamental rationale.** The importance of *facilitated serendipity* is likely to continue, as will the *role of the campus in wider clusters and flows of knowledge*. Its capabilities will be founded on scientific excellence and knowledge, but their application will pivot to address emerging societal and global challenges.
- **be a place that can win the global 'war for talent'** through a compelling live, work and play offer. The *needs and aspirations of internationally mobile workers and their families* will be met – either on the campus itself or in its immediate environs – and *talented people from any and all backgrounds* will be stimulated to excel and thrive.
- **operate as a Net Zero exemplar,** perhaps in the context of *multi-site models* which will be unlocked through advanced digital technology. 'Distance' will be of much less consequence, but the importance of *relationships between people* – as a force for innovation – will be recognised fully; and the value of proximity in facilitating these relationships will not be lost. The campus will also *develop tools and insights* for other places/communities to adopt Net Zero approaches.
- **be confident in its role and telling its story**. This will be enabled by a *supportive public sector*, and steered through *new and creative approaches to management and governance*.

6. There are however uncertainties and risks surrounding the core scenario. These include: prioritising sovereign capability in strategically important areas; near-term recession, with an uncertain global financial system and public sector austerity; technological disruption; and the consequences of any failure to attract and retain an appropriate workforce.

Looking ahead

7. Future evolutions will be complicated. A constructive dialogue between national and local government and those responsible for the governance and management of campuses will be important. This ought to focus especially on:

- the steps that might be taken to **manage private and public relationships, and remaining boundaries between science, innovation and commercialisation**.
- the scope to **use campuses as 'living laboratories',** responding to the challenges of the day and gaining critical insights in the process.
- the **'liveability' of campuses and their environs** and the steps that might be taken to improve further the quality of life (in the widest sense) associated with them.

1. Introduction

Context and purpose

1.1 In March 2022, Harwell Science and Innovation Campus (Harwell Campus) commissioned SQW to complete a programme of independent research to inform a debate about the changing nature and role of single-site campuses within global innovation clusters. Looking ahead to 2040, we were asked to consider what the characteristics of a globally leading campus ('*Pioneer Campus 2040*') could be. Our research question was:

"What can we learn about Pioneer Campus 2040 from the way key drivers of change are being navigated and addressed across eight campuses around the world?"

1.2 The intention was to crystallise views and to inform an important, broader, debate. The pandemic emphasised the critical role of science-based research and innovation. The speed with which capabilities were pivoted – especially across advanced materials and engineering specialisms as well as life sciences – reinforced the strategic significance of science and technology competencies across wider national innovation ecosystems (including universities, research organisations and businesses). At their best, major single-site campuses play an important role in this process of research translation. At the same time, however, levels of remote working and digitised research and development (R&D) have increased, and potentially these challenge the traditional workplace model. The future evolution of such campuses – and that of the broader clusters of which they may be a part – is therefore a key consideration for policy-makers across the UK and beyond.

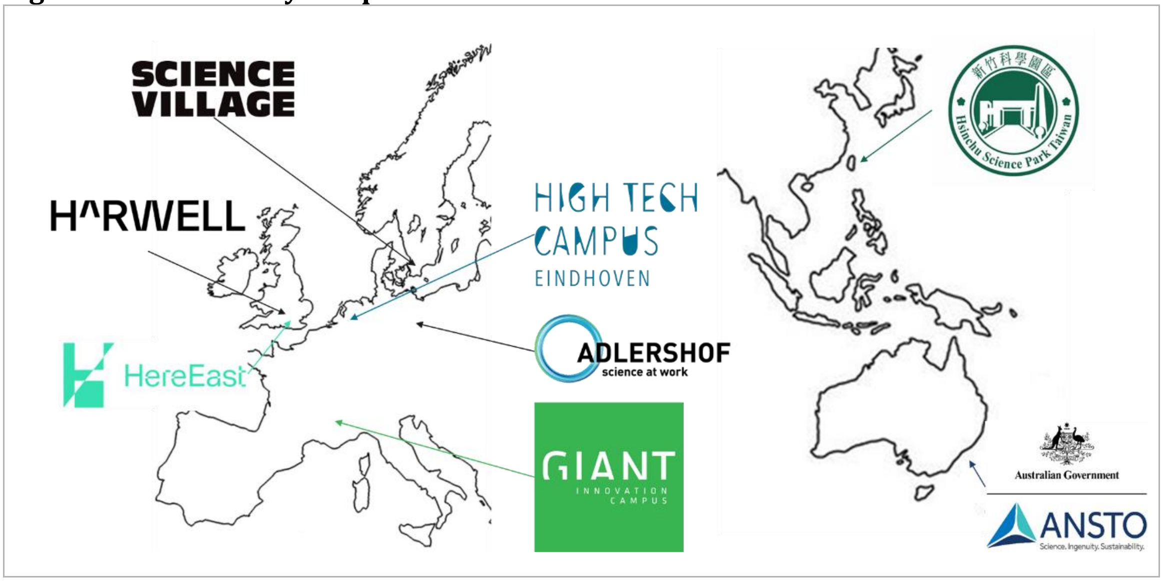
Approach and methodology

1.3 In discussion with Harwell Campus, we identified a long list of campuses that could form the focus of this study. Four criteria were used to move from a long list to a short list. Case study campuses should be:

- single-site in structure
- multi-disciplinary in focus, with strengths in more than one core discipline
- internationally visible because of the quality/quantity of research and innovation conducted
- characterised by a 'mixed economy' of public and private sector actors.

1.4 Eight case study campuses were chosen. These are shown in the map below. Two are from the UK, four are from elsewhere in Europe (Sweden, Germany, Netherlands, France), with one each from Taiwan and Australia. As explained in Chapter 2, the eight campuses have similarities but there are also substantial differences between them. In combination, they were intended to provide a rich and challenging evidence base.

Figure 1-1: Case study campuses



Source: SQW

1.5 Across each of the case studies, we reviewed relevant literature and other evidence. We also spoke both to campus owners/managers and, where possible, to local/regional policy makers. The purpose of these discussions was: to explore the past evolution of the campus; to understand the essence of the campus currently and consider the role it is playing in relation to cluster growth more generally; to examine drivers of change; and to consider how the campus might evolve looking ahead (taking into account both formal proposals/plans and wider ambitions).

Structure of this report

1.6 This report is divided into four further chapters:

- **Chapter 2** draws on case study evidence and a review of wider literature to consider the history of different campuses, and to distil key insights into '*what has made them work?*'
- **Chapter 3** considers some of the drivers of change that are shaping the environment in which the campuses operate, and reflects on how campuses are responding.
- Looking ahead – and very much as a basis for discussion – **Chapter 4** addresses what a '*Pioneer Campus 2040*' might look like and what role it might play within broader innovation clusters.
- Finally, **Chapter 5** draws together some wider reflections and conclusions.

1.7 Annexed to the report is a detailed profile of each of the case study campuses.

Acknowledgements

1.8 We would like to thank the managers of case study campuses, and local/regional policy makers, for sparing the time to speak to us, for reviewing and approving the draft case study reports (which are presented in Annex A) and, in some cases, for hosting highly informative case study visits. We would also like to thank our immediate client group – from Harwell Campus and the Science and Technology Facilities Council (STFC). We are very grateful for these different inputs.

2. Clusters, innovation locations and campuses: what makes them work?

2.1 This chapter summarises evidence from the literature on clusters and innovation locations to frame the study. It then introduces the eight case study campuses and reviews evidence from them to understand past evolutions and pinpoint '*what works*' currently.

Framing the study

Introducing clusters and innovation locations

2.2 There is a large body of theoretical and empirical work about clusters. Following Michael Porter in the 1990s, these are commonly defined as "*geographic concentrations of interconnected companies and institutions in a particular field*."[1] Successful clusters rely on many factors including the availability of skilled labour, the growth of 'supporting trades' and infrastructure, and the specialisation of firms in different stages of production. Perhaps most importantly, clusters are driven by shared rules and conventions which are often informal and based on tacit knowledge and trust. The importance of this was recognised as long ago as 1890. The economist Alfred Marshall observed that once the process of local specialised industrial concentration has begun, it becomes both cumulative and socialised such that "*the mysteries of the trade become no mysteries; but are as it were in the air.*"[2]

2.3 Innovation is at the core of successful clusters. Often this is fuelled by exchanges between talented people[3]. Proximity plays a clear role in facilitating unplanned or serendipitous 'collisions' – especially within the context of a cluster where individuals will share tacit knowledge.[4] Edward Glaeser and Richard Florida, amongst others, have written about the importance of dense networks of human capital/creativity in creating successful places.[5] However, improvements in technology – and the rise of remote working – mean there is now greater potential for these exchanges to occur online.

2.4 Alongside the cluster narrative, there is a large and 'multi-purpose' literature – from academics and think tanks through to property agents – concerning innovation locations. The variety of authors (and audiences) has led to a proliferation of definitions of innovation locations from Science Parks through to Innovation Districts/Corridors/Hubs, with different terms sometimes used to refer to places that are, in reality, similar.

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[1] Porter, M *Clusters and the New Economics of Competition* in Harvard Business Review, November/December 1998

[2] Marshall, A (1890) *Principles of Economics*

[3] See, for example, Moretti, E *The Effect of High-Tech Clusters on the Productivity of Top Inventors* in American Economic Review, 2021

[4] Mulgan, G. (2019) Innovation districts

[5] For example, Glaeser, E (1994) *Cities, Information and Economic Growth* in Cityscape 1(1): 9-47 and Florida, R (2017) *The Rise of the Creative Class*

The links between clusters, innovation locations and campuses

2.5 It is apparent that there is a clear – but complex – relationship between clusters and innovation locations (whether these are campuses or other configurations). Clusters can develop at different spatial scales. In some cases, clusters may occur at the scale of a single-site science and innovation campus. Here, a campus offers both the commercial space which growing firms require, and also access to cutting edge scientific research and networks of likeminded individuals. More frequently, a campus will be one location in a wider cluster which could be defined at city, regional, national or international scale.

2.6 Importantly, campuses are not limited to hosting/being part of one cluster. The combination of research and innovation assets in different technologies/sectors allows activity on campus to drive innovation in a range of different technologies and contribute to diffusing technologies/techniques across sectors and industries.

Key success factors – from the literature

2.7 A synopsis of the 'success factors' identified in relation to innovation locations is provided in Table 2-1 overleaf. Reflecting the breadth of innovation locations included in the literature, Table 2-2 then illustrates how different 'success factors' have been identified by different studies at different times.

2.8 There are common themes from the literature. Notably, the importance of building and maintaining a set of **core competencies** to provide competitive advantage, and having the **leadership and vision** to develop these competencies and the site as a whole over the long term. This includes providing a **mixture of affordable commercial space** as well as encouraging networking to promote **idea sharing** and **clustering behaviour**. Achieving a **critical mass of activity** is both a cause and consequence of 'success'. It is an important factor in stimulating further activity and – potentially – further success by creating a virtuous cycle of growth.

2.9 Innovation locations do not develop in isolation and successful locations are frequently enabled by **supportive local public organisations** and the **wider infrastructure** they provide or enable – such as transport, broadband and housing. The latter is particularly important for innovation districts where the **lifestyle** offer is an integral part of the location.

2.10 In common with other business districts, but perhaps to an even greater degree given the highly specialised nature of activity, innovation locations also rely on a **skilled workforce**, **access – and often proximity – to markets**, and the **access to funding and business expertise** which entrepreneurs require to turn technological innovations into commercially successful businesses.

Table 2-1: 'Success factors' in relation to innovation locations – as identified in literature[6]

Factor	Why is it a 'success factor'?
Core competency(ies)	Successful innovation locations often have a competitive advantage in one or more areas to provide a USP. This could be gained from the presence of specialist 'big science kit', the organic growth of likeminded organisations or a policy decision to focus on emerging specialisms (rather than broad sectors). Entry criteria for businesses and research organisations can be used to build/maintain these core competencies. A clearly defined core competency may help to attract companies and talented individuals.
Leadership and long term vision	Successful innovation locations frequently benefit from clear leadership and a long term vision. Institutional leadership can come from the public or private sector, a university and/or public research facility, commonly with multiple actors working as a partnership over many years. Developing a common ambition and long term commitment from all stakeholders is crucial as innovation locations take time to develop. The development of innovation locations is often linked to an individual (or small group) with the ability to drive the vision forward, due to personal commitment, charisma, and authority.
Critical mass	Achieving a critical mass of activity on site is both a cause and consequence of 'success'. It is an important factor in stimulating further activity and – hopefully – further success by creating a virtuous cycle of growth. This requires a sufficient number of organisations and talented individuals with capabilities in the same core competency(ies) and, crucially, strong linkages between them.
Skilled workforce	Many successful innovation locations rely on a talent pipeline from universities and other educational institutes on site or nearby to build a long term supply of high-skilled labour. This can be supplemented by recruitment from elsewhere, including internationally.
Ideas sharing	Successful locations have a culture of sharing ideas between – and within – research and business communities. This may be through formal or informal collaborations which operate within disciplines and/or between adjacent sectors where technologies are converging. Idea sharing is facilitated by physical infrastructure and 'social engineering' to create environments for individuals to 'collide' and form new ideas.
Lifestyle	The work, live, play and learn offers of innovation locations have become a key part of their success. Creating a community with a 'buzz' – rather than a 9am-5pm business park – helps to attract talented people and encourage them to interact. Common areas and shared public spaces within the innovation location are important to this, as are wider contextual factors such as affordable housing and the cost of living, accessibility, etc.

[6] See Table 2-2 for full list of sources

Factor	Why is it a 'success factor'?
Access to markets	Access - and ideally proximity - to markets support the growth of innovation locations, for example a cluster containing the whole supply chain or nearby industries that require the capabilities of organisations based at the innovation location. Product and service markets eventually become national and global, but may start more locally. Sometimes this is through a single (major) purchaser such as a large hospital or government department. Innovation locations can also benefit from public policy incentives to develop solutions to societal problems. This can create new (local and/or national) markets for organisations based at the innovation location.
Access to funding and business expertise	Technically skilled company founders require access to wider business acumen to support growth, this includes professional leadership and management, mentors, IP lawyers, accountants, etc. Successful innovation locations provide easy access to these services. Linked to this is access to financial support for start-ups and firms at different stages of development. This includes private sector Venture Capital funds and business angels etc. alongside public sector support (e.g. R&D grants and tax incentives). Again, successful innovation locations may provide this on-site or facilitate access to financiers based elsewhere.
A mix of affordable commercial space	A broad property offer in terms of the scale and type of accommodation available to suit companies of all types and sizes is required to ensure that a mix of organisations are accommodated at innovation locations. This mix is important to the 'vibrancy' of a given location and prevents it being dominated by, for example, large corporates. Increasingly, locations have provided flexible spaces which can be adapted by tenants as they grow and/or by property owners as tenants change. Property costs must also be competitive with other innovation locations and not 'price out' exciting early stage businesses.
Wider infrastructure	Transport infrastructure - roads, railways and airports - is necessary to easily move people and goods to/from the innovation location. High speed broadband connectivity and a reliable electricity supply – especially for operating big science kit – are also crucial. Other physical assets such as access to (affordable) housing and retail/leisure space also influence the attractiveness of a given location, although they can be provided adjacent to the innovation location rather than on-site.
Supportive local public organisations	Innovation location owners/managers cannot deliver the wider infrastructure themselves. They rely on a supportive public sector at the local/regional level to enable and deliver the transport and digital infrastructure, as well as leisure offer, housing etc. The public sector also sets the planning context for the construction of new office/lab space at the innovation location. This factor is more context specific than some others, e.g. whether land use planning is conducted at city, region or national level, and whether the relevant city/region has scope to vary tax rates and employment law within national parameters.

Source: SQW analysis

Table 2-2: Evolution of 'success factors' identified in the literature

	SQW (2001)	PwC (2011)	Brookings Institution (2017)	Global Institute of Innovation Districts (2019)	HR&A Advisors, New Localism, GIID (2020)	Royal Society (2020)	Satellite Applications Catapult (2021)	Savills (2021)	Connected Places Catapult (2021a)	Connected Places Catapult (2021b)	Arthur D. Little (2021)
Core competency(ies)	x	x	x	x		x			x	x	x
People: leadership, researchers, workforce	x	x	x	x	x	x	x	x	x	x	x
Culture: idea sharing and lifestyle	x		x	x	x	x	x	x	x	x	x
Business capabilities	x		x	x	x	x	x		x	x	x
Access to markets			x			x			x	x	
Access to funding	x		x	x	x	x	x	x	x	x	
Infrastructure provision	x		x	x	x	x	x	x	x	x	
Regulatory environment			x		x	x	x	x	x	x	
Inclusion-innovation link				x	x				x	x	
Critical mass				x			x		x	x	
Environmental sustainability / Net zero principles									x	x	
Flexible spaces									x	x	x

Source: SQW analysis of SQW (2001) The Cambridge Phenomenon Revisited, Arthur D. Little (2021) The future of innovation districts, Brookings Institution (2017) Clusters and Innovation Districts: Lessons from the United States Experience, Connected Places Catapult (2021) Hubs of Innovation: The role of Districts, Corridors and Quarters as hubs of the Covid-adjusted innovation economy, Global Institute of Innovation Districts (2019) The Evolution of Innovation Districts, HR&A, New Localism & Global Institute of Innovation Districts (2020) Innovation Zones: How the Federal Government Can Create Thriving, Place-Based Innovation Ecosystems, PwC (2011) Uncovering excellence in cluster management, Royal Society (2020) Research and innovation clusters, Satellite Applications Catapult (2021) An International Comparison of Approaches to Space Cluster Development, Savills (2021) Science Cities

Introducing the eight case study campuses

2.11 This sub-section introduces the case study campuses and some of the differences between them. It then explores how the campuses have evolved and examines – from the perspective of the campuses – '*what works*' currently.

The campuses in 2023

2.12 A brief synopsis of each of the eight case studies is provided below (and a more detailed account is available at Annex A).

Table 2-3: Introduction to case study campuses

Campus	Introduction
Adlershof Science and Technology Park, Germany	Adlershof's origins go back to the early 20th century when the site housed the testing facilities of the German Research Institute for Aviation, and subsequently several institutes of the East German Academy of Sciences. The 193-acre Park – and the wider Science City – are now operated by a subsidiary company of the State of Berlin. The Park hosts 16 scientific institutions and has over 500 companies. Employment on site is about 11,600 people, and there are 6,650 students.
ANSTO Innovation Precinct, Australia	The Australian Nuclear Science and Technology Organisation (ANSTO) is an Australian Government agency with leading nuclear science and technology capability. Refocused in 1987 towards the peaceful use of nuclear technology, ANSTO is developing a 272-acre Innovation Precinct around its major research facilities outside Sydney. A key milestone was the opening of the 1,200sqm *nandin* Innovation Centre in 2021. The Centre has around 40 member businesses which support over 360 jobs.
GIANT Innovation Campus, France	GIANT (Grenoble Innovation for Advanced New Technologies) Innovation Campus was founded in 2008 to facilitate collaboration within and between research, higher education and industry already based in Grenoble. The origins of scientific activity can be traced to the establishment of the Grenoble physics laboratories of the French Atomic Energy and Alternative Energies Commission in 1956. Today, GIANT hosts 10,000 research jobs, and the same number of industrial jobs and students on a 568-acre site.
Harwell Science and Innovation Campus, UK	What is now Harwell Campus was founded in Oxfordshire in 1946 as a site dedicated to atomic energy research. The Campus now hosts over 6,500 scientists, engineers and innovators across more than 200 public, private and academic organisations on a 700-acre site. The Campus is owned by and operated through a public/private Joint Venture between the UK Government (Atomic Energy Authority and the Science and Technologies Facilities Council) and Brookfield Asset Management.
Here East, UK	Here East is an innovation and technology campus situated in Queen Elizabeth Olympic Park, London. Originally developed as the media complex for the 2012 Olympic/Paralympic Games, the site is developing into a digital and creative hub. Around 130 businesses have a presence at Here

Campus	Introduction
	East and there are c. 5,500 people working or studying at one of the three universities on the Olympic Park.
High Tech Campus Eindhoven, Netherlands	The former site of Philips' R&D activity on the southern edge of Eindhoven was opened to other tech companies in 2003. Philips remains the largest tenant but is no longer the owner of the site. As of 2022, the Campus was home to over 280 organisations, including c. 100 start-ups. Around 12,500 people are employed at the site.
Hsinchu Science Park, Taiwan	Hsinchu Science Park was the first science park in Taiwan when it opened in 1980 as part of a national strategy to move the economy into higher value, science based areas. Known for its semi-conductor cluster and location adjacent to the Industrial Technology Research Institute (ITRI), the main Hsinchu site hosts over 400 tenant businesses and has employment of almost 140,000 people.
Lund Science Village, Sweden	Lund University is an historic institution and hosts the Max IV synchrotron. The university, Lund Municipality and Region Skåne have formed a joint venture to develop a new urban extension called the Science Village which aims to become 'the world's best research and innovation environment', with an eventual target of 16,000 residents and 24,000 jobs.

Source: SQW analysis. See Annex A for further details

2.13 Looking across the case studies, it is notable that the more mature sites exceed 250 acres in footprint. These sites generally host over 200 public, private and academic organisations, with total on-site employment typically summing to between 6,000 and 12,000 jobs. All are substantial operations. Some of the sites are also characterised by the presence of 'big science kit' – e.g. a synchrotron/neutron source. Industrial and research strengths in energy, health and digital technology are common to most case study sites.

Differences between the campuses

2.14 Beyond these high level similarities, however, there are important differences between individual campus examples. For example, site locations vary with some campuses situated in relatively stand-alone settings (such as **Harwell Science and Innovation Campus** and **ANSTO Innovation Precinct**), whilst others have evolved in or very close to large urban areas and 'global cities' (e.g. **Adlershof Science and Technology Park** on the southern edge of Berlin). Maturity is another important distinction between the sites. Scientific activity at some dates back to the immediate post war period, whilst **Here East** and **Lund Science Village** are much more recent developments; albeit Lund University is an historic institution.

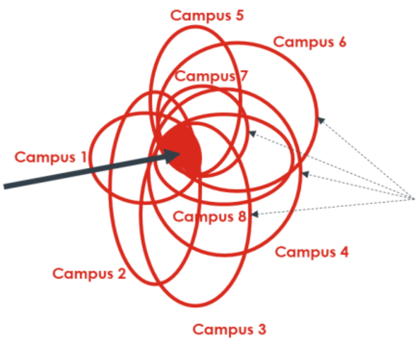
2.15 The relationship between campuses and clusters also varies. The semi-conductor cluster at **Hsinchu Science Park** is defined at the scale of the single-site campus. Conversely, **High Tech Campus Eindhoven** needs to be recognised as part of the wider Brainport initiative. All of the Campuses have global connections, but of many different forms. Large scale research facilities such as synchrotrons, for example, attract researchers from multiple countries to visit a campus, and businesses on a campus are often part of international supply chains.

2.16 These contextual observations matter. It is important to understand them, as '*what works*' for each site will vary depending on their differing characteristics/contexts. The similarities and differences between the case study campuses are summarised in the graphic below.

Figure 2-1: Eight case study campuses: similarities and differences

Case study campuses are:

- **Internationally visible hubs** of research and innovation activity
- **Single site**
- **Multidisciplinary**, with strengths in more than one core discipline
- **A 'mixed economy'** of public and private sector actors



Individual hubs vary substantially on many other characteristics such as:

- the role of the state in seeding and growing the site
- levels of maturity
- scale, both in terms of physical size and number of organisations/employees on site
- presence of big science 'kit' and HEI teaching functions
- balance between employment, live and play
- proximity/relationships to urban areas
- wider regional/national context

Source: SQW

Looking backwards: how campuses have evolved over time

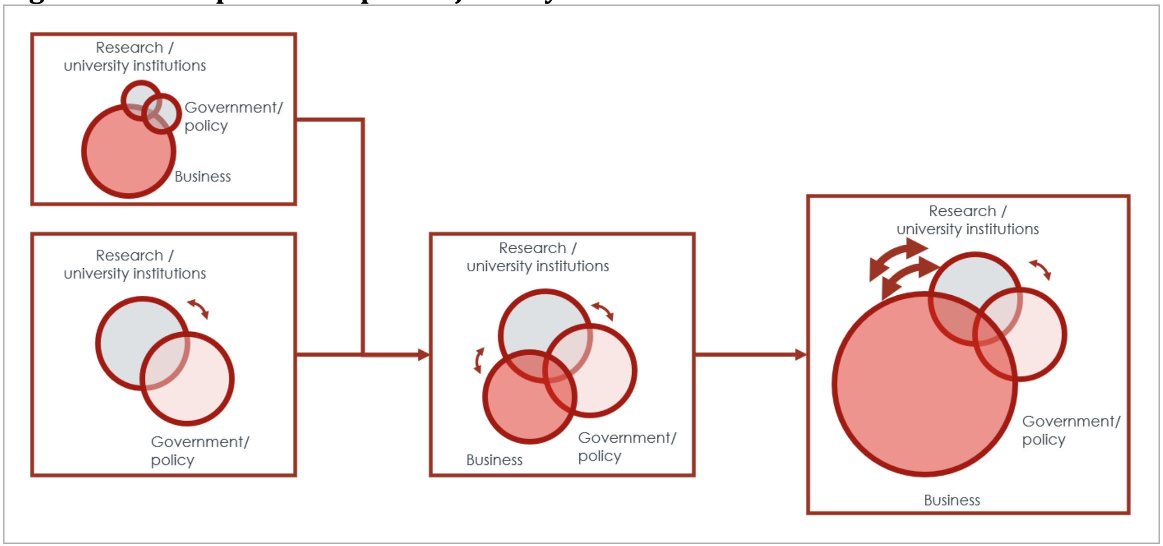
2.17 Most of the older case study campuses (**Adlershof, ANSTO Innovation Precinct, GIANT, Harwell Science and Innovation Campus,** and perhaps **Hsinchu Science Park**) were defined around a key set of related objectives all linked more or less closely to national security concerns in the post-war/mid-20th Century period. This in turn led to five key underpinning characteristics:

- **National assets** – Despite their location in particular places, the campuses were established as national assets with objectives linked to national level capabilities rather than generating local economic impact.
- **State-led** – For the most part, the older campuses were founded, planned and financed by the State (often at national but sometimes at regional levels). The objectives of the campuses, or at least the science and industrial activity conducted on them, were also set by national government and/or its agencies.
- **Infrastructure** – In general, the older campuses were founded and grew up around (expensive) state-funded large scale research facilities such as synchrotrons, nuclear facilities, and high specification laboratories.
- **Applying science to national challenges** – The initial focus of activity was typically the application of science for defence or energy security purposes rather than industrial or commercial application – although **High Tech Campus Eindhoven** and **Hsinchu Science Park** were outliers as they were explicitly founded by/for industry.

- **Secure** – There are two dimensions here. First, some of the older campuses were specifically located in relatively remote areas to contain any risks/negative effects, particularly those associated with nuclear facilities. Second, the campuses were designed to be secure to contain any knowledge/benefits within their boundaries because of the national security implications of knowledge generated, and/or due to vertically integrated innovation models.

2.18 Within their particular national and locational contexts, all of the older campuses evolved as relationships between government, research institutions/universities, and the private sector changed. In character, the sites have converged over the years towards a 'mixed economy' model as shown in the graphic below. Typically the campuses now host a higher level of industrial activity, and greater levels of collaboration between organisations (both public sector and private sector) on site. The private sector has also played a greater role in financing the development of the campuses over recent years.

Figure 2-2: Campus development journeys



Source: SQW

2.19 As part of their development journey, the focus of the older campuses has typically broadened out from the key early objectives and underpinning characteristics. In large part, this has reflected changing balances in relation to uncertainty and risk, for example knowledge sharing and 'open innovation' behaviours are now actively encouraged and supported. The newer case study campuses were founded with this innovation model firmly in mind.

'*What works*' currently?

2.20 Previous studies have tried to consider '*what works?*' in relation to innovation locations. As set out above in Table 2-1 and Table 2-2, the literature identifies success factors for varied locations from individual buildings through suburban Science Parks to urban Innovation Districts.

2.21 Evidence from the eight campus case studies broadly supports the same group of 'success factors', although **nationally/internationally significant core competencies** are especially prominent. The role of hard infrastructure in **building a critical mass** of activity is also important, but so too are 'softer' success factors relating to the **culture of an effective campus** and the **skills of its workforce**.

2.22 One of the major themes from the case studies was the importance of **sustained long term support from the public sector**.[7] This is perhaps a more prominent success factor for major campuses than for other innovation locations given the history of many of the case study sites with their foundation based upon significant public sector investment in scientific facilities and capabilities for the national interest.

2.23 Previous studies have identified the importance of having a **high quality campus management team**. Our research supported this, but interestingly there is a wide range of different management models amongst the case studies. Some are owned by a single private sector actor, others by the state (sometimes through a wholly owned operating company). Joint ownership is also represented; some sites have formal public/private joint ventures and one is an informal alliance of eight partners. Rather than formal structures, the evidence suggests that '*what works*' in relation to management is perhaps more strongly linked with the quality of the respective leadership and management teams, including their ability to adapt to external changes, trial new approaches, encourage collaboration on site and develop constructive relationships with external organisations.

[7] The case study campuses were from different countries with different institutional contexts. Public sector here refers to support from central, state and/or local government or their agencies.

3. Drivers of change

3.1 The eight case study campuses have all evolved since they were first established. This evolution is ongoing. It responds to, and anticipates, a series of STEEP (Social, Technological, Economic, Environmental, and Political) drivers which are shaping the environment in which the campuses operate. The STEEP divers presented below have emerged from the case study research and background literature review. They are 'live' issues to which campuses are responding currently and/or developing near-term solutions. They also start to provide an insight into the probable backdrop for *Pioneer Campus 2040.*

Table 3-1: STEEP drivers

Social	• Lifestyles and expectations in Gen Z and beyond
Technological	• Digital transformations • Scientific breakthroughs leading to new knowledge with industrial applications
Economic	• Global markets for investment, knowledge and people • Cost imperatives, including around large scale research facilities
Environmental	• Net Zero obligations and other environmental considerations
Political	• Geopolitics/national security alliances • National politics and the structure of public sector research funding • Local politics and civil society

Source: SQW analysis

Social drivers

Lifestyles and expectations of Gen Z

3.2 Generation Z (or Gen Z for short) refers to the cohort that was born between the late 1990s and early 2010s. Whilst individual preferences vary, Gen Z collectively is recognised to have different expectations about work and lifestyle preferences compared to their millennial predecessors and older generations.[8]

[8] Deloitte: Understanding Generation Z in the Workplace

3.3 Gen Z is demanding that employers integrate commitments to societal goals into organisational culture, rather than merely paying 'lip service' to them.[9] In this context, striving towards net zero (discussed below) is helping to attract individuals to specific employers and their campus locations. Given the potential impacts of technologies developed through research and innovation, the campuses should be well placed to provide Gen Z with careers that are rewarding and can have a positive effect on society.

> **Campuses are well placed to provide Gen Z with careers that are rewarding**

3.4 Questions about the location of work are harder to answer. They are also particularly important for campuses where spatial proximity and 'collisions' support the innovation process. Much of the existing workforce adapted to remote working during the pandemic. For Gen Z, this coincided with their first exposure to the world of work. For the economy overall, a hybrid model seems likely to persist, with employers providing flexibility to attract and retain the best staff.[10] Companies based at campuses – and public sector researchers – often rely on access to big science kit and/or laboratories which cannot be recreated in a remote working scenario (although see below on *in silica* advances). More broadly, in person communication continues to be important for innovation communities, e.g. where designing/discussing prototypes. Whilst campuses are therefore seeing less working from home than purely office-based service/business locations, there have been significant changes in working patterns nonetheless.

3.5 For campuses this is meaning simultaneously planning for higher levels of remote working, whilst also enhancing efforts to make sites into 'people places.' In relation to the former, campuses are considering the total amount of floorspace they provide as well as how it is configured, e.g. flexible spaces to adapt to changing occupier requirements, as well as more hot desks and meeting spaces to facilitate interactions when staff are on site. Equally, campuses are working hard to generate a 'buzz' to encourage people to work at the site. Across the case study campuses, there are programmes of events to bring people together, for example lunchtime seminar series, or expanding the 'non-work' related offer of food and drink options, sports and social clubs, etc. (such as the Wellness Centre at **High Tech Campus Eindhoven** or the Canalside at **Here East**). Another response identified through discussions is partnering with other campuses or developing satellite locations to cater for individuals who want to be surrounded by like-minded people

> **Campuses are working hard to generate a 'buzz' to encourage people to work at the site**

[9] Forbes: How to meet Gen Z's Workplace Expectations
[10] PwC: PwC's Global Workforce Hopes and Fears Survey 2022

but do not want to commute the full distance to the 'main' campus every day. **Adlershof Science and Technology Park's** emerging partnership with Lusatia Science Park and the town of Lübben is an example.

3.6 All of the campuses rely on international flows of knowledge to stimulate innovation and will continue to do so. This can be through conferences or short-term project based visits. However, campuses are also catering for globally mobile workers with young families looking for medium or longer term opportunities. Notably, the provision of international schooling on (as at **Hsinchu Science Park**) or near campus is important for attracting and retaining the current international workforce, as well as the workforce from Gen Z and beyond. Such schooling allows talented individuals to move between campuses/countries without excessive disruption to their children's education caused by the need to adapt to new languages, curricula, etc.

Technological drivers

Digital transformations

3.7 Advances in technology often originate in research and innovation (R&I) activity on campuses. As these technologies are adopted, they influence the next generation of R&I activity and how the campuses are functioning more broadly.

> **Campuses are acting as testbeds for digital technologies**

3.8 Digital technology is already a key theme for R&I activity at most campuses and its importance is growing. Technologies such as AI, robotics, and sensors – all enabled by 5G – have the power to transform the way businesses operate and life is experienced. Research underpinning these advances continues to be undertaken on the campuses. To facilitate this, campuses are providing testbeds for the new technologies such as the European Space Agency's 5G/6G Hub at **Harwell Science and Innovation Campus**, the autonomous drone trial at **High Tech Campus Eindhoven,** and the 5G Lab planned at **Adlershof Science and Technology Park**. **Harwell Science and Innovation Campus** is also acting as a testbed for the Darwin autonomous vehicle, whilst **Hsinchu Science Park** and other sites are using (or planning to use) digital technology as part of smart traffic monitoring programmes.

3.9 Within this context, R&I process are becoming increasingly digitised – a fact that was recognised on most case study campuses. An example is the rise of *in silico* studies in life sciences.[11] This concept is defined against *in vivo* studies which use living organisms (such as clinical trials or animal testing) and *in vitro* studies which are performed in controlled

[11] https://www.grandviewresearch.com/industry-analysis/insilico-clinical-trials-market-report

environments outside of a living organism. Both require specialist kit, lab space and highly skilled people. In contrast, *in silico* studies are biological experiments carried out entirely via computer simulation. This may have implications for the scale and nature of space required on campuses, as in silico studies may reduce requirements for specialised lab space for some studies. However, it is unlikely that lab space will be replaced completely.

3.10 Digital communications are also allowing research and innovation to be conducted across multiple sites. For example, the European Spallation Source (ESS) at **Lund Science Village** in Sweden will be a major facility for conducting experiments, but the data analysis team will be based in Copenhagen in Denmark.

3.11 As digital technology becomes more pervasive, the requirement for cyber security is rising. This applies equally to protecting the results of R&I activity and the day-to-day functioning of the campus. Moving towards 2040, campuses are seeking to ensure their digital defences remain at the cutting edge.

Scientific breakthroughs

3.12 Most of the case study campuses have defined a set of themes, priorities or clusters to describe and develop activity on-site (for example healthcare or quantum technologies) although some have concluded that the speed of change is making this impossible. The frontier of knowledge is advancing at pace and this seems set to continue. Some firms (most likely those off campus which are further from the R&I process) lack the capacity and capability to stay up-to-date with the latest scientific advances and what they might mean for their business. This is creating a role for campus teams in animating and nudging industry, facilitating interactions across clusters, and thereby shaping how insights generated by scientific breakthroughs might eventually be adopted and used.

> **“Campuses are shaping how scientific insights might be adopted by industry”**

3.13 Campuses are working to ensure they have the right capabilities to support these scientific breakthroughs and encourage their adoption across clusters. This means, for example, attracting Government investment into cutting edge large scale facilities to develop, maintain and continually improve capabilities / capacity. Similarly, campus operators are seeking to cultivate the presence of, or easy access to, enabling technologies such as AI, robotics and 5G which can be deployed to support business growth across multiple sectors.

Economic drivers

Global markets

3.14 The world economy is increasingly globalised, with supply chains often spanning multiple countries. There are worldwide markets for companies based at campuses. However, these worldwide markets are also meaning increased competition for investment and people.

3.15 These same competitive forces apply at campus level. The *UK Science Parks Association (UKSPA)* counts over 100 innovation locations as members, whilst the *High Level Forum* – an international network of innovation ecosystems, founded by **GIANT** – has received contributions from 45 locations around the world.[12] As the number of national and international sites grows, individual campuses are differentiating themselves so that they are well positioned to attract the investment necessary to sustain growth. The associated investment has been (or is being) secured from individual states, multinational bodies (particularly for big science kit, e.g. the ESRF at **GIANT** which is a partnership of 21 nations[13] and the ESS in **Lund Science Village** which is a collaboration between 13 countries), and private sector investors such as Oaktree Capital Management at **High Tech Campus Eindhoven,** Brookfield at **Harwell** and Delancey at **Here East**.

> "Campuses are operating in an increasingly competitive funding landscape"

3.16 Whilst the environment is competitive, it is also characterised by collaboration and knowledge sharing. For example, associations such as UKSPA and the High Level Forum are providing opportunities for sharing knowledge on '*what works*' to support the growth of campuses. The involvement of individual owner/manager organisations across multiple campuses – for example STFC at **Harwell Science and Innovation Campus** and Sci-Tech Daresbury, and **Hsinchu Science Park** Bureau at its main campus and five 'sister' sites – is also providing opportunities for knowledge sharing.

3.17 Importantly, campus management teams are increasingly seeking to articulate their offer to help attract the support they need in what is an increasingly competitive and crowded landscape. This is being achieved through conversations at national level with government, and in interactions with other stakeholders and potential (investment) partners. Discussions suggest that this in turn is helping campuses to work with local partners to shape key contextual factors such as basic infrastructure capacities, physical connectivity and the development of communities (discussed further below). Having a compelling offer is also

[12] UKSPA and High Level Forum
[13] https://www.esrf.fr/about/organisation/members-and-associates

allowing campuses to attract the talented individuals required to the drive growth and development of their sites.

Cost of large scale scientific infrastructures

3.18 As scientific knowledge advances, the cost of building and maintaining large scale research infrastructure is significant. The European Spallation Source (ESS) at **Lund Science Village** for example is forecast to cost €1.8 billion[14], whilst replacing the scientific kit and state of the art instruments at **ANSTO Innovation Precinct** would cost up to $AUS10 billion (approximately £1.6bn and £5.6bn respectively).

3.19 These infrastructures can be funded at national levels, such as the Diamond Light Source at **Harwell Science and Innovation Campus**. In other cases, individual countries are unable or unwilling make such significant investments alone, and therefore the costs are shared between multiple countries – the ESS itself is a pan-European project with 13 European nations as members. The consequence appears to be a greater concentration of assets in a smaller number of places that support and encourage collaboration with a broad user community. This is shaping campuses already and the process seems set to continue.

Commercial imperatives

3.20 There are warnings of a global recession in 2023 and beyond.[15] The economic shock caused by the Covid-19 pandemic, geopolitical uncertainties disrupting international trade, a severe energy crisis, rising inflation and a possible financial crisis are concerning policy makers around the world. While economic cycles are just that, the prospect of a downturn lasting a few years is bringing increased commercial pressures to bear on campus operators.

> **“Campus operators are facing commercial pressures”**

3.21 Constrained budgets – at least in the short term – are requiring campus operators to make difficult decisions. In adapting to higher levels of remote working, for example, campuses are having to think about how to design in flexibility cost effectively – both for new buildings and when redeveloping older buildings on site. Similar considerations apply to investments around Net Zero for new builds and retrofitting projects.

3.22 The same funding pressures also apply to the public sector in relation to the total volume of investment available for big science kit, as discussed above, and also the level of revenue expenditure directed towards research and innovation projects. Businesses will also be

[14] https://europeanspallationsource.se/ess-organisation
[15] World Bank: Risk of Global Recession in 2023 Rises Amid Simultaneous Rate Hikes

affected. Whilst there are benefits to R&D investment during times of crisis,[16] this is not always an easy decision for businesses to make and a prolonged recession may lead to lower levels of business innovation activity on campuses.

Environmental drivers

Net Zero obligations and other environmental considerations

3.23 Energy research was prominent in the early days of many of the case study campuses, and is likely to be so again in future. Climate change and rising global temperatures are topics of international concern. The United Nations Climate Change Conference (COP27) in Egypt in November 2022 was the latest of several attempts to design a collective global response. National governments are also acting unilaterally. The UK and France have both set a Net Zero goal by 2050, whilst Germany's target is 2045. This is having – and will continue to have – various consequences for the different campuses.

3.24 Technologies designed to support the transition towards Net Zero are already a key theme of R&I activity conducted on some campuses as research funders react to Government policy and imperatives from industry. Demand side R&I themes include reducing energy use (including through the design of new/improved processes). R&I themes on the supply side include alternative energy sources and battery technology. As sites of 250 acres (although there are larger and smaller outliers among the case studies) with easily identifiable boundaries and user groups, some campuses are piloting new approaches. They have the potential to be national leaders in the drive towards Net Zero.

> "Campus organisations are conducting R&I to support the transition to Net Zero"

3.25 Net Zero obligations – for example the UK's Minimum Energy Efficiency Standards for commercial properties – are also requiring campus management teams to embrace Net Zero in relation to new building design and operation, and to consider how best to retrofit existing properties, for example with roof mounted solar panels. As a more novel approach, **High Tech Campus Eindhoven** already uses sheep to 'mow' the grass on campus. For the campuses which host them, operating large scale facilities such as synchrotrons is energy intensive, but the discoveries they enable are creating a range of global benefits, from financial returns to reduced carbon emissions, in excess of the energy inputs required.

[16] Forbes: Why You Shouldn't Cut R&D Investments In Times Of Crisis And Recession

3.26 Environmental considerations are influencing how people travel to campus (although the absolute volume of people commuting to the campus on a given day is also influenced by remote working trends). The EU has approved a ban on sales of new petrol and diesel cars from 2035, whilst the UK has a 2030 target.[17] In response, campuses are providing higher numbers of charging stations for electric vehicles. The use of public transport is also being encouraged. However, this is easier for campuses based in/adjacent to large urban areas than those in more remote settings. For both **Lund Science Village** and **GIANT**, extending tramlines to the campuses has improved connectivity with research facilities/universities off site and promoted more sustainable patterns of commuting. A similar solution has been implemented at **Here East** where a fully electric shuttle bus service provides a quick connection to a nearby transport hub, linking into London's public transport network. All campuses are acting to make travel around their sites more sustainable by encouraging cycling and walking, and many of the campuses already have dedicated cycle paths.

> **Campuses are promoting sustainable transport**

3.27 Individual companies based on campuses have their own environmental initiatives and some are planning to reach Net Zero ahead of national targets. This is especially the case where companies are part of global supply chains, such as the semi-conductor cluster at **Hsinchu Science Park**. Firms based in Taiwan are reacting to the Net Zero demands placed on them by customer firms around the world, and this will be similar for companies based at other campuses.

Political drivers

Global geopolitics

3.28 Although the links are complex, geopolitics are one factor shaping the prioritisation of specific research areas and the capabilities deemed strategically important by national governments. This includes the priority attached to alternative energy sources/energy security, defence technology (including cyber security), AI/digital and perhaps developing within-country vaccine manufacturing capabilities. For some of the campuses, this represents a return to original focus areas. As defined single sites, (parts of) campuses can meet the physical and data security standards required for R&I on national security related research more easily than, for example, city centre innovation districts.

> **Campuses are reacting to national research priorities**

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[17] Reuters: EU approves effective ban on new fossil fuel cars from 2035

National politics and research funding

3.29 At the national level – and also internationally through initiatives such as Horizon Europe – research funding applications are increasingly favoured if they include an industrial partner and/or will generate (economic) impact. This contrasts with earlier approaches which focused on scientific excellence and application alone. The change is designed to encourage universities and publicly funded research facilities to increase industrial collaboration and support subsequent commercialisation. Campuses and the research organisations they host are already responding to this – for example, the Max IV synchrotron facility adjacent to **Lund Science Village**, is working on educating industry and attracting more industry collaborations. A continuation in this trend amongst research funders is likely to see even greater emphasis placed on commercialisation and research translation activity at campuses in future.

> **Campus organisations are increasingly prioritising wider impacts**

3.30 Alongside the generation of (economic) impact, there is increasing interest amongst policy makers and research funders about *where* this impact is realised. In the UK, for example, the levelling up agenda has increased awareness of spatial considerations and the role that R&I activity can play, both in terms of where the investments are made and where the benefits are realised.[18] Campuses are positioning themselves in response to this, and seeking to demonstrate the benefit that on-campus activity has for the local area, for other areas and for the national economy more broadly.

Local politics

3.31 The case study campuses are nationally significant assets which are located in particular places. Whilst national or state level governments are often key sources of funding, local political considerations are also playing an important role in the campus growth process. This refers both to relationships with councils/planning authorities and the wider local community.

3.32 As noted above, campuses are increasingly competing on the basis of being '*great places to work, live and play*' in their own right, or by being located adjacent to areas with these characteristics (for example **Adlershof Science and Technology Park** on the edge of Berlin). Local government plays an important role in this context. This includes, but is not limited to, housing, transport, education, leisure and safety.

[18] SQW (2022) Research and Innovation and Place

3.33 All of the case study campuses are significant operations. Many also have ambitious growth plans which must be approved by local planning authorities. These can be contentious locally, particularly when the use of previously undeveloped land is proposed, or large increases to on-site employment or residential numbers are considered. Campuses are working with local planning authorities, and with the communities they represent, to develop and deliver future plans.

> **Campuses are working with public authorities and communities on their future plans**

3.34 The case study campuses are also seeking progressively to become more open places with greater levels of collaboration on-site. For some, the next step is to extend this to their external relationships, and work to make campuses part of their local community rather than spaces independent from it. Indeed, many of the campuses spoke of a growing sense of civic pride or duty and want this to continue. Educational outreach programmes with local communities are common, such as the Here East Scholarship Programme (**Here East**) which provides full undergraduate tuition to local students from disadvantaged backgrounds. Physical centres to host outreach activities also exist or are planned – for example the **ANSTO Innovation Precinct's** Discovery Centre and **Lund's** planned Science Centre – but further actions will be required for science and technology hubs to be seen as more inclusive and spaces for everyone. This will have to be delivered in a way which maintains the safety and security of the campus and its nationally significant assets – a balancing act which is evident in developing a masterplan for the **ANSTO Innovation Precinct** amongst others.

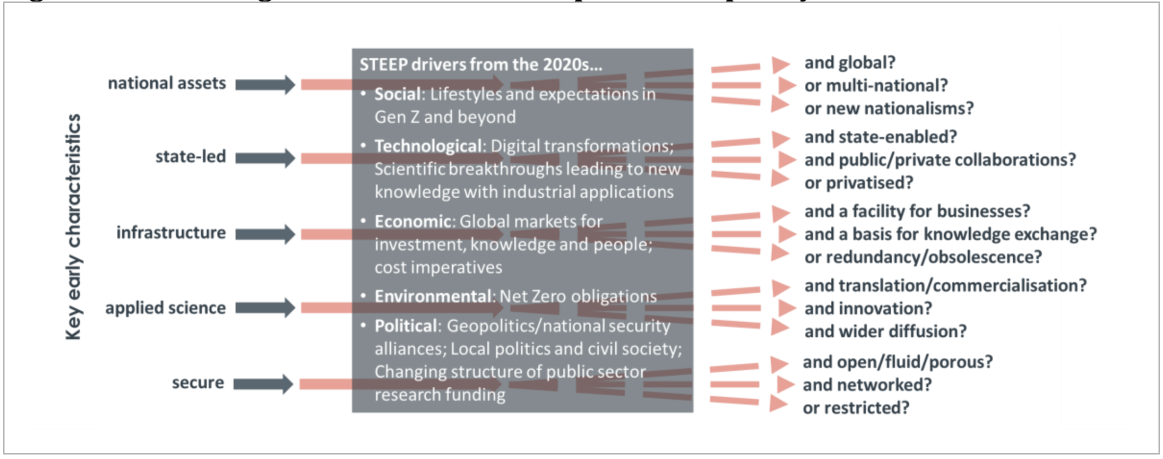
4. *Pioneer Campus 2040*

4.1 In the light of the discussion of trends and drivers in Chapter 3, we now turn to consider what *Pioneer Campus 2040* might look like.

Framing the discussion

4.2 The STEEP drivers discussed in Chapter 3, doubtless in combination with others, will affect how the objectives or imperatives underpinning campuses continue to evolve. From their original purposes described in Chapter 2, different future outcomes (and combinations of outcomes) are possible. The diagram below attempts to capture some of these possibilities.

Figure 4-1: Evolving characteristics of campuses – shaped by wider drivers



Source: SQW

4.3 Future gazing is hard, and it comes with no certainty at all. However in considering different possibilities in terms of *Pioneer Campus 2040*, three overarching comments are important:

- **First, 2040 is only 17 years away; it is as far into the future as (at the time of writing) 2006 is in the past.** Seventeen years is a relatively short time for an existing campus to look and function in a radically different way: individual and organisational level behavioural changes take time to embed, and property development requires time to raise finance and progress through planning systems. Change will certainly happen, but for existing campuses, the narrative may be one of continuing evolution and growth, rather than revolution.
- **Second, there is no single form for a successful campus in 2023, and we suspect this will be equally true in 2040.** The characteristics of sites in 2023 will frame how they develop over the next 17 years, e.g. a suburban campus will face different opportunities/challenges in relation to transport links and becoming a 'people place' than one which is part of a major urban area.

- **Third, through on-going evolution, some/all of the case study campuses could become *Pioneer Campus 2040.*** But equally, it may be that emerging campuses (or other campuses which are already well developed but were not selected as case studies) shape the narrative half a generation from now.

4.4 With these points of principle firmly in mind, the paragraphs that follow describe a core scenario for *Pioneer Campus 2040*. Even if this materialises, there will be variants of it, reflecting different local and national contextual factors. However in a fluid global political economy, it is possible that change is more structural – more revolution than evolution. The final section of this chapter considers what this could, plausibly, mean.

A core scenario for *Pioneer Campus 2040*

Driving innovation…

4.5 *Pioneer Campus 2040* will need to continue to drive innovation; indeed, that must continue to be its fundamental rationale. The innovation process itself will take many different forms, although the importance of 'facilitated serendipity' is likely to continue. *Pioneer Campus 2040* will do much to facilitate chance encounters – and to increase their effectiveness in terms of research translation and commercialisation. It might, for example, attract (or even seed) a new generation of venture capitalists or early stage investors. It will also develop new relationships with institutional investors and/or major charitable trusts, given the risky and costly nature of commercialisation journeys. In this context, it will also continue to be underpinned by a strong but mature relationship with the state – locally and nationally.

4.6 The sectors/technologies that are the focus of the innovation activity will vary between individual examples of *Pioneer Campus 2040*. They will also evolve over time. Management teams will assess the R&I specialisms of their own campus and how they compare to other internationally leading sites. Admissions criteria will continue to be an important tool in building and maintaining excellence in particular fields.

4.7 Linked to admissions criteria, promoting clustering behaviours will also be important in driving innovation. This applies both to how management teams organise and facilitate activity on campus (both within sectors and between adjacent sectors/technologies), and to how links with leading off-campus organisations are built and maintained. *Pioneer Campus 2040* will not be an island – it must be connected to wider scientific and technological advances to maintain its competitive position and maximise its contribution to economic growth.

4.8 More speculatively – and in partnership with research funders – those responsible for *Pioneer Campus 2040* might start to precipitate a changing set of relationships around IP ownership, giving more flexibility and incentive for outstanding researchers to become entrepreneurs within wider campus ecosystems. In this context, the relationship with funders (and perhaps especially central government and its agencies) could change – becoming more enabling than controlling, and unlocking the full potential of the assets on major campuses in the process.

…through agility…

4.9 As part of this journey, it seems likely that *Pioneer Campus 2040* will have a greater focus on societal challenges. Much of the history of many campuses has been linked directly or indirectly to defence and national security and this may need to continue given global uncertainty. But it is also possible that wider societal challenges will come to the fore; the consequences of ageing populations could certainly be one, and issues linked to Net Zero are likely to be a second.

4.10 The pandemic demonstrated that the use of large scale research infrastructures can be pivoted in response to changing priorities. Indeed, scientific facilities were crucial in helping to understand the fundamental mechanisms behind COVID-19 and finding effective strategies to defeat the virus. However, the presence, or indeed absence, of such infrastructures at a campus is part of a long term investment cycle – the fixed costs associated with them are huge and maintaining the facilities could become prohibitively expensive, certainly at the level of individual nation states. One consequence for *Pioneer Campus 2040* could potentially be new alliances – between nations, and perhaps between the public and private sectors – to help maintain and develop these core assets, as well as to maximise the benefits of hosting them.

4.11 Management teams will ensure that the research infrastructure which sits at the heart of their campus offer remains appropriate to the developing science and technology landscape. The types of 'big science kit' hosted at campuses could evolve as the frontiers of science advance. Entirely new or 'next generation' forms of research infrastructure may be required, for example in relation to nuclear fusion. In other cases, smaller scale infrastructures such as laser based accelerators may emerge to complement the capabilities of larger facilities. The associated cost of maintaining and enhancing scientific capabilities may well be substantial. Where individual research infrastructures are funded by multiple countries, prioritising users from the immediate vicinity of the infrastructure over technically excellent proposals from other countries which contribute to the costs of equipment could be a difficult balancing act.

4.12 Imperatives around agility sit uncomfortably with ongoing requirements surrounding site security. Whilst security concerns will not disappear, new approaches to managing them will be important. Security fences can be a major barrier to collaboration and *Pioneer Campus 2040* will find better solutions to current figurative 'castle and moat' arrangements.

…and attracting the best talent…

4.13 For *Pioneer Campus 2040*, it will be absolutely essential that talented people are attracted by the work – and the life – that is on offer. Gen Z is different from its predecessors and the imperatives surrounding the quality of the lived experience are far more demanding than previously. *Pioneer Campus 2040* must be a place that can win the 'war for talent'. This means it will recognise the needs and aspirations of both internationally mobile workers and, crucially, their families – either on the Campus itself or in its immediate environs. This requires outstanding schools (and to this end, the campus management for *Pioneer Campus 2040* will have an important advocacy role to play with education providers). It also means high quality amenities and leisure opportunities; and good provision in relation to all the many facets of a quality of life that is increasingly valued alongside, if not in excess of, straightforward remuneration packages.

…through radical inclusivity and diversity

4.14 In seeking to win the 'war for talent' there will be a need for radical inclusivity. *Pioneer Campus 2040* will be a place where talented people are stimulated to excel and can thrive – irrespective of their gender, class, nationality, ethnicity, age or any other factor that deters effective participation. Indeed the diversity of the workforce associated with *Pioneer Campus 2040* should itself be a catalyst for innovation.

4.15 Campus managers can do much to effect greater diversity, but this – like many other aspects of the route to *Pioneer Campus 2040* – needs to be a shared endeavour. At a local level, there will be a need to work more effectively with local government and local communities. Central government will have a role to play too. Policies surrounding visas will, for example, have a major bearing on the shape of *Pioneer Campus 2040*.

Operating as Net Zero exemplars…

4.16 Another critical feature of *Pioneer Campus 2040* will be its creativity and performance in relation to Net Zero. It will be exemplary on all fronts. It will pioneer new approaches and – as a hub of innovation – it will develop the tools and insights for other places/communities to do likewise. But it will also adopt these itself, leading the way in terms of environmental outcomes. *Pioneer Campus 2040* should therefore be a living lab. It should host mini-modular or innovative power solutions, building on established expertise linked to the production of energy. It will also be a pioneer in relation to the design of new buildings and, crucially, the retrofitting of existing ones. Finally, it will find zero carbon solutions for travel – both on campuses and from them to other centres of population. Active travel will be part of this, but so too will be the use of electric and autonomous vehicles and other solutions in respect of future mobility.

…in the context of multi-site models…

4.17 *Pioneer Campus 2040* will have an economic footprint that extends well beyond its spatial core. This may mean that it adopts a 'hub and spoke' model, enabling it to grow whilst allowing its impacts to benefit other localities and also ensuring that it remains manageable in terms of the scale of the core site.

4.18 We expect that *Pioneer Campus 2040* will also have a relationship to economic growth processes more generally. It will actively encourage links to non-Campus businesses, investors, researchers and entrepreneurs, wherever they are located. It will – in economic terms – actively nurture and promote the 'spillovers' which effect economic, knowledge and technological benefits far more broadly. In a UK context, it ought particularly to be encouraged to contribute to wider imperatives linked to levelling-up.

…which will be unlocked through advanced digital connectivity

4.19 At the heart of all this, *Pioneer Campus 2040* will embrace digital connectivity fully and intelligently. This means it will recognise both the possibilities it presents but also some of the limitations. Through technologies such as augmented reality, 'distance' will be of much less consequence, but the importance of relationships between people – as the motive force for most innovation – will be recognised fully; and the value of proximity in facilitating these relationships will not be lost.

Confident in telling its story…

4.20 Many of the changes will be driven by increased international competition for talent and investment. To help attract this, *Pioneer Campus 2040* will be able to 'tell a story' about why it is an internationally leading place and what makes it distinctive from its competitors. This narrative will not replace the importance of hosting leading research and innovation capabilities, but will supplement it. Put simply, *Pioneer Campus 2040* will be a leading location and it will also be *seen* to be a leading location, often within a wider cluster narrative.

…enabled by a supportive public sector…

4.21 The importance of the public sector as a source of funding for research and big science kit has already been noted. Public sector bodies more broadly will also be crucial to the success of *Pioneer Campus 2040* by creating the opportunity for researchers and businesses to build an effective campus. This applies at national, regional/state and local levels of government, and encompasses the facilitation or direct delivery of transport, digital and energy infrastructure, housing and schools, and leisure amenities. The provision of these assets on, or in close proximity to, the campus will help drive its success.

…and steered through new and creative approaches to management and governance

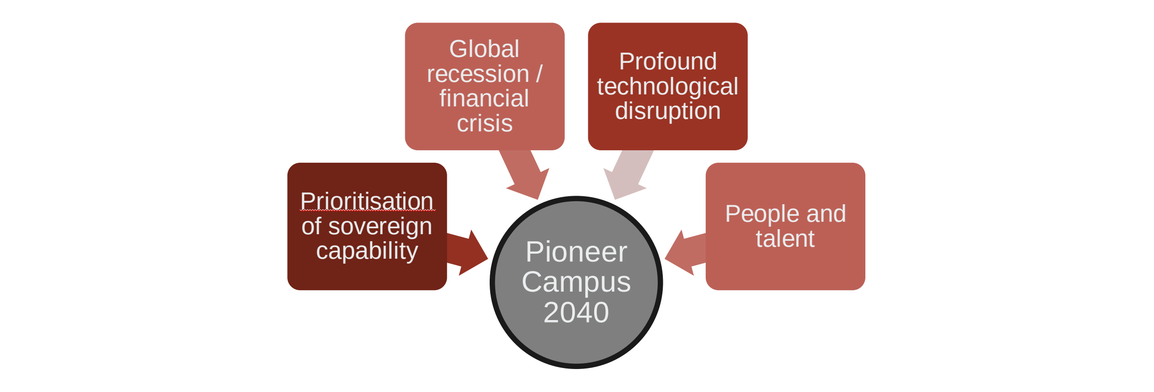
4.22 Finally, *Pioneer Campus 2040* will be characterised by new approaches to management and governance. Land and property assets will continue to be managed to a high standard, but greater attention will also be paid to animating an ecosystem that is increasingly agnostic in relation to campus boundaries. This in turn will be premised on new routes to value creation and capture. The straightforward economics of land and property development will not disappear, but for *Pioneer Campus 2040* the balance sheet will be more complicated and nuanced.

4.23 Moreover, a much wider group of partners and collaborators will be brought into a constructive relationship. This ought, really, to include local communities and local government as well as investors, charitable trusts, research funders and central government. In developing these new approaches, genuine innovation will be imperative – and it will be one of the features of *Pioneer Campus 2040*.

Disruptions to the core scenario

4.24 There are many uncertainties and risks – both upside and downside – surrounding the core scenario outlined above. Four appear especially important over the next 17 years. They are introduced in the graphic below and explained in the paragraphs which follow.

Figure 4-2: Major risks and uncertainties surrounding the core scenario



Source: SQW analysis

4.25 **The increased prioritisation of sovereign capability in strategically important areas, with implications for public spending priorities and attitudes towards international collaboration**. Many of the case study campuses trace their origins to public investment in national defence and/or security and many developed against a backdrop of the global order that has defined the last 75 years. This could now be changing. A new global order would almost certainly have consequences for some campuses, particularly as priorities for both governments and investors shift. It is not impossible that by 2040, the *de facto* objectives linked to some campuses are actually closer to their original ones. Two dimensions that would have implications for the core scenario outlined above are:

- The **global cooperation patterns** of campuses may align increasingly closely with international strategic alliances. For example, if countries such as Russia and China are seen as a threat, academics and businesses from, or with ties to, these countries could well be prevented from engaging in R&I with organisations on campus. These restrictions could be set by governments, research funders or campus management teams themselves.
- Countries are already investing in the **development of sovereign capabilities**, for example the CHIPS Act in the USA, to secure competitive advantage and supply chains in key technologies. Campuses may be well placed to attract such investment from national

governments, although perhaps at a cost of a reduced level of funding available for multi-national research infrastructures.

4.26 **The possibility of global economic recession, a global financial crisis and public sector austerity.** Over the near term, the economic outlook is gloomy – both in the UK and internationally (including crucially in the USA). A major downturn will slow the pace of investment from the private sector while public sector austerity will affect most major research funders. In combination, this would slow progress towards *Pioneer Campus 2040* but without necessarily changing its path. The case study campuses have previously faced pressures caused by broader macro-economic challenges and ought to be able to apply lessons from the past to similar future situations.

4.27 **The possibility of technological disruption.** Over the next 17 years, major technological change is possible. Two dimensions appear especially important:

- First, and as noted already, **large-scale science facilities will need to continually develop and improve capacity and capabilities** in order to continue to push the frontiers of science. In some cases, new or 'next generation' big science kit may be required, and it is likely – although not certain – that such new facilities will be co-located on existing campuses with established capabilities. An increasing concentration of big science kit at a smaller number of campuses could lead to diverging future development paths for campuses with and without such infrastructure.
- Second, and potentially even more disruptive, is **the range of possibilities linked to profound digitalisation**. Increased levels of remote working and the use of big data, AI and machine learning, automation and remote experimentation in R&D could call into question the rationale for a campus as a single location where individuals/companies cluster. In this scenario, the campuses may need to increase support for the 'softer' aspects of cluster building and knowledge exchange such as networking, and support for entrepreneurs and businesses to adapt and exploit disruptive technologies.

4.28 **The implications of losing the 'war for talent.'** Finally, there is a risk that the ongoing battle in the 'war for talent' is ultimately lost. One factor – which is particularly germane in a UK context – surrounds the issue of international visas and how these are resolved as the UK continues to adjust to life outside the EU. Another links again to Gen Z and the life/work experience(s) that it is really seeking; a failure to understand, respond and ultimately to attract and retain talented people from Gen Z presents an existential threat, particularly to those campuses that are some distance from a major urban area.

5. Wider reflections and implications

5.1 This report was commissioned to investigate the current role of eight major campuses; to explore the key drivers and influences that are shaping their evolution; and to consider what *Pioneer Campus 2040* might look like. The intention more broadly was to influence and stimulate a policy debate – both in the UK and internationally.

5.2 **A first important conclusion is simply that the eight campuses we have considered are important nodes in the knowledge economy**. While they vary in terms of longevity and science intensity, there is evidence to suggest that all eight are contributing to science, research and innovation, and to wider processes of economic growth. They are helping to accelerate processes of enterprise and commercialisation, and many are providing a focus for inward investment. They ought, arguably, to be seen as a key national infrastructure in these terms.

5.3 **Second, we have observed that all eight campuses are international players.** They host and curate international science and innovation, sometimes linked to 'big science' infrastructures; they employ a workforce that is mobile internationally; and they are – increasingly – financed by investment that is in part international. The policy framework in relation to international research, science, innovation, commercialisation and finance will be critically important looking ahead. It will be shaped by geopolitical considerations, but the choices that are made will have a major bearing on the character of *Pioneer Campus 2040* – and its underlying economics.

5.4 **A third observation is that all eight campuses have gone through some level of evolution.** This is clearest amongst those with the longest histories. Many were conceived with a particular purpose in mind. In some cases, new purposes have either supplemented or replaced the original rationale. This in turn means that campus 'forms' have shifted too. There is every indication that this on-going process of evolution will continue. The campuses are behaving as ecosystems and responding to – or in some cases precipitating – major changes across the science, innovation and enterprise nexus. We anticipate that this incremental process will need to continue – and local planning authorities and other local partners have an important role. For the most part, campuses are *in* a place rather than *of* it, but the local context will have an important influence in terms of future evolutions.

5.5 Future evolutions will be complicated and there are many uncertainties as we look forward over the next 17 years (and beyond) – but a constructive dialogue between national and local government and those responsible for the governance and management of campuses will be critical. This ought to focus especially on:

- **the steps that might be taken to manage public and private relationships, and remaining boundaries between science, innovation and commercialisation.** This embraces many dimensions from the physical design of campuses to the rules surrounding the protection of IP. In general, the more integrated the campus ecosystem

– and the better the flow of knowledge and insight – the more effective, innovative and resilient it is likely to be so long as the campus also engages fully in international collaborations and dialogues.

- **the steps that might be taken to use campuses as 'living laboratories' responding to the challenges of the day and gaining critical insights in the process.** Campuses are, by definition, home to some of the world's best scientists and engineers. They ought therefore to be responding to global agendas and developing new and different responses, and the campuses themselves should be part of the process. They need to be recognised and used by policy makers as a resource in these terms.
- **the 'liveability' of campuses and their environs and the steps that might be taken to improve further the quality of life (in the widest sense) associated with them.** Plans need to be made for the workforce of the future, and the norms and expectations that will come with the next generation rather than the previous one. Both local and national policy makers have a role to play in this context.

Annex A: Campus case studies

A.1 This Annex presents summary accounts of the eight case studies:

- Adlershof Science and Technology Park, Germany
- ANSTO Innovation Precinct, Australia
- GIANT Innovation Campus, France
- Harwell Science and Innovation Campus, UK
- Here East, UK
- High Tech Campus Eindhoven, Netherlands
- Hsinchu Science Park, Taiwan
- Lund Science Village, Sweden.

A.2 The table overleaf provides a summary of the key characteristics of each case study campus.

Table A-1: The eight case studies at a glance

Site	Scale (as reported in 2022)	Sector / technology strengths
Adlershof Science and Technology Park	• 193-acre site • 530+ companies on site • 11,600 people employed on site	• Photonics and optics, microsystems and materials, IT and media, biotechnology and environment, renewable energies and photovoltaics
ANSTO Innovation Precinct	• 272-acre site (with scope for a further 740 acres) • 37 companies at *Nandin* Innovation Centre, supporting over 360 jobs	• Nuclear technologies, environment, human health
GIANT Innovation Campus	• 568-acre site • Approximately 40 companies • Over 10,000 research jobs and 5,000 industrial jobs	• Energy, information and communications technology, health
Harwell Science and Innovation Campus	• 700-acre site • More than 200 public, private and academic organisations • Over 6,000 scientists, engineers and innovators on site	• Space, energy, health tech and quantum, all underpinned by multi-disciplinary science, engineering, advanced materials and technology expertise
Here East	• 130 companies on site • c. 5,500 people working or studying on the campus	• Digital and creative industries
High Tech Campus Eindhoven	• 247-acre site • 280 organisations, including c. 100 start-ups on site • Approximately 12,500 people employed at the campus	• Semiconductors, photonics, 5G/Li-Fi, digital services, AI, user experience technologies
Hsinchu Science Park	• 1,695-acre site • Over 400 companies on site • Almost 140,000 people employed on site	• Integrated circuits/semiconductors, precision machinery, computer and peripherals, telecommunications, optoelectronics, biotechnology
Lund Science Village	• 44-acre site • Eventual target of 24,000 jobs	• Advanced research in material science and nanotechnology, microelectronics, quantum technology, energy, health and life sciences, the environment, food and packaging

Source: SQW based on a review of background data and documentation

Adlershof Science and Technology Park

Figure A-1: Adlershof Science and Technology Park

Source: © WISTA Management GmbH – www.adlershof.de

Adlershof is located on the south-east outskirts of Berlin. It is served by Berlin's S-Bahn rail transit system which provides a direct connection to the city centre in around 30 minutes and, in the other direction, Berlin Brandenburg Airport. More local connections are provided by the tram and bus network.

Figure A-2: Context map

Source: Produced by SQW 2022. Licence 100030994

Origins and development

Adlershof's origins go back to the early 20th century when the site housed the testing facilities of the German Research Institute for Aviation. Subsequently it was the location for East German Academy of the Sciences institutes for natural sciences, physics, chemistry, materials research, aeronautics, and aerospace research. After reunification in 1990, the country's research landscape was reformed and Academy research institutes were radically restructured, with a significant reduction in jobs.

The Berlin Senate, with the support of all political parties, decided to develop an 'integrated landscape of science and business' in Adlershof. In 1991, a 1,038-acre land area and dilapidated buildings – some military but mostly research – were vested in a company (now WISTA Management) which was given operational independence. From 1998 to 2003, Humboldt-University moved its mathematics and natural science faculties to Adlershof and in 1998, Helmholtz-Zentrum Berlin took up operation of BESSY II, an electron storage ring and Germany's leading soft X-ray source.

The following years have seen the development of the wider area known as Adlershof Science City. In addition to the Science and Technology Park (STP) this includes commercial and residential developments as well as the development of Media City. Adlershof's research and innovation landscape was further expanded with the addition of a new technology centre (the Centre for Photovoltaics and Renewable Energies) in 2013 and the site's first business accelerator in 2016. Alongside this, the wide range of technology businesses founded and developed at Adlershof contributed significantly to its role as a research and innovation cluster.[19]

Adlershof today

The Science and Technology Park (193 acres) now has approximately 530+ companies, 16 scientific institutions, 11,600 employees and 6,650 students. The wider Adlershof Science City has a further 650 companies with 13,000 employees. There is a wider leisure offer, including the Adlershof/Johannisthal Nature Park at the heart of the Science City, as well as a range of food and drink options, sports and cultural facilities.

WISTA[20] develops, manages and operates the site. Its responsibilities include establishing and operating the Technology Centres (see below); making properties available for sale; supporting start-ups; advising companies; promoting networking between the science base and business; encouraging national and international cooperation; and handling PR for the entire development area. Although WISTA is a subsidiary company of the State of Berlin, it is financed through income from rent, land sales and, to a minor extent, grant support for projects from sources such as ERDF. Its Supervisory and Advisory Boards consist of both public and private sector representatives, including from Adlershof companies, Humboldt-University and the non-university research institutions.[21]

Adlershof's sectoral profile derives to some extent from the legacy of the East German Academy of the Sciences. Some of its research groups were taken over by new non-university research institutes, other enterprises were established by former Academy scientists who lost

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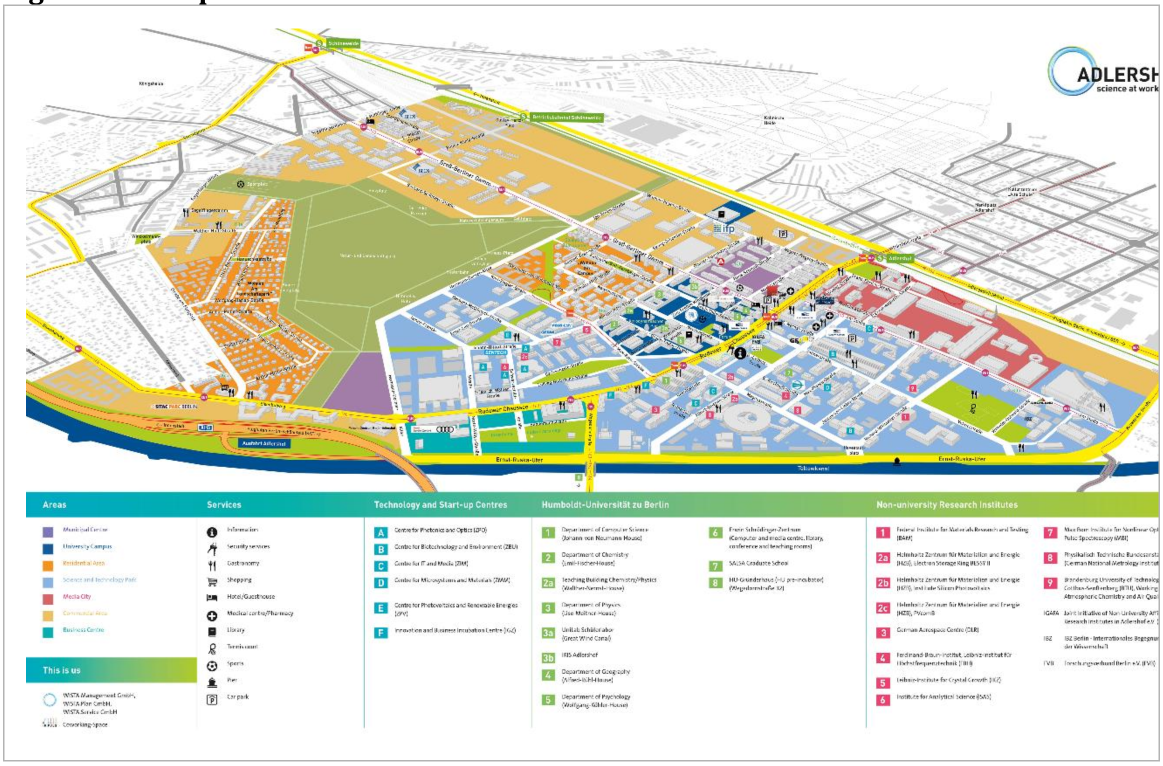
[19] WISTA Management, https://www.adlershof.de/en/vicinity/history.
[20] Its subsidiaries include WISTA.Plan GmbH, an urban development agency, and WISTA.Service GmbH responsible for the commercial, technical and infrastructural management of buildings
[21] WISTA Management, 2014, *Start-up Business Services vs Acquisition of Global High-tech Players*,

their jobs in the transition. The Park now specialises in five technology clusters: Photonics/Optics; Microsystems/Materials; Biotechnology/Environment; Renewable Energy/Photovoltaics; and IT/Media.

The clusters consist of a mix of large companies and start-ups, together with university and non-university research institutes. They are supported by Technology Centres which offer access to labs, offices, workshops and small manufacturing spaces, as well as providing specialist networks and contacts. The Centre managers seek actively to animate their clusters.

Figure A-3: Map of Adlershof



*Source: © **WISTA Management GmbH** – www.adlershof.de*

The STP's business accommodation offer reflects different stages in the business life cycle. Humboldt-University's Start-up Incubator provides office space for company founders from the university targeted at early-stage businesses. WISTA's Business Incubator is in turn suitable for young companies at the next (incubation) stage of development – it offers 18,000m^2 of multifunctional space available for rent on flexible terms. During the growth phase, businesses can rent larger, more specialised spaces in the Technology Centres, which provide access to laboratories whose equipment helps to reduce the companies' capital outlays and to facilitate the transition to pilot production and then on to manufacturing. On moving out from the Technology Centres, companies can either rent space or construct their own properties.[22]

Adlershof also provides businesses with a range of advisory support. Humboldt-University's Venture Service team provides information and practical assistance, including helping start-

[22] WISTA Management, 2014, *Start-up Business Services vs Acquisition of Global High-tech Players*

ups to apply for finance. Start-ups can also apply for the Adlershof Founder's Lab programme consisting of monthly grant payments, free co-working space, workshops and mentoring. Similarly, the AdMaLab programme developed by Humboldt University and INAM (Innovation Network for Advanced Materials), focusses on material science innovation and provides researchers and entrepreneurs with a stipend, access to lab and co-working spaces, and business mentoring.[23]

In addition to Adlershof, WISTA also manages other knowledge focused facilities such as the Charlottenburg Innovation Centre (in Berlin's City West) and operates the business office for Berlin's "Zukunftsorte" (places of future innovation) on behalf of the Berlin Senate.[24] More broadly, the Park is a member of the International Association of Science Parks and Areas of Innovation.

The future

Berlin-Brandenburg aims to become Europe's number one science and innovation region. Although land availability at Adlershof could accommodate double the number of jobs, transportation systems would not cope. There are, therefore, plans for Adlershof to become a node in a planned innovation corridor stretching around 130km from Berlin to the city of Cottbus, known as the Adlershof–Lusatia Future Corridor. The Park has plans to create strong links with Lusatia Science Park – a campus to be led by the Brandenburg University of Technology Cottbus-Senftenberg[25].

At the Park itself, a new Grand Challenges Centre will be developed to serve as an innovation space where founders, entrepreneurs and scientists will be able to work on interdisciplinary technology-based solutions to challenges around health, climate change, and pollution.[26] WISTA is currently working on developing a 5G Campus License, a new 5G Lab (an innovation hub and showroom for 5G technologies), and the Mobility 2030+ project for managing traffic and people flows.[27]

Alongside this, the Park is adjusting to new working patterns including remote working. A current initiative is being developed in collaboration with Lübben (some 70km south) whereby Adlershof companies' employees, as an alternative to working at home, will be able to access a shared workplace in the town – adding a further dimension to networking through the intermingling of staff from different organisations and benefitting those with less-than-ideal working conditions at home.

[23] WISTA Management, Business Incubators and Services for Start-Ups
[24] WISTA Management, 2019, Annual Report
[25] See Adlershof Lusatia Future Corridor and Brandenburg University of Technology
[26] WISTA Management, https://www.adlershof.de/gc/.
[27] WISTA Management, https://www.wista.de/en/projects/overview.

ANSTO Innovation Precinct

Figure A-4: ANSTO Innovation Precinct

Source: ANSTO

ANSTO Innovation Precinct at Lucas Heights is some 40km south west of central Sydney in Sutherland Shire, a prosperous area of high environmental quality. It sits within a landscape shaped by Heathcote National Park and the Royal National Park Woronora river. The site is not served by public transport but, on weekdays, ANSTO provides a mini-bus service between the site and the Sutherland bus interchange.

Figure A-5: ANSTO Innovation Precinct

Australian Government

ANSTO
Science. Ingenuity. Sustainability.

Map source: Produced by SQW 2022. Licence 100030994. Logo source: ANSTO

Origins and development

Refocused in 1987 towards the peaceful use of nuclear technology, the Australian Nuclear Science and Technology Organisation (ANSTO) is an Australian Government agency with leading nuclear science and technology capabilities. Research teams contribute to industry, the health sector, and environmental challenges. ANSTO's other major campus, near Melbourne, houses the Australian Synchrotron.

The impetus for the Innovation Precinct, a phrase that encompasses all the facilities, organisations and activities on the 2,224-acre Lucas Heights site, came from the publication of the *National Innovation and Science Agenda* (2015). Coincidentally, the Sutherland Shire Economic Development Alliance, 'ShireBiz', had presented a proposal to ANSTO in 2014 for an advanced manufacturing facility at Lucas Heights. ANSTO senior management responded to these stimuli by launching the ANSTO Innovation Precinct[28].

The initial strategy (2019) envisioned *"a globally connected, vibrant and inclusive community with researchers, start-ups and industries creating inspired solutions in partnership for a sustainable world. The Innovation Precinct will be a campus that will be connected through walking and cycling links. It will be surrounded by the existing natural landscape and have centres of activity with a mix of lifestyle, cultural, commercial, business and mixed used spaces"*[29]. Final details are currently being agreed for the physical masterplan covering 272 acres (with scope for a further 740 acres).

The first key milestone was reached in November 2018 with the opening of the *nandin* Innovation Centre. In 2019 the Precinct was allocated $AUS 12.5m from the NSW Government to: create a new incubator for the development of next generation nuclear medicines to treat cancer and other diseases; help establish a Graduate Institute; and support collaboration between start-ups, researchers and industry to grow advanced technology businesses in NSW[30].

In June 2021, the new home of the *nandin* Innovation Centre opened. It includes a prototype lab for up to 50 start-ups to build and test products, a creation lab for producing digital content, multiple collaboration zones, and room for 50 additional businesses as the Centre continues to grow[31].

ANSTO Innovation Precinct today

The Innovation Precinct has four key components:

- **ANSTO's major research facilities,** research centres and manufacturing operations which are mostly within the high security site perimeter.
- The area of land south of the New Illawarra Road and up to the high security campus which will comprise the **Technology Park** (for which the masterplan will shortly be published).
- ***nandin* Innovation Centre (1,200 sq m), the world's first nuclear science and technology incubator**. Currently, the Centre has 37 member businesses, which support over 360 jobs. *Nandin* offers desks, offices, prototyping labs and design spaces. It also supports members through programmes such as start-up bootcamps, mentoring and

[28] ANSTO Innovation Precinct — ShireBiz
[29] https://gsc-public-1.s3-ap-southeast-2.amazonaws.com/s3fs-public/ansto_place_strategy_web.pdf
[30] Launch of deep technology incubator and Funding commitment for ANSTO's Innovation Precinct
[31] Expanding ANSTO's Innovation Precinct: Putting science to work | Transparency Portal

corporate partnerships[32], and is home to the ANSTO nodes of the Design Factory Global Network and the Sydney Landing Pad[33]. A virtual membership scheme for SMEs has been established recently. Its aim is to educate SMEs about the possibilities offered by the nuclear industry and for the first year it is subsidised by a grant from the State Government.

- **The ANSTO Graduate Institute is designed to nurture the next generation of Australian nuclear scientists, physicists and engineers**. There is a strong emphasis on industry translation and developing entrepreneurial skills such as business models, funding and finance, and IP protection. Students will also engage with industry partners involved in other core components of the Innovation Precinct. The Institute offers two scholarship programs for early career researchers: FutureNow Scholarships; and the Sir William Tyree Nuclear Scholarship[34]. It was envisaged that there would be a student-union-type social facility within *nandin*, but to date this ambition has been prevented by the effects of the pandemic; although there are 120 PhD students, most of them are not currently on the site.

More broadly, SMEs working with *nandin* and ANSTO may be eligible for Government funding and grants, such as the TechVoucher grant. The site is also home to an educational centre – the ANSTO Discovery Centre – which delivers events and workshops. These animation activities have likewise been hampered by the Covid pandemic.

Fundamental research at ANSTO focuses on the nuclear fuel cycle, environment, and human health. Businesses and graduates located at the Precinct have access to assets which would cost as much as $AUS10 billion to replace (scientific equipment and state of the art instruments), including the Open Pool Australian Lightwater (OPAL) reactor. Other facilities include the Australian Centre for Neutron Scattering, Centre for Accelerator Science and National Deuteration Facility. The surrounding area has two laboratories from CSIRO (critical minerals and land and water) in addition to ANSTO's minerals business unit and Synroc Radioactive Waste Treatment Facility,

ANSTO's wider networking is facilitated by both The Australian Institute of Nuclear Science and Engineering and ANSIE having a presence on the site; the latter has members from universities across Australia and New Zealand. In addition, the innovation centre management is involved with both the High Level Forum (for innovation ecosystems) and the Design Factory Global Network.

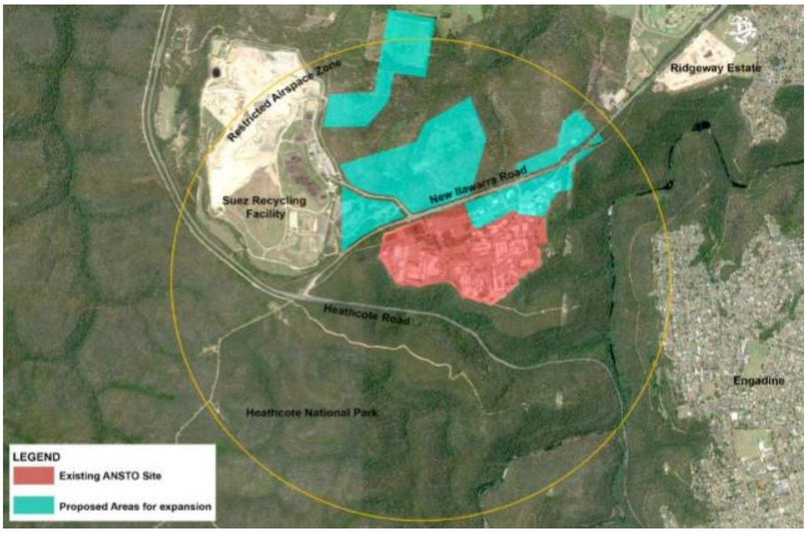
The future

The masterplan for development of the Innovation Precinct is currently being finalised, but major changes are already underway: first, constructing several new buildings for ANSTO research groups to replace outdated accommodation which is to be demolished, and second,

32 https://www.*nandin*.com.au/
33 Expanding ANSTO's Innovation Precinct: Putting science to work | Transparency Portal
34 For more information see: Graduate Institute | ANSTO

changes to the boundary ('fence') protecting ANSTO's high security assets which will help provide more open access to facilities within the Technology Park.

Figure A-6: Map of existing ANSTO site and proposed areas for expansion



Source: ANSTO Collaboration Area Place Strategy (December 2019)

The strategy to realise ANSTO's full potential will call for: stimulating the **research culture** which may experience low staff turnover in highly specialised core research areas; minimising the constraint which the high security fenced area has on the achievement of a **lively "people place"** in which both planned and serendipitous interactions will naturally happen; and **improving transport links** to attract firms and assist staff recruitment. Responses to these challenges are likely to include:

- aligning ANSTO's commercial and intellectual property strategy with the current national policy debate and giving increased weight and recognition to researchers' involvement with industry
- further increasing the animating presence of young people on site by attracting a higher education university or similar institution
- making key facilities more easily accessible to industry and selectively attracting firms to the site whose staff will usually work on the premises – e.g. in labs or manufacturing
- being alert to the possibilities offered by the possible future Australian policy shift towards nuclear energy to achieve 2050 climate change targets and being positioned to support the AUKUS pact and nuclear submarines that will underpin the country's defence strategy.

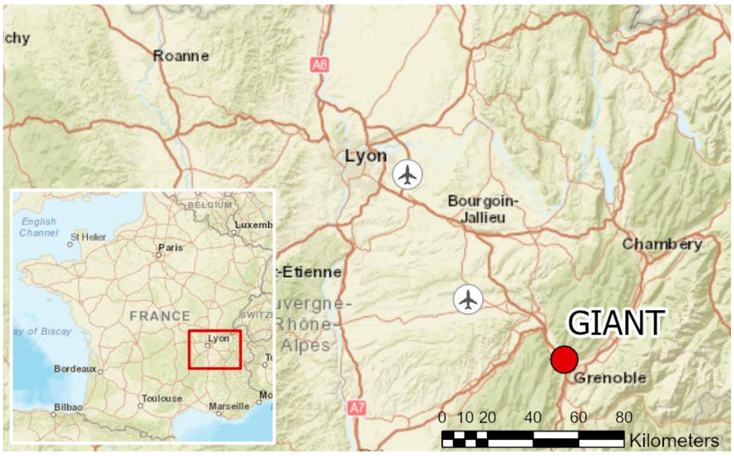
GIANT Innovation Campus

Figure A-7: GIANT Innovation Campus

Source: GIANT Innovation Campus / D. Morel

The city of Grenoble is in the Auvergne-Rhône-Alpes region of southeast France, around 110km south east of Lyon. As of 2019, the city area had a population of over 150,000 people. The Grenoble Innovation for Advanced New Technologies (GIANT) campus is located in the north west of the city on a peninsula formed by the Isère and Drac Rivers. GIANT is adjacent to Grenoble's main railway station and bus station, and is served by the city's tram line.

Figure A-8: Context map



Source: Map produced by SQW 2022. Licence 100030994. Logo source: GIANT Innovation Campus

Origins and development

GIANT (*Grenoble Innovation for Advanced New Technologies*) Innovation Campus was founded in 2008 to facilitate intellectual collaboration within and between research, higher education and industry already based in Grenoble. The origins of scientific activity at the GIANT site can be traced to the establishment of the Grenoble physics laboratories of the CEA (the French Atomic Energy and Alternative Energies Commission) in 1956 and the CNRS (French National

Centre for Scientific Research) in 1962. Subsequently, Grenoble became home to both the Institut Laue-Langevin (ILL) neutron source (in 1967) and the European Synchrotron Radiation Facility (ESRF, in 1988).

In the early 2000s, MINATEC was developed at the southern end of what would become GIANT to bring together micro and nanotechnology experts from higher education, research, and industry on a single site. This collaborative 'triple helix' approach was then expanded to a broader technological and geographic area with the foundation of GIANT. The eight founding members are research organisations (CEA and CNRS), large-scale research infrastructures (ESRF, ILL, and European Molecular Biology Laboratory), and universities (Grenoble Ecole de Management, Université Grenoble Alpes and Institut Polytechnique de Grenoble or Grenoble INP).

Partly as a result of the decommissioning of three nuclear reactors formerly used for research purposes, there has been significant construction since the foundation of GIANT with a total investment of €1.8bn. This includes research and translation facilities on the CEA site such as GreEN and NanoBio for energy and biotechnology respectively. There has also been residential development in the Presqu'île neighbourhood overseen by the City of Grenoble, alongside a new HQ for Credit Agricole and expansions of Schneider Electric and Xenocs (a spin-off from the ILL).

GIANT Innovation Campus today

GIANT hosts 10,000 research jobs, and the same number of industrial jobs and students on a 568-acre site.[35] GIANT itself is an alliance – rather than a formal legal structure – of the eight founding partners, with each partner retaining responsibility for its own landholdings. Campus level strategy and coordination are overseen by Steering and Executive Committees. GIANT's mission is to:

- address societal challenges in three priority areas: ICT, Energy, and Health
- break down barriers between fields of study by creating centres of excellence that are oriented around functional objectives, rather than academic disciplines
- harmonise urban and scientific development.

GIANT hosts three large-scale research infrastructures which conduct fundamental scientific research that can be applied across multiple industries. The three priority areas of research at the Campus are[36]:

- **ICT:** MINATEC hosts companies in microelectronics, microsystems, embedded systems, computing, multimedia, and advanced imaging. Applications of these technologies range from portable and wearable systems, to processors, medical systems, and solar energy.

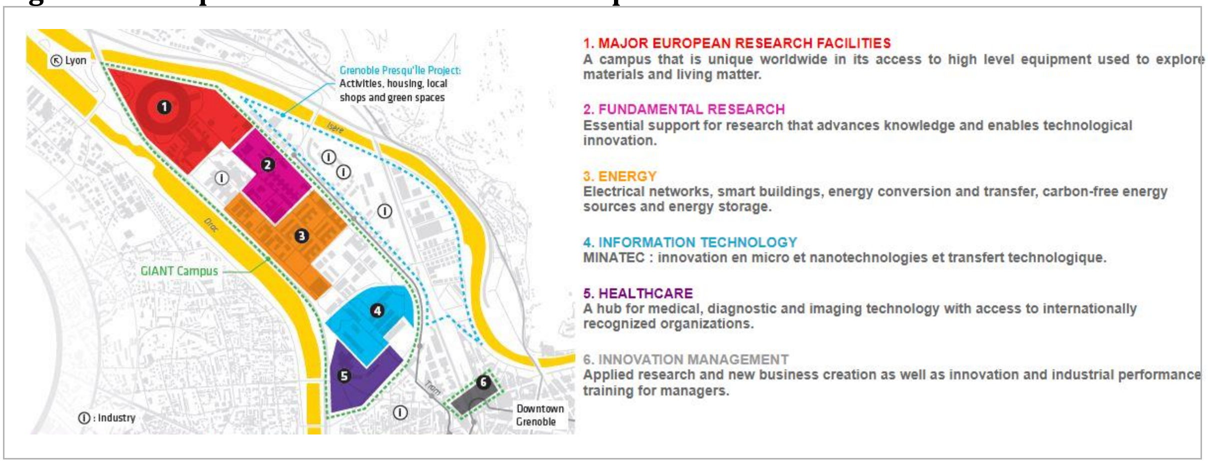
[35] GIANT Innovation Campus (2022) Presentation
[36] GIANT Innovation Campus (2022) Centers of Excellence; and (2012) Press information

- **Energy:** the development of carbon free sources of energy (e.g., solar and biomass energy), and the development of energy storage capabilities (e.g., fuel cells and advanced batteries).
- **Healthcare:** medical, diagnostic and imaging technology with potential applications in therapeutic microelectronics, advanced medical imaging and real-time neurostimulation.

GIANT offers a variety of business accommodation with key examples including[37]:

- **Large scale business accommodation –** including the 12-acre Polytec Business Park opened in 2003 – with flagship companies including STMicroelectronics, Siemens, and Schneider Electric. Companies working with GIANT research organisations are given priority to buy or rent space.
- **MINATEC High-Tech 1 (BHT1**), a 10,000m^2 building (including 2,650m^2 clean rooms) which is home to around 20 companies, ranging from large corporations to start-ups, developing innovative technology in association with GIANT research labs and institutions. Completed in 2019, **BHT2** offers 4,600 m^2 of modular space.
- **Y.SPOT Labs** and **Y.SPOT Partners** act as the CEA's Open Innovation Centre. Y.SPOT Partners includes Village by CA, a 2,000m^2 accelerator part funded by Crédit Agricole Sud Rhône Alpes.

Figure A-9: Map of the GIANT Innovation Campus



Source: GIANT Innovation Campus

GIANT also offers a range of support to organisations on site. For example, in partnership with the Grenoble Alpes University, it gives personalised support to European Research Council candidates to increase young researchers' chances of success and Grenoble's national ranking. GIANT organises the "Junior Scientist and Industry Annual Meeting" event which aims to better explore R&D careers within the industry and facilitate networking opportunities. In addition, the GIANT International Internship Programme offers non-European students the opportunity to gain experience of scientific research through a 10 to 12-week internship. More widely, the GEM Entreprendre, a non-profit group founded by Grenoble Ecole de

[37] See, for example, Companies at the GIANT Campus, Polytec, High-tech building and MINATEC BHT2

Management students, runs activities for local entrepreneurs and provides management and marketing[38].

Immediately adjacent to the scientific and industrial activity is the Presqu'île urban development project, which has 10,000 residents.[39] The majority live in apartments built since 2011. This new urban district offers amenities to campus employees including shops, restaurants and leisure facilities such as riverside green spaces.

More widely, GIANT launched the High Level Forum (HLF) in 2012 as an international network of innovation ecosystems. The HLF brings together representatives from the worlds of higher education, research, industry, and public authorities who are all engaged in the management and promotion of innovation within their regional ecosystems. The HLF is managed by CEA in cooperation with the rest of Grenoble's innovation ecosystem, with its strategy designed by a committee of international delegates from leading innovation ecosystems around the world[40]. The HLF's objectives are to share policies, strategies and experiences about innovation management and promotion between leading campuses, strengthen collaboration and develop common initiatives to maximise the social and economic benefits of innovation to support a resilient society.

The future

The Y.SPOT Labs and Y.SPOT Partners buildings towards the southern end of the campus opened in 2020 and 2022 respectively. Both are intended to promote open innovation and help transform the scientific research on campus into positive economic impact. Using the capabilities of organisations on campus to tackle societal challenges such as climate change continues to be a key focus for the GIANT founding members.

Physical development of the campus will also continue. In a similar area to the Y.SPOT buildings, construction is underway for a new hotel and a separate 12,600m^2 office building due to open in 2024.[41] In 2014, Grenoble's tram system was extended to serve the ESRF and Presqu'île neighbourhood. An urban cable car is due to open in 2024 to connect the campus to other tramlines to the north of the Isere and south of the Drac rivers to help further promote the use of public transport. Once fully operational, the system could transport 3,000 passengers per hour.[42]

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38 GIANT Innovation Campus (2022) Support for start-ups
39 GIANT Innovation Campus (2022) Presentation
40 GIANT Innovation Campus (2022) High Level Forum
41 Katene: Zac Presquile
42 In 2024, an urban cable car in the metropolis (grenoblealpesmetropole.fr)

Harwell Science and Innovation Campus

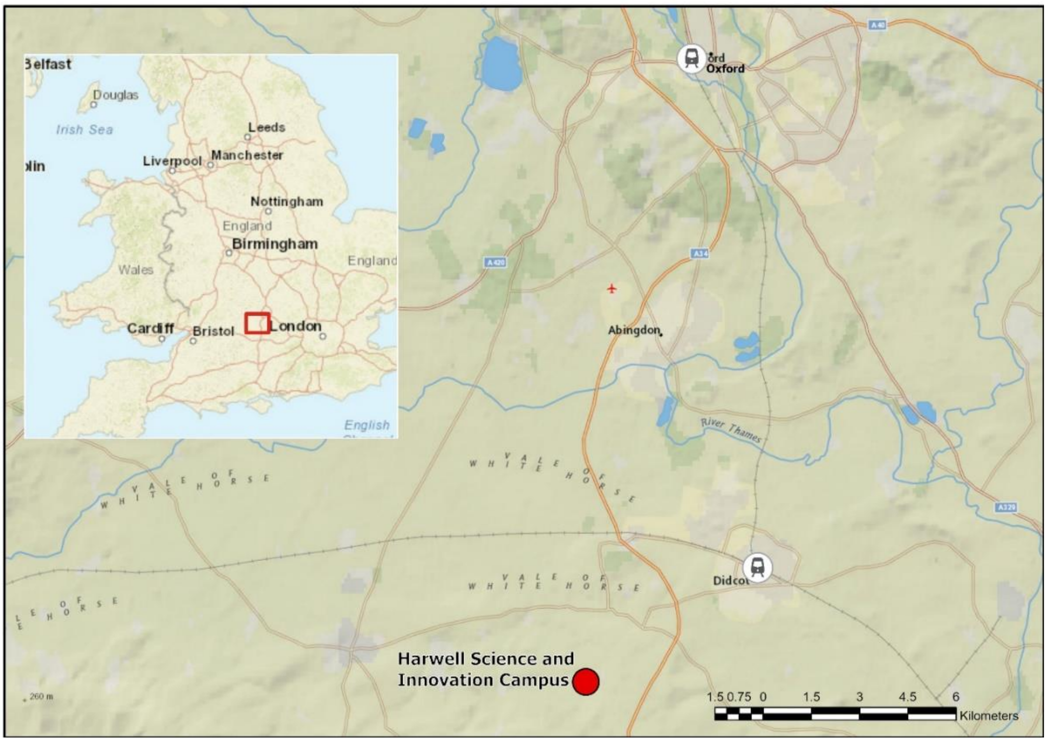
Figure A-10: Harwell Science and Innovation Campus

H^RWELL

Source: Harwell Science and Innovation Campus

Harwell is a rural southern Oxfordshire village, some 20km from Oxford. To the south east of the village, near to the A34, is *Harwell Science and Innovation Campus (Harwell Campus)*. It is around 15 minutes' drive from Didcot Parkway Railway Station, from which there are connections to London (40 minutes), and to Reading, Bristol and Birmingham. London Heathrow Airport is within about an hour's drive. Whilst the site of Harwell Campus is in a relatively rural location, wider national and international connections are, therefore, good.

Figure A-11: Context map



Source: Produced by SQW 2022. Licence 100030994

Origins and development

The origins of Harwell Campus may be traced to an airfield site on which the *Atomic Energy Research Establishment* was established in 1946 to advance nuclear technology. In 1957, the (now) *Rutherford Appleton Laboratory (RAL)* was also opened. RAL was (and is) funded and managed by UK government – latterly this has been through the Science and Technology Facilities Council (STFC). STFC's national laboratories at Harwell Campus and Daresbury (Cheshire) are of critical importance to UK science. Through the Atomic Energy Research Establishment and RAL, Harwell became a focal point for 'big science', linked especially to particle physics, scientific computing, laser development and energy.

Over subsequent years – and particularly the first two decades of the 21st Century – further key national scientific infrastructures were established. These included, *inter alia*, the *Diamond Light Source Synchrotron* (2007); the European Space Agency's *Europe Satellite and Space Telecommunications Centre (ECSAT,* 2009); the *Satellite Applications Catapult* (2013); and the *Faraday Institution* (2017). In 2019, Harwell Campus saw the *Vaccines Manufacturing and Innovation Centre (recently acquired by Catalent) and* the *Nucleic Acid Therapy Accelerator*. The *Rosalind Franklin Institute* – which seeks to connect physical sciences to life sciences – was formally opened in 2021. The *National Quantum Computing Centre* opened in 2022 and the *Extreme Photonics Application Centre* building was also completed.

By virtue of its scale, the Diamond Synchrotron needs special mention. Funded by STFC (with support from the Wellcome Trust), it was/is the UK's largest scientific facility: construction costs were close to £500m (over three phases to 2021) and annual operating costs were estimated at £67.7m in 2019/20 alone. It is, therefore, a very significant resource.

The Campus itself is owned by and operated through a public/private Joint Venture. In 2020, Brookfield Asset Management acquired a 50% stake (from U and I Group plc and Harwell Oxford Partners Ltd). The public sector Joint Venture partners continue to be United Kingdom Atomic Energy Authority and STFC[43].

Harwell Science and Innovation Campus today

Today, Harwell Campus hosts over 6,000 scientists, engineers and innovators across more than 200 public, private and academic organisations; and the value of scientific infrastructure on the Campus is has been variously estimated in the range £2bn-£3bn[44]. The Campus occupies a 700-acre site, with about 1 million sq ft business space[45]. This includes some provision for small businesses – including an Innovation Centre which was established in 2000 and provides offices/flexible workspaces (110-1,400 sq.ft[46]). Speculatively developed commercial buildings are available to lease; currently these include Zephyr, Quad One, Zeus,

[43] Harwell Gets Funding Boost From Brookfield Harwell Campus (Harwell Campus, 2020)
[44] Harwell Science and Innovation Campus (2022) Science and Innovation - Harwell Campus; Bidwells (2022) Harwell Science and Innovation Campus Limited Partnership (bidwells.co.uk)
[45] Harwell Science and Innovation Campus (2022) Science and Innovation - Harwell Campus; Bidwells (2022) Harwell Science and Innovation Campus Limited Partnership (bidwells.co.uk)
[46] Harwell Science and Innovation Campus (2022) Harwell Innovation Centre

Quad Two and BEPO (with different combinations of lab, R&D, manufacturing and office space). Many of the new buildings however are tailored for particular occupiers, developed on a 'design and build' basis to meet bespoke requirements.

The underlying cluster narrative

In seeking to brigade its asset base – and to 'animate' the diversity of organisations and individuals within it – the managers/owners of Harwell Campus, led by STFC, have been increasingly proactive in the definition, management and promotion of a series of clusters. This was partly a response to UK Government policy and the recognition that outstanding science ought to be translated into economic growth across the UK and into wider international visibility and competitiveness. Facilitated by dedicated cluster managers and with oversight from wider steering groups (with representatives from Campus bodies, wider Oxfordshire stakeholders and national funding bodies/institutions), these have sought to encourage networking and collaboration within and between research organisations and businesses, *and* to provide a narrative that is compelling and communicable across the UK and internationally.

Figure A-12: Harwell Science and Innovation Campus

Source: Harwell Science and Innovation Campus

Currently the focus is on four key clusters[47]. *Space* was the first to be formally defined (in 2009). It is now associated with around 100 organisations with more than 1,400 staff. These include RAL Space, ESA's hub for satellite communications (ECSAT) and Business Incubation Centre, the UK Space Agency, the Satellite Applications Catapult, and companies such as Astroscale and Oxford Space Systems. As a cluster, *Energy Tech* was launched in 2018, bringing together over 80 organisations on Campus and over 1,400 people working within them. Key organisations and infrastructure include the Faraday Institution and the Extreme

[47] Harwell Innovation and Science Clusters - Harwell Campus

Photonics Applications Centre, and companies such as Qdot and Reaction Engines. With 74 organisations on site and more than 1,600 associated staff, Harwell's *Health Tech Cluster* includes organisations operating across medtech, biopharma, medical imaging and cell and gene therapy. Key organisations include the Rosalind Franklin Institute, the Diamond Light Source national synchrotron, the Nucleic Acid Therapy Accelerator and Medical Research Council Harwell, alongside companies such as Vaccitech. The National Quantum Computing Centre (supported by a £93m investment from UKRI and due to be fully open in 2023) is at the core of the new *Quantum Cluster*. Other key organisations include e6 and RedWave Labs.

Building wider connections

Harwell Campus and STFC are working to encourage multidisciplinary research and development *between* the four clusters. The Campus provides a variety of support to organisations on site, including a start-up incubator initiative and the *STFC-led Cross-Cluster Industrial Engagement Proof of Concept Grant* (which runs across Harwell and Sci-Tech Daresbury); this offers up to £40k of grant funding from STFC (matched by businesses) to stimulate industrial engagement with organisations across the clusters. The Campus also runs schemes such as *Connect Harwell*, bi-monthly networking events open to all, and *Connect Harwell Next Gen*, a programme for early-career professionals and students[48].

Harwell Campus has also developed leisure, social and cultural offers[49].The origin of some clubs and activities can be traced to the 1970s, and in 2011 the RAL Recreational Society (RecSoc) was opened up to organisations across the campus. Alongside other initiatives, this has encouraged the formation of sports and recreational clubs, interest groups including professional forums and networking groups, and facilities for health, well-being and social interaction. This emphasis on wellbeing is reaffirmed by the provision of dedicated support and training for individuals. Wider amenities on the Campus include a post office, hotel, medical care, nurseries for childcare, and a variety of options for food and drink. More widely, the Campus supports wildlife, wellbeing and environmental initiatives including re-wilding areas, relaxation spaces, and Campus trails. It has a Sustainability Plan, including a commitment to Net Zero carbon by 2050 (or earlier for some organisations on Campus) and Sustainable Travel. To date, significant efforts have been made to meet this target, including the installation of solar panels on roofs across the STFC site on Campus.

The future

Harwell is planning for significant future growth: the wider 5m sq ft Campus Masterplan is described simply as "*one of the most ambitious campus investment plans in the world*"[50]. The intention is to add 1.5m sq ft of commercial space by 2027. Importantly new homes, a hotel, travel hub, and amenities and green space are also part of the masterplan. The number of people employed on site is expected to grow to 15,000 over the next decade.

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[48] Harwell Campus Proof of Concept Programme and Life at Harwell - Harwell Campus
[49] Harwell Science and Innovation Campus (2022) Life at Harwell
[50] Future plan - Harwell Campus

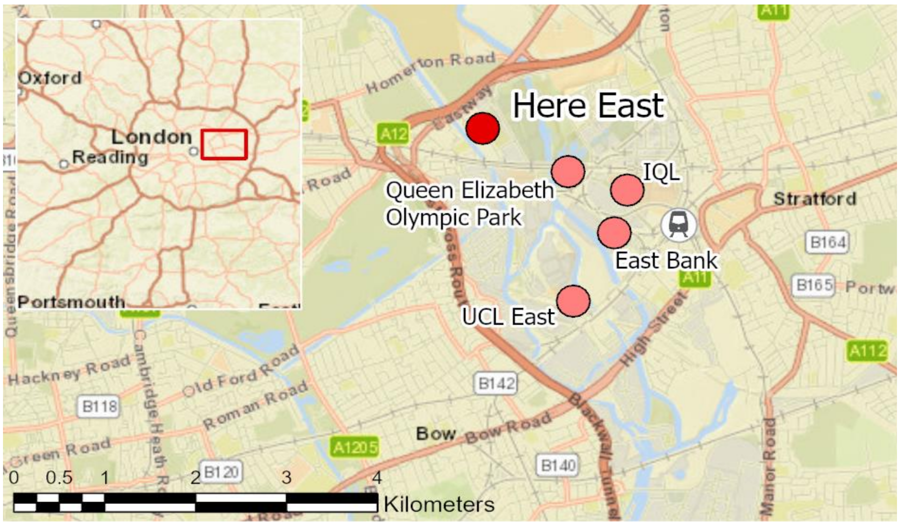
Here East

Figure A-13: Here East

Source: Here East Management Ltd

Here East is located in the Borough of Hackney in north-east London. It is sited on the western edge of Queen Elizabeth Olympic Park which served as the main site of the 2012 London Olympic and Paralympic Games. It is well connected to other parts of London (including direct journeys to London St Pancras and London City Airport) thanks to its proximity to Stratford, a major transport hub with underground, overground, DLR and rail services. With a World City location, it also benefits from good access to London's hub airports.

Figure A-14: Context map



Source: Produced by SQW 2022. Licence 100030994

Origins and development

The history of Here East goes back to the 2012 London Olympic and Paralympic Games. As part of the wider Olympic Park, the site was developed as a media complex housing an International Broadcast Centre (IBC) and a Main Press Centre (MPC).

Following the Games, the London Legacy Development Corporation, a mayoral corporation for the development of the Olympic Park, leased the site to a joint venture between Delancey, a major property development company, and Infinity SDC, an operator of data centres.[51] The lease is long term (200 years). The goal was to transform the media complex into a digital and creative cluster for London companies and to deliver a long-term post-Olympic legacy by generating employment, training and education opportunities in an area characterised by high levels of socio-economic deprivation.[52] In 2013, BT Sport, the first active tenant, moved its production hub to the IBC building, and in 2014, the site was officially renamed 'Here East'.

The following years saw further development of the complex, including the opening of the Canalside, a hub of independent cafes, bars and restaurants; the launch of Plexal, the site's own innovation centre; and the development of low-cost studios for creative businesses known as The Trampery on the Gantry. During this time, UCL, Loughborough University and Staffordshire University all took space within the IBC. As of 2022, 130 businesses have a presence at Here East, including c. 100 businesses based at Plexal. There are c. 5,500 people working or studying on the campus.[53]

Delancey was critical to the early growth of Here East. Delancey provided funding and development expertise for the repurposing of the buildings and it also supported revenue funding to help nurture the innovation process and environment in the early years.

Here East today

The Here East site is managed and operated by Here East Management Ltd. The company is responsible for developing, animating and promoting the campus, providing business space and support services, and curating the tenant mix, as well as having an orchestration role – supporting innovation by linking on- and off-site organisations and establishing new projects.

At the outset, Here East was envisaged as an innovation campus for the digital and creative industries, building on East London's heritage in these fields. The sectoral profile of the site has developed substantially over time; whilst the overarching digital and creative focus remains, new tenants have brought (and created) many related specialisms, including around e-sports, online gaming, automation, culture, TV and education. In the process, it has also attracted some high profile tenants. For example, Ford Mobility (now Ford: Drive) chose Here East as its European HQ for its Smart Mobility Innovation Office, which is exploring smart mobility solutions for Europe's major cities.

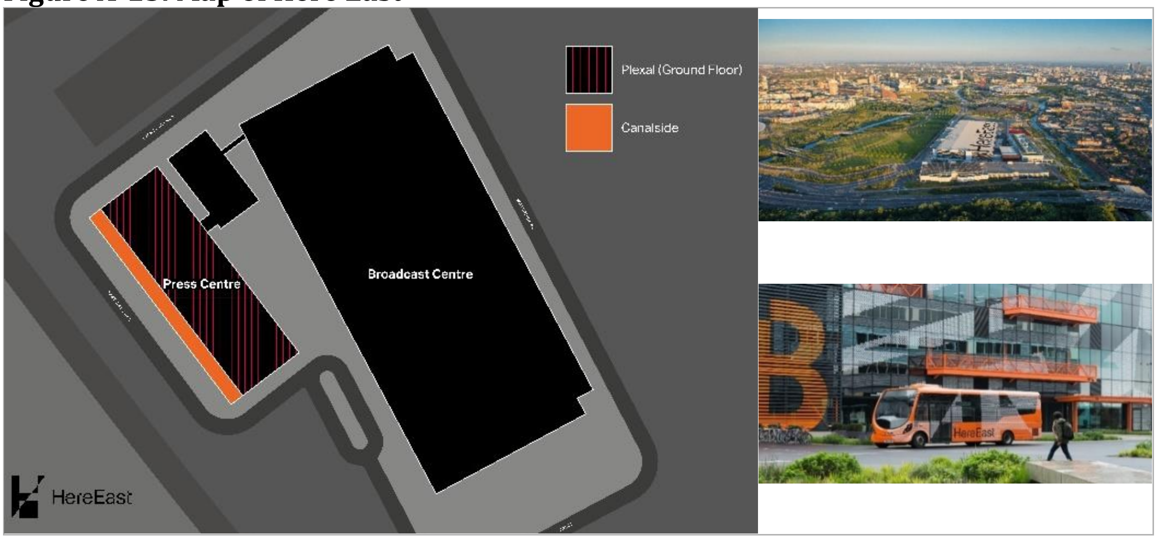
Here East is regarded as an innovative place that transcends traditional sectoral classifications. There are some synergies between these different activities and research delivered by the universities with a presence at Here East. This includes engineering, architecture and robotics at UCL; design, digital, media, sport and creative innovation at

51 Queen Elizabeth Olympic Park
52 London's four 'growth boroughs': Hackney, Newham, Tower Hamlets and Waltham Forest
53 Information provided by Here East Management Ltd

Loughborough University London; and games, cyber security and e-sports at Staffordshire University London.[54]

The site's physical space offer consists of the MPC housing a total of 227,200 sq ft of offices including Plexal, and the IBC, covering 661,000 sq ft of office and studio space, home to Here East's biggest tenants. For start-ups and scale-ups, Plexal provides 68,000 sq ft of co-working, office, prototyping/workshop and events space with a total capacity of up to 1,000 people. Small creative businesses are accommodated by the Trampery on the Gantry, providing low-cost desk space as well as 21 one- and two-storey freestanding studios at the back of the IBC, ranging from 260 to 760 sq ft.[55]

Figure A-15: Map of Here East



Source: Here East Management Ltd

For Plexal-based businesses, support functions are delivered by the centre's management and innovation teams which provide advice on collaboration opportunities and specific business challenges. Members also have access to one-on-one financial consultations and a range of community events for company founders. In addition, for Here East tenants more broadly, campus management provide softer business support by facilitating interactions between on-site businesses and creating opportunities for people to meet (e.g. through quarterly meetings for company leaders).[56]

The social life of the campus is concentrated around the Canalside housing, five locally-owned eateries, a gym, a small spa and independent retailers, all facing Hackney's Lee Navigation canal. Lunch options are also provided by a set of food trucks at the centre of the side.[57] Here East's location next to the vibrant Hackney Wick area ensures a wide nightlife offer, while its proximity to three parks – Queen Elizabeth Olympic Park, Hackney Marshes and Victoria Park – provides a range of recreation and leisure options, including the Olympic sport facilities.

[54] Here East, https://hereeast.com/whos-here/
[55] See Here East, Plexal and The Trampery
[56] Plexal, plus information provided by Here East Management Ltd
[57] Here East, https://hereeast.com/eat-drink-do/

Here East is a member of the International Association of Science Parks and Areas of Innovation (IASP). Its connections to local, national and international innovation systems are also developed through Plexal's innovation consulting work which is delivered by its team of management consultants for a range of public and private-sector clients.[58] By partnering with multinationals, global tech networks, government departments and start-ups from across the UK, Plexal plays a role in expanding Here East's network of collaborators and attracting prospective tenants.

The future

Across the wider Queen Elizabeth Olympic Park there are plans for a new 'inclusive innovation district' (*SHIFT*) which will serve as an urban testbed for new technologies addressing major challenges of city life, including climate change, health, wellbeing and mobility. The initiative is led by seven core partners – Here East, Plexal, University of the Arts London, UCL, Loughborough University London, Lendlease and the London Legacy Development Corporation.[59] It is expected to generate new collaborations between Here East and the Park's other innovation assets, most notably East Bank, an emerging culture and education hub consisting of the BBC, V&A, Sadler's Wells Theatre and London College of Fashion, as well as UCL East (UCL's new major campus on the south side of the Olympic Park), and International Quarter London (IQL), a new commercial development housing government, charity and private sector organisations.

Here East's future will be shaped by the campus' evolving sectoral profile as well as its net zero and community impact imperatives. In terms of environmental sustainability, Here East has been working on increasing the use of sustainable transport (via its fully electric shuttle bus service to Stratford) and the site's resource efficiency using 100% renewable electricity.[60]

In relation to community impact, the campus has launched initiatives targeted at local residents and members of underrepresented groups, including working with local schools to connect pupils with on-site organisations. The Here East Scholarship Programme provides full undergraduate tuition to local students from disadvantaged backgrounds to study at Staffordshire University London or LMA (a private creative HEI based on the campus). Additionally, Loughborough University London's Inspiring Success initiative targets unemployed or underemployed graduates from East London's four growth boroughs, and provides them with employability workshops and full tuition fee scholarships to study a master's programme at the university. The campus has also been involved in the East London Inclusive Enterprise Zone, a government-funded initiative led by a number of organisations including UCL, Plexal and Disability Rights UK, to create an accelerator programme for entrepreneurs who are disabled or whose work focuses on disabled people.[61]

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58 Plexal's clients include Innovate UK, DCMS, IBM and Amazon Web Services (among others)
59 SHIFT: the world's most inclusive innovation district
60 Here East, https://hereeast.com/about/different-makes-difference/here-east-planet/
61 Here East Scholarship Programme, Inspiring Success and East London Inclusive Enterprise Zone

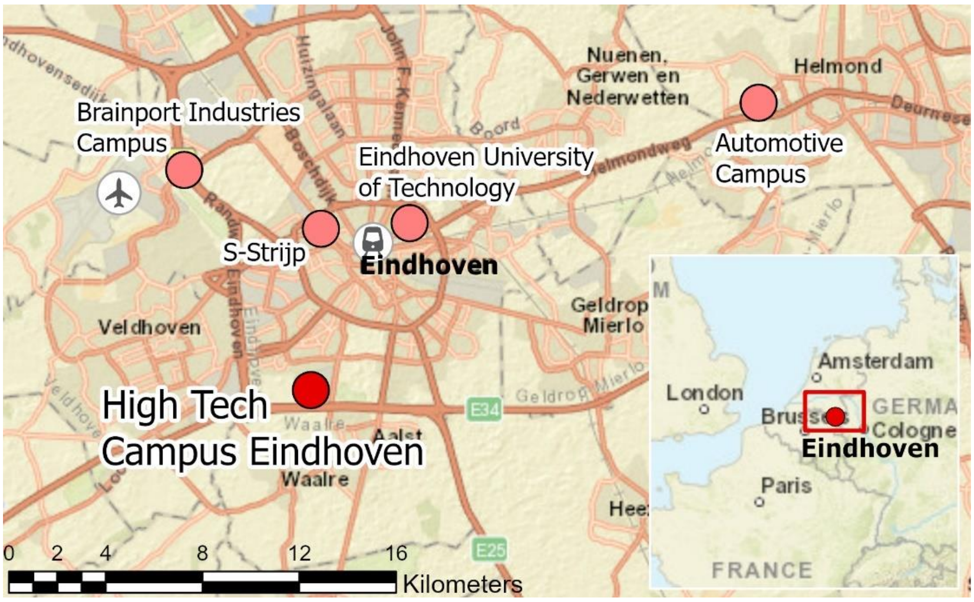
High Tech Campus Eindhoven

Figure A-16: High Tech Campus Eindhoven

Source : HTCE Site Management B.V.

High Tech Campus Eindhoven is situated on the southern edge of the city of Eindhoven in the Netherlands' southern region of Brabant. It is connected to the city centre via a 20-minute direct bus journey, as well as Eindhoven's extensive network of cycle paths. The Campus is next to the city's outer ring road which connects to Eindhoven Airport (c. 15 minutes by car).

Figure A-17: Context map



Source: Produced by SQW 2022. Licence 100030994

Origins and development

Philips & Co was founded in 1891 in Eindhoven, originally producing lightbulbs before expanding into electrical products. The history of R&D at the Campus dates to the 1960s when the area became home to NatLab (Philips' Physics Laboratory) known for fundamental and applied research in electronics, physics and chemistry. The Campus was the site of important

Philips inventions including the CD. In 1998, it became the prime location for all of Philips' national and international R&D activity.

In 2003, Philips welcomed other tech companies to the site under the name 'High Tech Campus Eindhoven' because of a desire to embrace open innovation and develop a shared centre for R&D. It was thought that it would be easier to attract other global companies to the Campus if it were not owned by Philips, and it was therefore sold in 2012 to a consortium led by a Dutch investor. Philips remains the site's largest tenant but is no longer responsible for Campus management or property upkeep costs.

Key milestones in 'opening' the campus to outside companies included setting up the Campus management organisation; establishing the Holst Centre[62] as an independent open-innovation R&D centre; and providing (paid) access to the former Philips' cleanroom laboratories and associated support services to third organisations via the MiPlaza initiative.

More recently, new initiatives to support the site's start-up ecosystem have been developed, often through collaborations between major international companies, public authorities and the Campus management organisation. These have included a venture-building programme HighTechXL; an Artificial Intelligence Innovation Centre serving as an incubator and accelerator; and a 5G Hub used as a testbed for 5G, AI, VR/AR, blockchain and photonics technologies.[63]

In 2021, the Campus was acquired by Oaktree Capital Management, an American investment management firm.[64] While privately-owned, the Campus has been supported by local and national government including through R&I funding for the Holst Centre, TNO and Solliance (solar energy R&D), among others, as well as help with creating international connections.

High Tech Campus Eindhoven today

As of 2022, the Campus is home to over 280 organisations, including c. 100 start-ups. Around 12,500 people of 100 nationalities are employed at the site (of whom c. 4,000 work at Philips).[65] The Campus is managed and operated by HTCE Site Management B.V. which is responsible for developing the site, providing facilities and support services, promoting the Campus, fostering collaborations, animating the social life of the Campus, and selecting prospective tenants based on technology and company culture criteria.[66]

[62] Holst Centre: jointly founded by TNO (Dutch national research institute) and imec (a leading semi-conductor and micro-electronics research and development institute, headquartered in Belgium)
[63] See HighTechXL, AI Innovation Centre and 5G Hub
[64] NautaDutilh, 2021, NautaDutilh assists Marcel Boekhoorn in sale of High Tech Campus Eindhoven
[65] Data provided by HTCE Site Management B.V., 2022
[66] Information provided by HTCE Site Management B.V., 2022

Figure A-18: Map of High Tech Campus Eindhoven

Source : HTCE Site Management B.V. – [https ://www.hightechcampus.com/campus-map](https://www.hightechcampus.com/campus-map)

The Campus specialises in wide-ranging high tech applications. Its sectoral profile is to a large extent a legacy of Philips' research with ASML, Signify and NXP all originating from Philips. While HTCE remains largely a campus for physics and deep science, more recently its profile has also been shaped by a new sectoral strategy defined around six technologies (semiconductors, photonics, 5G/Li-Fi, digital services, AI, user experience technologies) used in five application areas: Smart Environments & Connectivity, Applied Intelligence, Software & Platforms, Sustainable Energy & Storage, Health & Vitality.[67]

The Campus' business accommodation offer consists of office, lab and industrial spaces ranging from 20m^2 to 20,000m^2, as well as the option to build new tailor-made buildings on the site's development land. For start-ups and scale-ups, High Tech Plaza acts as a specialised hub split into three buildings, each with its own area of focus: start-ups, scale-ups and support services. It is home to over 80 companies using its office, lab and shared meeting spaces, and benefitting from lower rental rates. In addition, the AI Innovation Center – one of eight innovation hubs[68] on site – offers 16,500 m^2 of office, events and co-working space dedicated to AI innovation.[69] Many of the innovation hubs offer business support around training, mentoring, finance and networking opportunities to digital tech firms. The photonics industry is served by PhotonDelta, a private-public partnership connecting tech companies with investors, higher education and research institutions, and governments.

The Campus also provides business support functions to accelerate company growth and establish collaborations. These include HighTechXL, a deep-tech venture building programme which builds teams of entrepreneurs around advanced technologies sourced from

[67] 'High Tech Campus Eindhoven' presentation by HTCE Site Management B.V., 2022
[68] These include: AI Innovation Centre, 5G Hub, PhotonDelta, HighTechXL, LUMO Labs, EIT Digital, Twice, and Workplace Vitality Hub, *Future. Welcome to High Tech Campus Eindhoven*, Edition 1-2022
[69] See High Tech Campus Eindhoven, Business Locations and High Tech Plaza

organisations such as CERN, TNO or Philips, and connects them to investors, mentors, corporates and community stakeholders. Alongside this, DeepTechXL provides early stage (pre-seed and seed) funding and know-how to tech ventures. Community-building initiatives include the Campus Business Club and Fe+male Tech Heroes, a network of 3000 researchers, scientists and entrepreneurs aimed at promoting diversity.[70]

The Campus' social life is concentrated around The Strip at the centre of the site which houses 11 restaurants, a wellness centre and a conference facility, and is used for events ranging from lunchtime lectures to pub quizzes. The site also offers access to green spaces, a large multi-sport complex, and 150 free-to-use bicycles and electric scooters.[71]

The Campus is connected to other knowledge and innovation assets in the Brabant region through the 'Brainport' initiative, a collaboration between 21 local municipalities to strengthen the area's innovation base and cement it as a contributor to the national and global economy.[72] Internationally, linkages are developed through initiatives such as the International Association of Science Parks and Areas of Innovation (IASP).

The future

The Campus' strategy was co-created between the management organisation, on-site companies and wider stakeholders. It aims to be the most sustainable campus in Europe by 2025 to support the attraction and retention of international talent, and enable competition with innovation systems of global significance.[73] Three 'pillars of sustainability' are identified:

- **Being environmentally friendly**: solutions to minimise the Campus' carbon footprint include solar panels, closed water management systems, seasonal thermal energy storage, WELL Gold standards and BREEAM-certified buildings, and, in future, potentially on-site wind turbines and fuelling stations for hydrogen-powered cars. Steps are also taken to enhance the site's biodiversity, including adding animal and plant species.
- **Being a great place to work**: the creation of the Workplace Vitality Hub, a space for collaborative R&D of vitality-at-work solutions using smart technologies. The Hub is a collaboration between the Campus, research institutes, Eindhoven University of Technology and others. Other initiatives focus on improving the leisure offer and everyday experience of the Campus, e.g. via new mobility or healthy food solutions.
- **Accelerating innovation**: continuously investing in new facilities, partnerships and networks. The site's role is to initiate and foster collaborations around new technologies. It is already being used as a living lab for pilot projects, including for autonomous drones.

[70] *Future. Welcome to High Tech Campus Eindhoven*, Edition 1-2022
[71] *Future. Welcome to High Tech Campus Eindhoven*, Edition 1-2022
[72] Brainport Eindhoven, https://brainporteindhoven.com/en/discover/what-is-brainport-eindhoven
[73] See Sustainable Campus and *Future. Welcome to High Tech Campus Eindhoven*, Edition 1-2022

Hsinchu Science Park, Taiwan

Figure A-19: Hsinchu Science Park

Map produced by SQW. Logo source: Hsinchu Science Park Bureau

Hsinchu is a coastal city in the north of Taiwan, around 85km south east of the capital Taipei. With a population of over 400,000 people it is the sixth largest city on Taiwan.[74] Hsinchu Science Park (HSP) is located on the south western edge of the city. It is bisected by National Highway 1 and is close to National Highway 3, both of which run along the western side of the island. HSP is around 5km from Hsinchu's main train station, and slightly further from the high speed rail station. It is around 60km from Taoyuan International Airport, the island's largest airport.

Origins and development

The Hsinchu Science-based Industrial Park (HSIP, now HSP) was the first science park in Taiwan when it opened in 1980. It was designed as part of Taiwanese Government efforts to move away from low value, labour intensive industries into higher value, science based areas. The HSP site was created on previously agricultural land, chosen because it was adjacent to existing academic and research institutions such as the government-sponsored Industrial Technology Research Institute (ITRI, founded in 1973 to drive industrial development through R&D), National Tsing Hua University, and National Chiao Tung University (now National Yang Ming Chiao Tung University)[75].

PCs and peripheral product manufacture was the major activity at the Park in the 1980s. By the early 1990s, however, the design, manufacture and testing of Integrated Circuits (ICs, also known as semiconductors) became more important as a cluster developed around two ITRI spin-outs United Microelectronics Corporation and Taiwan Semiconductor Manufacturing Corporation (UMC and TSMC).[76] A decade later, the optoelectronics industry, particularly

[74] https://www.geonames.org/TW/largest-cities-in-taiwan.html
[75] Making IT: The Rise of Asia in High Tech (2007) H. Rowen, Stanford University Press
[76] The Emergence of Hsinchu Science Park as an IT Cluster in World Bank (2008) Growing Industrial Clusters in Asia: Serendipity and Science

makers of liquid crystal display panels, became an increasingly important industry on the park[77].

Since the foundation of the original HSP site, five additional sites in northern Taiwan have become part of the HSP group. The six sites cover a total area of almost 3,460 acres.

Hsinchu Science Park today

The main HSP site covers 1,695 acres, hosts over 400 tenant businesses and has on-site employment of almost 140k people.[78] It is primarily known as a location for IC companies, and these firms generate almost three quarters of the combined revenue of HSP tenant firms. This includes large firms such as UMC, TSMC and MediaTek as well as smaller supply chain firms.

The remaining 'pillar industries' at HSP are precision machinery, optoelectronics, PCs, telecommunications, and biotechnology[79]. Industry activity across all areas is supported by national-level research institutions and universities on/adjacent to HSP (shown in purple on the map below), including ITRI, National Applied Research Laboratories, National Synchrotron Radiation Research Centre, and the National Tsing Hua and National Chiao Tung universities. More than 50 enterprises operating in the park originated as spin-outs from such organisations, notably UMC and TSMC are both spin-outs from ITRI[80]. The Allied Association for Science Park Industries (ASIP, a membership organisation) acts as a bridge between individual companies and research institutions.

HSP is owned and managed by the Hsinchu Science Park Bureau (HSPB), a public sector body which is overseen by the Ministry of Science and Technology. At all of its six sites, HSPB is responsible for the power, water, and transport infrastructure. It directly provides ready built units for smaller companies to rent as well as serviced land for larger companies to construct bespoke facilities.

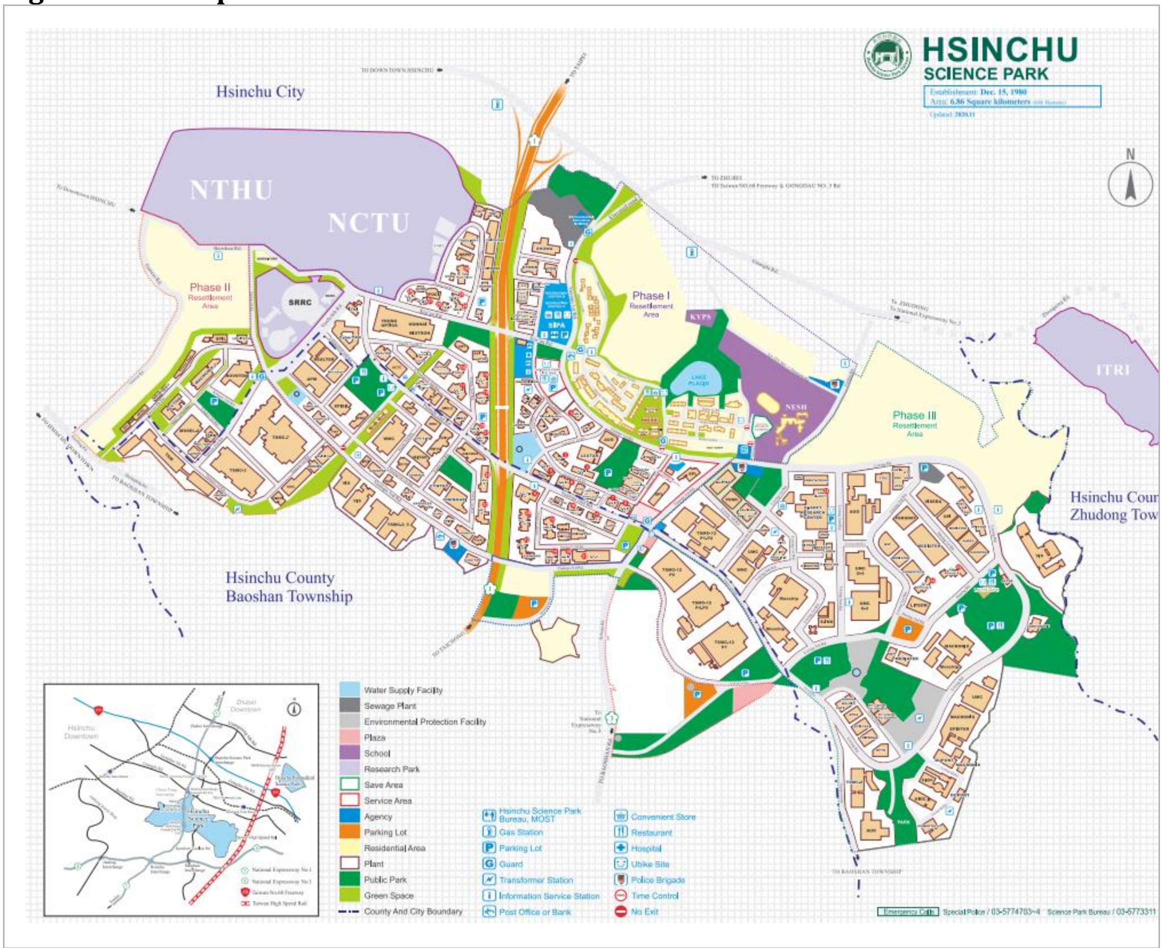
Tenants at HSP are exempt from import and export duties to help encourage international trade. They also benefit from:

- **R&D grants and incentives** to promote R&D and industry-academia collaboration. In 2021, across all six sites, the HSPB provided NT$60m (c.£1.7m) in R&D subsidies[81], in addition to funding available from national sources.
- **Support for start-ups** with around 20 incubators and accelerators across the six HSPB sites, large tenant firms and adjacent research institutes. HSPB runs the YES incubator at the main HSP site which offers early stage companies support for three years. HSPB also supports engagement between potential funders and entrepreneurs.

[77] https://topics.amcham.com.tw/2019/03/what-are-taiwans-science-parks/
[78] Hsinchu Science Park 2021 Annual Report
[79] https://web.sipa.gov.tw/english/HsinchuSciencePark
[80] https://topics.amcham.com.tw/2019/03/what-are-taiwans-science-parks/
[81] Hsinchu Science Park 2021 Annual Report

- **Networking and events** are organised by the HSPB. These moved online because of Covid-19 and in 2021 included a conference for medical devices procurement, a matching session with European medical devices buyers and the Taiwan Expo in Thailand.
- **Training programmes** on critical technologies, emerging industries, and biotechnology. HSPB funds universities to co-deliver training alongside industry experts to ensure that the content is relevant to businesses.

Figure A-20: Map of Hsinchu Science Park



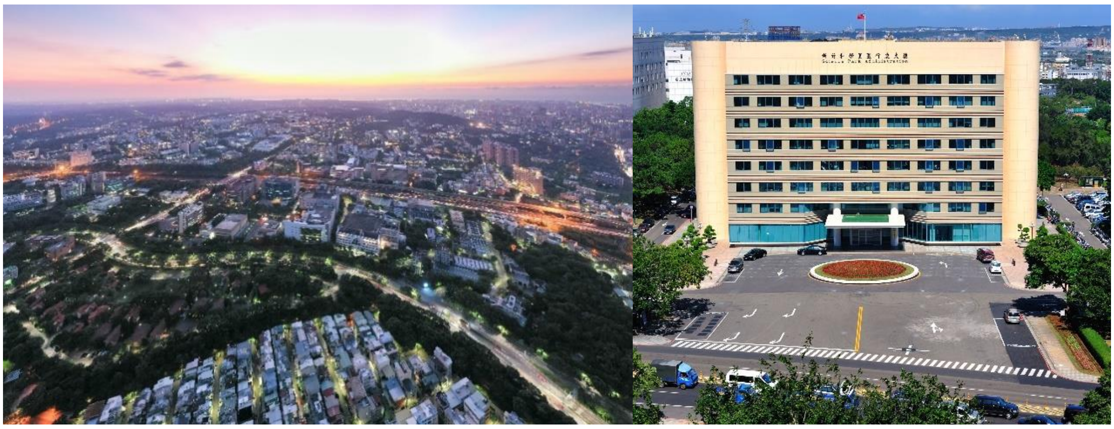
Source: Hsinchu Science Park Bureau

Wider facilities at HSP include a recreation centre with a gym, auditorium, and convenience store. There are also parks and sports facilities, a healthcare centre and restaurants. A bilingual school has been operational since the early 1980s to help encourage talent from overseas to move to HSP. HSPB also maintains three areas of housing (shown in yellow on the map) for tenant firm staff.

As the first science park in Taiwan, HSP influenced the design of the Central and Southern Science Parks - Taiwan's two other major science parks. More broadly, HSPB is a member of the International Association of Science Parks (IASP) and the Asian Science Park Association

(ASPA), and forms strategic alliances with other members.[82] The majority of HSP tenants are export oriented and part of global supply chains, and so have their own international linkages.

Figure A-21: Hsinchu Science Park



Source: Hsinchu Science Park Bureau

The future

In mid-2022, the main HSP site and majority of 'sister sites' were almost at full occupancy. Future growth will be generated through the renovation of existing units at HSP, growth the other sites within HSPB control (especially Tongluo and Yilian), or potentially the development of other sites acquired by HSPB. Two examples of the latter which are in close proximity to the main HSP site are:

- **Baoshan Phase II Expansion** to support the continued growth of the IC industry, c.220 acres of land to the south of the main HSP site will be developed, with TSMC as anchor tenant.[83]
- **Hsinchu Science Park X** will be developed around 5km to the north of the main HSP site. Partly developed on the site of an old oil depot, HSPX is designed to support software innovation in areas including AI, 5G, and big data. The first phase of the development on a c.7-acre plot is expected to open in 2024 and create 2,800 jobs.[84]

The future development of HSP will align with the goals of the Ministry of Science and Technology's strategy *Taiwan Vision 2030*: innovation, in particular for biotech and precision medicine; inclusion, by developing greater linkages with neighbouring communities; and sustainability, including wastewater recycling and increasing the use of clean energy.

[82] Hsinchu Science Park 2021 Annual Report
[83] Taipei Times (July 2021) EPA approves Hsinchu Science Park expansion plan
[84] Taipei Times (December 2021) Science park to give nation boost

Lund Science Village

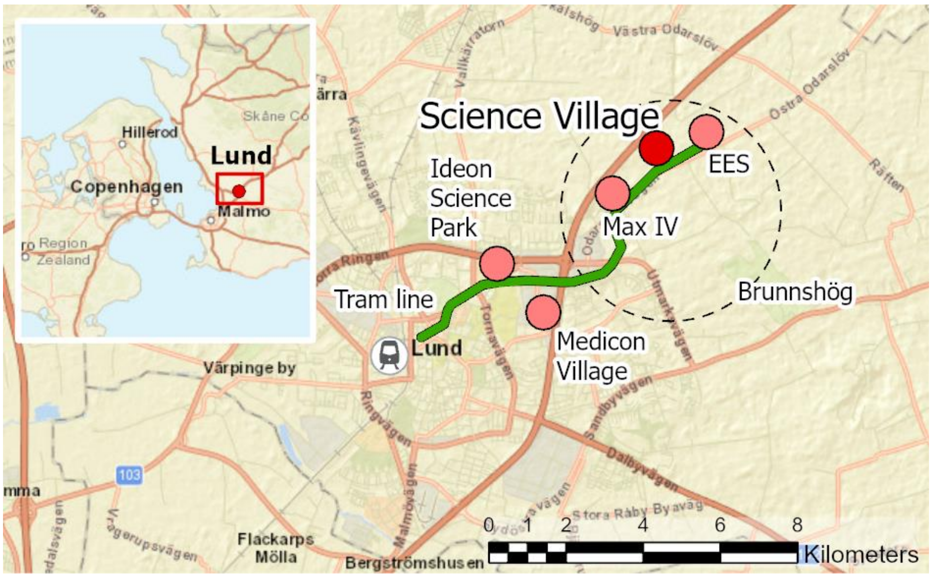
Figure A-22: Lund Science Village

SCIENCE VILLAGE

Source: Science Village Scandinavia AB

Located in Sweden's southern region of Skåne, Lund is a city of around 100,000 inhabitants. It is some 20km from the regional capital Malmö, which is linked to Copenhagen by the Öresund Bridge. Lund Science Village (SV) is set within a planned innovation district in Brunnshög, a neighbourhood to the north-east of the city centre. A modern tram line connects the SV with Lund's railway station and the city's main knowledge areas, including Lund University and the two science parks.

Figure A-23: Context map



Source: Produced by SQW 2022. Licence 100030994

Origins and development

The SV is being developed by a publicly-owned company, Science Village Scandinavia AB (SVS AB), created in 2009 as a joint venture between Lund Municipality, Region Skåne and Lund University with the ambition of creating *'the world's best research and innovation* *environment'*.[85] It aims for a global ambience and connectivity. Between the SV and the City, Lund Municipality is implementing a major urban extension with an eventual target of 16,000 residents and 24,000 jobs.

The 44-acre site is vested in SVS AB and lies between two major research assets: the MAX IV synchrotron laboratory which was formally inaugurated in 2016; and the European Spallation Source (ESS, an advanced neutron source), for which construction began in 2014[86] and operation should start in 2027.[87] The goal of the SV is to promote the development of an innovation ecosystem around these two facilities by attracting industry, research and education facilities.

In support of this concept, Lund University (already the host institution for MAX IV) has decided to move parts of its Faculty of Engineering and Faculty of Science into the SV. This will be undertaken in stages to 2030, with some 40,000 sq m of research and teaching space.

Lund Science Village today and in the future

SVS AB is responsible for delivery, supporting industry initiatives, selecting and guiding incoming property developers, and creating contacts between institutions and business. The company's tasks include developing the infrastructure, leasing the land, and supporting the early provision of key facilities by sharing the developer's risk; e.g. taking the lease for the new conference facility. Its management board, with five meetings per year, consists of representatives of Lund Municipality, Region Skåne and Lund University.[88]

The site's sectoral focus reflects the capabilities of its three main research assets.

- Hosted by Lund University, **the Max IV facility** is Sweden's national synchrotron and offers open access to 16 beamlines to academia, research institutes, industry, and government agencies worldwide. It currently welcomes 1,000 users every year and this is expected to double as the Science Village develops.[89] There is scope for 10 further beamlines.
- **The European Spallation Source** will be the world's most powerful neutron source with, initially, 15 instruments (scope for 22) and a supercomputing data management and software development centre (located in Copenhagen). It is a pan-European project with 13 European nations as members, and is expected to welcome two to three thousand guest researchers every year.[90]
- Lund University's established Nano Lab provides a clean room with semiconductor processing and metrology equipment. It is open to academia, start-ups and established

[85] SVS AS, 2015, https://sciencevillage.com/assets/SVS-Spring-201513.pdf
[86] ESS, https://europeanspallationsource.se/building-ess
[87] SVS AS, https://sciencevillage.com/theresearchfacilities/
[88] SVS AB, https://sciencevillage.com/about-svs-ab/
[89] Max IV, https://www.maxiv.lu.se/about-us/the-max-iv-facility/
[90] ESS, https://europeanspallationsource.se/about

companies, and offers access to training by metrology, equipment and process specialists.[91] The Lab will move to a major new building on the SV and be re-named **Nanolab Science Village**. It is expected to be ready by 2026/27 and will complement Max IV and ESS, meeting their guest researchers' needs for sample preparation and complementary characterisation.[92]

Together, the three facilities will service advanced research in material science and nanotechnology, microelectronics, quantum technology, energy, health and life sciences, the environment, food and packaging. The goal is to develop several 'knowledge environments' that offer access to specialised labour and collaboration partners. The sectoral themes build on and further strengthen Skåne's existing areas of specialisation.[93]

Business accommodation at the site will include two flagship buildings that are currently under construction. Expected to open in 2023, the SPACE building will offer 7,400 m^2 of office, lab and leisure areas. Most of the space will be occupied by Oatly, an alternative proteins company, with the remaining floors available for rent to other businesses. The Loop building will be home to 'mediator companies' (assisting others in the use of Max IV and ESS), as well as academia and industry. The building will offer 11,000 m^2 of space including a multi-purpose event hall, auditoria, offices and meeting rooms, educational premises and, potentially, small-scale laboratories. It is expected to open in 2024.

Figure A-24: Key assets at Lund Science Village – looking from the ESS towards Lund

Source: European Spallation Source

The SV will help MAX IV and the ESS to educate companies in how to use their capabilities. A current example of this is the MAXESS Industry Arena[94] which has, for example, partnered

[91] NanoLund, https://www.nano.lu.se/facilities/lund-nano-lab
[92] NanoLund, 2020, https://www.nano.lu.se/article/important-step-towards-new-nanolab-science-village
[93] FIRS, 2019, *Skåne's innovation strategy for sustainable growth*.
[94] MAXESS, https://maxess.se/about-maxess/

with Lund's life sciences business incubator in a project that helps companies to conduct experiments and then with the analysis of data generated through the experiments.

Figure A-25: Lund Science Village with MAX IV (bottom left) and ESS (top right)

Source: Science Village Scandinavia AB

The Science Centre will animate the social life of the SV, with interactive exhibitions and events open to the public. It will be a space for Science Village companies and researchers to meet audiences and showcase their work. In addition, the Event Hall at The Loop will be used as a venue for conferences and lectures, but also concerts, musicals, and theatre; it will be able to accommodate up to 1,000 people.[95] It is hoped that a spin off benefit from creating a vibrant and stimulating atmosphere, will be to help MAX IV and ESS to attract and retain their key staff. Over the next 10-15 years it is planned to achieve an additional 300,000 sq m. of development.

The Science Village is a member of the High Level Forum, while Max IV and ESS are part of the League of European Accelerator-based Photon Sources (LEAPS) and the League of advanced European Neutron Sources (LENS), respectively.

[95] SVS AB, Science Center and Science Village Hall

SQW

Contact

For more information:

Christine Doel
Director, SQW
T: +44 (0)1223 209 400
E: cdoel@sqw.co.uk

Reuben House
Covent Garden
Cambridge
CB1 2HT

Donald Ross
Managing Consultant, SQW
T: +44 (0)161 475 2108
E: dross@sqw.co.uk

Beckwith House
Stockport
SK4 1AF

www.sqw.co.uk

About us

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www.sqw.co.uk

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www.oxin.co.uk