Advance HE

MEMBER BENEFIT

Sustainable institutions

–

An evidence-informed review of good practice

Iain Cross and Alina Congreve

Executive summary

This project investigates the progress universities around the world are making in becoming sustainable institutions. It provides an evidence-based review of current practice in the form of a systematic literature review and five detailed case studies. Many universities have taken action on sustainability for over 30 years, conducting research to reveal the scope of environmental challenges and potential solutions. Universities support their students in acquiring the knowledge, skills and behaviours that will enable them to thrive in an uncertain world. Universities can also make a significant contribution by reducing their own environmental impacts. They are increasingly conscious of their reputation for sustainability, highlighted by the growing prominence of league tables and rankings. Many governments are expecting universities to take a central role in re-skilling people in the transition to a low carbon economy. The youth climate movement is an indication of the strength of feeling many young people have about the environment and concern for the future. Our research makes a timely contribution to understanding the work still needed for universities to become sustainable institutions.

Currently, sustainability action is uneven, with a strong emphasis in most universities on reducing the environmental impacts of their own estate (energy bills, recycling waste etc). Our research indicates that much of the good work being done is piecemeal and siloed. This includes: activity in teaching and learning; research; economic and skills engagement with partners/industry; civic engagement. This means potential synergies are unrealised – for example, sustainability action on campus can provide a powerful learning experience for students. Using the campus to trial and test research, in a living lab approach, can advance knowledge. Few universities are taking a whole institutional approach and connecting their work in research, teaching, the estate and civic engagement. Responsibility for 'doing' sustainability commonly rests with a small number of champions, rather than being embedded across the organisation. This leaves progress vulnerable to one or two key individuals changing roles. Every university is different, and operates within a particular set of legal, economic and cultural constraints. However, this report can offer insights which will help universities at many different stages in their sustainability journey.

Contents

List of figures

List of tables

Acknowledgements

This work was funded with a Collaborative Development Fund award from Advance HE. We are grateful to Kim Ansell, Kay Hack and Tracey Gunson from Advance HE for their support and guidance. We would like to express our thanks to John Sumpter at Advance HE for his advice and support to facilitate the Tweetchat, and the #LTHE Chat community for their thoughtful reflections. We are especially grateful to colleagues at Cardiff Metropolitan University, Deakin University, Falmouth University, Sharjah University and Wageningen University who generously gave up their time to share their perspectives. We would like to thank the participants in our workshops at the Advance HE Sustainability Symposium, Advance HE Teaching and Learning Conference, and project workshop in June 2023. We thank the LSHTM Ethics Committee for their helpful advice on the project, and the Centre for Excellence in Learning and Teaching at LSHTM for their support during the project. Baljit Sangha at LSHTM kindly assisted the development of formulae for the data analysis.

About the authors

Dr Alina Congreve is an experienced academic with 18 years working in higher education in the UK and Europe. She has researched how climate change is integrated into the university curriculum, looking at subjects where climate change is commonly taught (geography and environmental science) and where it is not routine (humanities, law, business; chemistry, etc). From 2016-19 she worked for Climate KIC designing and delivering courses with European universities, where students generate solutions to climate change challenges. She is now freelance: delivering training to PhDs and early career researchers for Vitae; and for CIEEM (professional body for ecologists) working on their Early Careers Programme. She has an MSc in Conservation from UCL and a PhD from Kings' College London, which focused on sustainability in the built environment.

Dr Iain Cross leads the Academic Professional Development team within the Centre for Excellence in Learning and Teaching at the London School of Hygiene and Tropical Medicine (LSHTM). Iain is responsible for LSHTM's continuing professional development provision, and is the Programme Director for the Postgraduate Certificate in Learning and Teaching. Prior to joining LSHTM, Iain was Associate Dean for Learning and Teaching at St Mary's University, Twickenham. He also led the BSc Geography programme and lectured in a wide range of environmental geography and research methods modules. He has a background in environmental studies; including a PhD on lake ecology and climate change from the University of Nottingham and BSc in Environmental Geography from UCL. His interests focus on teaching climate change, assessment and feedback, authentic learning and decolonising doctoral research.

1 Insights

Our research concludes that sustainability responsibility primarily rests with the campus and estates team. In most universities this is where sustainability activity started – in efforts to save energy and reduce waste. Our literature review revealed that sustainability policy and programmes remain closely aligned to estates and campus teams. This is shown by the clustering of 'campus' with the terms 'policy', 'management', 'strategy', 'plan', 'performance' and 'implementation'. Our analysis of the literature also reveals where synergies are not realised. Very few papers discuss education, learning and curriculum together with the campus or buildings, indicating the frequently missed opportunities to connect the sustainability actions on campus to students' learning. Many reports and guidance documents in education for sustainable development highlight the important role of the campus in learning for sustainability.

Sustainability is increasingly important in student recruitment, and many universities encourage pro-environmental behaviours. Many potential students now expect their university to align with their values, raising the importance of sustainability in university recruitment. At university, students are often encouraged to adopt pro-environmental behaviours. For example, reducing waste, saving energy and green travel choices all featured very prominently in our literature search. Sustainability action is directed at students to encourage their participation in specific projects and initiatives. However, we found very limited evidence of co-creation with students or students as partners, which was referred to in only 1% of articles. This contrasts with other policy debates in higher education, where it is strongly advocated.

Use of sustainability assessment tools was uneven, with more well developed and accepted approaches in estates compared to teaching and learning and research. Most tools were utilitarian and data driven, relying on information that is collected anyway (such as energy bills) rather than developing robust ways to collect qualitative and quantitative data about research, teaching and civic engagement. League tables, including People and Planet, Green Metric and Times Higher Impact Rankings, drew considerable attention from the mid-senior sustainability professionals in our case studies. This is partly for pragmatic reasons, and they acknowledged their usefulness to win support from colleagues and in student recruitment. They also genuinely found them useful in benchmarking their progress, thinking about what actions to prioritise next, and taking a more rounded approach. This positive finding contrasts with the often critical commentary on the principle of sustainability benchmarks and league tables across many fields in the academic literature.

Our research found that the Sustainable Development Goals (SDGs) did not provide a strong and central conceptual framework to support action. SDGs were not prominent in the literature, mentioned explicitly in only 15% of articles, and were also largely absent as drivers of action in our case study research. Universities had instead developed mission statements and values to frame sustainability that were unique to their own circumstances and the national and regional context. For example, a national policy framework which is progressive and ambitious can support change (The Future Generations Act in Wales); while the lack of Government priority over many years in Australia has spurred many universities to take action themselves. In our case studies, these institutional narratives were diverse and included:

+ an environmentally responsible anchor institution in their region (Deakin, Falmouth, Cardiff Met)
+ a living lab where social and technical innovations could be tested for adoption by municipalities (Deakin)
+ maximising the opportunity that a move to university brings to engage students in pro-environmental behaviours (Cardiff Met)
+ enhancing the potential for students to be change agents for sustainability in their future careers (Falmouth, Sharjah)
+ finding solutions to pressing environmental challenges through collaborative, interdisciplinary research, supported by strategic investment of the universities' own resources (Cardiff Met, Wageningen, Deakin).

The structural tensions between current university practices and sustainability are rarely engaged with. For example, university business models that focus on international student growth are in tension with aims to reduce carbon emissions and address green skills shortages in their region. Many universities promote their research that helps address sustainability challenges, while continuing to engage in other research that supports unsustainable practices such as the oil and gas industry and industrial agriculture. Research cultures still give priority to air travel and presenting research findings internationally, and action to minimise these environmental impacts of research are piecemeal. However, disruption following Covid has started to challenge the assumptions of continually adding new buildings to the university estate, and refocusing on making better use of the existing buildings.

2 Recommendations

2.1 For those undertaking research into higher education

+ **Conduct more empirical research about the sustainable institution.** There are very few empirical studies which look at sustainable institutions and whole institutional approaches, even fewer if accounts by those working on sustainability and writing about their own experience are excluded. Our research represents a starting point, and there are many other examples researchers could develop and explore, including:
  - **The adoption of a whole institutional approach in different geographical contexts.** In our longlist we identified many interesting examples in Asia, South America and the US and Canada that we did not have the capacity to engage with.
  - **Different sampling approaches to identify examples of good practice that are missing from our longlist.** We struggled to identify examples of whole institutional approaches from any African university, and SE Asia was under-represented. The limited number of articles in the literature review only reported modest energy saving projects and other pro-environmental behaviours.
  - **The implications of a whole institutional approach for universities that diverge significantly from a 'standard' European model.** How does it differ for small institutions of 1-2,000 students or very large universities of over 80,000 students? What about universities that are entirely teaching focused, or are highly specialist in one or two disciplines?
  - **The adoption of a whole institutional approach in a private university context could be very different, and would benefit from investigation.** A related group of organisations are the small, private providers delivering courses on behalf of larger universities.
+ In our literature search and case studies, we noted different models for where sustainability is located. The most common model is in the estates team, but other options are available. **We think there would be benefits in exploring the potential advantages and implications of different sustainability leadership models, and how these relate to existing institutional contexts.**
+ We observed in our case studies an interesting correlation between universities that were advanced in adopting the whole institutional approach, while in parallel making marked advances in research capabilities. **We feel the relationship between the whole institution approach and research capabilities warrants further investigation.**
+ In the section below for sustainability managers and those who manage toolkits and benchmarks, we make recommendations for advances in measurement and evaluation approaches. **These would benefit from research expertise from diverse disciplines.**

2.2 For sustainability managers and champions

+ **Look for opportunities to co-create sustainability projects and programmes with students and move away from it being something that is done to students.** Explore models for more strategic involvement of students in sustainability, such as students meaningfully contributing to sustainability reports.
+ **Develop a theory of change for sustainability activities – understand how and why the activity you are undertaking will lead to the change you want to see.** Gather support for and engage in more robust evaluation of sustainability activities to see if the desired change is taking place. This evidence could be used to refine activities so they have more impact, and leverage in further resources.
+ **Refocus your role to reduce the emphasis on implementation and event management.** Decentralising and delegating implementation, so sustainability becomes part of everyone's job, can also create space for you and your colleagues to engage more strategically. Time could also become available by scaling back on activities that are identified as having limited impact following an evaluation. Teaching and research are central activities for universities, and working to make these more sustainable and facilitating connections between them and with the campus will have more impact than working in an estates silo.

2.3 For organisations that design and coordinate toolkits and ranking schemes

+ **Many other sectors have moved to science-based targets, so emissions reductions are in line with the Paris Agreement.** The energy, emissions reductions and climate change targets in ranking schemes and toolkits could be adjusted to align with universities limiting their contributions to warming of 1.5°C.
+ **Universities need more credible and robust ways of measuring impacts beyond their estates functions.** For example, pro-environmental behaviour change is widely advocated, but the projects and programmes are very rarely subject to meaningful monitoring and evaluation. Toolkits and ranking schemes would be more valuable if they supported universities in their efforts to conduct more robust measurements.
+ **Other evaluation and benchmarking processes in education facilitate an institutional narrative.** For example, the TEF (Teaching Excellence Framework) in England contains a narrative statement. This approach, accompanied by expert input, has potential for sustainability benchmarking and warrants further consideration.
+ **Toolkits and benchmarks would be improved with summary outputs for different audiences** including students, the governing body and external partners, to ensure that all stakeholders are informed and engaged with understanding sustainability actions, promoting student engagement and transparency in strategic planning and decision-making.

2.4 For senior university leaders

+ **There is no single 'right way' for a university to be a sustainable institution.** Prioritising pro-environmental behaviour change among students is different to, not better than, the campus becoming a living lab to trial green technologies. However, if the university mission is to be a living lab and trial for municipalities or a catalyst for pro-environmental behaviour change among students, this needs to be robustly evaluated. Current sustainability reporting measurements of energy bills or number of people who attend a sustainability event are not giving a clear picture to assess if the university is delivering on its mission. Senior leaders could better support sustainability by allocating adequate resourcing to develop this evaluation, and implement governance mechanisms to consider the results.
+ **Having sustainability in a 'line of sight' can benefit senior leaders by clearly connecting the university purpose with its policy, practices and programmes,** through effective organisational structures and reporting mechanisms.
+ **Consider relocating the sustainability team away from the estates department.** Basing the team in estates can create barriers for a whole institutional approach to sustainability across research, teaching and civic engagement. Other structural options include a dedicated sustainability office or a strategic unit in the office of the vice chancellor. On its own, this change will not make the university a sustainable institution, but it could help facilitate progress.
+ **Re-evaluate where responsibility for sustainability lies, so it is seen as everyone's responsibility, not something that is only done by the sustainability team.** There are parallels here with the way health and safety, and equality, diversity and inclusion have been decentralised in many universities.
+ **Universities have increasing expectations placed on them to address national and regional skills gaps, and help people re-skill as a result of labour market change. Government funding models for higher education often run counter to these expectations.** A prominent example of this is the reliance in many UK and Australian universities on international students to generate income. If governments expect universities to make a larger contribution to the skills needed for a green economy in their own countries and regions, a different funding model would better support this objective. This is not something university leaders can achieve alone and would be best taken forward through collective action.

3 The origins and definitions of 'sustainable institution'

A considerable body of literature published over the last two decades seeks to address the role of higher education institutions in advancing sustainability. While a comprehensive review of publications prior to 2016 is beyond the scope of this report, it is helpful to set out earlier efforts to define what we mean by the 'sustainable institution'.

An early definition of a sustainable institution is one that is "attempting to be a reflective microcosm of a sustainable society" (Sterling, 2003). Cortese (2003) identified four areas of practice where sustainability actions are embedded: education, research, operations and community engagement. Later work includes the addition of governance or culture (Yarime and Tanaka, 2012; Fischer et al., 2015). Governance in this sense refers to organisational structures and mechanisms for decision-making, and the different ways that stakeholders are engaged in this process. By the early 2010s, interest in the term sustainable institution had grown. Amaral et al. (2015) brought this work together in a review. They observe that the "definition present in the literature…always refers to environmental, economic and social concerns…and the obligation of leading by example" (p157). The literature at this point references:

+ the role of universities in protecting human and ecosystem health
+ the use of knowledge produced by the university to address ecological and social challenges
+ the conservation of energy and resources
+ promotion of social justice and equity.

Sterling extended his earlier definition to provide a holistic framing of the term, that recognises where sustainability is embedded throughout a university's practices and processes:

> "the sustainable university is one that through its guiding ethos, outlook and aspirations, governance, research, curriculum, community links, campus management, monitoring and modus operandi seeks explicitly to explore, develop, contribute to, embody and manifest – critically and reflexively – the kinds of values, concepts and ideas, challenges and approaches that are emerging from the growing global sustainability discourse" (Sterling, 2013, p23).

These definitions focus on the university activities which need to change and the appropriate philosophical approach to take. Sterling also draws attention to how a university can embed sustainability, highlighting core activities such as teaching and research but also broader issues of institutional governance and mission. Subsequent work has helped clarify the ways in which change might be achieved, through framing this endeavour as a 'whole institution approach' (WIA). UNESCO places the WIA as central to its action plan on implementing education for sustainable development (ESD) (UNESCO 2014). The report was produced at the end of the United Nations Decade of Education for Sustainable Development (2004 – 2014) and intends to provide detailed guidance for a wide variety of stakeholders, including governments, the private sector, academics and researchers, and individual teachers and learners on adopting ESD. The report describes the WIA as the:

> "…reorientation of teaching content and methodology, but also campus and facility management that is in line with sustainable development as well as the cooperation of the institution with sustainable development stakeholders in the community" (UNESCO 2014, p35).

WIAs seek to integrate the "socio-physical context of learning with the learning processes", and the positioning of sustainability as a core organisational objective (Holst, 2023). Holst (2023, p1015) defines WIA as:

> "a continuous and participative organisational learning process aimed at institutional coherence and sustainability, consistently linking the formal and informal (hidden) curricula".

The literature discussed here evidences a shift in the last 20 years, from initial work to define the 'sustainable institution' to more recent use of the phrase 'whole institution approach' (WIA). There is now greater recognition of the stakeholders involved and the actions required to achieve sustainability in universities. The most recent literature also implies the positioning of sustainability as an organisational objective, achieved through continuous learning (see section 4.3) arising from stakeholder collaboration, rather than an outcome or endpoint.

4 Implementing a whole-institution approach

The holistic nature of the WIA means it is important to think systematically about what it may look like in practice and how it can be achieved. Adopting the WIA takes time, and different stages can be identified in the implementation process. Furthermore, different universities will have contrasting and context-dependent approaches to the WIA. It has been explored in terms of the following considerations, which form the structure of this section:

+ the institutional requirements for a WIA to develop
+ the areas of activity in an institution involved in a WIA
+ how a WIA evolves over time
+ strategies for implementation of a WIA
+ the challenges of implementation a WIA.

4.1 Institutional requirements for adopting a WIA

UNESCO sets out three overarching requirements for the adoption of a WIA, drawing attention to the importance of stakeholder engagement in developing a vision, and appropriate support through resourcing and networks.

1 "An institution-wide process is organized in a manner that enables all stakeholders – leadership, teachers, learners, administration – to jointly develop a vision and plan to implement ESD in the whole institution.

2 Technical and, where possible and appropriate, financial support is provided to the institution to support its reorientation. This can include the provision of relevant good practice examples, training for leadership and administration, the development of guidelines, as well as associated research.

3 Existing relevant inter-institutional networks are mobilized and enhanced in order to facilitate mutual support such as peer-to-peer learning on a whole-institution approach, and to increase the visibility of the approach to promote it as a model for adaptation." (UNESCO 2014, p35)

The specific ways that the WIA is achieved are particular to different institutions (eg Mallow and van't Land, 2020). However, some commonality exists in the principles which describe the institutional characteristics that typify the WIA in all institutions (Holst, 2023):

1 **Coherence:** the ways that all educational approaches to sustainability and operational processes at all scales within institutions are aligned.

2 **Continuous learning:** viewing the institution as a learning organisation or learning community, which facilitates learning for all, and therefore frames sustainability as a process rather than an end point.

3 **Participation:** a culture and approach to institutional functioning which means that all individuals, regardless of their role, are supported to participate in the WIA in ways that are authentic and meaningful.

4 **Responsibility:** recognising that, for an organisation to be sustainable and promote participation in the WIA, various people have responsibility to act on behalf of the whole organisation.

5 **Long-term commitment:** understanding that the WIA requires time to develop, and patience to enact, particularly in educational institutions where there is a high degree of complexity associated with change.

These principles point to the importance of organisational values and culture in developing a WIA, and emphasise the need to consider how actions are decided upon and implemented. They support the engagement of all institutional stakeholders and reinforce the need to understand and reflect on leadership approaches and institutional cultures in the development of WIAs.

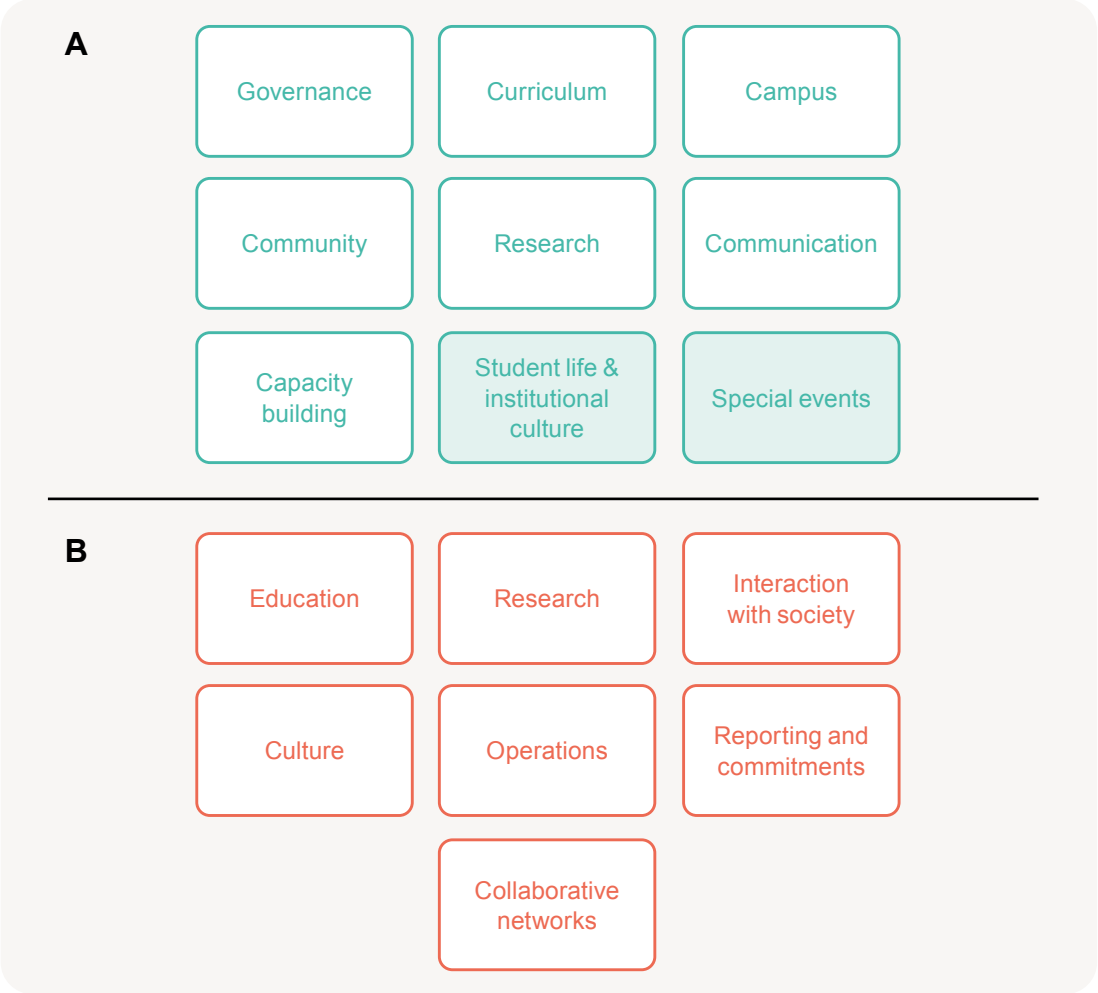
4.2 Areas of activity in a WIA

Implementing a WIA requires systematic integration of sustainability activities across different areas of institutional activity. A number of differing definitions of the WIA have been put forward, which define different areas of institutional activity (Figure 1). Despite this variation, there is value in identifying groupings of activities at an institutional scale to support universities' adoption of the WIA in their own contexts. It also helps break down silos by looking for the potential for synergies and interactions across the areas of activity. Holst (2023) sets out seven 'organisational areas of action', arguing that "in practice the boundaries are not sharp – instead, their overlaps and interactions are a key feature of WIAs" (p1018):

+ governance
+ curriculum and formal learning
+ operations and campus management
+ community and networks
+ research (in higher education)
+ human capacity building
+ communication.

Analyses of the WIA often focus or centre on education activity, and draw attention to the connections between curricula and the learning environment. This includes the 'curriculum and learning processes [with] facilities and operations, interaction with the surrounding community, and governance and capacity-building with the surrounding community' (Buckler and Creech, 2014). For example, this may include learning opportunities within the campus or local area, working with local communities on issues of sustainability and sustainability education, or governance approaches that support the engagement of local communities.

Figure 1. Areas of action through which sustainability is embedded in whole-institution approaches. A) Unshaded boxes from Kohl and associates (2022); shaded boxes are additions by Jiménez-Elizondo (2023). B) Ramísio et al. (2019)



Education for Sustainable Development (ESD) describes a wide range of learning and teaching approaches that are designed to equip people of all ages with the knowledge, skills, values and agency to address sustainability challenges (UNESCO, 2023). An extensive review of ESD is provided by Vogel et al. (2023), whose work highlights:

+ the importance of interdisciplinarity and transdisciplinarity among disciplines, and among universities and wider society
+ 'add-on' approaches to ESD are less effective than embedded and integrated learning at promoting transformational changes in mindsets and sustainability competencies
+ self-reflection is an important element of ESD to challenge underlying assumptions and analyse diverse perspectives.

Sustainability learning can take place explicitly through taught programmes, where sustainability is embedded in learning outcomes, course content and assessments (eg Gamage et al., 2022; Winfield and Ndlovu, 2019). Structured activities outside of the formal curriculum, also called extra-curricular activities or the informal curriculum, can also play an important role in engaging students with sustainability (Garrecht et al., 2018; Díaz-Iso et al., 2019). A WIA can seek to fundamentally reshape the process of learning away from the formalised curriculum (Joyner Armstrong et al., 2016). They argue that "in a holistic setting, the line between the informal and formal curriculum are significantly blurred and what is implicitly communicated through university practices and values is what most transforms the students' explicit understanding of sustainability" (p756). Evidence from the literature suggests that the informal or hidden curriculum can promote pro-environmental values, attitudes and behaviours through physical infrastructure, institutional processes, decision-making and communications (eg Winter and Cotton, 2012; Nunes et al., 2018; Gramatakos and Lavau, 2019).

Despite some differences over what constitutes a WIA, Kohl et al (2022) highlight that the WIA has been reaffirmed by UNESCO as a powerful way to conceptualise thinking about sustainability, and continues to be advocated as a way to drive sustainability initiatives in higher education. Its value stems from highlighting the importance of joined-up and consistent action at an organisational scale, and recognition that systemic change is needed to embed sustainability into higher education institutions (HEIs). Much of the literature about the WIA is concerned with identifying additional areas of universities' activities in which sustainability should be embedded, suggesting that, in a conceptual and practical sense, the WIA is helpful in emphasising the joined-up nature of becoming a sustainable institution.

4.3 Developing a WIA over time

Achieving a WIA requires institutions to progress their thinking about sustainability across all their areas of activity, and making the necessary structural and systemic changes is a significant investment in time. Some institutions have moved more rapidly to embed the WIA compared to others, resulting in a patchwork of progress across different HEIs. Models of how the WIA is implemented over time can be useful for benchmarking institutional progress and defining a trajectory towards becoming a sustainable institution. For example, the following sequence from Rath and Schmitt (2017) is based on an analysis of German universities.

+ **Level 1:** activities relating to sustainability and are not connected to other areas of the HEI. Even if activities are in multiple areas of university operations, overall a lack of connectivity still in evidence. Many activities may be underway but are not actively integrated together.
+ **Level 2:** a governance concept of sustainability exists; sustainability is recognised formally in institutional missions and strategies. Evidence of commitment from the senior leadership team; fixed into the core value of the university and structures for transformation exist.

+ **Level 3:** a whole-institution approach; integrating disciplines and university areas to focus on sustainability related issues and affect institutional change at organisational level. Coordination and systematic clustering of activities. Professionalisation of institutional knowledge through organisational development, network and internationalisation.
+ **Level 4:** the institution is explicitly focused on sustainability in research, teaching and operations, and is considered integral to the institutional profile of the institution. Sustainability is a unique selling point of the institution, and ultimately all activities are designed to support sustainable development.

For those organisations at level one, the concept of a whole institutional approach may not be something that resonates or they connect with their own university. The four-stage model is interesting in that it suggests a stage beyond adopting the WIA (level 4), in which sustainability is not just business as usual but intrinsic to the purpose and mission of the institution. One critique of Rath and Schmitt's four stage model is the inference that the transition to sustainability is a simple linear progression. Furthermore, it is unlikely that 'becoming' sustainable is an endpoint: the meaning and nature of sustainability will change over time in ways that have yet to be imagined; it is not a fixed state. These ideas are captured in the work of Kapitulčinová et al. (2018), whose model of transitioning to sustainability comprises three phases:

1. **awakening:** the initiation of sustainability
2. **pioneering:** the implementation of sustainability initiatives
3. **transformation:** the institutionalisation of sustainability practices.

Both models conceptualise implementation of a WIA to sustainability as a transition over time. While there are calls in the literature for radical and disruptive approaches to sustainability, a progressive approach that is inclusive of all stakeholders is generally recognised as most likely to≈lead to meaningful, systemic change. For many institutions, sustainability is an aspiration, and≈something that needs to be progressed in a way which responds to their own unique context (UNESCO, 2014). Implementing this change requires a long-term commitment and strong leadership, partnership and co-creation among all stakeholders (including students), and effective approaches to governance.

4.4 Structures and strategies for developing a WIA

The ways in which an WIA can be developed, and the extent to which these efforts are successful, vary widely across institutions. For example, organisational structures may hinder stakeholder interactions and be challenging to navigate, or may present an opportunity for collaborative sustainability initiatives. Some institutions may invest resources in dedicated sustainability teams to drive forward the WIA while others may frame this as a collaborative and embedded activity and take a more decentralised approach to sustainability leadership. A summary of the key structural and strategic factors is given in Table 1.

Table 1. Structural and strategic dimensions associated with implementing a WIA in universities (Appleton, 2017)

Structural dimensions	Strategic dimensions
+ Organisational structure	+ Leadership and authority
+ Governance matters	+ The right leader
+ Highest level of reporting	+ Champions, sponsors and academic leads
+ Monitoring and reporting	+ Engagement and representation
+ Implementation	+ Bottom-up, student voice
+ Top-down process	+ Partnerships and collaboration
+ Careful language	+ Community engagement
+ Service orientation	

Within organisational structures, Appleton (2017) argues that six different approaches characterise current practices (Figure 2). She demonstrates a broad range of approaches to organising and governance structures for sustainability work, the differing roles of senior leaders in supporting sustainability, and different approaches to funding and resourcing sustainability activities. Appleton's review is particularly helpful in exploring how issues of leadership, authority, strategy and student engagement vary across these different models. For example, in a decentralised model, there is a high degree of authority and therefore the ability to influence practice across the institutions. However, the effectiveness depends significantly on the senior leader's approach and ability to gain meaningful support through top-down strategic directions. A dedicated sustainability department can lead and manage a wide range of initiatives to generate positive internal and external messaging, such as submitting to competitive sector-wide sustainability awards, yet needs significant resourcing and careful approaches to addressing tensions when sustainability cuts across existing departmental remits (Appleton, 2017). Her work also acknowledged the importance of institutional missions in developing a holistic approach to sustainability and shaping appropriate policy decisions. While senior leadership plays an important role in driving sustainability, champions and academic leads on sustainability are "essential in initiating and maintaining drive" towards sustainability, particularly across the professional services / academic staff divide (Appleton, 2017).

Other researchers have identified different approaches to categorising activities within the WIA. Based on a large systematic literature review, Fia et al. (2022) complement Appleton's study by focusing on strategies at different scales. They define: i) micro initiatives focused on one area and a single SDG; ii) meso-level activities focused on initiatives at departmental and campus levels; iii) macro-level strategies organised and led by senior leaders. Their results show that some university practices span multiple scales. In teaching, the design of individual programmes is at the micro-scale, while at macro-scale are whole-curriculum re-orientation projects. This question of scale adds further nuance to how WIA are implemented.

Living labs demonstrate the WIA in practice and can support approaches to embed the UN SDGs in universities (Verhoef et al., 2020). They typify the concept of universities being a 'microcosm of society' (Stirling, 2003). Living labs typically comprise a number of projects relating to sustainability being brought together to transform a campus environment. They work by demonstrating different technologies or ways of living which can be monitored and evaluated. Many universities have adapted their campus to be a living lab through, for example, energy generation and monitoring schemes, water management and waste management experiments. In doing so, they require integration across all areas of university operations as articulated by the WIA. The concept is popular in universities as it contributes to the development of a sustainable campus environment, supports research and innovation (for example, through leveraging funding, production of research publications) and local innovation and business collaboration (Leal Filho et al., 2023). Living labs also have broader societal relevance, by demonstrating and evaluating various technologies in 'the real world'. They also have broader relevance to supporting whole-institution scale learning about sustainability and play a role in shifting universities from being knowledge producers to anchor organisations with stronger flows of knowledge and innovations between the university and society (Tercanli and Jongbloed, 2022; Burbridge, 2017).

Figure 2. Typical approaches to structuring sustainability work in universities (based on Appleton, 2017)

5 Challenges when adopting the WIA

While using the WIA to embed sustainability in universities is widely advocated in the literature, challenges have been identified in adopting and implementing the WIA. Existing research also highlights that meaningful engagement by students and staff in sustainability initiatives is difficult to achieve. Furthermore, challenges arise from the political nature of higher education and ways in which universities engage with the sustainability agenda. While all these challenges are closely interrelated, for the purposes of clarity, this section is structured around brief discussions of issues relating to

1 student engagement
2 staff engagement
3 sector-wide and structural challenges in implementing the WIA.

5.1 Student engagement

Student partnership is broadly agreed to be a driver of student engagement (Peart et al., 2023). Effective partnership can offer many benefits for students, including developing skills beyond the taught curriculum, enhanced employability skills and 'deep learning'. However, the role of students as active participants in the WIA has not been widely explored and there is little evidence to demonstrate conclusively positive outcomes for sustainability from student partnership and co-creation. Much of the literature about the WIA makes little or no reference to students as stakeholders. Student participation in the WIA is distinct from participation in specific sustainability initiatives, such as those exemplified in the EAUC Green Gown Awards. A small number of studies have identified the mutual benefits for students and universities working in partnership to implement whole-institution sustainability, such as students working with the estates team to reduce carbon emissions (Erlandsson et al., 2017); students co-authoring sustainability reports (Schoeps and Hemmer, 2018) and student led, bottom-up approaches to whole-institution change (Block et al., 2016).

Not all research indicates that students are ready to be enthusiastic partners in the transition to sustainability. One reason for this lack of visible enthusiasm may be a lack of training and support structures to engage effectively with sustainability initiatives (Abubakar et al., 2016). Students may be more motivated to engage in these opportunities if it were framed as a way to upskill in preparation for their future careers (Aboelnagah and Metwally, 2019). There can be a challenges for all forms of student partnership including time for students to engage, complex power dynamics between students and staff, lack of diversity in partnership initiatives due to differential opportunities for engagement among students (Peart and associates, 2023).

This apparent lack of student engagement in sustainability initiatives contrasts with recent global evidence that young people are concerned about the challenges of climate change and sustainability and believe that more needs to be done to address them. For example, 59% of 16 to 25 year olds are 'extremely worried' or 'very worried' about climate change (Hickman et al., 2021) and 92% of students agree that universities and colleges should 'actively incorporate and promote' sustainability (SOS, 2020). Many young people concerned about sustainability have yet to progress into university-level study, suggesting these concerns are likely to be amplified in the future (Congreve and Cross, 2021).

While there are some small-scale examples of students meaningfully contributing to WIA, student co-creation and partnership is not fully embedded within the WIA. Explicitly doing so could help position students more clearly as agents and drivers of systematic change, and offer rich learning opportunities across the different elements of the WIA.

5.2 Staff engagement

Addressing sustainability is one of many activities that academic staff are expected to engage with. There are many examples in the sector of individuals or small teams leading successful sustainability projects in learning and teaching, campus management, engagement or outreach. These examples tend to be 'bottom up'; they are designed, implemented and run by staff outside of formal leadership or management roles, and tend to rely on goodwill and time commitments beyond expectations. These approaches often lack strategic oversight and are generally not part of a WIA. However, in many cases, efforts to embed sustainability that are top-down (ie strategically driven by senior colleagues) are met with indifference, scepticism or even resistance from academics, particularly in the context of curriculum enhancement. For example, institutional sustainability strategies may conflict with academics' personal viewpoints, or it may not be clear how sustainability initiatives and strategies intersect with their priorities such as teaching and research (eg Dyball et al., 2015). A wide range of reasons has been put forward to explain academics' resistance to engaging with sustainability (Cebrián et al., 2015):

+ lack of time and financial resources
+ lack of deep understanding of sustainability
+ current curriculum structures and ways of delivery
+ academic pressures
+ external factors such as the requirements of an accrediting body
+ lack of organisational support
+ existing organisational conditions.

McConnon (2020) noted this lack of engagement as a major challenge in moving from a 'champion' based model of sustainability, in which a few individuals initiate and lead sustainability work, to one in which all teaching and professional services staff actively participate. Nonetheless, 'champions' have a significant role to play in supporting other university staff. Champions can help their discipline or professional service to find some consensus around the meaning of 'sustainable development', and in doing so demonstrating how sustainability-focused activities integrate activities across research, education and engagement (Högfeldt et al., 2022). This research points to the importance of effective and meaningful engagement and discussion of university teachers and professional service staff who support teaching around sustainability, and explicitly recognising how a plurality of viewpoints and motivations can collectively enhance institutional approaches.

5.3 Structural and sector-wide challenges

The literature also identifies a set of challenges associated with the way that higher education is framed politically and funded, and, consequently, ways that universities engage with the sustainability agenda. Neoliberal ideologies of higher education (such as in the UK) present both challenges and opportunities for advancing sustainability in universities. The fees regime and marketisation of higher education drives students to study subjects with tangible career benefits (Bessant et al., 2015). Sustainability has often been seen as 'soft' and less directly valuable for their earnings potential. Therefore, sustainability focused degree programmes may recruit fewer students and are targeted for closure against a backdrop of institutional efficiency and performance objectives. Nonetheless, competition among institutions for both students and research funding can help promote sustainability. Embedding sustainability within existing managerialist frameworks rather than trying to create new structures can be an opportunity to strengthen action on sustainability at all levels.

Despite this opportunity, there is a persistent gap between what universities research and what they do in practice. O'Neill and Sinden (2021) point to a lack of radical action to embed the sustainability being done by universities, despite the large body of academic work produced by universities themselves advocating for such an approach. Their research emphasises how traditional silos of activity across the dimensions of the WIA need to be broken down. This thinking aligns with the idea that universities are slow to respond to change and are fundamentally too resilient to radical change, as explored by Robinson and Laycock Pedersen (2021). They argue that a process of destabilisation is necessary to enable universities to overcome sector-wide, prevailing paradigms and a culture that inhibits progress and action for sustainability. Many institutions have had (or continue to have) financial investments in carbon-intensive industries, and carry out research which benefits the status quo in those industries, while publicly promoting their sustainability credentials. Universities can also be heavily dependent on recruiting international students for financial benefits, and many promote overseas mobility schemes (such as Erasmus) to their students. These activities both facilitate and encourage international travel, and contribute to universities' carbon footprint (for example, Shields and Lu, 2023). They can also be at odds with universities' intention of promoting sustainable behaviours and skills through their curricula, and contrary to upskilling local communities and supporting 'green jobs'. Some university activities can therefore be seen to be a form of 'greenwashing' (eg Stein, 2023; Cownie, 2021).

A final and emerging critique is of the nature of sustainability itself. Successful approaches to addressing sustainability require a pluralistic approach that enables critical discussions about the complexities of climate change and sustainability (Stein, 2023). She argues that, driven by the UN Sustainable Development Goals, many approaches currently adopted by universities reproduce the existing "Eurocentric paradigms of progress, development, and innovation" that have led to the current sustainability crisis. University responses have so far included greenwashing, 'climate colonialism' and '(techno)solutionism'. She argues that climate colonialism reinforces the link between patterns of colonial rule and exploitation of natural resources, and is perpetuated in sustainability mechanisms such as carbon-offsetting. These are used by many universities, in which emissions produced in the

Global North are offset by purchasing offsets in the Global South, ultimately maintaining the impact of emissions on marginalised communities. Understanding how and why issues of sustainability are closely related to colonial practices can help develop more transformative approaches to higher education (for example, Porter, 2023). (Techno)solutionism identifies universities as sources of technical solutions to address sustainability challenges. This has been criticised in three key ways:

1. it implies a simple solution can be found to complex, 'wicked' problems such as climate change (eg Cross and Congreve, 2021; Levin et al., 2012)
2. universities, and particularly those of the Global North, can and should be creating solutions for all people, rather than just for the Global North
3. solutions to sustainability challenges can be found in largely western technologies.

While universities have the potential to be significant contributors to addressing sustainability challenges, it is incumbent on them to do so in a way that is inclusive of diverse forms of knowledge and sensitive to different cultural contexts.

6 Expert opinion

In a workshop held in June 2023 (see section 9.7, p42), we asked a group of around 20 higher education sector experts to define a 'sustainable institution'. A summary of their responses is shown in Figure 3. The responses suggest a lack of consensus around a single, shared definition. Some of the responses aligned clearly with the literature on sustainable institutions (for example, embedding sustainability across different university functions; 'mainstreaming' sustainability thinking into all university business), and others were directly aligned to more general meanings of sustainability (for example, sustainable resource consumption; meeting current needs without undermining future needs). Other responses highlighted ideas that were novel or less prominent in the literature:

+ a people-focused institution in which all staff understand how sustainability applies to their area of work (ie moving beyond a shared definition of sustainability to meaningful implementation)
+ an institution which is self-sustaining (suggesting a synergy between sustainability in both an environmental and financial sense)
+ reforming governance and embedding sustainability into governance (recognising that sustainability happens through effective decision-making that takes place at all levels of an institution)
+ recognition that universities can have a positive impact on sustainability at local and global scales simultaneously (sustainability requires external engagement at different scales).

Figure 3. Expert responses to the question "what is a sustainable institution?"

7 Reflections on the literature

Below we summarise the key points from reviewing and analysing the terms 'sustainable institution' and 'whole institution approach', reflecting on themes which emerge clearly from the literature and those that are under-developed.

+ There is little consensus on what a 'sustainable institution' is. Being a sustainable institution means something different to different universities, depending on their context. For example, in some institutions, sustainability may be strongly rooted in educational activities, whereas for others it may be more about their research or campus.
+ The literature emphasises the importance of universities reaching their own definition of sustainability and basing their actions on it. Making it relevant in their particular context should engage multiple stakeholders within the university.
+ Sustainable institutions require engagement from all functions and/or departments of a university, including but not limited to research; learning and teaching; estates and campus management; civic engagement and community. This was an area of strong consensus in the literature, particularly related to the whole institution approach.
+ 'Whole institution approach' is widely used in contemporary academic literature and some policy articles. We find it a more helpful phrase than 'sustainable institution' because it communicates the extent and breadth of change across universities that is required for them to be more sustainable. The literature about the whole institution approach often positions it as a process rather than an immediately achievable endpoint.
+ There is a wide variety of governance approaches that can be adopted. Some universities take a top-down approach with leadership that is focused on reporting, metrics and centrally led initiatives. In others, individuals play a very important role through championing sustainability issues, moving inside and outside of formal structures. Most institutions that are well advanced in sustainability fall somewhere in between, with a combination of top-down and bottom-up actions and initiatives, operating at different scales, and covering both educational and operational activities.
+ While student partnership and co-creation is widely advocated in higher education, evidence for its use in whole institution approaches to sustainability is lacking. Students tend to be seen as 'recipients' of sustainability initiatives, with their engagement in sustainability often limited to specific projects. While there have been some positive efforts to deepen student engagement (for≈example, as co-creators of sustainability reports), there is little systematic recognition of their active role in whole institution approaches.

- There are inherent tensions in the way that higher education is structured and universities' ambitions to be sustainable institutions. For example, the current approach to funding UK higher education encourages international recruitment activities. These carry a high carbon footprint and leave local green skills needs sidelined. The marketisation of higher education in the UK and many other contexts promotes competition and ranking of universities' sustainability performance. While this may promote sustainability to senior leaders seeking to enhance reputation and student recruitment, it can marginalise other more meaningful and radical approaches to sustainability.
- Reiterating our reflection on the value of the whole institution approach, being sustainable is not an endpoint, it is a journey. Research will advance our understanding, uncovering emerging environmental risks (such as microplastics) and positioning concerns that were niche as mainstream issues (as has happened with fast fashion). Sustainability is a contested and fluid concept, which changes over time. One example is the growing decolonisation agenda in higher education which has highlighted how sustainability is conceptually intertwined with coloniality. Being sustainable requires universities that can adapt and be open to new ways of understanding the world. Through redefining and continually working in these ways, they can take steps towards, and help shape, a positive future that has yet to be fully understood.

8 A model for exploring a whole institutional approach

In order to structure our analysis of the whole-institution approach to sustainability, we developed a model which draws on, but is distinct from, the definitions we discussed in the preceding section. We refined the model with input from the Advance HE project steering group and participants at the Advance HE sustainability symposium. We designed this model because of the lack of consensus as to what constitutes a 'sustainable institution' or 'whole institution approach'. While both have been explored widely in the literature, we noted that neither term is defined in a consistent way. No single definition is referenced frequently, suggesting it has become widely accepted. Nonetheless, our model is most notably influenced by Stirling's (2013) and Kohl and associates' (2022) definitions. They both highlight the areas of activity within an institution in which sustainability must be embedded, and the interconnected nature of these. Our interpretation of these areas of activity are defined in Table 2.

We also note that governance plays an important role in the whole institutional approach. The process of governance refers to the organisational structures, administrative processes and decision-making processes that support the implementation of the WIA (Bauer et al., 2020; Niedlich et al., 2020). Governance instruments, such as policies and action plans, can have a positive influence on the way that sustainability is addressed and embedded within universities (Leal Filho et al., 2021). Governance can also be seen to be a process of organisational learning about sustainability. Embedding governance approaches that facilitate shared decision-making, networking and decentralisation of leadership can help create cultures in which stakeholders and the organisation as a whole can learn (Bauer et al., 2020). Legal responsibility for governance in universities lies with the governing board and the executive. A much broader range of stakeholders is involved in sustainability governance, including sustainability teams or offices, university management, administrative staff, students, researchers and external bodies and agencies. This diversity of stakeholder engagement emphasises the direct connections between governance and the whole institutional approach (Bauer et al., 2018).

Figure 4. Our model to structure analysis of the whole institution approach in universities

The following sections provide an overview of how we use the terms purpose, policy, programmes and practices to structure our case study analysis. Each section also explores the role of governance for each component of our model.

Table 2. Definitions of the areas of activity in the whole-institution approach adopted for this report

Area of activity	Definition
Teaching and learning	Primarily, the design and delivery of credit-bearing courses, learning activities and assessment at all levels of higher education. Including from foundation courses (ie before undergraduate degree/Level 3 in England and Wales) to undergraduate and postgraduate taught courses (Level 7). 'Learning' may also encompass informal opportunities that shape the student experience.
Research	Knowledge-generation activities, and the infrastructure to support them (such as funding, research management, equipment). It ranges from projects supported by large public funders intended for publication in academic journals to applied studies that address challenges of local stakeholders including NGOs and municipalities. Research also includes doctoral students' research.
Estates	The physical infrastructure of the university, including the campus environment, buildings, and utilities (for example, water and energy supply). Estates management can also include the design and maintenance of ecological features such as on-campus wetlands, gardens or wildflower meadows. Many universities have a department which is responsible for management of the physical infrastructure and natural environment, referred to in shorthand as 'estates'.
Outreach	Activities taken to attract students to study at the university, often with a focus on encouraging students from underrepresented backgrounds (eg lower income households, or first in family) to participate in higher education. The typical activities universities run include tours and taster sessions. This is usually referred to as 'widening participation' in the UK, but also encompasses other approaches in different contexts (eg indigenous participation programmes in Australia).
Civic engagement	Activities undertaken by an institution to form, develop and evolve partnerships with their local communities. Includes approaches community-based research, service learning and economic or social development within the immediate region of an institution. Civic engagement may be with community associations, non-governmental organisations or charities. It may also take place with local municipalities and locally owned business.

8.1 Purpose

Institutional purpose is also often known as the mission statement. The institutional purpose articulates what an institution seeks to accomplish in the larger environment (Lang and Lopers-Sweetman, 1991). It provides a sense of coherence for institutional planning, and gives reasons for the practices that support sustainability (for example, Mogren et al., 2019). Mission statements are typically overseen directly by the governing board, who typically have ultimate accountability for the institutional mission statement and oversee implementation with responsibility delegated to the executive.

The mission statement can be seen to fulfil two objectives: i) to determine which activities support the institution's priorities and 'inspire and motivate' staff to work towards them; ii) provide a shared sense of purpose for institutional members through communicating 'characteristics, values, and history' to external stakeholders (Morphew and Hartley, 2006). Institutional purpose statements can have a key influence on internal decision-making, planning and prioritisation. They are therefore an important element of governance, setting the broad direction and approach to the policies of the university. Integrating sustainability into institutional mission statements can therefore be seen as a signifier that sustainability is a material concern to the institution, that it is becoming embedded within governance and management decision-making, and that it is seen as part of the 'core framework' of the institution (UNESCO, 2022; UNESCO, 2017).

8.2 Policy

We define institutional policies as documents which set out the way that institutions work, and mandate or constrain opportunities for action. Policies enact a university's mission in ways that should be consistent with the values and educational character of the institution, and as such are an important component of effective governance. They may focus on specific areas of institutional practice (for example, procurement, academic promotion or student admissions) or be structured thematically (for example, sustainability, zero carbon, informational security or whistleblowing). Some tie into societal goals – to have achieved a level of progress in addressing climate change or biodiversity loss by a particular date (for example, 'Strategy 2030'). Policies are the connection between the institutional purpose and the day-to-day practices of the institution, and are intended to articulate how institutional values are enacted in decision-making and actions. Policies also play an important role in managing institutional risk. Policies define the standards expected in decision-making, referenced against institutional expectations or national policy frameworks and guidance documents. Policies can sometimes inadvertently create barriers for activities that mission statements position as desirable, for example teaching or research collaborations across different departments. Our interpretation acknowledges the work in policy studies research, which takes a more nuanced and less binary approach to policy 'success' and 'failure' (Drobinski, 2019).

8.3 Practice

Practices are the actions that are taken, which occur at a wide range of scales: for example, teaching practices relate to a specific session or topic, or practices for the review of taught programmes across the university. In a sustainability context, practices are important because they demonstrate how institutions move beyond teaching 'about' sustainable development, to how they enact sustainability and enable students and staff to participate in sustainability (such as by taking sustainability-informed decisions in their work, choosing sustainable behaviours, or contributing to sustainability initiatives).

We also include sustainability assessment tools (SATs) alongside our discussion of 'practices'. Researchers have argued for over 10 years that SATs have evolved to exert considerable influence on the activities of universities (Yarime and Tanaka, 2012). SATs comprise a wide range of qualitative, quantitative and mixed-methods frameworks and scoring systems which assess, monitor and benchmark sustainability. The tools vary considerably in the extent to which they focus on one or two specific areas (estates, curriculum) or look more broadly at how sustainability is embedded in institutional practices. A large number of SATs have been developed in the last decade in response to the growing interest in sustainability in universities. They are used for a range of different purposes, broadly grouped between those that are designed to ensure compliance with external standards, and those that provide data for performance comparisons. Some SATs that are now widely used for performance comparison were originally developed for other purposes. Four groups of tools have been identified by Fischer et al. (2015), that:

1. involve external auditing, derived from traditional environmental management systems
2. facilitate internal reflection and self-assessment based on open and unstandardised criteria and questions
3. generate an overall 'performance rating' based on data which can be used ranking and benchmarking
4. use the same approach as 3 but replaces benchmarking with certification, with the aim of reducing competition and reputational concerns associated with rankings.

In their application these may overlap, and in our case studies discussed later we found examples that were primarily intended for 1 and 3 being used to internal reflection and self-assessment. SATs are important for initial diagnosis of sustainability practices, for defining improvement to practices and determining options for future change (Caeiro et al., 2020). Many SATs are based on a particular set of indicators that align to sustainability objectives (eg carbon emissions; water use; SDGs embedded in the curriculum). They are shaped by specific conceptual models of what sustainable practices are, widely drawn from the natural sciences. A key intended outcome of SATs is to facilitate conversations about the complex and multidimensional nature of transitioning to whole-institution sustainability (Ramos and Pires, 2013). This role for SATs is something that we sought to understand in our case studies.

Several studies have critically explored SATs used in universities, and readers are directed to consult Mapar et al. (2022), in particular, for a critical review of SATs in higher education. They highlight that i) many SATs rely on self-assessment rather than independent judgement, ii) SATs tend to be based on natural environment themes (for example, energy, waste, carbon emissions) rather than indicators of institutional management; iii) stakeholder engagement and participation is not widely included in SATs; iv) there is a stronger focus on operational matters (ie campus management, energy usage etc) than the core functions of universities (ie teaching, research, community outreach).

8.4 Programmes

We define programmes based on the definition used in project planning: “a unique and transient strategic endeavour undertaken to achieve a beneficial change and incorporating a group of related projects and business-as-usual activities” (APM, 2023). In the context of sustainability activities in HEIs this may include, for example: one-off or ongoing on-campus events and activities, projects to promote sustainability, capital works projects (such as installing solar panels), extra-curricular events and activities. We explicitly do not mean programmes of study (courses, degree programmes) or other non-credit bearing educational courses.

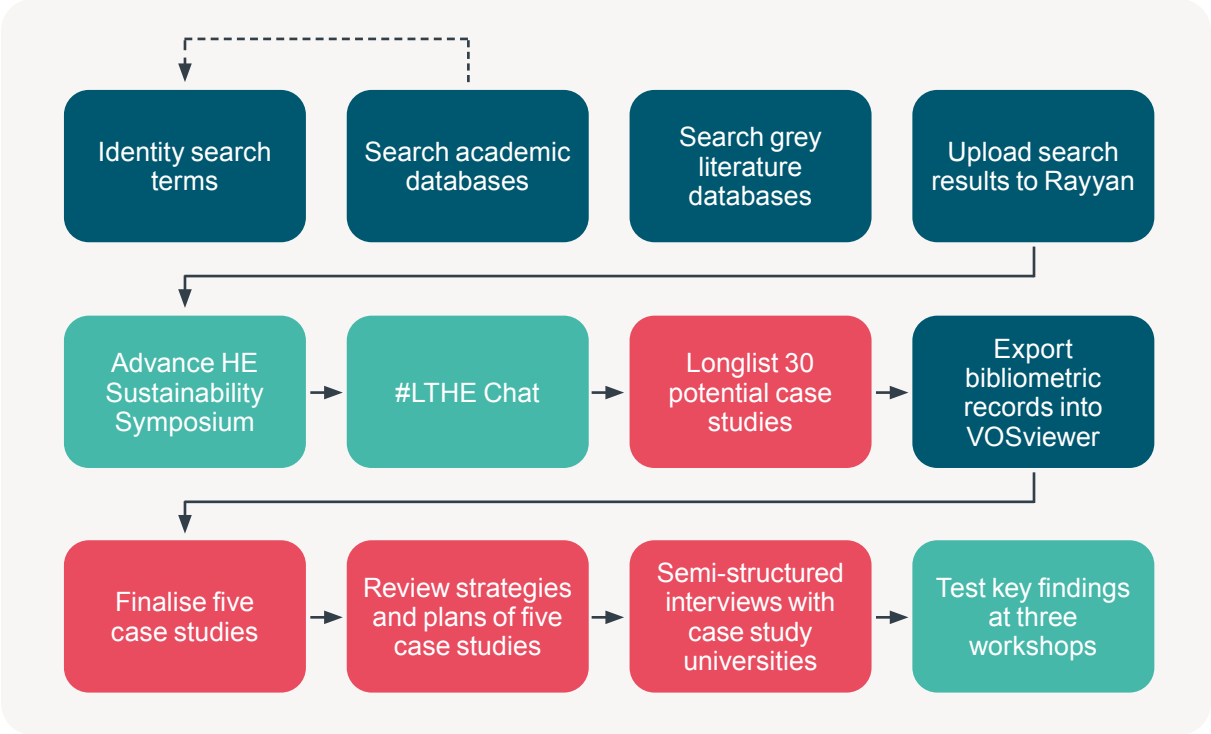
9 Methods

Our methods comprised two approaches, summarised in Figure 5:

+ a large-scale, systematic review of the academic and policy literature related to sustainable institutions
+ researching five case studies, developed through a review of university policies and plans and in-depth interviews.

These took place alongside several stakeholder engagement activities with the sector. Our approach is summarised below and set out fully in Appendix 1, p101.

Figure 5. Schematic overview of methods



9.1 Systematic literature review

We began by reviewing the keywords and titles of 20 academic journal articles that were highly relevant, focusing on the whole institutional approach and sustainable institution. This helped generate a search strategy which included a university term, a sustainability term, and, the most difficult to define, a term that indicated a strategic and whole institutional approach. We searched three academic databases: i) Scopus (the largest abstract and citation database of peer-reviewed literature); ii) Greenfile and iii) Education Abstracts. Greenfile and Education Abstracts were included to ensure specialist publications in sustainability and higher education were included. The time limits searched were articles published between January 2016 and December 2022. The language was restricted to English (although some articles also had abstracts in one or more other languages). The academic database searches resulted in 12,491 unique items returned comprising:

+ 8,534 journal articles
+ 2,632 conference papers
+ 1,181 book chapters
+ 140 other miscellaneous academic outputs.

For the grey literature, we searched using two databases, Policy Commons and Overton, and the Advance HE Knowledge Base, returning 36 reports. The results of all the searches were uploaded into Rayyan, an online systematic review tool that uses a combination of artificial intelligence, machine learning and natural language processing to aid literature searches (Ouzzani et al., 2016). It is one of a small number of specialist programmes which assist in the review of large bodies of literature. In comparative studies of tools, where the same journal review data is inputted into several tools, it outperforms others for both accuracy and user preference (Van der Mierden et al., 2019; dos Reis et al., 2023). Despite the use of Rayyan to support our literature analysis, we found that ambiguity in both key terms ('university' and 'sustainability') meant that a large volume of articles required manual review. By the end of the process we refined our search into a database of 2,504 articles for analysis.

9.2 Bibliometric analysis

We undertook a range of counts on the article data to describe our database. First, we counted the number of academic publications per year, then extracted a list of journals, book series and periodicals in which the articles were published and counted how many articles appeared in each publication. Then we analysed the countries mentioned in the authors' affiliations as a proxy for the geographical distribution of the literature. This analysis was conducted on a subset of articles for which full affiliation information was provided (653 articles; approximately one-quarter of the dataset). We therefore consider this analysis to be indicative rather than absolute. We grouped countries according to geographic region to summarise this data.

We then extracted the keywords provided for each article in our database, using an online word art tool. These keywords are those that are assigned by the article authors. From this initial list of 25,043 keywords we created a list of unique keywords occurring 100 times or more then counted how many times each word occurred. We used the tool to create a word cloud for the academic literature. Our analysis for the grey literature was different because the dataset was considerably smaller (comprising 36 reports). We manually counted how many reports were published each year, the publishing organisation, and undertook a word cloud analysis on the titles of the reports, as keywords were not consistently provided for the grey literature. All numeric analysis was undertaken in Microsoft Excel, and WordArt.com was used for the word clouds and keyword counting.

9.3 Data visualisations

9.3.1 VOSviewer in systematic reviews

VOSviewer (van Eck and Waltman, 2007; van Eck and Waltman, 2010) is a software tool used to visualise and assist in the analysis of bibliometric data. It is one of a small number of tools (other examples include CiteSpace and Leximancer) that allow researchers to look for common themes and connections from large text-based datasets. They have particular value as exploratory tools to describe the main themes of research activity (as indicated by publications, conference papers etc) in a given discipline. VOSviewer is open source and relatively simple to use, which contributes the rapid rise in publications using it in the last two to three years (Kirby, 2023).

The scope of this research, including 2,504 articles, made reading every paper impractical. For bibliometric searches that return dozens, or even hundreds of articles, it is more practical for the researchers to review all the abstracts and read selected articles, drawing out common themes. This approach is prone to researcher bias in terms of the papers selected and the topics focused on in the subsequent narrative. There can also be bias towards well-known authors; research from higher ranking universities and institutes; and work published in higher status journals (Boell and Cecez-Kecmanovic, 2015). This can lead to underrepresentation of work produced in other contexts, particularly those writing about experiences in regions such as Africa, Asia and South America. Using VOSviewer as a tool to explore our literature helps overcome these limitations and produce a more inclusive and representative analysis of key themes in the literature.

9.3.2 How the data visualisations were produced

Using VOSviewer, we created a series of visualisations based on the co-occurrence of words in the titles and abstracts. We did this by exporting the data from Rayyan into VOSviewer. We also created and uploaded into VOSviewer a dictionary text file, in which we merged synonymous terms, abbreviations and American spellings (eg ‘HEI’ and ‘Higher Education Institution’; ‘behaviour’ and ‘behavior’). We also made subjective decisions to remove words that are commonly used, but have no specific meaning in this context (eg ‘type’, ‘way’, ‘point’). Researchers can also customise the number of words to visualise in VOSviewer, and we set a threshold of those which occurred 50 or more times,

which gave us 251 words. Once we had created the visualisation, we could adjust the strength of links to show only the strongest links, or to show the medium and strongest links. We manually adjusted visualisations (eg scaling of words or links) to improve clarity. It is also possible to 'zoom in' or highlight particular words and their links, which are presented in many of the figures below.

VOSviewer output includes a data file containing the words and their link strengths, cluster and other numeric data. We extracted additional information from these files to report with the visualisations.

9.3.3 Interpreting visualisations

The purpose of the visualisations is to help explore the structure of the literature and identify the main patterns; they are not absolute or quantitative in any way. They are always relative and we made choices about how to present the data in order to draw out trends. The size of the circle reflects the total link strength of the word, which is determined by the total number of times the word co-occurred with other words in our dataset. Larger words are therefore more important in the literature.
The visualisations have two further important features: clusters and links. Together these can help us understand the structure of the literature. Clusters are groups of words that are considered similar to each other (ie words that tend to co-occur with each other). Links are lines between the words, indicating the number of articles in which the two words co-occur. Words that appear more prominently in the visualisation have larger circles because they occur more frequently in the abstracts.

+ **What are the words in the visualisation and why are they included?** They are words in the titles and abstracts (not the keywords associated with an article) that meet a threshold for the number of co-occurrences. Other words are excluded from the visualisations because they are less frequent in the papers, and therefore they are considered less important to the literature. In this case the threshold was 50, but a researcher can choose to set this higher or lower.
+ **Why do some words have a bigger circle than others?** Words with larger circles co-occur with other words more than those with smaller circles. More co-occurrences indicate the word is more often found in abstracts and titles with other words in our visualisation.
+ **Why are words positioned near each other, and how are they clustered?** Words are positioned near each other because they tend to be found together in the titles and abstracts. For example, 'campus', 'efficiency', 'water', 'building' and 'construction' are commonly found together. This indicates that they are related terms in the literature. Each cluster is signified by a different colour and represents a group of words that are associated with each other. They can be interpreted as the main themes or topics of research activity in the literature.
+ **How is the number of clusters determined?** The number of clusters is determined by the VOSviewer algorithm. The algorithm automatically creates clusters that are distinct and cohesive based on their co-occurrence. The algorithm does not analyse the terms thematically, and therefore the researcher must interpret whether the clusters have meaning in the context of their research. It is possible for the user to adjust the algorithm parameters to force the creation of more or fewer clusters to create alternative visualisations. This may produce clusters which are more or less meaningful.

+ **Why are some pairs of words linked together?** Some pairs of words are linked because they meet a threshold number of co-occurrences in the titles and abstracts of the articles. Some pairings occur within the same cluster, while others may link more distant words: for example, 'campus' and 'sustainability'. These two terms are clearly in different clusters and therefore co-occur with different groups of similar terms (eg 'campus' is related to other terms shown in red such as 'buildings', 'construction', 'waste', 'emissions'). However, the literature frequently includes a co-occurrence of 'campus' and 'sustainability', suggesting they are conceptually linked: authors often include both words.
+ **Why are some linking lines stronger than others?** The width of the line linking two words is proportional to the number of co-occurrences of the pair of words: this is the link strength. A greater number of co-occurrences is indicated by a stronger (wider) connecting line. The researcher can adjust the settings in VOSviewer to show all links, medium and strong links, or only strong links. The presence of a co-occurrence does not necessarily imply that there is a conceptual connection (VOSviewer visualises data on the number of co-occurrences only): this is the researcher's interpretation.
+ **Why do some words not have any connections?** Some words appear isolated and not connected to any others. These words may have links, but these links are not shown because the number of times that the words co-occur falls below a threshold we set. They may have no links to other words. Showing all linked pairs of words tends to create a dense network of lines that is difficult to read and interpret meaningfully. Not showing all linked pairs helps to simplify the visualisation.

9.4 Case study longlisting

Generating a longlist of potential case studies we could select from involved two approaches. Firstly, universities that featured prominently in our systematic literature search. This prominence is in terms of the number of articles about sustainability across all fields: estates and campus, learning and teaching, research and civic engagement. We paid particular attention to universities that featured multiple times across different areas of activity. We also noted articles that refer directly and indirectly to a 'sustainable institution' or 'whole institutional approach'.

We supplemented this with input from the Advance HE community via an online form. Attention was≈directed to this form via a number of conferences and workshops, including the Sustainability Symposium and member events in Scotland, Ireland and the Middle East (detailed in Appendix 1). We also sought advice from the sector on the case study selection and what would be most useful to know about our case studies from the #LTHE Tweetchat community.

9.5 A case study shortlist

From the systematic literature review and stakeholder engagement, we identified a longlist of 38 institutions from which to select five to feature as case studies. Ultimately, we wanted to select a range of types of university, but with a sample of five, it was not possible to have all permutations of defining features, including: size; public or private; teaching focused/research focused/combined. We also wanted our sample to be geographically varied and include institutions from outside the UK and Europe.

Our final selection includes a range which addresses many of these characteristics, but more important than this was selecting universities that had taken different approaches. Our literature review highlighted the importance of context for determining how the whole institution approach to sustainability is implemented in different institutions. We reviewed in more detail the work of the 38 institutions from a variety of sources, including articles in our systematic literature review, public information on their website, and information from rankings and league tables. Through this review, very different philosophical and practical approaches emerged. For example, a technical university could pioneer renewable energy, link this to teaching activities on campus and knowledge transfer to local business. In contrast, a small liberal arts university could focus on behaviour change among staff and students, and engagement with disadvantaged groups in the local community. We wished to capture some of this diversity of intellectual and practical approaches to becoming a sustainable institution.

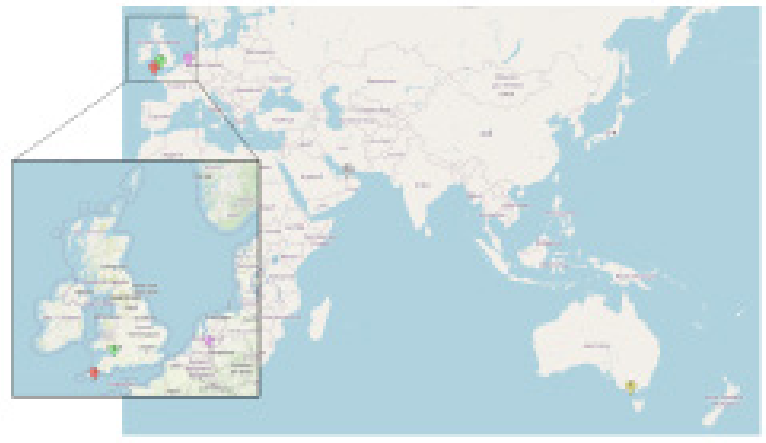
We are aware that many high-profile examples of sustainability in universities were not included in our final case study selection. We do not wish to suggest in any way that we have selected the five ‘best’ examples, or marginalise the excellent work that is taking place across the sector. Our final selection offers a diverse group of universities in terms of their practical and philosophical approach. Those we selected – Falmouth, Cardiff Met, Deakin and Wageningen – all featured prominently in both the literature search and member suggestions. Sharjah featured prominently in the suggestions, was notable as a ‘rising star’ in league tables, with a limited presence in the literature. We found Advance HE member engagement especially helpful in sourcing suggestions outside Europe.

From our longlist (Appendix 2) we selected the institutions listed in Table 3 and shown in Figure 6.

Table 3. Universities selected as good practice case studies

Institution	Country	Approx number of students	Characteristics
1 Falmouth University	UK	7,000	Small, liberal arts, teaching and research, public
2 Cardiff Met. University	UK	10,000	Medium, teaching and research, public
3 Deakin University	Australia	60,000	Large, teaching and research, public
4 Wageningen University	Netherlands	12,000	Medium, research/technical, public
5 University of Sharjah	UAE	18,000	Large, multidisciplinary, teaching-focused with some research, private

Figure 6. Approximate location of case study universities. Numbers correspond to those given in Table 3



9.6 Case study research

The first stage in researching each case study was a more detailed review of the university policies online and email requests for documentation (such as teaching and learning strategies, research strategies, mission statements, climate and sustainability action plans etc). This review of policies was followed by four or five interviews of senior staff at each university. These were carried out online using Zoom or Teams and typically lasted 40-60 minutes.

The exact job title of interviewees varied according to the institution and included: the pro-vice chancellor for teaching, the dean of research, and the director of sustainability. In the case of Wageningen, we interviewed the head of policy, a senior professional role that manages the universities' relationship with all levels of government; and a coordinator at the Green Office. In two instances, Deakin for research and sustainability at Sharjah, these were group interviews.

We asked all the participants:

+ why they thought it was important their university acts on sustainability
+ the main internal and external drivers
+ the relevant networks their university belongs to
+ any impacts their university is already experiencing from the climate and biodiversity crisis.

We also asked our interviewees about implementation, including the role of policies and their use of sustainability assessment tools (SATs). Questions about research, teaching, estates, outreach and civic engagement depended on the interviewees' background. We found the term sustainable institution did not 'land well' with our interviewees and it took some discussion before they engaged with it. A full list of our interview questions is in Appendix 3.

We also tried to interview student representatives involved in the students' union or students' society with sustainability or in university governance. With the exception of the Green Office at Wageningen, which is a hybrid role, we were not successful. Despite attempts over several weeks, and requests to our interviewees for suggestions, we did not secure any replies. The timing of our requests may have mitigated against this, but we also got the clear sense from our interviewees that there were limitations to strategic level student engagement in universities' efforts to become a sustainable institutions.

9.7 Sense checking our emerging findings.

In June and early July 2023 we re-engaged with Advance HE members through three workshops:

+ with senior leaders as part of the collaborative project 'Aligning Organisational Strategy to the UN SDGs'
+ a project-specific workshop where we presented our interim findings and sought feedback. Participants were currently taking part or who had recently completed sustainability-related projects in collaboration with Advance HE
+ at the Advance HE Learning and Teaching Conference at Keele University where our discussions covered a wide range of topics including: top-down vs bottom-up approaches; workload pressures and models; impact and measurement; resourcing; the importance of place; and the risks of greenwashing.

Full details of our stakeholder engagement activities are in Appendix 1.

10 Results

10.1 Literature review overview

10.1.1 Bibliographic data

Our final dataset of academic articles comprised 2,504 articles. The highest number of papers was published in 2022, more than double that of the first year in our dataset (2016) (Figure 7). Most articles were published in the journals Sustainability (Switzerland) (15.5% of the total dataset), followed by International Journal of Sustainability in Higher Education (14.1%; abbreviated as 'Int. J. Sus. He' in Figure 8), World Sustainability Series (an edited book series; 10.0%, 'WSS') and Journal of Cleaner Production (5.6%; J. Clean. Prod.'). The remaining journals ('Others') made up over 50% of the total publications, reflecting the diversity of journals publishing papers relevant to sustainability and higher education (including those focused on sustainability, education, environmental management, science and built environment). Other abbreviations in Figure 8 are: Env. Ed. Res. (Environmental Education Research); EES (IOP Conference Series: Earth and Environmental Science); E3S (E3S Web of Conferences); ASEE (ASEE Annual Conference and Exposition, Conference Proceedings).

Figure 7. Number of publications in our dataset per year, 2016-22

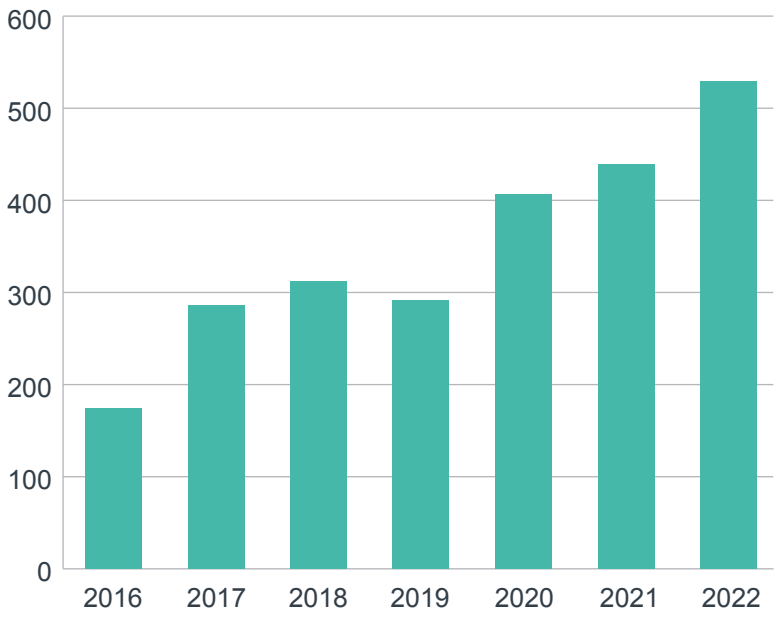
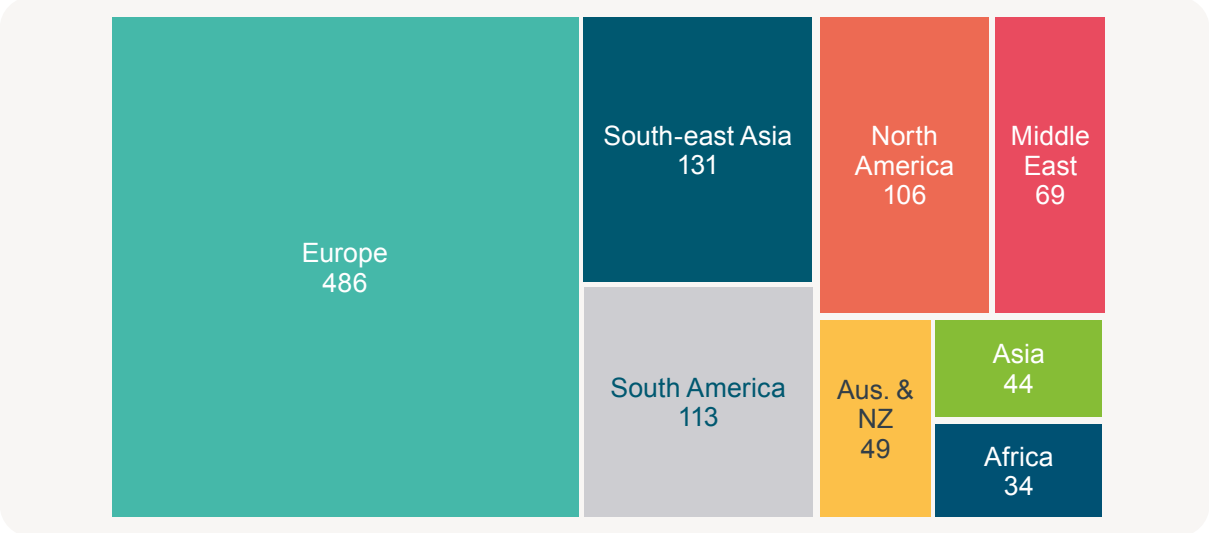


Figure 8. Number of articles by publication. Abbreviations given in the text

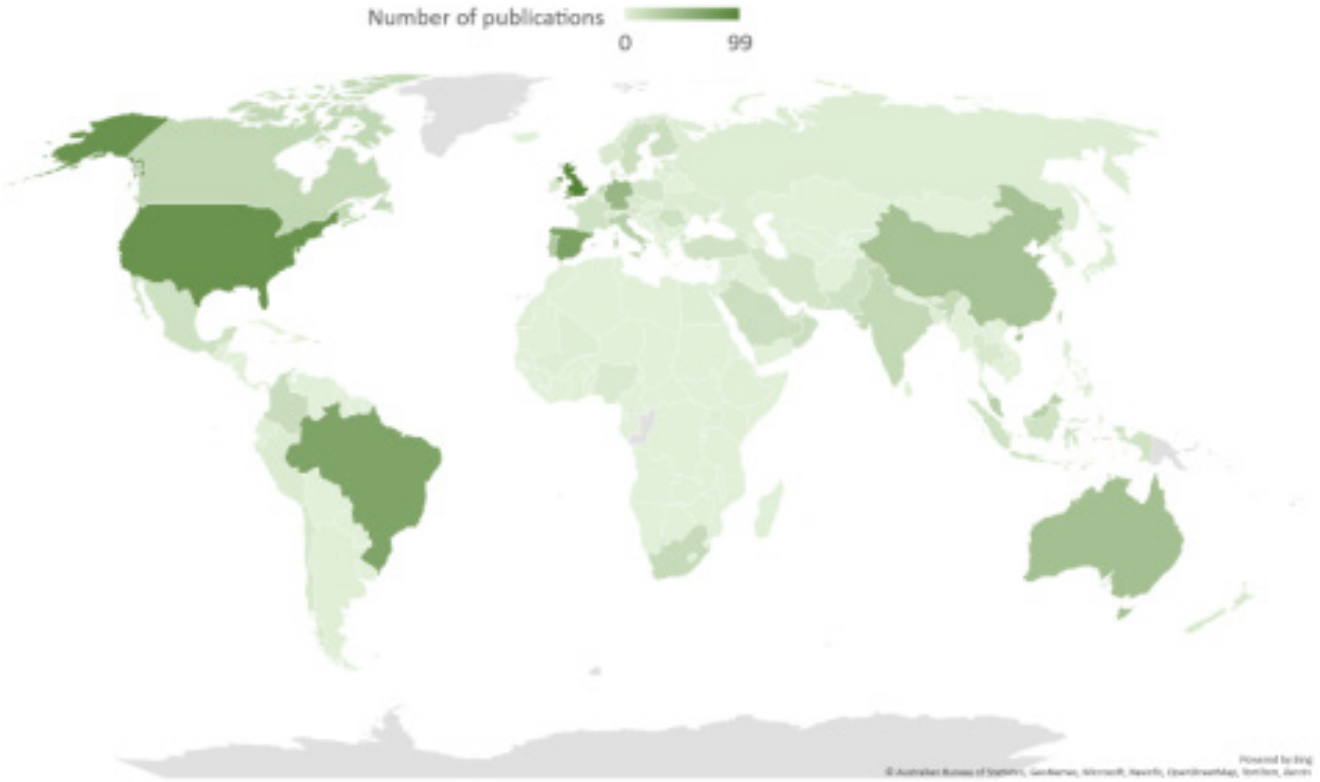
The location of the authors' institutions was extracted from the affiliation data (Figure 9). This data was available for approximately a quarter of academic papers in our dataset, therefore this data should be considered indicative rather than conclusive. The origin of papers was predominantly European (47%). North America, South America and South-East Asia comprised in total around one-third of the affiliations given.

Figure 9. Origin of author affiliations by region. Numbers show count of affiliations from each region



A total of 85 different countries were represented in the authorship data; the most frequent affiliations were to institutions in the United Kingdom (99), United States (84), Spain (71) and Brazil (68), collectively accounting for 31% of the affiliations given. Other notably well-represented countries were Germany (51 affiliations) Australia (43) and China (41). Out of the 39 affiliations to African institutions, most were to South Africa (19) and Nigeria (5). Among the Middle East countries, Oman and Saudi Arabia were represented 15 times each, and Iran and the United Arab Emirates represented 10 times each.

Figure 10. Global distribution of institutional affiliations included in the literature dataset



10.1.2 Article keywords

We analysed the keywords associated with each publication. A total of 25,043 keywords were attached to the publications in our dataset. The most prolific keywords were ‘sustainable’, ‘educate’, ‘developed’ and ‘higher’ (Figure 11 and Figure 12).

Figure 11. Keyword frequencies of words appearing 250 or more times in our academic articles dataset

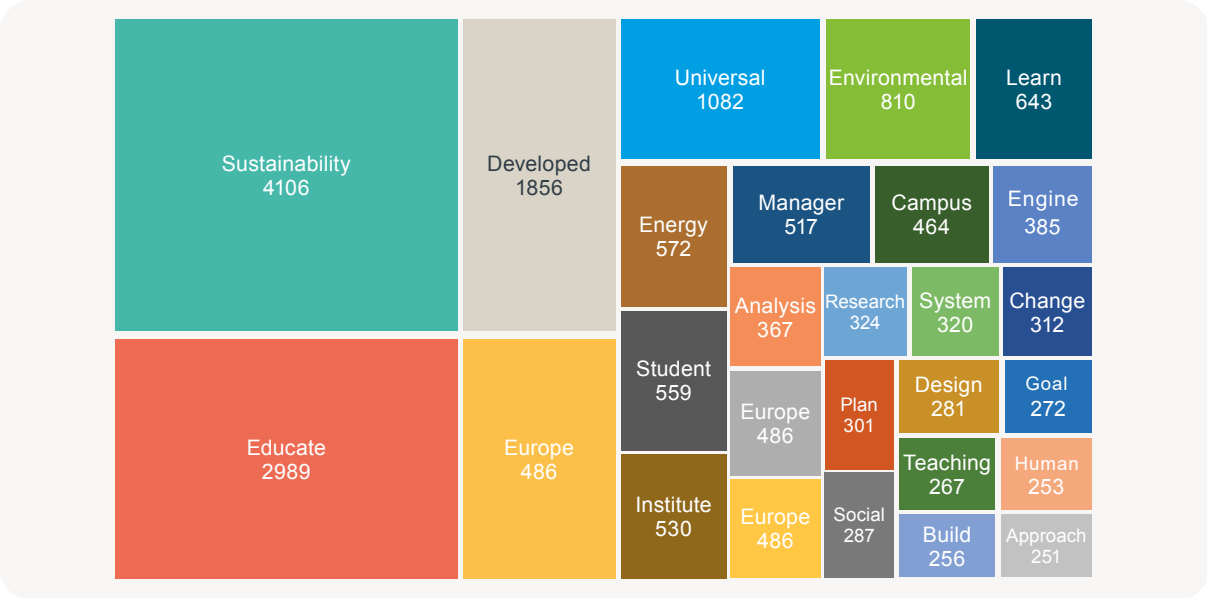


Figure 12. Word cloud representing all keywords occurring in our academic articles dataset

In our dataset of grey literature, we identified 36 reports. The majority of these reports were published in 2021 (11) and 22 (9). The remaining were mainly published in 2020. The reports were authored by a wide range of organisations, among which UNESCO and EAUC were the most prolific (three publications each). While keywords were not present for the grey literature reports, a word cloud based on the title of the reports reveals that ‘education’ (13 occurrences), ‘sustainable’ (12) ‘higher’ (10), ‘green’ (9) and ‘university’ (7) were the most commonly occurring words.

Figure 13. Word cloud representing all keywords occurring in our grey literature dataset

10.2 Academic literature visualisations and analysis

Our visualisation of the academic literature (Figure 12) revealed that the words with the strongest total link strengths in the abstracts analysed were 'sustainability' (total link strength: 122,755); 'student' (104,327), 'HEI' (73,927) and 'research' (65,232). 'Education', 'sustainable development' and 'approach' all had link strengths of 50,000 - 60,000. This means that these words are the most important in the dataset. This is consistent with the focus of the literature search and implies that these words are integral to the academic literature as a whole. It is also interesting to consider words that are not strongly present within the structure of the literature, in particular:

+ **Curriculum** (total link strength 25,348; ranked 27th out of the 251 words in our analysis that occurred 50 or more times in all the titles and abstracts)
+ **Tool** (19,184; 43rd)
+ **Stakeholder** (16,723; 51st)
+ **Partnership** (8,822; 96th)
+ **Leadership** (6,701; 124th)
+ **Vision** (5,883; 144th)
+ **Governance** (4,656; 165th)
+ **Social responsibility** (4,594; 177th)
+ **Communication** (4,127; 188th)

The five clusters suggest major themes within the academic literature. The first cluster (red) is broadly related to campus management issues and actions related to environmental performance. Compared to the other clusters identified, the red cluster is more dispersed, and link strengths more evenly distributed. The red cluster also differs in not having one or two very prominent words; all the other clusters feature one or two dominant words. The second (green) cluster centres on a 'wider university' scale, including words relating to sustainable development, institutional processes and engagement. The blue cluster includes words relating to learning, education and the curriculum. The fourth cluster (yellow) is orientated around students, their perceptions and behaviours. The purple cluster includes terms that relate broadly to analysis, monitoring, impact and reporting methodology. The five most prominent words (those with the highest number of occurrences) for each cluster are shown in Table 4.

In the analysis that follows, we look at selected terms in more detail: which cluster they align with and their co-occurrences with other words. VOSviewer allows a highlight view, which we have used to focus in on a particular word, and show more clearly the links between keywords. This provides a deeper insight into how these terms are explored in the literature.

Figure 14. VOSviewer visualisation of all academic articles. Colours indicate thematic clusters (see Table 4)

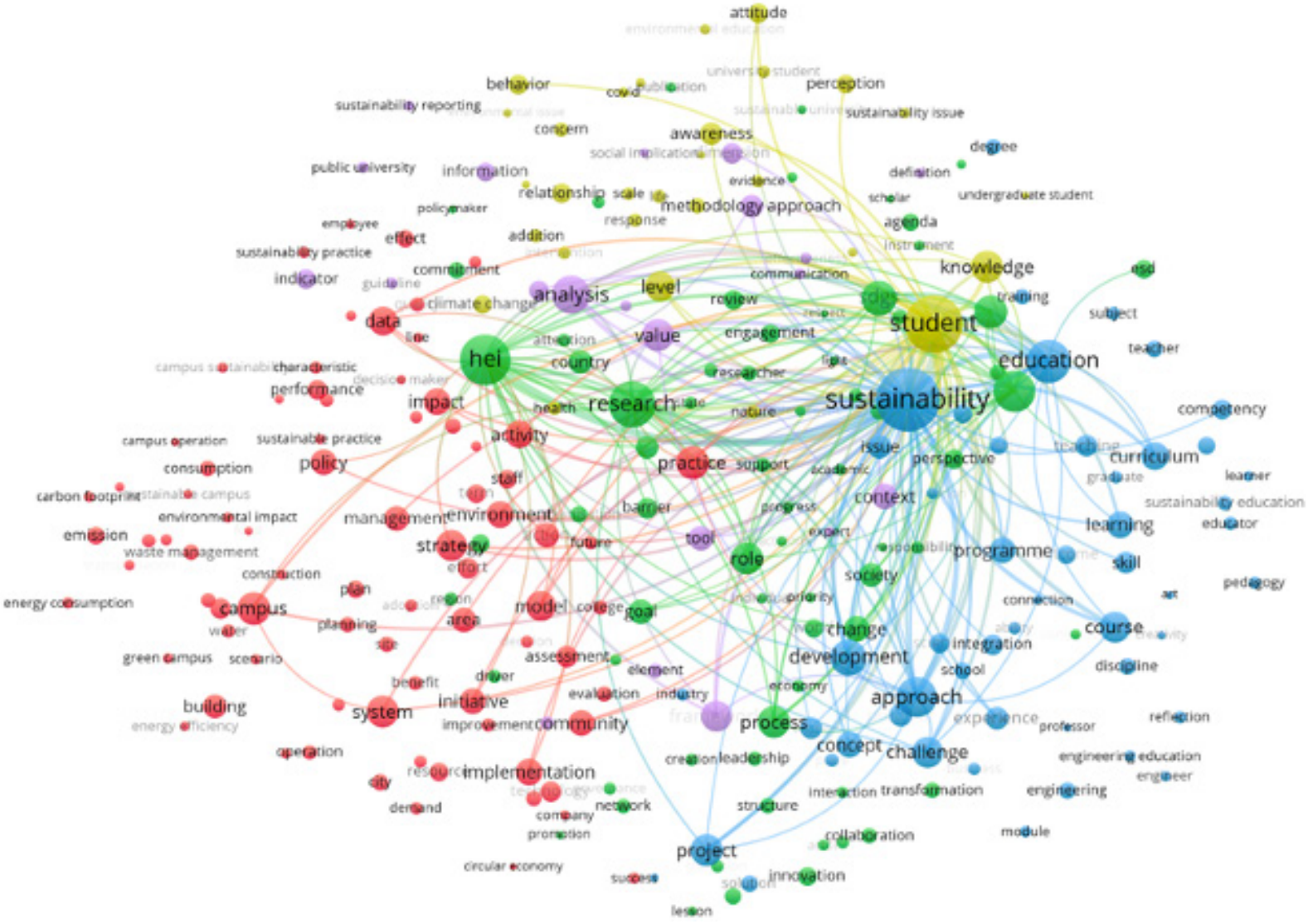


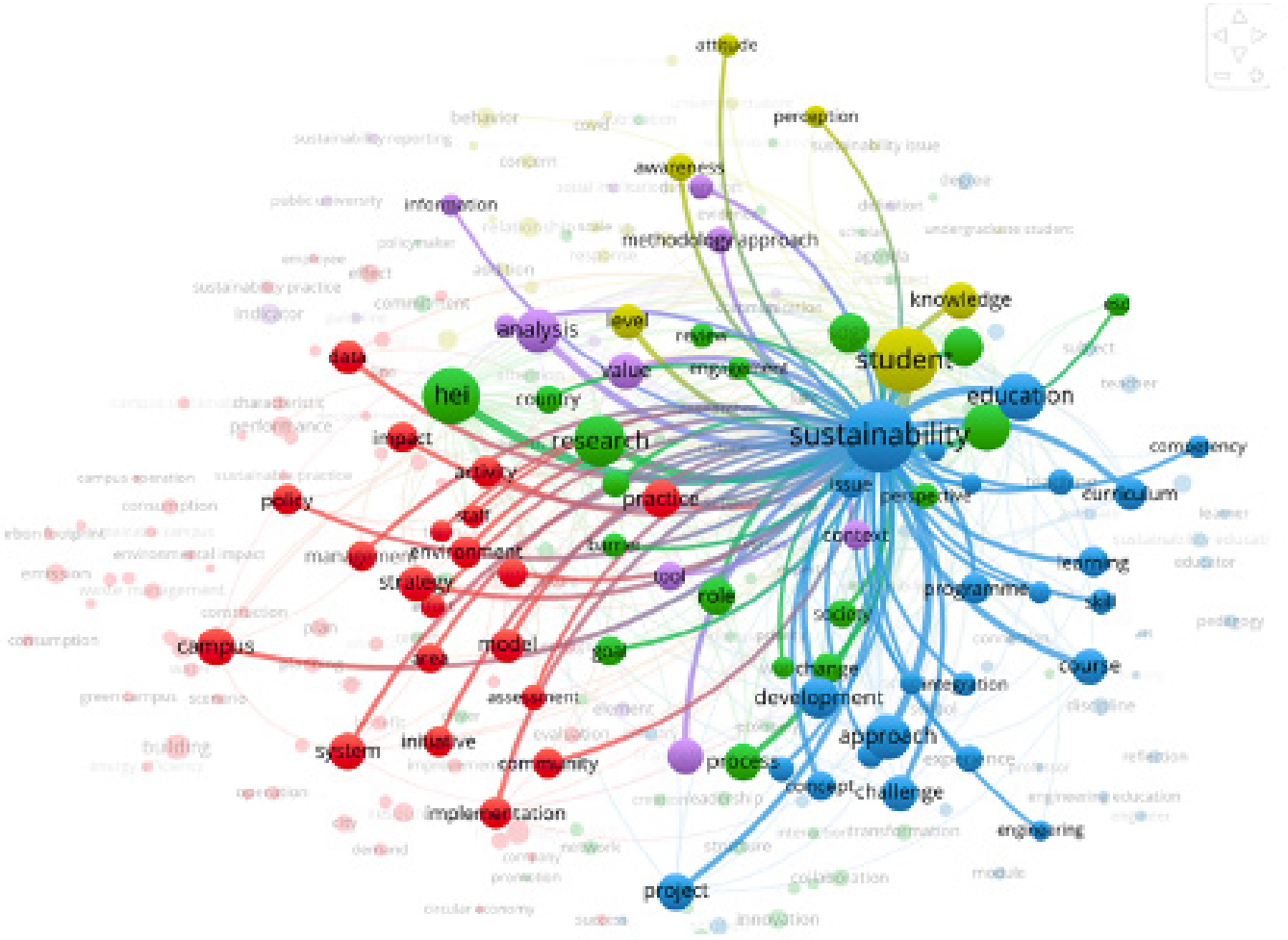
Table 4. Clusters in our visualisation of the academic literature, thematic interpretation and indicative keywords

Cluster 1 (red)	Cluster 2 (green)	Cluster 3 (blue)	Cluster 4 (yellow)	Cluster 5 (purple)
Campus management	***Wider university scale***	***Education***	***Students***	***Monitoring and reporting***
practice campus strategy system model	HEI research sustainable development SDGs higher education	sustainability education approach development project	student knowledge level awareness attitude	analysis value framework context tool
Other indicative terms (in order of link strength):				
action policy building technology emission construction	process role goal stakeholder ESD engagement	curriculum learning programme teaching skill competence	behaviour climate change perception concern health sustainability issue	dimension indicator information social responsibility guideline communication

'Sustainability': in our dataset, approximately three-quarters of papers contain the word 'sustainability' (77%). In general, the positioning of 'sustainability' indicated it is close to words relating to students and education, and more distant to words relating to technical management of campus and estates operations (Figure 15). It is also positioned close to several terms from the green cluster (such as 'SDG', 'sustainable development' and 'higher education'). As would be expected given its presence in so many papers, 'sustainability' is strongly connected to words across all clusters. The visualisation suggests that 'sustainability' often co-occurred with more general words from the red cluster. 'Sustainability' and 'campus' co-occur in 600 papers.

There are also a significant number of co-occurrences of sustainability with words such as 'management' (556), 'strategy' (457), 'model' (400) and 'policy' (357), suggesting strong connections with projects and approaches to implementing sustainability. 'Sustainability' also frequently co-occurs with a range of education and learning-related words: 'education' (1,579 articles include both terms), 'project' (410), and 'curriculum' (340). Words relating to student engagement also frequently co-occur in articles with 'sustainability', such as 'awareness' (307 co-occurrences), 'perception' (175) and 'attitude' (167).

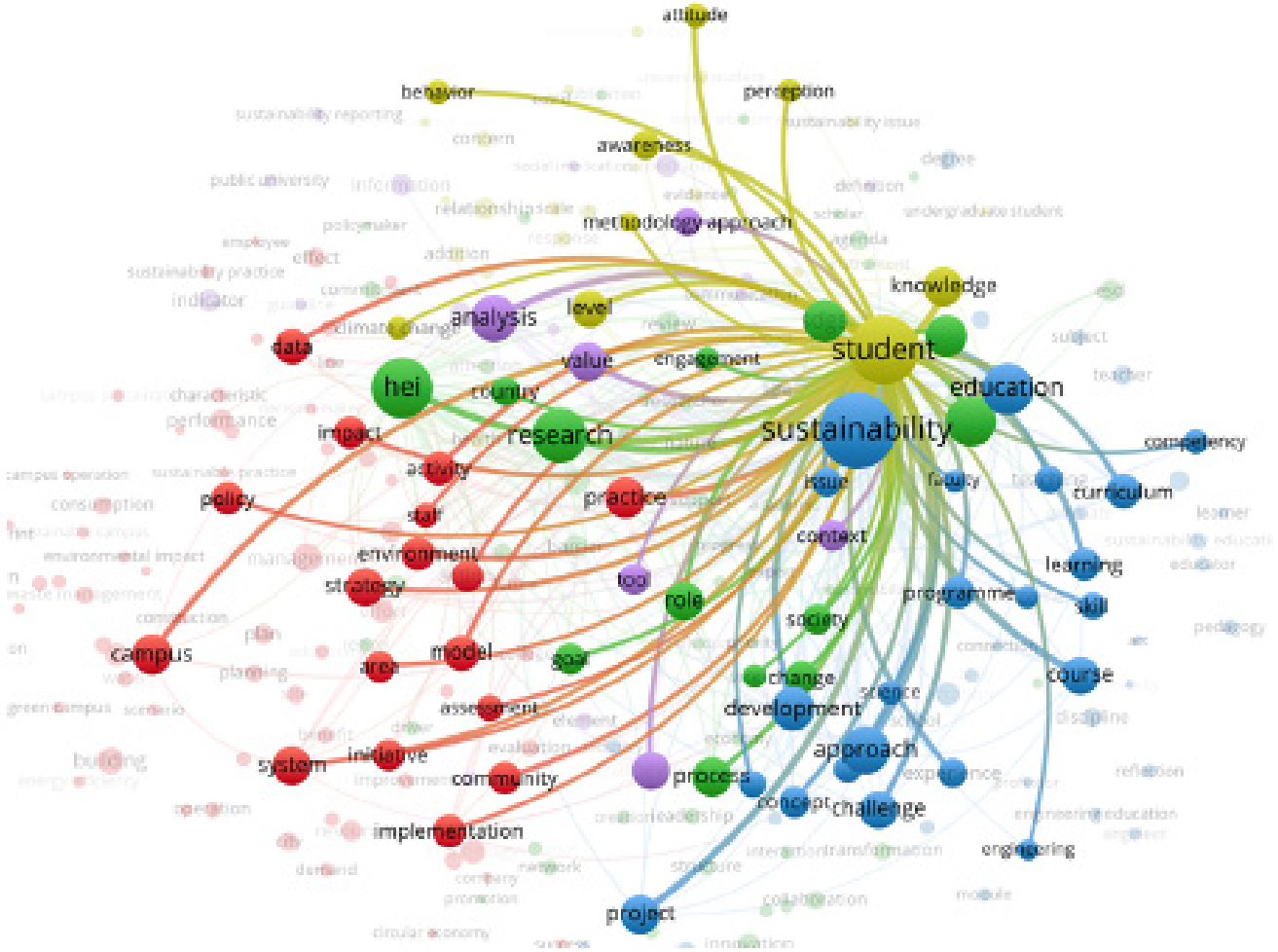
Figure 15. VOSviewer visualisation of the word ‘sustainability’ in the academic literature



Similarly to ‘sustainability’, **‘student[s]’** is a prominent word in the articles, appearing in 43% (1,077) of papers in our dataset (Figure 16). It too is strongly connected to education-related words, co-occurring frequently with words such as ‘project’ (275 articles with both words) ‘development’ (808), ‘course’ (306) and ‘programme’ (83). There is a strong connection to ‘research’ (co-occurring in 601 articles), but it is difficult to untangle whether ‘research’ in this context refers to students undertaking research projects or being the subjects of research: our interpretation from the literature is that it is more likely to be the latter. There is a greater emphasis on connections within the yellow cluster, including ‘climate change’ (114 co-occurrences) as part of the attitudes- and perceptions-focused literature.

We also note the co-occurrence of ‘student’ with a range of more general keywords in the red cluster, such as ‘strategy’ (236 articles), ‘campus’ (302), ‘practice’ (451) and ‘data’ (288). One reflection we have here is the absence of the term ‘co-creation’ or associated terminology, which we would expect to see if there was a strong theme around meaningful approaches to engage students in sustainability: out of 2,504 papers in our dataset, only 24 (1%) include the word ‘co-creation’ in the abstracts and one includes the phrase ‘students as partners’. Instead, we infer from our data a prevalence of sustainability being ‘done to’ students in the literature and a general lack of significant co-creation and student partnership projects. Nonetheless, the extent of the links across the visualisation suggest students are central in the literature about sustainability.

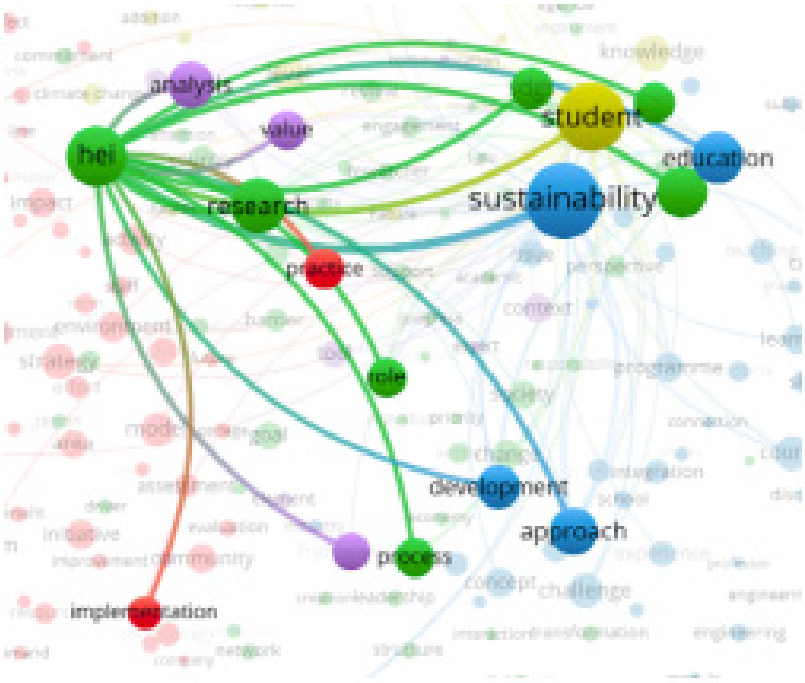
Figure 16. VOSviewer visualisation of the word ‘student’ in the academic literature



'HEI' is a prominent word in the literature, and is positioned in between campus and estates management-related words of the red cluster, and the yellow and blue clusters relating to students and education in Figure 17. The visualisation of 'HEI' shows it is generally connected to words that reflect institution-scale approaches to different components of sustainability. Taking the abbreviation 'HEI' and the phrase 'higher education institution', they are frequently found with the words relating to large-scale elements of universities, such as 'education' (co-occurring in 676 articles), 'framework' (161) and 'student' (265). None of the strong co-occurrence links are to specific or small-scale elements of a university's work.

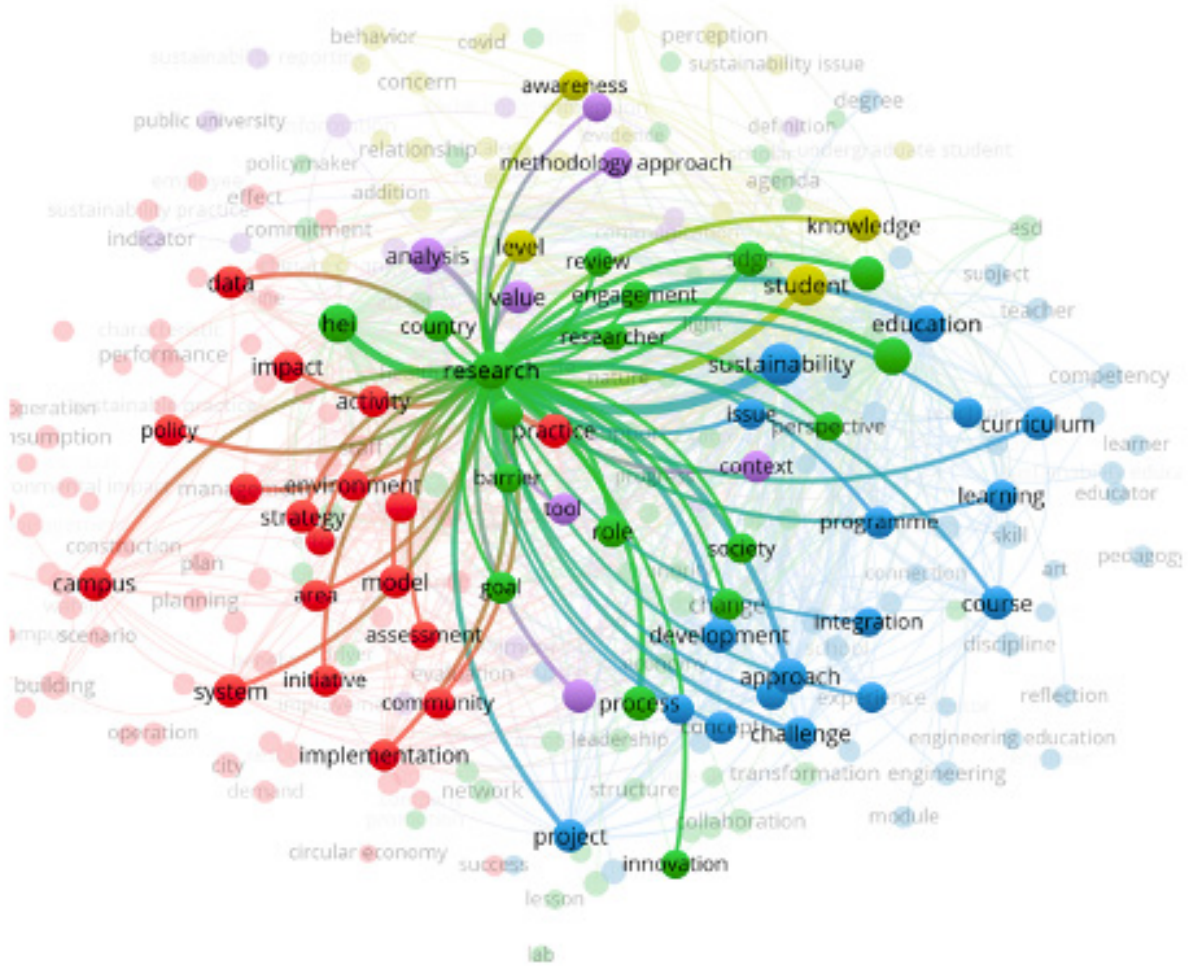
The connections to 'development' (co-occurring in 515 articles with 'HEI' and 'higher education institution'), 'approach' (256) and 'process' (186) broadly reflect the active and ongoing nature of sustainability activities in the literature, and efforts to review and understand approaches at the institutional scale. It is notable that 'HEI' / 'higher education institution' does not consistently co-occur with all words associated with the whole institutional approach: there are 10 co-occurrences in our database with 'estates', 101 with 'governance', 130 with 'engagement', 33 with 'outreach', 436 with 'research', 157 with 'teaching', and 174 with 'learning'.

Figure 17. VOSviewer visualisation of the word 'HEI' in the academic literature



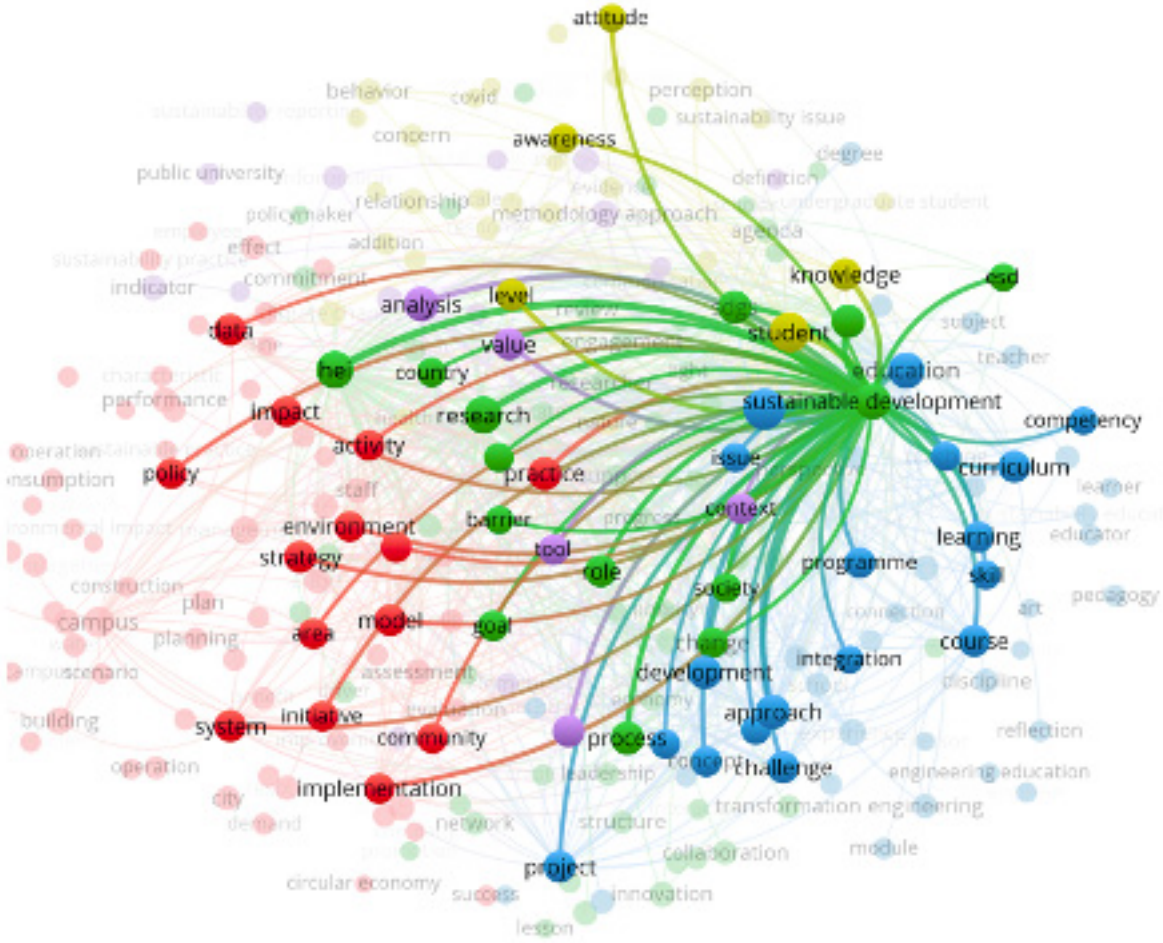
A visualisation of **'research'** is shown in Figure 18. The word appears in just over half of those in our dataset (54%). We are cautious in over-interpreting connections and occurrences of 'research' due to the multiple meanings that 'research' may carry (for example, an institutional activity, student research projects, the focus of a published paper), but note that it is prominent within our visualisations and is therefore important to the structure of the academic literature. 'Research' is clearly well-connected across all clusters, and closely positioned next to keywords relating to the process of research (eg 'data', 'analysis' and 'review'). 'Research' is strongly associated with 'sustainability' ('research' and 'sustainability' co-occur in 52% of papers in our dataset). The visualisation suggests that research associated with sustainability is both a process and an output of universities, connecting with an interestingly wide variety of activity, including campus operations, curriculum and students.

Figure 18. VOSviewer visualisation of the word 'research' in the academic literature



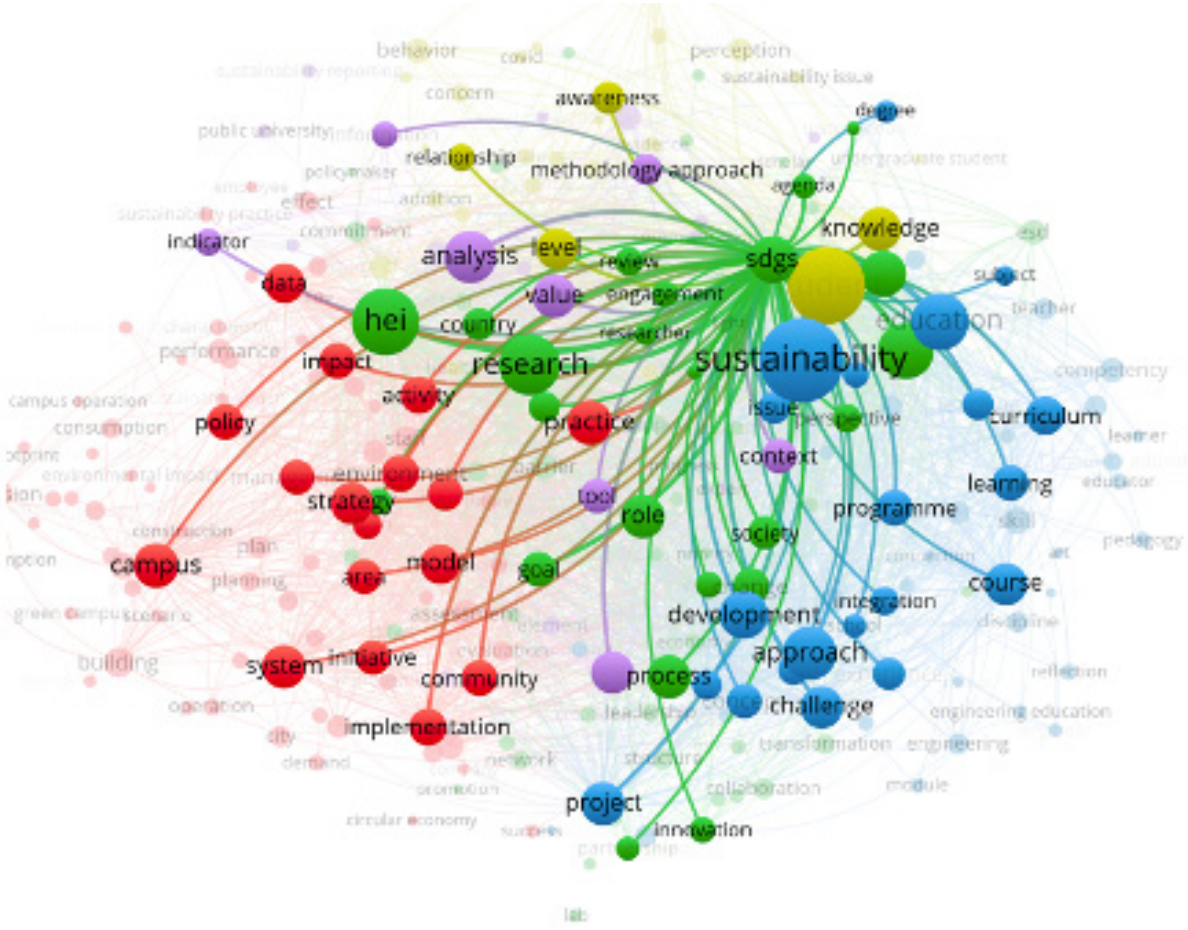
‘Sustainable development’ is found frequently in our dataset, appearing in 43% of papers (1,080), although this includes meanings such as the sustainable development goals and sustainable development of projects and institutions etc. Overall, the phrase widely co-occurs with other words in the academic literature (Figure 19). There are strong links to research-oriented words (green cluster), education (blue), students (yellow) and campus (red). However, we note that with the campus theme words, the links extend only to the more general terms such as ‘strategy’ (co-occurring in 283 articles), ‘environment’ (218), ‘impact’ (244), and ‘policy’ (252), rather than the more specific technical aspects of sustainability such as ‘building management’ (only found in two papers) and ‘energy usage’ (found in eight papers). The general positioning of ‘sustainable development’ near education- and student-related keywords suggests it is closely associated with issues around curriculum design, skills development and approaches to learning and teaching.

Figure 19. VOSviewer visualisation of the phrase ‘sustainable development’ in the academic literature



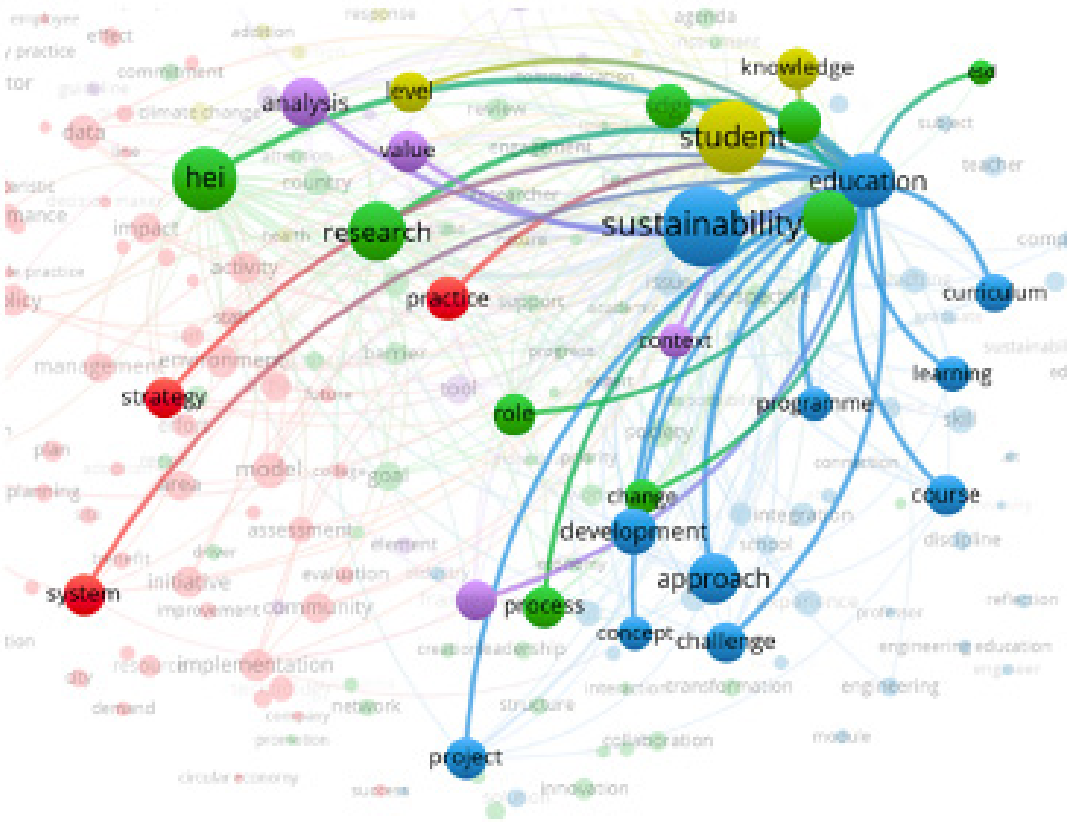
We separately visualised **'SDGs'** (Figure 20), in which we first noted that 'SDGs' was less prominent than other words in our visualisation. 'SDGs' or the phrase 'sustainable development goals' occurred in 381 (15%) of articles in our database. We also noted that it was not central in the visualisation. This suggests a greater affinity of 'SDGs' with keywords associated with education, students and research, rather than the campus operations and management: 'SDGs' or 'sustainable development goals' co-occurred with 'campus' in 73 articles, 'student' in 185 articles, 'education' in 333 articles, and 'research' in 212 articles.

Figure 20. VOSviewer visualisation of the abbreviation 'SDGs' in the academic literature



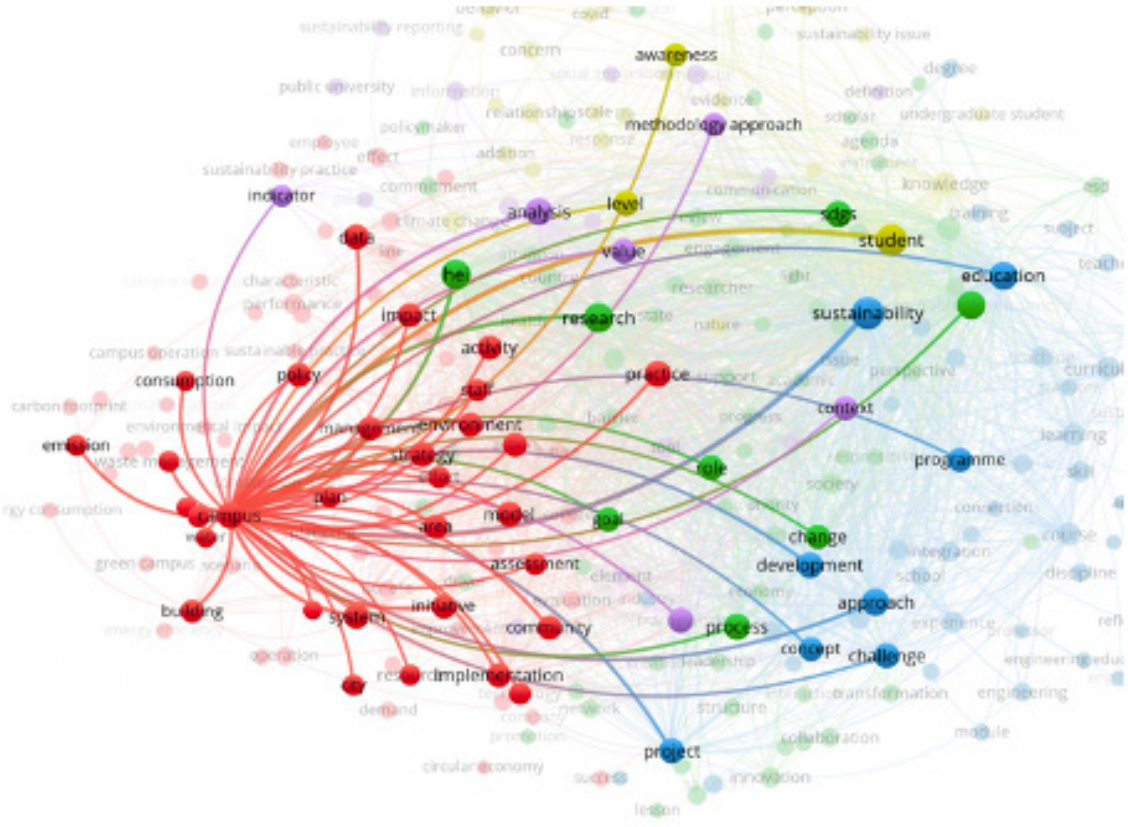
Our visualisation of the word **'education'** (Figure 21) suggests a strong distancing of education from campus and estates management. This is reinforced by the lack of co-occurrence links between 'education' and terms such as 'campus' and 'building' in the visualisation. In our database of articles, 'education' occurred frequently (71% of articles), but this is associated with the frequent use of the phrase 'higher education institution[s]' suggesting that further analysis of co-occurrence among our articles will not reveal meaningful patterns. Nonetheless, as would be expected, there are strong links in the visualisation between education-related keywords (blue cluster) and 'student'. Interestingly, 'tool', 'analysis', 'cluster' and 'value' from the purple cluster (monitoring and reporting) suggest some interest in efforts to systematically understand education practices within HEIs.

Figure 21. VOSviewer visualisation of the word 'education' in the academic literature



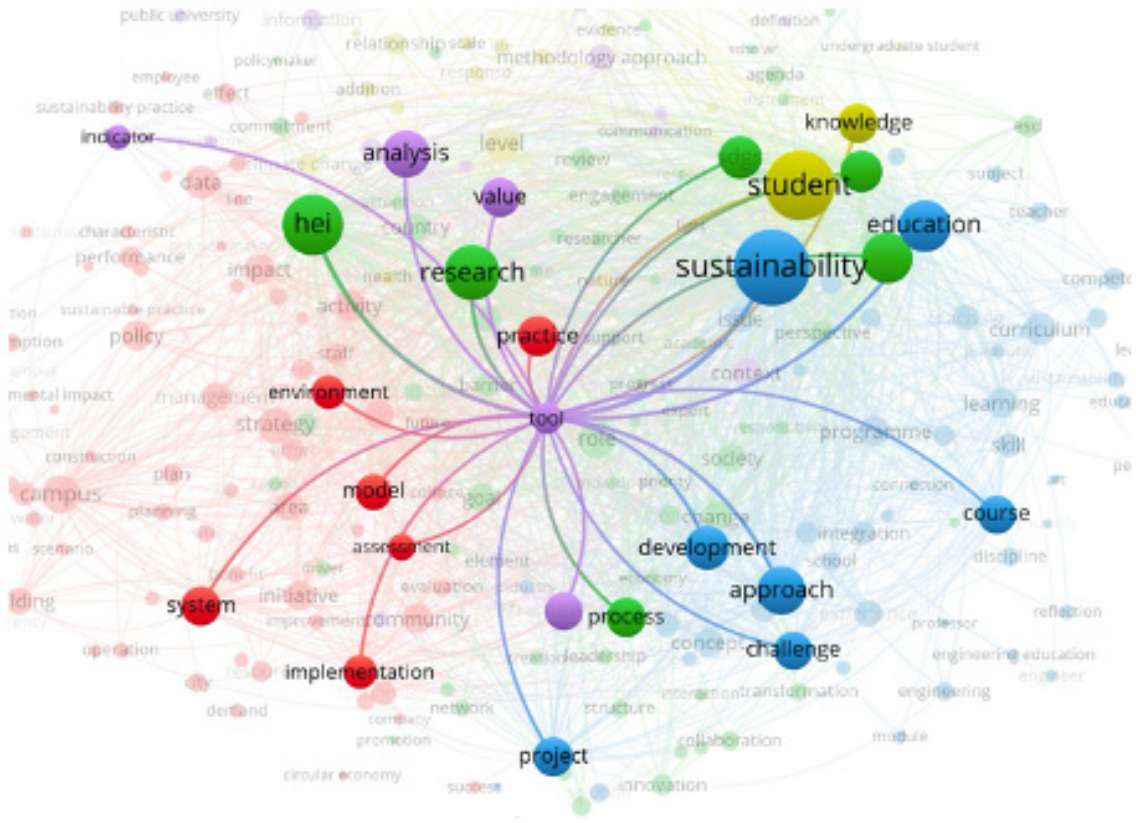
'Campus' was clearly positioned with a range of keywords relating to estates operations and management (Figure 22), reflecting literature relating to technical issues of sustainability in terms of energy management, building design, carbon footprinting and emissions. 757 papers (30% of the total dataset) included the word. 'Campus' co-occurred with a number of other terms in the red cluster; links to other clusters were comparatively weak compared to other keywords, with most links to general words that might describe project work or management plans, for example 'change' (co-occurring in 215 articles), 'development' (492), 'data' (217), 'project' (185) and 'goal' (166). There was an expected and strong link with 'sustainability' (co-occurring in 680 articles), 'education' (426) and 'student' (320), although again these are general terms relating to research about higher education, rather than signposting specific collaborative projects ('collaboration' and 'campus' appeared together in only 3% of our articles).

Figure 22. VOSviewer visualisation of the word 'campus' in the academic literature



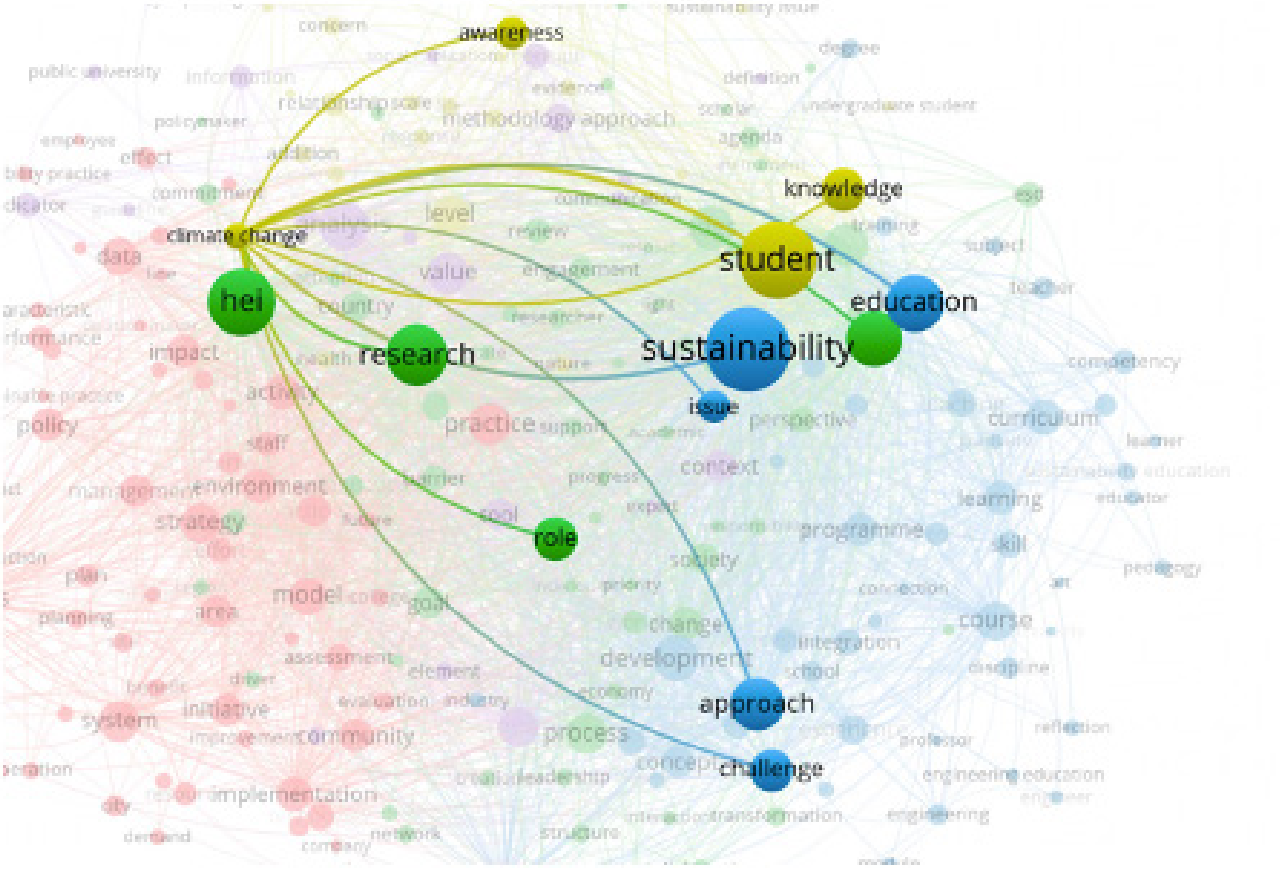
The keyword **‘tool’** occupied a central location in our visualisation (Figure 23) between the red, green and blue clusters, although it was not a notably prevalent term: it occurred in 193 articles (7%). It co-occurred with general terms in all other clusters, predictably including ‘sustainability’ (187 articles), ‘HEI’ (39), ‘framework’ (48) and ‘practice’ (87). There were also links with ‘education’ (co-occurring in 156 articles) and ‘course’ (28) but few links to specific campus-operations keywords in the red cluster. We interpret this to suggest that there is a theme in the literature around the creation and development of tools to promote thinking about educational practices, but campus operations literature is more focused on the application and use of existing tools. Keyword links with ‘development’, ‘approach’ and ‘analysis’ (co-occurring with ‘tool’ in 147, 75 and 71 articles respectively) appear to suggest an emerging and active area of interest.

Figure 23. VOSviewer visualisation of the word ‘tool’ in the academic literature



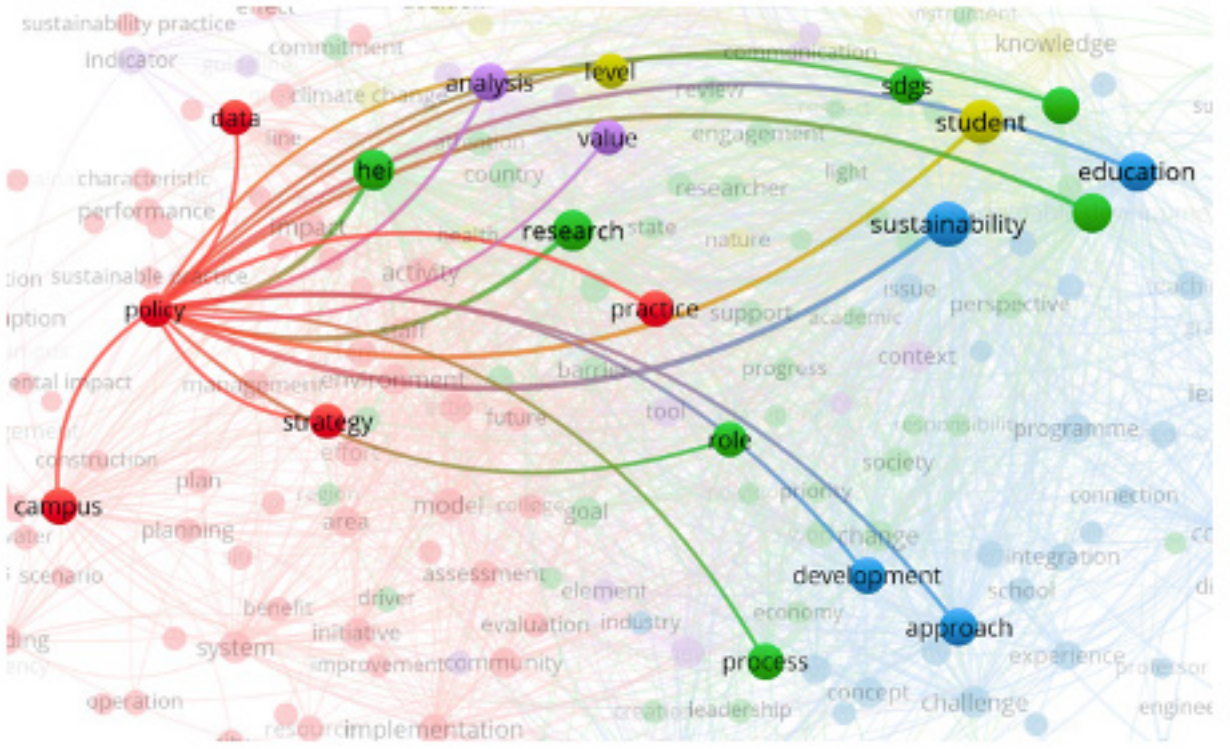
'Climate change' appeared in 240 articles, and we were interested to see that it was positioned in the yellow (student-focused) cluster, with links to 'student' (co-occurring in 211 articles), 'awareness' (60) and 'knowledge' (61) (Figure 24). This reflects the theme of research in the literature, which explores student engagement with, and understanding of, climate change. We found no meaningful evidence that other SDGs (such as gender equality, health, economic growth, peace and justice) were clearly referenced among our papers. References to these terms were in other contexts, such as the gender mix of participants. It was also unexpected to see no clear links to the red cluster terms, suggesting that climate change is not being used to frame campus operations and estates management processes as it is with education. There was also relatively low co-occurrence of these words among our articles, co-occurring with 'campus' in 85 articles and only once for 'estate'.

Figure 24. VOSviewer visualisation of the phrase 'climate change' in the academic literature



'Strategy' was connected to words in all clusters. There were links to several words in the red cluster, which we interpret as reflecting a typically top-down approach to campus planning and management. It also connected to education cluster terms and the students cluster. The extent of co-occurrence links across the dataset point towards the interest in approaches to scaling-up and strategically embedding sustainability in the academic literature. We noted a strong – and largely predictable – association between 'policy' and 'strategy' (both within the red cluster). The keyword 'policy' (Figure 25) was found in 341 articles (14%) and had links with 'SDGs' (20 co-occurrences among articles), 'sustainability' (318), 'education' (260) and 'HEI' (43). This could be interpreted as a reflection of articles addressing how institutional ambitions around sustainability are integrated into their policies and education activities, but also that 'SDGs' are rarely embedded explicitly within institutional policies.

Figure 25. VOSviewer visualisation of the phrase 'policy' in the academic literature

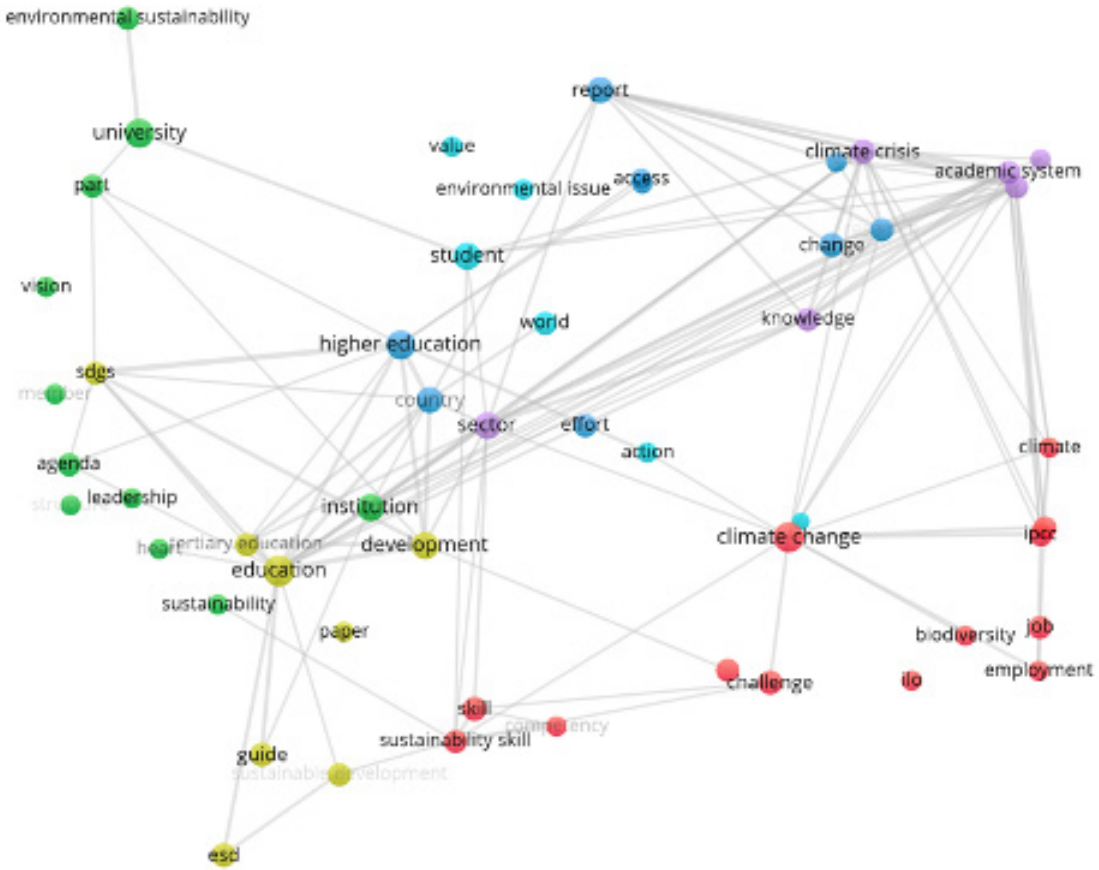


'Outreach' (in the sense it is used in the UK higher education system of encouraging people from more diverse backgrounds to take part in higher education) is not in our visualisations, meaning it fell below the threshold of 50 occurrences to be included. It appeared in 62 articles (2%). On the few occasions it is mentioned, it is used to mean 'civic engagement'. The related terms of 'widening access', 'widening participation' and 'higher education access' are absent from articles in our database. One article by Trahan et al. (2017) discusses campus tours, a practice identified in our case studies as an approach to outreach. One study in our grey literature (Martel and Bhandari, 2016) analysed the benefits participants from the Global South gained from funded fellowships to take part in higher education abroad (85% at master's level and 15% PhDs). Around a fifth studied an environmentally related subject and a third worked in the environment field after their studies. In the survey of 1,800 participants, the report frames the success of the funding in supporting a generation of social justice leaders. However, our findings confirm that sustainability activities are not widely used as a tool for outreach.

10.3 Grey literature visualisation

The grey literature puts more emphasis on the high-level drivers, in particular climate change ('climate', 'climate change', 'IPCC', 'climate crisis') as well as 'biodiversity' (Figure 26). There is also more emphasis on the educational role of universities in supporting the skills needed in future (skill, sustainability skill, competency, job, employment). The connection between universities, and the supporting skills needed for the transition to a green and low carbon economy is more prominent in the grey literature. There are also indications that the strategic steps needed to achieve this are recognised (academic system, vision, agenda, leadership). The small dataset of grey literature (36 reports) precludes more detailed interrogation of the VOSviewer visualisation.

Figure 26. VOSviewer visualisation of the grey literature



Case study 1: Falmouth University

+ A medium sized, multi-campus university with a portfolio focused on art, design and the creative industries; the university seeks to have impact on the local region through harnessing creativity to explore sustainability.
+ The university uses a partnership approach to estates and infrastructure management, working with an external organisation to manage the Penryn campus, which is shared between Falmouth and the University of Exeter.

Falmouth University (Figure 27) is a medium sized institution (approximately 7000 students) with two main campuses in Falmouth and Penryn. It is the only university based in Cornwall, a largely rural part of the UK. Traditional industries in mining and fishing leave a rich cultural legacy but few jobs, and tourism puts pressure on local infrastructure while bringing only seasonal employment. The University was granted full university status in 2012 and offers around 100 degree programmes in predominantly arts and creative industries disciplines at undergraduate and postgraduate levels. A high proportion of students (approximately 40%) declare disabilities, in particular, dyslexia and ADHD. Although a teaching-focused institution, research is growing in importance, particularly in art and design disciplines. Falmouth University declared a climate and ecological emergency in 2019. The University's Penryn campus is managed by a third-party organisation, FX Plus, which provides facilities management across both Falmouth and Penryn campuses.

Figure 27. Falmouth University campus

External recognition

+ Top ranked arts university in the 2023 Good University Guide.
+ In 2022, Falmouth was recognised as a Top 10 Institution for 'Students Reached' in the SDG Teach In, run by Students Organising for Sustainability.
+ Won the 'Reporting with Influence' category of the 2022 Green Gown Awards; shortlisted for a 2023 Green Gown Award in the 'Tomorrow's Employees' category.
+ The Penryn campus has been awarded the Green Flag award for six years consecutively.
+ Falmouth has developed a tool for embedding climate education in the curriculum, featured at COP26 as a case study.

Purpose

The university's mission focuses on excellence in education and research through the 'fusion of creativity and technology', and use of 'knowledge and expertise…to generate positive and sustainable opportunities for all'.

The institutional vision highlights the synergy of technology and creativity within the local region, specifically to 'develop the next generation of creative leaders and explorers who will change the world through their curious minds, creative impact and unique skillsets' and 'build on strengths in research and knowledge exchange to deliver experimental, environmental and societal impact'.

Policies

The Sustainability Policy (2020) commits Falmouth to 'operate as a more responsible [HEI] that addresses the challenges of sustainable development…[and] seeks to create a culture within the institution that supports and encourages staff and students to recognise that we all have an element of personal responsibility for the environment and to act on that' while working and studying at the university (Table 5). The policy sets out the university's intention to i) comply with environmental legislation; ii) use targets to inform improvements in sustainability; iii) control pollution; iv) communicate the policy to students, staff and stakeholders; v) co-operate on sharing good practice in sustainability at local, regional, sector and international levels.

Table 5. Extract from Falmouth University's Sustainability Policy

Theme	Specific commitments include:
1. Learning and Teaching	+ Sustainability learning outcomes and assessment criteria in all courses + Sustainability related projects and challenges aligned to transdisciplinary approach to education + Ensuring graduates have understanding of UN SDGs and can apply to business start-ups
2. Environment and Operations	+ Scope 1 and 2 net zero by 2040; Scope 3 net zero by 2050 + Maximising biodiversity, including regeneration of natural vegetation to support carbon sequestering
3. People and Behaviour Change	+ Ensuring staff and students have greater awareness of sustainability and impact on the environment + Drive change in behaviours in all aspects of student and staff at home and at work

A separate policy has been developed by FX Plus, an organisation with responsibility for managing the Penryn campus (shared between Falmouth University and the University of Exeter) and estates and facilities management at the Falmouth campus. The Falmouth Exeter Plus Sustainability Policy (2020) shares the same headline commitment as Falmouth's own Sustainability Policy, with a specific vision to 'decarbonise Scope 1, 2 and 3 emissions to net zero, while integrating sustainable regenerative and circular principles'.

The policy outlines eight sustainability working groups (covering, for example, sustainable travel, biodiversity, communications and behaviour change, and waste and recycling) and with specific objectives to support the delivery of the strategy in conjunction with Falmouth and Exeter universities and the local council. The policy provides further details on the People and Behaviour Change theme, noting specific approaches to 'drive positive organisational culture change and [to] influence behaviours', including: top down leadership; embedding sustainability in staff induction; a reward scheme; communication to recognise achievements.

Practices and SATs

The Head of Sustainability is employed by FX Plus; a Sustainability Coordinator (employed directly by Falmouth) was introduced following the climate emergency declaration in 2019. Senior operational responsibility for sustainability lies with the Director of Estates, Operations and Infrastructure. Sustainability in learning and teaching falls under the remit of the Director of Academic Innovation and Quality. Both sustainability policies state the role of the Board of Governors is to ensure that reporting against plans and targets occurs effectively. The Falmouth policy and progress is reviewed by the Vice Chancellor's Executive Group, with individual members of the group taking responsibility for aspects of the policy. The FX Plus policy is reviewed by the Cornwall Campuses Environment and Climate Emergency Board, including representatives of both Falmouth and Exeter universities. A Students' Union Green Committee lobbies FX Plus for change and promotes campus sustainability.

The university and FX Plus use a number of SATs to support sustainability in campus operations. The most influential tool used by the institution is the Climate Commission HE Climate Action Toolkit, due to close alignment between the toolkit structure and the institutional strategy. A gap analysis is undertaken annually and RAG-rated progress included in the annual report and as a basis for reporting progress to the Board of Governors. The tool also has value for external benchmarking with other HEIs. ISO20400 (sustainable procurement) is used at macro-scale reviews of procurement and also the practices of individual business units. FX Plus procurement services use the NETpositive Supplier Engagement Tool (HE) to engage with suppliers and assess the sustainability of the supply chain.

An education tool (The Falmouth Curriculum Ladder) was developed by the sustainability team. The tool enables programme teams to explore how sustainability is evident in their programmes through student focus groups, staff team surveys and programme documentation.

Programmes

A number of co-curricular events also focus on sustainability, enabling students to create authentic outputs that support their employability skills and benefit the local community: for example, in 2021 MA Illustration students focused on 'repair' as a theme for an annual forum, producing a 'zine' presented at international and local book fairs; Sustainable Tourism Management students undertook projects to develop sustainability toolkits for local cultural heritage organisations. Falmouth also runs events and projects that support local communities. For example, the university has taken part in community tree planting activities and partnered with a local mail order nursery to distribute surplus stock to students, staff and campus visitors. FX Plus donated unwanted furniture after the Covid-19 pandemic to community organisations and schools.

Several projects and activities on campus support the university's climate emergency declaration. The Sustainability Café on campus sells only vegetarian and vegan options and prioritises local and Fairtrade products, based on student feedback. An annual Sustainability Week and a Fairtrade Fortnight (aligned with the national event) are a collaboration between the Students' Union and Green Committee, plus Falmouth's and the FX Plus sustainability teams. FX Plus has undertaken a range of projects to reduce the carbon footprint of campus operations, including replacing campus vehicles with electric vehicles, sourcing food and drink supplies from the local region, planting wildflower meadows, installing solar panels, and using highly concentrated cleaning products that reduce carbon emissions from transport.

Institutional narrative

Implications of using SATs

Two SATs play a particularly important role in driving sustainability at Falmouth: the Climate Action Toolkit and the in-house Falmouth Curriculum Ladder tool. The Climate Action Toolkit is tightly embedded within approaches to reporting, and used to measure institutional sustainability progress and outcomes. It was described by interviewees as being a "very useful outline…of what you should consider as an institution" but also accessible and relatively easy to use compared to the EAUC

scorecards: “the scorecard [tool] is very granular… we’ve looked at it… it was almost a bit too advanced”. The Climate Action Toolkit was having an impact because it was considered “more user friendly and a bit more introductory”. The relative simplicity of it is evident in clear RAG ratings being used by the institution as a reporting mechanism, and ability to quantify the number of successes in reaching a ‘green’ status.

The utility of the tool itself is complemented by measuring progress through a ‘gap analysis’ approach which leveraged the value of the toolkit, for example through reporting to the Board of Governors and structuring the Annual Sustainability Report around the RAG ratings. The annual review of progress was described as “where we really sit down and like… how can we improve?...[also] from a more strategic level”. The gap analysis process happened through issuing templates to relevant heads of services and collating the findings, although there was generally little discussion among those completing the analysis.

The Falmouth Curriculum Ladder (FCL) tool also had significant implications for embedding sustainability, particularly focusing on education and student learning. The purpose of the tool was articulated quite differently compared to the reporting- and benchmark-focused use of the Climate Action toolkit. The impact of the FCL was much more about stimulating discussion than gap analysis or annual sustainability reporting:

> “it’s useful because it’s built on a system that requires an argument or a conversation to be part of it…it’s not going to just spit out an answer that says ‘“you haven’t got enough [sustainability]...it’s an academic development tool”.

The FCL combines qualitative analysis (evidence of nine sustainability themes in the curriculum identified by teaching staff and experienced by learners) with quantitative analysis (occurrence of the themes in programme documentation). The tool has implications for all disciplines because each theme is defined based on an extensive literature review – the themes were sufficiently broad to enable all disciplines to contextualise them, and there was evidence that it was clearly influencing the curriculum: “we’ve got someone who took the nine themes and essentially turned it into nine weeks of content”. The impact of the tool is enhanced through embedding it into curriculum approval and programme review: it is ‘baked-in, not bolted-on’. The FCL largely replaced an earlier strategic decision to embed ‘sustainability learning outcomes’ into the curriculum:

> “we didn’t really have the strategic mandate to make [sustainability learning outcomes] a requirement…we realised we needed a more fluid and dynamic approach… the core driver now is learning on this tool because we can use it to detect [the presence of sustainability] themes”.

The expectation is that the tool becomes a self-evaluation resource for programme teams, rather than led by learning and teaching staff in facilitated workshops. The FCL was also seen to have value to other universities, and within the ‘spirit’ of sustainability to share the tool as a model of good practice with other institutions. It was the subject of the university’s shortlist for the Green Gown Awards (UK and Ireland) 2023.

Place and location

Falmouth is keenly aware of the importance of place in its institutional mission. As an anchor institution in a largely rural area, the university frames its impact on sustainability through its education activities – upskilling students to be active participants in sustainable development:

> "the biggest impact we can make is through our graduates and sending them out into industry…we have great influence over [the creative arts] sectors and industries… our graduates…are the most powerful tool we have to make change".

The nature of Cornwall as a largely economically underdeveloped region also interacts with the university's sustainability activities. The university has taken pride in investing in the region, which positively influences impact on social sustainability. However, this was not seen to be integrated into the strategy but 'nuzzled' into the institutional approaches.

Interviewees noted that the natural beauty of Cornwall played an important role in driving concerns about sustainability among the student and staff population. Students were thought to be from a 'certain demographic' and largely 'creatives', motivated and engaged by the local environment to be passionate about sustainability.

Potential contradictions. Despite the generally positive narrative around Falmouth's sustainability agenda, there were a few points mentioned by interviewees that reflect some inherent tensions in the way that sustainability is practised. One example was around travel. The location of the university meant that engagement in events and initiatives often required significant amounts of travel. Guided by a proactive member of the senior leadership team, staff would be encouraged informally to take the train rather than fly to, for example, London. A similar issue emerged for global travel, where academics attending conferences was noted as a particularly unsustainable practice, but one vital to their profession and role. Applications for travel would have to consider sustainability issues, and these would be approved at a faculty level (rather than approved through the sustainability team, for example). While pro-environmental choices not to go to international conferences could also be a cost-saving measure (and also a positive sustainability outcome), for other travel choices the reverse was true: in some cases flights were cheaper than the journey by train, but the cheaper flight would carry a higher carbon footprint.

As an arts institution, there were some potential contradictions around the materials required for students to practice their discipline and sustainability:

> "this is an issue, because, you know, there's got to be chemicals… [and] electricity. Resources are quite intense for those kind of things".

Interviewees did not suggest any specific steps being taken to mitigate this issue aside from maximising the value of the student exhibitions (ie re-showing the outputs). Another tension identified was that an opinion that the staff incentive programme promoted 'consumerist' approaches to spending:

> "a lot of the things that are in it…are like money off and cultural things that don't seem to be a part of our local culture…like takeaways or money off tech[nology]...it's quite consumerist… and kind of jarring".

Size and governance. The relatively small size of the university was thought to be an important way that collaborative activity was stimulated. Interviewees reflected on being literally sitting next to colleagues from other departments, and this provided an opportunity for sharing ideas. This was associated with an 'organic' approach to developing sustainability. It was also noted that the sustainability coordinator was widely known across professional and academic staff and able to make connections across the university. One interviewee reflected on how colleagues were used to working across boundaries because of the small staffing base:

> "…I think in small institutions everybody is used to there being blurred boundaries about what is theirs and what isn't… people get used to taking on accountability for things".

The smaller size of the institution was also discussed in relation to resourcing. Interviewees discussed how it was important for any initiative to be fully integrated into business as usual, as maintaining momentum for a 'bolt-on' initiative would be resource intensive. The advantage of this was also that it would safeguard progress against any change in the senior leadership team, by being built into the institutional governance processes.

The small size of the sustainability team had an impact on its ability to drive change. While it was widely integrated into thinking about sustainability, it had little authority to make decisions:

> "…there's not enough power given to the sustainability team to make decisions…it's still very much a consultation service…they are the experts that work with teams in many ways… when it comes to senior agendas, they can only really recommend [actions]…then it sits with our senior leadership committee…it doesn't have the authority to solve".

Interviewees had differing perspectives on governance of sustainability issues. In the estates context, interviewees acknowledged that actions were driven in a strongly top-down way, led by FX Plus, not by the university itself. (The complexities of this joint-management arrangement might account for the perception of top-down process.) Campus management was set out in strategies developed by senior colleagues with relatively little input from others, because "everything's funded and everything's...financially done…it's quite hard to come in and change the operations". In contrast, much more bottom-up activity was evident in learning and teaching activities, where there were opportunities to 'catalyse' thinking and use it to enrich the curriculum.

Despite the small size of the institution, there was still an issue of siloed thinking. One example of this was that annual sustainability reporting templates were distributed to the heads of service to write individually; there was no clear process by which sustainability progress was looked at holistically among heads of service. The responsibility for drawing together and integrating sustainability initiatives was thought to reside firmly with senior management:

> "I'm less worried about [the other services]. The luxury of my position is I don't have to care… but somebody above me has to be able to draw these threads together".

One interesting comment on the governance of the institution was that issues around ethical funding (such as divesting from carbon intensive industry) were quite "actively picked up" by the Board of Governors. However, this was seen as "more an ethical point of view than a sustainability issue" and one that "came back round to marketing" and "embodying things the younger generation are concerned about".

Students. Student pressure led to the declaration of the climate emergency, which triggered the development of the institutional approaches to sustainability. The students were generally seen as quite artistic and in touch with cultural issues; they are keen to be involved in ideas around sustainability. There was some isolated but intense student activism which had been significant in developing the climate emergency declaration. Interviewees noted there had been some instances of students requesting – and having – meetings with senior members of the university leadership team to discuss sustainability.

Case study 2: Cardiff Metropolitan University

+ A medium sized university, teaching a range of applied and technical subjects. It has gained widespread recognition for its work in sustainability, by coming first in the recent UK People and Planet rankings.
+ Focuses on the potential for pro-environmental behaviour change among its students. The approach is framed by Welsh environment and education policy – which focuses on wellbeing and on future generations.

Cardiff Metropolitan University (Cardiff Met) is a medium sized institution, with 12,600 students. The two Cardiff Met campuses are in suburban locations, which creates challenges for promoting sustainable travel behaviour. It is one of three higher education institutions in the city, which combined has the potential to significantly impact the local community through car-based travel and student occupancy of houses in residential neighbourhoods.

The University was granted full degree awarding powers in 1992 and prior to this existed as an institute for higher education. It offers approximately 160 undergraduate courses and 80 taught postgraduate programmes, with a focus on art and design; sport; business and management; health science and education. Many of the courses are accredited by professional bodies. A quarter of students currently at the university come from neighbourhoods in Wales in the lowest 20% for the WIMD (Wales Indices for Multiple Deprivation).

External recognition

+ People and Planet Green League: Cardiff Met was ranked first in the 2022-23 People and Planet Green League.
+ Green Gown Awards – Benefiting Society: in the 2021 Green Gown Awards the University was highly commended in the Benefiting Society category for Hero's Haven. This is a student-led project, where University students worked as volunteers with children in a local pupil referral centre to meet their needs of wellbeing, life skills, learning and community engagement, through environmental and sustainability-based workshops. The children involved were vulnerable, so in-person workshops were permitted during Covid restrictions: covering activities such as gardening, environmental protection, nature-based arts and crafts using recycled materials. A community forest was planted on campus of 80 trees which produce edible fruit and, when established, the produce will be sold at the on-campus Community Market.
+ Green Gown awards – Build Back Better: in 2021 the University was also a winner of the Build Back Better category for the Down to Zero project. This is a partnership with an affordable housing provider, Cynon Taff Community Housing Group and renewable energy company Cenin Renewables. The project aims to reduce the carbon emissions of the 1,900 homes to net zero. Researchers at the university have determined opportunities for carbon reduction over a short-, medium- and long-term timeline, with milestones to deliver net zero carbon emissions by 2030. The residual emissions will be addressed through carbon sequestration options locally by planting trees and vegetation that not only sequester carbon but also provide sustainable and local food such as fruit, vegetables and herbs for local communities.

+ The University also has recognition from the Sustainable Restaurant Association (Gold Award, 2022); Hedgehog friendly campus (Silver Award, 2022) and from Buglife NGO for Bee Friendly Campus. The University travel plan received a Platinum Award from the Welsh Government and was winner of the Cardiff Cycling Awards for most cycle-friendly business.

Purpose

The University reviewed its strategy in 2023, updating the 2017-22 strategy with Strategy 2030. There is a strong focus on the civic mission, and the contribution the university can make through education and partnerships to support a fairer society, richer culture, more prosperous economy, environments that are greener, and communities which are healthier. As a Vice Chancellor at Cardiff Met explained:

> "so I think that one of the things about straplines – in ours is about being a local university with a global outlook… and being a university of the place that we're in – in Cardiff and in Wales, and wishing to be good corporate citizen of that place. We are in a global outlook, so you're not looking inward, you're to look outwards…being good citizens, and then feed that into where you are".

The Wellbeing and Future Generations Act Wales, not only frames environmental policy, but also education policy and governance. By policy focusing on future generations, education becomes something which is a priority, as a Vice Chancellor at Cardiff Met describes:

> "where education is valued by the change that it can make, and that there is a suggestion... it can be a force for good... it ought to be shaped to be a force for good".

The unique framing gives the opportunity, as the Sustainability Lead explained to:

> "educate students, whether they be from Wales initially, or they're visiting Wales while they're doing their degree. to understand that Wales is leading the way with our Future Generations Act".

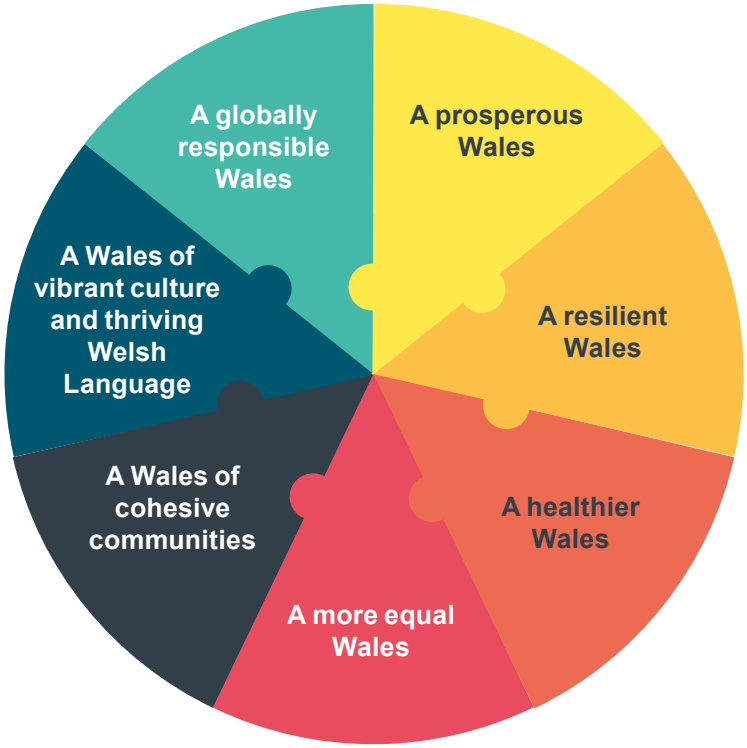
Although the University is not bound by the Act, its funder and regulator as a public body is. This sustainability framing through the Act is illustrated in Figure 28.

Interviewees repeatedly referred to the University as a values-led institution. These values are:

> "…committed to social, economic and environmental responsibility. Our education, research and innovation deliver positive impacts for equality, social inclusion and environmental sustainability, locally, nationally and internationally".

These values can then be used to guide decision-making with 'thorny' policy issues and practices.

Figure 28. Representation of sustainability in the Wellbeing and Future Generations Act



Policies

The University has five strategic priorities in its 2030 strategy. Enhancing culture is the first, shaping the overall strategy with: 'Belonging and Becoming, enabling our students, staff and partners to fulfil their life chances and those of the communities and economies they belong to'.

Part of the reason for belonging comes from taking a fresh look at the University campuses post-Covid. Staff and students are coming to campus much less frequently during term-time, and 'belonging' is in part about making the campus a place people want to come to for work and study. It is also difficult to fulfil the potential for pro-environmental behaviour change among a student body who are not engaging with the campus. Belonging and becoming also ties into the widening participation and outreach agenda at the University. One strand to that is green jobs, and making potential University students in local FE colleges aware of the opportunities.

The University policy from 2017-22 was framed as EDGE: ethical, digital, global and entrepreneurial. This EDGE framing informed teaching and curriculum reviews. Sustainability featured in that, through 'global' and 'ethical'. Under the new Strategy 2030 sustainability sits above those, framing them all. From now onwards, sustainability is a strand within the curriculum with its own articulated identity, as part of the 2030 Strategy.

The other four strategic priorities in the 2030 Strategy are:

+ 2. Delivering an Estates masterplan will transform the campuses, creating a net zero carbon estate by 2030 and outstanding teaching, research, sporting, living and social spaces for students and staff.
+ 3. Low carbon futures – develop a platform for existing expertise, supplemented and complemented by new talent, to come together to create innovative teaching and research areas that respond to climate change, employer need and student demand for environmental sustainability, more green economies, education for sustainable development and the wellbeing economy.
+ 4. Wales's sporting University – to upgrade facilities, diversify activity and improve access, retention, outcomes and impact in both high performance and participation sport…. capitalising on sport as a lever for wider social, economic and cultural good.
+ 5. Global academies – those established during the last strategic period, with their focus on research and postgraduate education, will strengthen their volume, reach and impact of research and innovation, particularly through international collaboration.

Practices and SATs

The University has created a single point with the Sustainability Office, which looks at, measures and audits everything that is going on. This includes sustainability but also wellbeing and lived experience projects. There is one 'space' at the Sustainability Office that owns it all, connects it all together and then shows it – reflecting it back to colleagues. There are two main tools that inform this process: the environmental management system (ISO14001) and the People and Planet league table.

The University has had a carbon management plan since 2005. This is now nested within an environmental management system which addresses the physical estate, but also aims to address learning and teaching, staff and student engagement, and community engagement. Each area within the environmental management system (called an aspect) has an aspect owner. The aspect owners meet regularly to report how are they getting on with their targets and objectives.

The use of the People and Planet league table is prominent and notable. It is being actively used as a tool to help guide and steer University processes. As the Sustainability Lead observes:

> "I see that as a framework to be able to implement activities based on what their criteria methodology is. You can benchmark against. There's a filter on it, so you can benchmark against the Welsh Universities, the top English, top Scottish. There's all different categories where you can benchmark, you can benchmark using each different category within their criteria as well. So if you wanted to look at energy, for example, you could look at who was the best at the energy and where you come in comparison, and look at what they're doing and how you could improve that".

A similar process operates for research, aided by being a medium sized university with applied research across several disciplines. Associate Dean Research and REF coordinators meet regularly and discuss what works well, and where one area is doing it better than another, and then try to share that practice across. This is an example of bringing people together, sharing practice and reflecting it back out again.

Learning and teaching follows a similar process to research. The teaching and learning leads meet regularly and practices spread across the University. As the Director of Research describes:

> "I think, the School of Art and Design, maybe 12 years ago – they decided to scrub out all their modules on sustainability. They just took those out, because they felt that by modularising them, they were encouraging a thought: 'well, I've done sustainability. Now I can move on to other stuff'. And so they took the view that what they needed to do was constantly teach sustainability through everything that they did. And I think the University has started to do more and more of that, and put sustainability through things rather than isolating them".

In the curriculum review process, EDGE (ethical, digital, global, and entrepreneurial) are related to each programme. The University has amended its curriculum design process to become a little bit more didactic. Rather than recommendations right at the end, changes are made during the validation process and creates a space for dialogue. This replaced waiting until the end of validation and making recommendations that then later need to be acted on.

Programmes

The University has undertaken several interesting and innovative sustainability-specific programmes and initiatives. Within all of these, the Wellbeing and Future Generations Act was an important consideration, as a Vice Chancellor explained:

> "any additional project funding [from the University regulator in Wales], any multi party engagement, agency sort of process, you report on your outcomes with an appreciation of Future Gen. Or you bid into those projects with an appreciation of Future Gen….So those are the main criteria".

Three examples of the kinds of programmes are described below.

Widening participation

The Sustainability Lead is actively involved with the widening access group at the University. When prospective university students from local high schools come onto campus, she regularly meets with them. She gets into a discussion with them about sustainability within their school, trying to help them think differently about their issues. In a recent example, the school had a 'camp', a basic, glass conservatory where all the students went in their free time and lunchtime when it was raining. After breaks, the school pupils described is as "like a bomb had gone off in there". All over the floor were all their plastic bottles, all the crisp packets, and anything else they had eaten. Working with the school pupils, she encouraged them to try to understand why they didn't put them in the bin.

They were encouraged to think how they were going to improve that within their school. What signage were they going to put on the bins? But also, what about all the stuff people would bring into school from home? They started to think about reusable bottles and cups – it was trying to get them to approach the problem differently. She took the students on a campus tour to look at how things worked at the University. On their visit, the University campus did not have any litter, and has prominent and clearly marked recycling points. The school pupils could also see the use of reusable cups, reusable bottles and water fountains. The school pupils left feeling empowered, and with a set of solutions that they could implement within their school.

The Dye Garden

The Dye Garden (Figure 29) has grown out of a 2022 student work placement project in the Sustainability Office. The project, which opened in June 2023, is a space for growing plants that produce natural dyes. These can be used by the textile and other arts students to create dyes that are much more friendly to the environment than chemical dyes. The fashion students also worked with engineering students who wished to test a 'farm bot', a robot which assists with the garden maintenance. This gives both student groups a unique opportunity to work with others from a very different discipline. The dye garden is adjacent to an existing green space, the Cardiff Community Garden. Together they also provide a pleasant outdoor green space with benches where staff and students can relax outdoors. The funding came from three 'pots' – the sustainability budget, the estate budget, and one of the contractors who work for the University donated money. Additional income is also gained from the sale of spare plants and dyes at the community market.

Figure 29. Opening of the Dye Garden, June 2023

The Community Market

A Community Market on campus provides access to affordable, fresh and healthy food to students and residents living in the adjacent suburbs. It is also an opportunity for the Sustainability Office to showcase everything it is doing from a sustainability perspective. The 20 stalls from the farmers market are supplemented by others. For example, the city council regularly has a stall about reducing food waste and using a food caddy for residual waste. There is a free bike servicing stall and security marking. A repair café for residents and students to bring items, often electrical, to be fixed, without charge. The students' union also has an opportunity to showcase projects they are working on, recently with a focus on Fair Trade. There is a plastic-free shop where people can by reusable items. Some University students will also have stalls to sell some of their artwork or designs. It provides a safe trading environment for them to sell their work, perhaps for the first time. It also improves relations with local residents, who rather than seeing only the nuisance from the University from traffic and parking, also benefit from the things the market offers. Visitors to the market do not have to buy anything during their visit, and can enjoy live music and take up the free services.

Institutional narrative

The institutional narrative is strongly embedded in place, responding to the environmental issues of the locality and the student body, but without becoming parochial. The Sustainability Office provides a central focal point, which works well in a medium sized university to bring everything together into one place and then reflect it back. There was a lot of emphasis on peer learning across departments, and adoption of approaches that work in other departments. This has many advantages but comes with limitations too, which participants acknowledged. It is highly dependent on the commitment, enthusiasm and professional qualities of the sustainability manager to facilitate it.

The University focuses on the potential to change students' behaviour while they are at university, and encourage them to adopt pro-environmental behaviours. Starting university is viewed as a specific opportunity: when students make that change in their lives they are open to making sustainability related changes as well. In terms of careers, Cardiff Met students, especially those who are the first in their family to go to university, are under pressure to make pragmatic choices that will lead to graduate employment. The University views its role as opening up for students the possibility of good quality green jobs, rather than a campaigning mindset. It still leaves the question of whether more co-creation of sustainability with students, beyond individual projects and initiatives, could deepen the University's work. It also raises questions about evaluation, and measuring the effectiveness of specific programmes and initiatives to change students' behaviour.

The University research around food, design, and sport and wellbeing rarely led to ethical sustainability contradictions. It also had relatively modest environmental impacts from the research activities. The global academies have been boosted by the appointment of five new professor levels posts with a sustainable angle to them (such as sustainable food, sustainable tourism). This came from the University core budget, and was written into policy after the decision had been made, rather than steered by it.

The important role of the People and Planet league table in shaping university action on sustainability is intriguing, and challenges an academic narrative that tends to view sustainability league tables and benchmarking negatively as 'tick box exercises' which can lead to unintended consequences. The University has made significant progress in its sustainability journey, and the attention from the People and Planet award has helped the institutional focus on sustainability.

The Wellbeing and Future Generations Act provides a strong narrative the University embraces, distinct from the economic-centred environmental policy coming from the Government in London. Despite the alternative narrative offered by the Future Generations Act, the University cannot evade financial realities. Where will funds come from to refurbish its building stock to net zero? How to manage the tensions between its desire to widen participation in Wales and support those students into green jobs, and the financial reality, which necessitates increasing international student recruitment? Unlike counterparts in Australia, the University has not yet experienced serious climate change impacts in its operations. However, rising energy and food prices are beginning to affect the University, its students and stakeholders. The tensions outlined above will impact on the University over the period of the 2030 Strategy.

Case study 3: Deakin University

+ Deakin is a large, multidisciplinary teaching and research University with four campuses in Victoria, Australia. The University is already experiencing the direct impacts of climate change with more intense rainfall events, heatwaves and wildfires. It uses its Waurn Ponds campus as a living laboratory to test solutions at scale that could be implemented by municipal governments and other stakeholders.

The University has 60,000 students and 5,000 staff across four campuses – two in the suburbs of the state capital, Melbourne, one in Geelong and one in Warrnambool. The scale of the University means it has a sizable energy usage, as well as water and consumption of other resources. The Waurn Ponds Campus has been used as a living lab to test innovative approaches, including sustainable water management and a microgrid. In Geelong, traditional sources of employment at the port, rail hub and heavy manufacturing have declined. The waterfront campus occupies refurbished 19th-century industrial buildings, acting as an anchor institution in a medium-sized city. The University is involved in the repositioning of the city economy, including the growth of green jobs. Warrnambool is a much smaller city with a settled population, focused on agriculture and tourism.

All the University is located on land which was under the custodianship of First Nations. A non-statutory plan, called the Health Country Plan and produced by the Traditional Custodians has shaped both the pattern of development and overall approach to sustainability. In the past 10-12 years, Deakin has shifted from being a teaching focused university to a teaching and research focused university. It has become a global leader in education research, in the top five globally. Strategic investments in research have often aligned with sustainability priorities. It now ranks in the top 300 universities in the world across the three main rankings and in the top 50 for universities under 50 years old.

External recognition

+ In 2020, the University won the Sustainability Victoria (an arms-length body from the state government) award for the programme Blue Carbon Army. The programme has educated more than 300 corporate executives from industry partners on climate change science. It provides an immersive experience into coastal wetland research. The #BlueCarbonArmy connects executives with nature, leading to scientifically documented sustainable behaviours. The programme was designed as a full-day immersive experience combining educational talks, discussions and research activities on local wetlands.
+ In 2021, the University was a finalist in the Sustainability Victoria awards, for leading a programme of Victorian Coastal Wetland Restoration. The University brought together a range of stakeholders and oversaw the restoration of 600 hectares of critical wetland habitat. It is a nature-based solution to sequester carbon, mitigating the risks of climate change and helping recover Victoria's native biodiversity. The project worked closely with traditional owners and community members to monitor and protect heritage sites and coastal wetlands.

Purpose

When the University values were last reviewed, 'sustainability' was added specifically as one of the six core values. Two other values, 'brave' and 'dynamic', align with the living lab and innovation. The other values are 'excellent', 'ethical' and 'inclusive'. Inclusive means valuing diversity, embracing difference, and respect and welcome to all. It also means moving indigenous knowledges into the mainstream of Australian life. All the University endeavours aim to reflect Australia's full history and seek to build an inclusive future.

The purpose of the University is to provide, as a Dean explains:

> "opportunity to come together to solve global challenges on a local level, and that opportunity for innovation, especially in areas that that haven't naturally been innovative".

Central to this is the conception of the University as a living lab, implementing and testing approaches which can then be replicated beyond the campus. As the Sustainability Lead observes:

> "our campuses are like small urban settings, we've got residents, we've got retail, we've got medical centres, we've got office buildings, we've got transport systems, we've got infrastructure, like water and metering for energy. We've got a micro-grid on our campus to produce our own energy. So that's why it's so exciting to undertake work on those campuses, because they can be replicated – tweaked, tested, tried, and replicated".

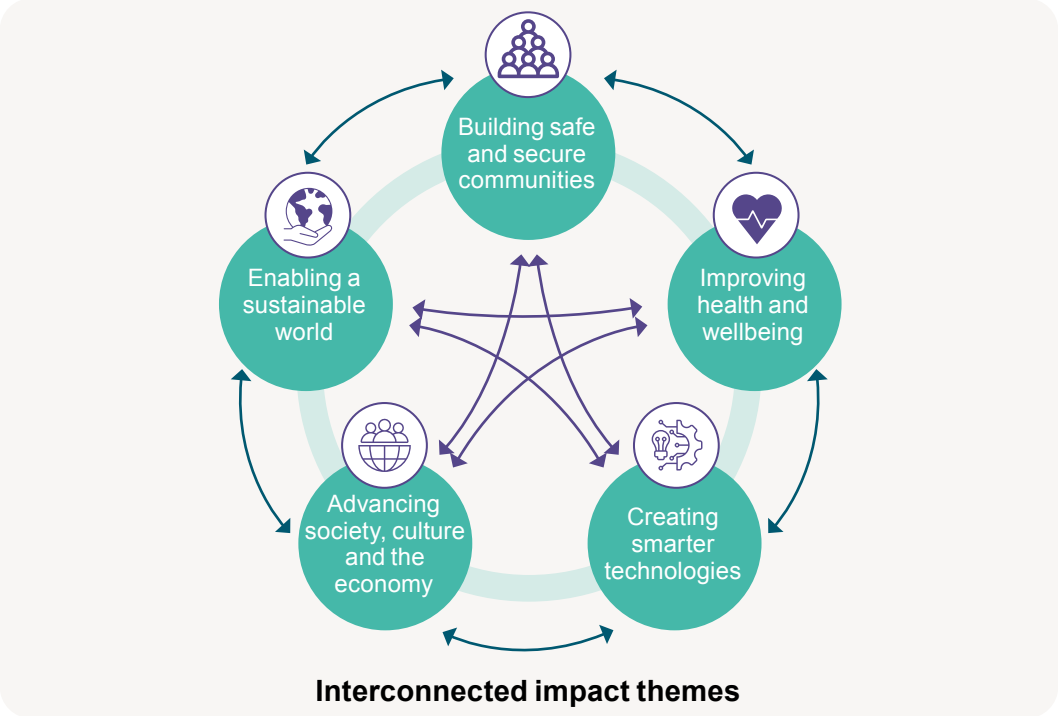
Policies

Sustainability now features strongly in University strategy. This has been important, according to the Sustainability Lead, in transforming sustainability from a niche, estates-based activity to one which is critical for how the whole institution works. As the Sustainability Lead explains:

> "when I first came into this role, [it was] called the environmental team back then. And it was only a couple of people doing things like sticking stickers on light switches to say 'turn me off when you leave the room'. Which I didn't find that exciting… Six years ago that I came into this role, I think the world was changing back then and expecting something different of large organisations. So there was a bit of groundswell that really helped us to take it from the light switch kind of stickers to that higher level strategy. We understood that we needed to make a greater authentic, genuine impact than we ever had before – carbon neutrality or net zero was starting to be spoken about. You don't get to carbon neutrality without having a really strong strategy".

The University's strategic plan is Deakin 2030 Ideas to Impact, published in December 2020 and updated in December 2021. The approach taken in the strategic plan is illustrated in Figure 30 below. The Strategic Plan is focused on key challenges, not just for the University but for the world. This circle – safe and secure communities, health and wellbeing, smarter technologies, a sustainable world – came first from a review of research. It has resulted in strategic research investments that has seen the University shift from a teaching focused university to a teaching and research university over a short period of time – 10-12 years. This has included research in a wide range of sustainability topics, including batteries; hydrogen technology; the circular economy; ecological restoration and sustainable aquaculture. The strategic approach has seen the recruitment of key researchers, investment in researcher development, and also deliberately investing in strategic entities like institutes and centres. From being the focus for research, these challenges have now moved into all university policy across all its activities.

Figure 30. Deakin University strategic plan approach



Practices and SATs

The University established Sustainability Commitments in 2017 with targets for 2020, 2025 and 2030. The more detailed document sets out the practices that the university is going to take to achieve its high-level ambitions. The University had a target to be carbon neutral by 2030, which was brought forward in 2020 to 2025. Since 2017, the University has broadened out the Sustainability Commitments to include a wider range of issues, cross-referenced to the SDGs. These now comprise: procurement; travel and transport; energy and emissions; waste management; water;

built environment and natural environment. The work to mitigate climate change is underpinned by robust scientific evidence of climate conditions on campus. University researchers conducted climate modelling for the campuses for 2030, 2050 and 2070 and beyond.

Procurement practices are an important approach to driving change. This applies to suppliers who provide goods and services to the University, and the opportunity to expect more from them. It also applies when the University is working on projects and in larger partnerships. As the Sustainability Manager explains:

> "procurement is a really interesting process and tendering for projects, or work or partnerships. Because you have to really 'fess up and be very genuine in how you act, and how you behave, and your decision-making and what policies do you have?"

Sitting under the Deakin 2030 strategy is an additional technical layer of documents. The most recent of these is the Universities' first biodiversity strategy and action plan. The current biodiversity on Warum Ponds Campus is poor. The land was previously agricultural, but managed by Europeans without the knowledge that their farming techniques were poorly suited to the Australian climate. There are utilitarian reasons for acting to support the renewal of native biodiversity. More trees and vegetation will result in a cooler local microclimate and reduce runoff after heavy rainfall events. The biodiversity strategy will create habitat that supports the return of keystone species, which should be present and are not currently resident. The presence of the swift parrot in the woodland and keystone yarra pygmy perch are indicative of the health of native ecosystems.

The sustainability team meets on a monthly basis with First Nations representatives. All the projects the sustainability and estates team are considering are run past this group first. The team also makes sure it aligns its work with their non-statutory Health Country Plan.

Programmes

The objectives in the Sustainability Commitments and Biodiversity strategy are being taken forward through specific programmes.

Integrated Water Management Project at the Warum Ponds Campus is an example of the living labs approach taken at the University. The project not only looks at a living lab from a technical standpoint, but also overcoming policy barriers. In Australia, the management of water is highly siloed. Stormwater is managed by the councils or shires. Potable (drinking) water is managed by the Water Corporations, while natural waterways (rivers and streams) are managed by a Catchment Management Authority. These organisations never meet and, as a result, innovation in the water sector is very stunted. The Warum Ponds Campus already had a network of ponds through the middle of the site. The ponds helped with stormwater management but not much else. The water quality was poor and they readily became murky and stagnant. The University has converted the ponds to functioning wetlands, which improves the water quality, improves their biodiversity, and increases the stormwater capacity and opportunity for reuse. As a result, it means the quality of water going into natural waterways, which are alongside the campus, is improved. By bringing recycled water to

campus, the university is able to reduce its potable water use. University students and researchers did a multitude of studies and research to adjust that system to get the best out of it. This approach, both the technical and the policy co-ordination across authorities, can then be replicated in municipalities. Universities in Australia received Covid relief funding, with considerable flexibility in how they invested it. Part of the funding for this project came from that state funding.

Solar farm and micro-grid: also on the Warun Ponds campus, the University generates substantial amounts of electricity with its own solar farm and micro-grid. It is the largest of its kind in an Australian University. It comprises a seven-megawatt solar farm, Australia's first grid-connected megawatt-scale lithium iron phosphate battery, and 0.25-megawatt solar generation and storage across the rooftops of campus buildings. This is managed through a central Microgrid Visualisation Centre. The data from the project informs renewable energy companies, the Federal Government research organisation (CSIRO) and Energy Networks Australia about the viability and reliability of microgrids. The installation meets over 50% of the power consumption on the Warun Ponds campus.
The microgrid also brings much needed resilience to the energy supply following a number of recent blackouts in the suburbs of Melbourne. Connections to teaching and research are important with many opportunities for staff research and student projects.

Connecting research and green skills. One of University's larger research programmes focuses on hydrogen as an energy source at the Warrnambool campus. It ranges from fundamental research in materials science to applied projects with local bus operators. The researchers also worked with industry partners to conduct a skills need analysis for the sector. The University is now taking forward education efforts with a dedicated training facility in hydrogen technologies. This work to map and then meet local and regional green skills needs in other sectors is at an early stage, and still quite localised within the University. It is helped by already having strong links to employers in the public, private and voluntary sectors, though widespread work-based learning in taught degree programmes.

Curriculum review. The work on the curriculum is ongoing, taking themes that had been developed in research, which became organisational priorities and now are to be applied to learning and teaching. The approach the University is taking to sustainable world mapping is dividing all taught programmes into three types: those that focus on sustainability; those where sustainability is an important component; and those where sustainability is a moderate component. The process has been informed by the project to decolonise and embed indigenous knowledges into the curriculum: it is better to do it deeper once, than at a surface level multiple times. The original intention was to wait until each programme was subject to periodic review. Recent climate change events in Australia have led the teaching and learning leads to decide they cannot wait that long, and the process must be accelerated.

Institutional narrative

The idea of a living lab and fostering innovation frames the way Deakin approaches sustainability. The experimentation on campus connects students and teaching to the work of researchers – which is starting to make sustainability a joint mission across the university activities. A university has a unique opportunity, as the Sustainability Lead describes:

> "universities have great permission to be a little bit crazy, you know, but to test some really crazy stuff. So I think that permission is a real advantage compared to, you know, a corporate".

Another key factor in the institutional narrative at Deakin is the wider political situation in Australia. This vacuum at a national scale in fact spurred the University into action. As the Sustainability Lead explains:

> "that was a real drive to take it on ourselves…. if they're not going to make decisions that will help us we have to help ourselves. So that really empowered organisations and universities to really take a big leap forward. We thought no one's going to help us so we need to crack on".

In common with Falmouth and Cardiff Met, a committed and dynamic Sustainability Lead, with the professional qualities to bring stakeholders together around complex projects has been very important to the successes at the University. Strategy has played a significant role, but activity to raise the profile in strategy by sustainability champions came at a time when there was a shift in societal expectations.

A strong connection has been made between sustainability, performance, reputation, the university brand and recruiting students. Students actively choose to go to Deakin because it is a university that aligns with their values. Prospective students expect their university to behave in an ethical way and sustainability is a large part of that. This has led to strong interest from the recruitment team and the Vice Chancellor International in the work of the sustainability team. There have been student campaigns on very specific topics – to reduce paper wastage and a fossil free group. More significant has been the sustainability reputation the University has developed, especially internationally. Students were active in many of the projects, inputting in creative and interesting ways, but there seems further the university could go to co-create sustainability with students as partners. There was no connection between the widening participation agenda at the university and sustainability.

The University was strongly impacted by Covid, with reduced international student numbers leading to a large loss of income. This resulted in a major re-orientation of capital programmes, with spending on new campus buildings cut dramatically. As the Sustainability Lead explains:

> "the things that remained in that financial plan were the sustainability projects, just about everything else was cut. But sustainability stayed in that financial plan because we knew it was the right thing to do. And the real priority is floated to the top, I think, in Covid".

Making better use of their existing university estate challenged a growth model of adding more and more buildings to the university campuses.

Case study 4: Wageningen University

+ A medium sized, research focused university in the Netherlands. It is based on a single campus, shared with companies and NGOs involved in research and innovation.
+ It takes an interdisciplinary, science-based approach to solving major global challenges. Action on sustainability is collaborative and decentralised, using an approach it calls 'finding answers together'.

All the university activity relates in a broad sense to life and natural sciences, covering five 'topics': environmental sciences; plant sciences; animal sciences; foods and bio based and social science. Its origins are as an agricultural university, and it still owns a research farm. Today, a significant proportion of the research is related to the Global South. The University shares its campus with the R&D departments of 25 medium sized and large life science and food companies, including FrieslandCampina, Noldus and Unilever. It also accommodates 25 NGOs and 150 SMEs, many of which are university spin offs. There is a strong emphasis now on making the campus ecologically rich and environmentally sustainable. The university consists of two entities – the university itself which conducts fundamental research and carries out the education of students, and the research institute which carries out applied research.

In terms of teaching, there is a focus on postgraduate education with 19 BSc programmes and 31 taught master's programmes. The number of students on taught programmes has grown significantly in the past 20 years, from 4.5,000 in 2003 to 13,000 in 2023. About a quarter of these are international. In addition to the taught students, there are 2,400 PhD students. An international audience is also reached through MOOCs. The campus environment, high profile research on sustainability challenges, and international recognition in rankings has given it a strong reputation for sustainability. This attracts students, researchers and companies who already have an interest in sustainability to the University from the Netherlands and internationally.

External recognition

+ First-ranked university in the world on the UI Green Metric for six years in a row, 2016-22.
+ Founding member of the Nature Positive Universities Alliance, launched at COP15 in Montreal, December 2022.
+ The Dutch student association – Studenten voor Morgen – conducts a ranking and awards scheme called SustainaBul of the 33 universities in the Netherlands. This has many common features to the People and Planet tables. Wageningen led this for six years. However, in 2022 and 2023 it has slipped down the table, mainly related to how the award scheme records sustainability in the curriculum, a topic discussed in more detail later.

Purpose

The organisational mission is "to explore the potential of nature to improve the quality of life". The core values of Wageningen are: independence, integrity, transparency and sustainability. These are set out in the Strategic Plan 2019-2024, called Finding Answers Together. The prominence given to independence, integrity and transparency reflects the polarising public debate about the role of science during the Covid crisis, and on other controversial topics. The Strategic Plan presents the role of the university, through both its research and teaching, as positively contributing to:

> "global challenges which have become even more urgent, such as climate change, healthy food and living, biodiversity, nitrogen-crisis, circularity, and competing claims for space".

As a university focused on the life and natural sciences, the research and teaching connects directly with sustainability. As a member of staff working at a senior level on sustainability describes:

> "well, that's because we're just working on these areas, life sciences that are close to what you do with Earth. So its logical…. We are doing research on environmental issues and climate and agriculture".

Policies

The central policy document is the Strategic Plan Finding Answers Together 2019-2024; updated in 2021 and extended for a further two years. Conducting research and its dissemination and application are the key way the university engages with sustainability. The Strategic Plan has a strong focus on the research work of the university, setting out three research investment priorities. These are:

+ biodiverse positive food systems, and how these can be scaled up in different regions
+ transformative bio-economies addresses replacing materials that are made from fossil fuels (such as construction, packaging, furniture, and textiles) and moving to a circular bio-economy
+ data-driven discovery in a changing climate research will take forward machine learning and AI to assist research into heatwaves, forest fires, floods, and landslides. It will advance understanding in how to mitigate and adapt to these complex problems.

In terms of teaching, there is reference to making sure sustainability is more visible in the education programmes. The plan also references the contribution the University can make to the shortage of experts in the technical sectors. There are ambitions by the end of the current plan period to significantly expand professional education and have a:

> "sustainable business model for professional education, with a diverse course portfolio that covers the entire scope of the WUR domain. It will include online learning paths tailored to the individual professional, as well as tailor-made in-company courses, executive education, and MOOCs".

Practices and SATs

Sitting underneath the Strategic Plan are a range of other more detailed technical documents. These technical documents for sustainability apply to the whole organisation – both the university, which conducts fundamental research and teaching, and the research institute. There is significant organisation complexity in having two organisations, but the work of the sustainability team cuts through that to deliver a joined-up approach. In 2021 the University approved an Energy Transition Plan. This involves reducing demand by insulation of existing buildings and behaviour change among staff and students. It also involves substantial investment in renewables – currently solar makes up 10% of the University's total energy usage. Solar energy will be complemented by investment in an Aquifer Thermal Energy Storage (ATES). In summer, buildings are cooled with cold water drawn from the aquifer, while in winter, the groundwater from the aquifer is passed through that same heat exchanger, but now in combination with a heat pump to provide heating in the building. This will reduce demand for natural gas by 75% when it is operational in 2025. There are parallel plans for the campus to improve sustainability related to transport, materials use and recycling, biodiversity and catering.

In common with many other universities, it has found the campus estate does not align with post-Covid hybrid working patterns. A new Working@WUR strategy and forthcoming strategic accommodation plan are intending to better align accommodation with current ways of working. The focus is on creating safe and physically healthy workplaces alongside greater investment in digital tools, support and training. Similarly to Deakin, a period of considerable campus building expansion is replaced by thoughtful assessment to make the optimal use of the existing estate. The Shared Facilities approach discussed below reduces pressure to add laboratory or greenhouse space. The small number of new buildings that will be added are to the highest environmental standards.

The University has attempted to map its research outputs against the Sustainable Development Goals (SDGs). This aligned with a major conference in 2018. This work lapsed and was not continued on an annual basis. There have been one-off efforts to map research subsequently and, for an event and anniversary in 2022, all the work related to SDG15 Life Below Water was identified. The SDGs were present, but being too focused on them could sometimes steer researchers away from the real problems that stakeholders experienced on the ground. The University wanted its research to contribute to real, pressing problems, not those it thought users experienced.

In terms of the curriculum, the University has not undertaken a systematic curriculum review or curriculum mapping exercise with a view to embedding sustainability into taught programmes. Programme Committees, where student representatives put their views, are the main mechanism where students could put forward suggestions for changes. The Green Office thought this was a robust and effective approach and that student contributions were taken seriously. Academic Consultancy Training (ACT) is a mandatory module for all taught master's students at the University. The students work in interdisciplinary teams on a real world challenge. This could come from the many start-ups or companies based on campus. It could also come from NGOs or local government. There is a very strong sustainability element to these ACT projects, and recent examples of projects have included: introducing more biodiversity into solar farms on behalf of the planning department at

the municipality; an agro-forestry project for land owned by the water company; and using the byproducts of hop production in the textile industry. Some projects have also been put forward by the University sustainability manager to look at challenges on campus.

Programmes

Global sustainability programme. This is an internal fund where the university uses its own reserves to support interdisciplinary research in sustainability. Versions of this fund have been running since 2000, when it was called INREF. Researchers can apply to the University to fund research that addresses pressing social and environmental challenges. There is seed funding of 25,000 Euro which can be used to develop a research idea, perhaps with external collaboration.

There is also project funding of up to 1.6m Euro to conduct research. For the larger research grant there is a condition that the researchers must raise 20% in match funding. The research must be interdisciplinary, and a key element of the fund is to support researchers in looking for solutions with others beyond their own discipline. Recent projects have been diverse and included: coral reef protection; the environmental impacts of palm oil; fermenting foods to reduce wastage.

Shared facilities. The University has a system of shared facilities for research equipment and laboratories. This means that expensive equipment is not duplicated, and researchers are not spending funds on the purchase of equipment that is under-used. The shared facilities approach also applies to the other organisations: the larger companies and SMEs that are co-located on campus. There are differential internal charging schemes so that researchers at the university build this into their grant. Those who work for larger companies based on site are charged more to use the facilities, and have the option to pay for staff to operate them. This saves money overall, but also has positive environmental benefits in reducing the environmental impact of research. There is significant embodied carbon in complex research equipment, and operational carbon in running laboratories.

Green Office and Finding Answers Together. The role of the Green Office is as a linking pin between the students and the University. Structurally it is part of the University and sits within the Facilities and Services Department. Students come to the Green Office with concerns, or problems, or project ideas that they are not sure of the best way to take forward. The green office also runs a number of events and engages in social media to encourage pro-environmental behaviour change among the student body.

One of the ways the University addresses sustainability challenges on campus is through a process called FAT Sessions – Finding Answers Together. These are attended by the Executive Board members and directors of departments along with lecturers and many students. The FAT sessions take place in a large amphitheatre. The formats differ slightly, some start with a presentation, most involve a trained moderator, and there may also be panel discussions.

The Green Office is in a unique position to bring people together, having access to the staff intranet and student social media. Almost all the ideas for topics have come from the Green Office themselves (often spurred by being approached from students) or the Executive Board. For example, a recent

dialogue about plans to expand a road on campus were contested, as some members of the University community argued it goes against the sustainability ethos. The road plan has been put under review following this, and the estates department is looking at alternative options. The University operates within a policy framework for transport, which has other stakeholders including the municipal and provincial governments.

Kids' University. This is part of the outreach and engagement activities that the University undertakes in a group of eight towns and many smaller villages in the region the University is based, colloquially known as Food Valley. The region is socially conservative, with little intrinsic interest in the research the university is conducting overseas. The University recruits few staff or students from Food Valley, and opening up the campus can help build connections. The University invites schools to come to the campus and look around in the greenhouses, dairy and stables. For younger visitors, one of the researchers dresses up in costume like a stereotypical university professor. Sustainability is a strong part of the visit, so that school students are more aware of where food comes from, and the visits prominently feature biodiversity and climate change. They also make connections with the local area, such as which plants you can grow in your garden at home or school to encourage bees.

Institutional narrative

Interviewees repeatedly referred to staff and students' passion and enthusiasm for sustainability.

> "I think they have sustainability in their DNA, that they (staff) are really driven to work on these topics. And the same applies for our students."

Very similar expressions, referencing sustainability being in the DNA of the University and its staff were also made by the other four interviewees. The consequence of this is that people are regularly advocating for sustainability. An interviewee with an overview of research across the University explained that researchers help make sure that important aspects are not missed in a research project:

> "when we talk about biodiversity, we should also talk about climate or the other way around. So the interconnectedness between the different Sustainable Development Goals is always very close. And there's also I think, it's because of this passion, people are quite easy to volunteer and all kinds of new programmes and new initiatives. So they're eager to mingle".

The level of concern for the environment led many staff to choose to take the train when travelling to conferences and research workshops. The University booking system steered them towards the train when flights were less than six hours, and senior research staff who travelled frequently led by example. There was nothing mandatory in policy or practices, but rather a research culture developed where taking the train within Europe was the norm. The high levels of pro-environmental behaviour among staff and students can mitigate against using the university as a living lab. One research project tested an approach to food waste on campus, which worked very well, because everyone was very attentive to food waste. When the approach was then taken to cities in the Netherlands it did not work well. The preferred approach at the University was to take and test and trial ideas with stakeholders, not on campus.

Despite the high levels of support for sustainability among staff and students, the personal qualities of the mid-senior sustainability manager were still highly important. The Strategic Plan Finding Answers Together did not embed sustainability into the reporting and governance processes. A committed individual was still needed so ambitious plans for reducing the carbon footprint of the university campus could be implemented. The narrative the University puts forward to describe itself refers frequently to an 'ecosystem', meaning the component elements that support innovation rather than ecosystem in a natural science sense. This role for the campus is to stimulate an open innovation ecosystem between the university and the companies, NGOs and other stakeholders is intriguing. There were signs of its operation in the ACT projects and shared facilities. We were not sure what the connecting point was that brought the elements of the innovation ecosystem together, it did not appear to be the Sustainability Lead or the Green Office. Investigating how an innovation ecosystem worked in practice and how it could be fostered in other universities was beyond the scope of this project to interpret.

The University had not experienced the marked impacts of climate change in the same way as Deakin. However, long-term research with crops and agriculture meant that researchers were very aware of climate change, with spring coming three weeks earlier to the University farm as a result. The current commitment to sustainability sat alongside a discomfort that in the past the university had conducted research that had led to some of the environmental problems we now experience. This is one of the thorny issues, undoing its work from the past, that the University is still coming to terms with.

> "I think that as a University, or as a Research Institute, we also contributed to the ways agriculture is now, so that intensive agriculture that we have in the Netherlands, is partly also because of the research that we did. So I think we have responsibility as well."

Case study 5: Sharjah University

+ A new university, founded in 1997 in the UAE. Medium sized institution with approximately 19,000 students, the majority taking undergraduate degrees, about 2,500 on taught postgraduate programmes and about 750 undertaking PhDs.
+ Significant growth and rise in international ranking for teaching, research and sustainability.
+ University intends that its students will be future leaders who have 21st century skills. High-level policy and strategy is complemented by 'learning circles' where staff at all levels collaborate to embed sustainability across the institution.
+ The main campus is in a suburban location in the historic city of Sharjah, known as University City because of the location of several private schools and the campuses of a number of overseas universities. It also has two much smaller centres in other cities – Al Dhaid and Kalba.

Sharjah University has the largest range of degrees in the UAE in subject areas including healthcare, computer science, engineering, business, economics, fine art and design, and communications. It is a private university, but has not followed the model of many private institutions in the region of avoiding programmes which are expensive to run (medicine, engineering) or attract smaller numbers of students (arts). About half the students are from the UAE, and most of the international students are from other Arab countries, about 1,400 other international students. It has a strong focus on teaching with research rapidly developing, in particular in engineering and computer science. About 400 academic staff are active in research across all departments. It operates in a policy environment where the country's leadership recognises the need for higher education to diversity from business and finance courses and address the priority sectors in the country including energy; tourism and hospitality; manufacturing; technology, media and communications. It has had a rapid rise in league tables, and in 2023 entered the top 300 universities in the Times Higher Education World Rankings.

External recognition

The University has advanced very rapidly in the Green Metric World rankings from 452/615 in 2017 to 81/1050 in 2022, scoring particularly well on setting and infrastructure and water. The university also achieved a gold rating in the Sustainability Tracking, Assessment and Rating System (STARS). This scheme is organised by the Association for the Advancement of Sustainability in Higher Education (AASHE) based in the US. Sharjah is the first university in the Arab World to be awarded.

Purpose

The University's overall policy document is the 2019-2024 Strategy. Teaching is core to the University mission; it is:

> "committed to providing a world-class education experience that prepared lifelong learners and leaders with integrated knowledge and skills".

This framing of the University's students as future leaders provides those championing sustainability within the University with a valuable 'hook' to engage colleagues.

The mission statement continues, stating:

> "we are passionate about building a collaborative and sustainable environment that cultivates twenty-first century skills and fosters pioneering research and scholarship. We seek to serve the current and future needs of our local community and beyond by offering innovative academic and professional programs".

The direct references to a sustainable environment and 21st century skills also provide a mandate for those championing sustainability within the University to act on. The University frames its mission with the wider societal context, referencing the Fourth Industrial Revolution; a technological fusion integrating physical, digital and biological resources. The University has six core values including:

> "dedication to providing students with knowledge and support, so they are fully prepared to be the leaders of the future".

This reinforces future leaders as central to the University's purpose. Another core value is Integrity and Ethics:

> "ethical standards at the University of Sharjah are founded on ethical and civic responsibility in accordance with progressive Arab and Islamic ideals".

This ethical core value provides a different way of approaching sustainability at strategic and operational levels. The Strategic Plan, published in 2019, pre-dates the Covid pandemic, but still forefronts changes we have seen expand dramatically in the learning environment, including blended learning and remote learning models.

Policies

The University has six strategic goals in the 2019-2024 Strategic Plan, which it terms SPIRIT: Students, People, Innovation, Research, Industry (and community) and Teaching (and learning). Teaching and learning directly references 21st century skills, and the need to review, develop and accredit academic programmes to meet the 21st century job market. During the plan period, each department and college is required to review their programmes, looking at sustainability alongside ensuring that the course is competitive.

The actions needed to make the campus more sustainable is a contribution by the University to the UAE Vision 2021, the national policy objective of saving resources and commitment to clean environment standards. Work to make the campus more environmentally sustainable is positioned in the 2019-2024 Strategic Plan in the Innovation section, with a strong emphasis on embracing new technology. Early sustainability activity at the University focused on water and energy. It has since broadened out to cover a much wider range of activities. Water remains a high priority, with work on saving water with new drinking water filtration systems, and installing water efficient devices across the campus. Technology works alongside behaviour change among staff and students, to promote,

for example, a culture that is positive towards tap water and reduces the use of plastic bottles. Work to reduce single use plastic bottles sits within policy objectives to reduce waste and segregate remaining materials for recycling. In its suburban location, sustainable transport is an important consideration and running University bus services takes place alongside the expansion of EV charging infrastructure. The 2019-2024 Plan recognises the need for sustainability actions to be strategic and master-planned into the campus, to ensure energy efficient and water efficient buildings and liveable outdoor facilities.

Practices and SATs

Work to operationalise sustainability is coordinated through the Sustainability Office. This was established in 2017, building on earlier work begun in 2014 led by subject specialists in academic departments. When taking actions, it deploys from business the PDCA cycle:

+ plan, identify an opportunity and plan for change
+ do, implement the change on a small scale
+ check, use data to analyse the results of the change and determine whether it made a difference
+ act, if the change was successful, implement it on a wider scale and continuously assess the results.

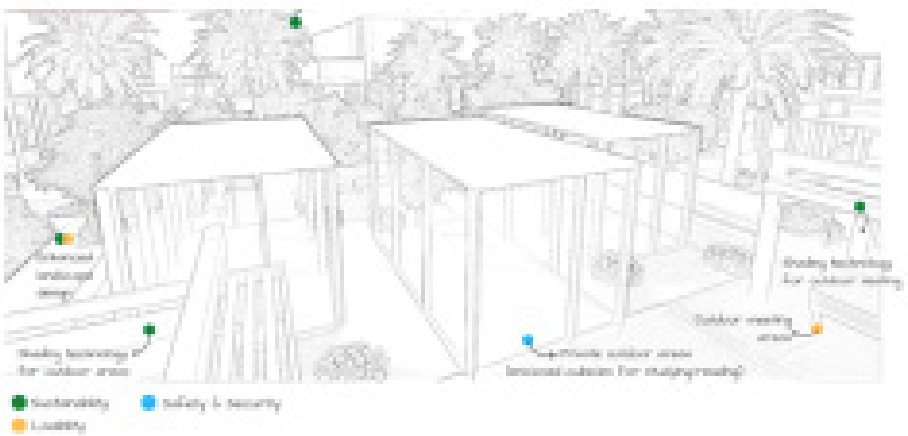
The Sustainability Office notes that some of its work will lead to incremental improvements over time, while other actions will lead to rapid, breakthrough change. The University Strategic Plan 2019-2024 recommends it develops a set of key performance indicators related to an environmentally sustainable campus for: greenhouse gas emissions; number of sustainability events for awareness raising; attitudes and adoption of sustainable behaviours by staff and students; reductions in water use and waste to landfill. The measurements and tools are developed for a University that is a private institution. Each key performance indicator has a value proposition. This does not mean every activity needs to conform to the financial bottom line, and justifications for sustainability actions are mainly stakeholder satisfaction: staff, students, faculty.

Information is also collected for external audiences, in particular the Green Metric ranking. The University Sustainability Office actively participates in this ranking and celebrates its rising performance, finding it useful leverage with both internal and external stakeholders. However, it has begun to question some of the underlying assumptions. The criteria for outdoor landscaping were developed for wetter climates, and points for avoiding hard surfaces to allow water infiltration and for forest cover are counterintuitive. Planting trees in what is a desert environment would be highly unsustainable, and areas of palm trees and sustainable desert garden (discussed below) on campus are not scored. This has led to academics in the University architecture department to question the applicability of some assumptions in the ranking.

Sustainability Circles: a notable feature in the way sustainability is taken forward at the University is through Sustainability Circles. The idea is adapted from the business technique, Quality Circles, and also shares common features with Action Learning Sets. A Sustainability Circle is a group who volunteer, coming together with an interest in sustainability. The group meets regularly to identify, analyse and suggest initiatives and solutions to sustainability related issues on campus. The group is normally led by a sustainability track leader and includes people with expertise and those who come without prior experience to the topic. The staff in the Sustainability Office can provide technical assistance in costing proposals and with advocacy to the Governing Board (Alsyouf, 2020). This approach has been adopted by the Sustainability Office to engage the University community of students, staff, and faculty members in its work to develop a culture of sustainability and incorporate sustainability in every aspect of the campus life. The circles have worked to broaden the views that staff and students hold about what sustainability is, for example to include equity and disability. This challenges previous preconceptions which could narrowly define sustainability as just about solar energy.

Quality Function Deployment (QFD) is a tool to help explain the relationship between customer requirements and design requirements. It translates the customers', or in this case students', needs into engineering parameters, while allowing a detailed insight throughout the entire process. This enabled designers to see what features were a priority for students and gain a better understanding of how they might use indoor and outdoor space that is currently not provided. Students were concerned with connectivity, wayfinding and easy access to amenities. They were also concerned with summer comfort, outdoor shaded areas and a mix of areas outside, some of which could be for entertainment, others more private and suited to study individually and in small groups. This was translated into designs to shape the masterplanning of the outdoor spaces, illustrated below in Figure 31. For further information on this approach, see Mushtaha et al. (2022).

Figure 31. Proposed outdoor cubicles from Mushtaha et al. (2022)



Programmes

Curriculum. The Sustainability Office has also taken a DMAIC approach (define, measure, analyse, improve, control) to sustainability. It considered five sustainability aspects (knowledge, behaviour, concern, awareness and attitude) of students and staff. It was selected as the approach because proponents argue it provides a structured and data driven improvement cycle, helping to solve problems by providing a potential road map for solutions. The first phases – defining, measuring and analysing – found that students with little sustainability content in their courses had lower levels of behavioural change and concern, in particular those in communications, arts and business administration (Hamdan et al., 2024). The work to strengthen sustainability in the curriculum was led by the Curriculum Sustainability Circle. It has resulted in the integration of sustainability into three of the compulsory modules all undergraduate students take: 'Islamic Culture', 'UAE Society', and 'Man and Environment'. The committee also prioritised sustainability content in modules that are not compulsory but taken by a large number of students across many degree pathways such as 'Fundamentals of Innovation and Entrepreneurship '. The committee also prioritised sustainability content in modules that are not compulsory but taken by a large number of students across many degree pathways, such as 'Fundamentals of Innovation and Entrepreneurship'. It has also developed a new interdisciplinary elective course on sustainability available for all students from 2024.
The Curriculum Sustainability Circle has also been effective in supporting colleagues develop modules with sustainability content outside of disciplines where it was normally taught. Now the highest number of sustainability modules is in the College of Sharia Religion (before their work, sustainability modules were strongly focused on engineering).

Sustainable garden and greenhouses. The University has introduced a system of composting so students living on campus and catering outlets send vegetable peelings and coffee grounds for onsite composting. These are used in a greenhouse on campus and a sustainable garden. The greenhouse and garden feature in the University's community engagement activities. University staff and students worked to create awareness among city residents about low-cost community gardening on a terrace or balcony of their apartment through social media, workshops and radio channels, encouraging them to develop community gardens. The sustainability garden uses plants that are native and well-adapted to the climate. Gardening is carried out by University staff, students and their families. It also aims for a behaviour change in staff and students, encouraging the use of outdoor space, which is still pleasant to be active in. The garden and greenhouses make use of intelligent technologies to reduce the use of water, fertilisers and energy. For example, an experimental water desalination unit is being installed in the sustainable garden, with technical input from the engineering faculty. The garden equipment is being powered by solar photovoltaics (PV). It is part of a wider programme at the University to create more liveable outdoor spaces.

Institutional narrative

The University is in a period of rapid growth, in contrast to our other case studies, which are generally in a period of consolidation or specific and targeted expansion. This has implications for sustainability in the development of new buildings and equipping teaching and research facilities. Sustainability could be highly impactful if adopted by universities at this stage. There are tensions here, but also an opportunity not to lock the University into environmentally intensive structures and practices.

Sustainability during the early stages at the University in 2014-15 was a fluid idea, and many different narratives featured: costs savings from energy and water bills; the University's reputation in the surrounding community; living labs and conducting sustainability research; showing regional leadership in higher education; and encouraging pro-environmental behaviour change among staff and students. The narrative that has risen to prominence is the one which aligns with wider University and societal objectives for creating future leaders with 21st century skills. Pro-environmental behaviour change is important, and sits within that framing.

There has been an interesting relationship between grassroots initiatives by staff to progress sustainability and strategic policy. Sustainability activity was instigated by academic staff in architecture, environmental engineering and renewable energy. A paper submitted to the Office of the Vice Chancellor led to the formation of a University Sustainability Committee. The Committee carried out studies looking into how the University could address energy consumption, water consumption and more sustainable patterns of transport. This subsequently led to the formation of the sustainability offices and inclusion in the Strategic Plan. Action is once again being driven forward by staff at a grassroots level in Sustainability Circles.

The other noteworthy feature is the prominent role for business approaches in the way the University approaches sustainability. Sustainability actions are approached in terms of their value proposition. Business practices also feature in the way the Sustainability Office organises its operations, using PDCA – plan, do, check, act – and the related DIAMIC – define, measure, analyse, improve, control. Quality Circles and Quality Function Deployment are both taken from Japanese business contexts. It raises questions about how to adapt these models to very different contexts to where they were first developed and effective policy transfer. It would be interesting to explore further how integrity, ethical and civic responsibility in accordance with progressive Arab and Islamic ideals leads to different approaches to those adopted within a Northern European mindset. There are also intriguing possibilities going forward of collaboration between the education institutions in University City (similar to Cardiff Met). Pragmatically, this could be about optimising transport and otherwise being a 'good neighbour' in the city. It also raises the potential for wider collaborations in research, teaching and shared facilities, which could reduce duplication and sustainability impacts.

11 Conclusions

11.1 Institutional journeys towards sustainability

Our research has highlighted how institutions are at very different stages of embedding sustainability. Some have clearly embraced sustainability and positioned it within their institutional mission, informing their teaching and research and using sustainability to enhance student recruitment. However, our literature review, shortlisting and case study selection processes have shown that sustainability is far from a core aim for many universities. While there are many examples of good practice that we could have included in our research, there is a global group of institutions at least an order of magnitude larger than our sample where sustainability actions are piecemeal and underdeveloped. Although we are keen to critically understand good practice and positive outcomes, there is little systematic evidence to explain why so many institutions have not engaged with the whole institution approach. A richer, empirically informed understanding of this would be valuable in addressing the challenges that may be faced, with practical examples of how to overcome them.

From our shortlisting of good practice examples, we noticed many appeared to have 'plateaued' in terms of their progress: we could identify good practice in the last few years, but no convincing evidence that this has moved forwards. This was evident, for example, from plans, strategies and targets that were out of date. We reflected that, in these institutions, there was a lot of sustainability activity taking place in different areas of the university, but that it was lacking the joined-up approach that defines a whole institution approach: progress had gone as far as it could without a more joined-up approach. This raises a question about how momentum to evolve a whole institution approach is maintained, and the factors that act against a positive trajectory. Future research could empirically evidence the impact of different contextual factors (for example, national policy; institutional mission and identity; disciplinary portfolio etc) on how a whole institution approach develops over time.

We also found tentative evidence that universities that had made significant progress in terms of their research also seemed to be having more success with taking a whole institutional approach to sustainability. We are not sure whether this is a correlation or a casual relationship: is it a feature of good governance that universities that can progress their research can also make advances in sustainability? More instrumentally, is it a feature of universities that are focused on league tables and benchmarks, and are putting university resources into moving up both rankings? Or is it a real synergy, where becoming a sustainable institution genuinely leads to advances in research? We saw indications of this in the research growth areas at Cardiff Met and Deakin, and more tentatively at Sharjah.

11.2 The value of the whole institution approach

The concept of the whole institution approach provides a useful framework to explore the extent to which universities are sustainable. Our model was helpful for guiding our research to the main areas of activity, and for structuring our case studies. While our case study interviewees rarely mentioned the phrase 'whole institution approach', we found the phrase helpful for understanding the sort of holistic activities and joined-up thinking that were being undertaken among our case studies. Our literature searches identified a trend towards using the term 'whole institution approach'

instead of ‘sustainable institution’. When we asked interviewees about being a ‘sustainable institution’, few were able to identify directly with this term or relate what it meant in their context. Neither did they volunteer the term ‘whole institution approach’. While it may not be a term widely deployed or used in higher education, we found that, because it draws attention to the breadth of activity that constitutes sustainability, ‘whole institution approach’ was helpful conceptually for our analysis, and we recommend that institutional leaders and sustainability champions explore how it can be deployed in their own contexts.

An overarching finding of our research is that the volume of activity differs widely in each of the five areas of the model of the whole institution approach we used (learning and teaching, research, campus operations, outreach, civic engagement). For example, campus operations were widely cited as a core activity, a pattern which we also observed from our literature review. In contrast, outreach activities were very difficult to evidence; we only found clear evidence of this at Cardiff Met and limited activity at Wageningen. Overall, it was limited in scope. Again, the analysis of the literature was in line with this, with very few articles or reports highlighting sustainability within outreach activities. We found very few examples of community engagement; the only notable example was at Deakin where indigenous communities were engaged in sustainability governance. Much of the sustainability activity we identified was restricted to one or two areas of our model, suggesting that while the whole institution approach is conceptually strong, its practical implications and impact on strategic thinking are limited. The synergies among the areas of sustainability activity in a university (for example, authentic learning experiences that collect data on campus which is used to inform institutional carbon reduction plans) are not widely being exploited to advance a whole institution approach.

While reviewing the term ‘whole institution approach’ we found several articles which advocated expanding the definition of it to include other areas of institutional activity. Such work draws attention to the diverse areas of activity that universities are involved in, and highlights the importance of consistently embedding sustainability into them. This work does not significantly advance theoretical or conceptual perspectives on the whole institution approach. However, we did reflect that two areas of operational activity could be more clearly included in the literature, as they are closely related to some of the practical challenges of the whole institution approach revealed in our analyses.

First, finance: our case studies suggested that procurement processes can guide decision-making towards sustainability considerations, for example by favouring suppliers with good environmental or ethical performance through a competitive scoring system. Effective procurement practices were also used to avoid duplication of specialist scientific equipment and reduce both capital expenditure and carbon footprint.

The second additional activity is in human resources. We found that staff resourcing often constrained opportunities to take sustainability activities, and that training and continuing professional development was needed to support sustainability activities. Our case studies and the literature did not uncover any recruitment strategies or practices that aimed to attract people with interests or experience in sustainability. We were aware of isolated examples in our case studies where individuals with research experience in sustainability were recruited for a specific need. We did not

see any examples that showed sustainability was being embedded into annual appraisals and promotional routes. These processes could be usefully explored in more depth and reviewed with a view to embedding sustainability as a lever to support institutional change and action.

11.3 Sustainability activity in diverse global institutions

The results of our literature search were geographically focused towards Europe: nearly half of authors of the articles were from Europe. China, the United States, Spain, Brazil, Australia and Germany were all prominently represented in the literature. China dominated the literature from South-East Asia, and South Africa dominated the small number of African articles. It is very likely that issues of sustainability are being explored in more diverse contexts than are represented in our shortlist. Similarly, many of the institutions in our shortlist (and those represented in the literature) were 'traditional' institutions: generally large, public universities. There is a plethora of small, highly specialised institutions and many private, for-profit profit providers who may have very different drivers and cultures of embedding sustainability. We did not have the capacity to engage with more case studies that could have broadened our understanding of the whole institution approach in different cultural, political and educational contexts. An empirically driven synthesis of how the whole institution approach is adopted in more diverse geographic and structural settings would be a valuable addition to the literature and should be a priority for future research.

11.4 Sustainability leadership and governance

We found that sustainability was present in, and the subject of, many policies and plans. Universities have taken steps to encode practice in their mission statements and strategic ambitions. However, we also found a strong emphasis on the roles of individuals in achieving outcomes for sustainability. We noted this when recruiting participants with a senior role in teaching and research for our interviews; many initially referred us to the sustainability officer or equivalent role. We had work to do to convince them why we needed their perspective on sustainability. In our interviews, we noted that mid-senior level sustainability managers or champions were widely viewed as central to sustainability initiatives, and the broader institutional success was highly dependent on that individual. Some referred to their role in developing sustainability policy, which they were then charged with delivering, acknowledging how they then used the policy to leverage support and engagement for their work. Some were 'hands on' in their approach to sustainability work, and were seen to be 'doing' sustainability through events, leading initiatives and communicating with other staff. Others facilitated colleagues to come together to discuss and advance sustainability in their own faculties or departments – bringing people together and then helping reflect practice back out again. People in these sustainability roles were known to be critical for progress, and therefore the whole institution approach was vulnerable to staffing changes.

To some extent, the reliance on individuals could potentially be mitigated by restructuring sustainability activities into central teams and investing senior leadership capacity in sustainability. Senior leadership is likely to be most effective when a 'line of sight' can be established between strategic ambition and day to day practices. In practice, this means that senior leaders can trace a commitment to

sustainability through all levels of the institution and across all areas of activity in their institution. Clear hierarchies for reporting sustainability progress and challenges enables informed decision-making and reassurance to governing bodies that sustainability is being addressed effectively.

Effective sustainability governance is already known to be essential to the success of the whole institution approach. Our research suggests a lack of maturity in sustainability governance, as evidenced by the low profile of governance in our literature visualisations and little or modest reference to university governance found in our interviews. Instead, a reliance on the visibility, personal commitment and enthusiasm of individuals in place of strong and effective governance mechanisms emerged. Good sustainability governance should provide a framework for decision-making, decentralised ownership of sustainability initiatives and progress monitoring, independently of the personal qualities of the sustainability manager. Future research could explore how good governance can be developed to promote robust, whole institution approaches to sustainability.

11.5 Students as co-creators of sustainability

A key finding of our work is the lack of engagement with students as partners or co-creation with students in sustainability. Although student partnership and co-creation is widely advocated in higher education, our research found few examples of this happening in the context of sustainability. We identified a handful of isolated examples of students being engaged in activities such as contributing to university sustainability reports, and only found the words ‘co-creation’ and ‘student’ and ‘students as partners’ co-occurring in 1% (24) of articles in our database. They are generally framed as ‘receivers’ of education or ‘users’ of a campus in the literature.

Our reflection is that sustainability is largely being ‘done to’ students rather than being ‘done with’ them. This passive role for students may not be intentional, and with limited time and resources happens by default. Our interviews revealed a mixed picture, and the findings appear at odds with the wider impression in society of young people motivated to take action by the climate crisis. Some of our interviewees argued that while students were looking for universities that had a strong commitment to sustainability and aligned with their values, this did not translate into them putting themselves forward to take action at the university. Others argued that among their students who did take action, the focus was on organisations with a very poor environmental record, not their university. In the few instances where students were proactively engaged on campus, this was on a very specific problem or topic. Students lack a central place in the whole-institution approach, and more work is needed to develop meaningful ways to involve students as partners.

11.6 Sustainability tools and evaluating impact

Tools tended to be used most in campus operations (such as BREEAM; ISO14000). Environmental management tools from industry such as these can be beneficial and influential for universities at an early stage of their sustainability journey. They can be effective for developing sustainable approaches to, for example, campus operations and energy use, before moving on to more complex practices in other areas of activity, such as curriculum. However, we found a lack of sector-wide tools

being used that helped universities embed sustainability into their curricula. Our literature analysis suggests that tools may be developed for internal use by universities to review or enhance their curriculum, but they are not being scaled up to be more broadly relevant across different institutional contexts. Sustainability assessment tools are prompting some action in universities, in part to benchmark themselves against other institutions but also to improve their standing in sustainability league tables. Many institutions were engaging with ranking and awards tools (for example, People and Planet). In several of our case studies, sustainability managers reported positive benefits from these tools, and that they assisted with thoughtful reflection about what actions to take next and how to prioritise. We are aware that the sustainability managers we spoke to are not representative, and their engaged approach may not be how the rankings and awards tools are used in other contexts. The impact of rankings on meaningful sustainability practices were clouded by 'gaming' the scoring metrics to increase their position in the league table.

A key point is that sustainability assessment tools make minimal use of data, with most (especially league tables) tending to use proxy measures. High scores can be achieved by the presence of a report or a target rather than what the target is and independent evidence it has been met. Science-based targets (ie those that frame sustainability around scientifically meaningful objectives such as limiting global temperature rises to 1.5°C) were absent from our literature and interviews. Current tools obscure the absolute impact of a university on the environment (for example, tonnes of CO2 emitted, amount of non-recycled water), which could vary widely between institutions. The use will be influenced by many factors from the size of the university, climate requirements for heating and cooling, or the use of energy intensive research infrastructure. We have not seen any evidence that sustainability assessment tools or benchmarks are steering universities towards the changes needed to align with the Paris Agreement to keep global temperature rise below 1.5°C. While it is difficult to implement science-based targets, it is worth noting that other large and complex knowledge-based organisations do undertake this kind of commitment. Large consultancies (such as Arup, AECOM) have committed to science-based targets and reporting on them. They do not confine this work to their own operations (ie ensuring their own buildings are in line with 1.5°C emissions reductions): more importantly, it applies to professional advice they give to clients, so those projects align with the 1.5°C target. This has common features with universities and their teaching and research, and the need for sustainability assessment tools to move beyond estates to include, for example, student and staff behaviour.

We also reflected that the tools used to assess sustainability do not support meaningful evaluation of sustainability outcomes, particularly those that are not very readily measurable. Some metrics of sustainability can be measured easily, such as water or energy use. However, evaluating behavioural or skills focused metrics is more complex. For example, if an institution wishes to develop pro-environmental behaviour among students, how can this be measured or evidenced to support the development of more effective strategies? The narrative element of England's Teaching Excellence Framework (TEF) may provide some inspiration for developing evaluation frameworks that combine quantitative and qualitative data, and that enable universities to scrutinise and critically reflect on their own context. It would enable the contextual factors that affect sustainability practices (for example, institutional mission and values, disciplinary specialisms, government policy frameworks) to be

included in judgments on sustainability performance. Such approaches could then contribute more towards meaningful evaluation of progress towards strategic ambitions and enable more nuanced benchmarking with other universities.

11.7 Learning from other whole-institution scale thinking

There is potential for universities to model their approach to sustainability on other high-priority, sector-wide issues, such as equity, diversity and inclusion (EDI). A whole institution approach to EDI has been advocated in recognition of the systematic changes required across all aspects of a university's operations (May and Bridger, 2010; Kelly, 2023). For example, it is common practice to see EDI embedded as a key concern in universities, for example in recruitment and promotion criteria, staff training and academic development, research practices and curriculum design. Many institutions have begun to interrogate their histories through the lens of decolonisation, prompting recognition of their roles in promoting colonial practices: these efforts have been in part driven by public demands in recent years. We noted from our Deakin University case study how the experiences of a decolonising project had helped inform approaches to a project to embed sustainability into the curriculum. Universities can learn from whole institution approaches to EDI when thinking about sustainability, for example by reflecting on how they are responding to societal change, how different areas of an institution can be aligned behind shared values, how diverse interpretations and meanings can be accommodated in frameworks and policies, and how resistance to change can be overcome through dialogue and effective leadership.

In the UK, the legal requirement of the Equalities Act 2010 has been a significant driver for action across the higher education sector. This legal imperative has played a significant role in universities' thinking and action on inclusivity, through the Act's direct applicability to universities as both educational institutions and employers (EHRC, 2014). There is no equivalent that drives sustainability action. The UK Climate Change Act (2008) includes a legal target to reduce carbon emissions to net zero by 2050; however the Office for Students (the regulator of UK higher education) does not have the remit or powers to require universities to act in line with this target (OfS, 2020). The impact of regulation on EDI – not least the institutional investments in resources to support data collection, evaluation and impact assessments, and public commitments to address equality of opportunity for all students through Access and Participation Plans – demonstrates how it can drive action. Could sustainability initiatives be advanced by a similarly regulatory and publicly visible framework?

Theories of change models are often used in EDI work, but were notably absent in our literature review and case studies, suggesting future work could explore their value in whole institution approaches to sustainability. We acknowledge that theories of change as an approach has its critics, and we are using it here in the straightforward sense of clearer thinking about why the sustainability intervention you are making will lead to the change you wish to see. We do not wish to suggest that EDI work is in any way perfect, and acknowledge that there is much to be done. We do want to urge universities to learn from their experience through critical reflection, and to identify effective strategies and avoid those with limited traction in their own institutional community.

11.8 Reflections on using Rayyan and VOSviewer for literature reviews

We feel it is worth reflecting on our experiences of using Rayyan and VOSviewer in our literature review analysis, given that they are emergent tools and have the potential to significantly influence how literature reviews are undertaken. There are numerous bibliographic tools being developed that are opening up new approaches and techniques for literature analysis; many of them, like Rayyan and VOSviewer, are freely available. VOSviewer in particular is being used extensively in published articles, and is seemingly at the point of transitioning from specialist bibliometric software into a mainstream analytical tool. We found that both VOSviewer and Rayyan were helpful in handling the large volume of publications on sustainability in higher education. Rayyan enabled us to rapidly screen papers for inclusion and exclusion, and despite us needing to spend more time than we had anticipated on manually reviewing papers, we were impressed with the reliability of the AI model and its ability to detect duplicate papers reliably. It would have been almost impossible to screen our full search results manually, and it is likely that we would inadvertently have introduced bias into this. Therefore, using Rayyan meant we were able to use a broader search strategy and include papers that would have been omitted with a manual include / exclude process, and be reassured that we were minimising researcher bias.

VOSviewer gave us useful insights into the structure of literature relating to sustainable institutions. It was able to highlight ‘clusters’ of keywords that can be interpreted to reflect the underlying themes in the literature. We found these clusters to be helpful insights into current thinking about sustainability and do not think that we could have generated these convincingly through manual reviews of the articles. The co-occurrence results helped us to further nuance our interpretations of the clusters. One particularly interesting reflection here is the value of noting where words are not present because they are not sufficiently frequent (such as ‘governance’) or where co-occurrences are weak where we would expect stronger evidence of research activity (for example, between ‘HEI’/‘higher education institution’ and words associated with the whole institution approach such as ‘estates’, ‘outreach’ and ‘learning’). Combining Rayyan’s highly effective keyword filtering with the data files produced by VOSviewer enabled us to understand the relative prominence of words and the extent of their connections. This, for example, revealed the relatively low prominence of words such as ‘leadership’, ‘vision’ and ‘governance’, highlighting topics that warrant further research. We believe the strength of our approach has been in using these tools appropriately across a large dataset of papers and coupling this with empirical evidence. Bibliometric tools provide useful insights, but it is incumbent on researchers to interpret them and attach meaning to them through empirical research.

Appendix 1: full methods

Systematic literature review

Stage 1 – identifying search terms and literature searches

We began our search by reviewing the keywords and words in the titles of 20 academic journal articles that were highly relevant to the topic. This generated a list of potential search terms which we then refined into a keyword list with search protocols. In collaboration with the steering group, we then finalise the parameters for the search including which databases to search and search terms to be used (including variant spellings and wildcards). The term 'university' or 'universities' is commonly used, but others, including 'higher education', 'tertiary education' and 'campus', are also present in the literature. 'Sustainable' and 'sustainability' are the most commonly used terms, but others, including 'green', 'SDGs', and 'SATs' (sustainability assessment tools), are also found. Looking for articles that engaged in a strategic and integrated way was the most challenging to define. We therefore selected a range of words to be used in combination. The search protocols are shown below in Table 6.

The searches were restricted to the title, abstract and keyword on all three academic databases (Scopus, Greenfile and Education Abstracts). The time limits searched were from January 2016 to December 2022. The types retrieved were restricted to the articles, conference papers, book chapters, reviews [literature reviews]. The language was restricted to English (although some articles also had abstracts in one or more other languages). The results of all the searches were downloaded in RIS file format to be uploaded into Rayyan.

Table 6. Literature search protocols

Single-term search	
“sustainab* Universit*”	[sustainable, sustainability] / [University, universities]
“sustainab* campus”	[sustainable, sustainability]
“sustainab* higher education*”	[sustainable, sustainability]
“green* universit*”	[green, greener, greening]
“green* campus”	[green, greener, greening]
“green* higher education*”	[green, greener, greening]
“Higher education for sustainability”	

Two search terms	
Term A:	AND:
“Higher Education”	“sustainable institution”
“Higher Education”	“sustainability practices”
“Higher Education”	“sustainability assessment tools”
“Higher Education”	“sustainability reporting”
“Higher Education”	“sustainability tracking”
“Higher Education”	“sustainability tools”
“Higher Education”	SATS
“Higher Education”	“Sustainability strategy”
Universit*	“sustainable institution”
Universit*	“sustainability practices”
Universit*	“sustainability assessment tools”
Universit*	“sustainability reporting”
Universit*	“sustainability tracking”
Universit*	“sustainability tools”
Universit*	SATS
Universit*	“Sustainability strategy”

“Tertiary education”	“sustainable institution”
“Tertiary education”	“sustainability practices”
“Tertiary education”	“sustainability assessment tools”
“Tertiary education”	“sustainability reporting”
“Tertiary education”	“sustainability tracking”
“Tertiary education”	“sustainability tools”
“Tertiary education”	SATS
“Tertiary education”	“Sustainability strategy”
Campus	“sustainable institution”
Campus	“sustainability practices”
Campus	“sustainability assessment tools”
Campus	“sustainability reporting”
Campus	“sustainability tracking”
Campus	“sustainability tools”
Campus	SATS
Campus	“Sustainability strategy”
HEI	“sustainable institution”
HEI	“sustainability practices”
HEI	“sustainability assessment tools”
HEI	“sustainability reporting”
HEI	“sustainability tracking”
HEI	“sustainability tools”
HEI	SATS
HEI	“Sustainability strategy”

Three search terms		
	AND	AND
Higher Education	Sustainab*	vision OR strateg* OR “organi?ational change” OR “change management” OR integrat* OR embed OR polic* OR silo* OR governance OR leadership OR barrier*
Higher Education	SDG	
Higher Education	“Sustainable development goals”	
Higher Education	Green*	
Universit*	Sustainab*	
Universit*	SDG	
Universit*	“Sustainable development goals”	
Universit*	Green*	
Tertiary Education	Sustainab*	
Tertiary Education	SDG	
Tertiary Education	“Sustainable development goals”	
Tertiary Education	Green*	
Campus	Sustainab*	
Campus	SDG	
Campus	“Sustainable development goals”	
Campus	Green*	
HEI	Sustainab*	
HEI	SDG	
HEI	“Sustainable development goals”	
HEI	Green*	

For the grey literature we searched using two databases: Policy Commons and Overton, and on the Advance HE knowledge base. Policy Commons makes searchable reports produced by NGOs, thinktanks and other policy stakeholders – currently over 24,000 organisations share their reports on the repository. Policy Commons has over three million documents with strong international representation. Overton similarly allows searches on over nine million policy documents from 29,000 organisations. We used the same terms as for the academic review, but it was not possible to restrict so precisely to title, abstract and keywords as in the academic articles. This generated a much smaller number of 36 reports. Neither database allowed the export of search results as RIS files, which had to be manually created in reference management software (for example, Zotero, EndNote).

Stage 2 – systematic review

The RIS files generated from the searches in Scopus, Greenfile and Education Abstracts were then uploaded to Rayyan. Rayyan software uses a combination of artificial intelligence (AI), machine learning and natural language processing to improve systematic literature reviews.

Firstly, Rayyan assisted with data cleaning – the removal of duplicate articles can be automated using Rayyan. Where the same article is identified through matching database fields (such as title, journal, volume, pages, etc), then Rayyan removes the duplicate entry. The software identified 3,489 duplicates and deleted the 100% matches automatically. Where there is uncertainty about whether an article is a duplicate, Rayyan will flag the article as a 'possible duplicate' for manual review, together with a percentage similarity. In this study, we removed those above 95% similarity without further review as samples showed them to be fully matching duplicates. The items below 95% were resolved individually by comparing the duplicate entries. This process was also very accurate and only 14 items were not duplicates. Rayyan also assisted with the removal of items included in error by the search process, despite being outside the date range or not in English (for example, from inaccurate information being produced from the literature databases).

The ambiguity in both terms created significant challenges for Rayyan. The term 'sustainable' can be used to refer to something continuing (eg 'course recruitment being sustainable') and to a university being in a secure situation with its budget ('financially sustainable'). We also found cases of 'sustainable' and 'SDGs' being included in the keywords in an apparent attempt to boost the article, despite no clear relevance to the article. Our searches also picked up articles about university researchers conducting sustainability-related research on highly specific topics, unrelated to the campus or any strategic discussion about research priorities. Similarly, the majority of the research was conducted by researchers in one or more named universities. This meant 'universities' frequently occurred in abstracts that were unrelated to the topic at hand. Given the ambiguities in both our main search categories ('sustainability' and 'higher education'), a large sample of the data seemed necessary for the AI function to be effective. We manually reviewed 20% of the data to train the AI model on what we classed as articles for 'inclusion' or 'exclusion', before instigating the AI component. The decisions to include and exclude this 20% were made by looking at the full title and abstract parts of the records – a time consuming process.

We then ran the 'compute ratings' process, which gives each article a star rating based on its likely chance of being included, based on those which have already been included and excluded (the training process). This was reasonably successful in identifying irrelevant material in its lowest ratings – in particular, those about sustainability research topics such as hydrology or soils.

This part of the cleaning process concentrated on removal of the unwanted material from the lowest ratings upwards. Those with the lowest rankings of 0.5 stars and 1.5 stars could be quickly removed by scanning through the titles. Any with potentially interesting titles were opened and the abstract viewed. Only one in 20 were found to be relevant. At the upper end of the search, those with 3.5 stars (860) and 4.5 stars (540) were almost entirely of relevance – with only one in 20 excluded during review. This still left a large number – over 5,000 – 2.5 star articles remaining. Manually reviewing these, we found about one in three was relevant. This process also refined the AI model further. We ran the compute rating process again, and this generated some more 0.5, 1.5 and 3.5 and 4.5 articles which could be scanned more quickly and included or excluded. We were also getting a clear picture by this point of common themes in those papers that we wished to exclude. We therefore put in terms including 'financial sustainability', 'programme sustainability', 'covid-19', 'school', and 'hospital'. We did not exclude all the articles that had these terms – a small number of those which had 'covid-19' in were relevant, and 'school' can be an academic unit used in a university context. But this approach did enable us to more quickly screen out significant numbers of irrelevant articles. Our search was picking up other uses of the term 'campus', which is also used in healthcare, and school-age education. We also found a significant number of articles in this 2.5 category where researchers had used their students (and sometimes colleagues) expediently as a data sample in a way that was unrelated to any improvement of activities at the university.

Our reflections on using Rayyan were that it greatly increased the speed and accuracy of the process, and its ability to predict which articles to accept or exclude in this complex field was impressive. The difficulties came from both key terms, 'university' and 'sustainability' being used ambiguously in the articles, leaving a large volume for manual review. By the end of the process we refined our search to 2,504 articles, which were then ready for analysis.

Stage 3 – data visualisation in VOSviewer

To produce the visualisations, we uploaded the CSV file output from Rayyan and selected the abstract field (the other options are to look at the title or title and abstract combined). There is a setting at this point to ignore abstract labels and copyright declarations, which we left on. VOSviewer then extracts the abstract text from the CSV file. We then selected full counting, which records each time a term appears in the abstract. For example, if the term 'sustainability' occurs three times in a single abstract, it will add three. We then selected the largest terms that occurred 50 or more times to produce a visualisation. This began to show interesting themes, but also had irrelevant material that reduced the clarity of the analysis.

We next created a dictionary to remove and merge terms that were reducing the clarity of the findings. The purple cluster on the bottom right – 'user', 'copyright', 'abstract', 'journal' – were all 'housekeeping' terms that had been missed by the VOSviewer automatic cleaning process. They were all removed. There were also American and UK English spelling variants, abbreviations and full text, and singular and plural terms (for example, we merged the counts for 'HEI', 'HEIs' and 'Higher Education Institutions'). We also removed obvious methodological terms that related to how the research had been carried out, for example 'questionnaire', 'survey', 'originality value'. We removed any reference to specific countries. We also took the more subjective decision to remove words that are common parts of sentences but do not have a particular meaning in this context (for example, 'type', 'way', 'part', 'point'). We also took a decision to remove 'university' – the whole research is about universities, so we want to see how these terms relate to each other without a large cluster around the term 'university' dominating the analysis. In total we removed 112 terms at this stage. We are also aware that some terms we left in will be overrepresented because they are used in several different ways in the abstracts. Researchers will be discussing the sustainability of research in universities, but they will also be talking about what their own research article shows. We took the decision to keep the term 'research' included, and were reassured that most of the articles were talking about research in higher education and its sustainability, due to its central position as a term, and distance from the other purple 'housekeeping' terms we removed. We did not make any adjustments to the VOSviewer algorithm to change the number of clusters, leaving this at the default setting of 1.0.

We then re-entered the CSV file and uploaded the dictionary file we created which removes and amends terms as we have described above. This gave us a visualisation to use in our analysis. Once the visualisation is produced, settings can be amended to change the font size of the terms, zoom in on particular parts of the visualisation, or highlight terms to see how strongly they connect to others. At this point, line variation can be used to bring out only very strong connections, strong and moderate connections, and all connections. Including all connections where there is a co-occurrence of terms in a dataset of this size leads to a cluttered presentation that obscures rather than illuminates key points.

We then re-ran the analysis on the abstracts of the 34 policy reports. This sample size is at the lower end of the scale of data that can be meaningfully analysed in VOSviewer. We include it for comparison, as it shows distinct themes from the academic papers.

Stakeholder engagement

Project page and blog

At the start of the research, we created a project page and blog on the Advance HE website. This was shared through Advance HE communications to members and social media. On the page was a feedback form where members could share their thoughts. We were looking for examples of universities that were doing exemplary sustainability work, and far advanced in their journey towards becoming a sustainable institution. We sought Advance HE members' views, to try to capture examples which had not been widely published and written about. Many professional staff in

universities are so busy doing sustainability work, they have limited time to write it up for any form of publication in either the grey or academic literature. The call for examples of good practice and link to the feedback form was also shared at Advance HE member events in the Republic of Ireland, Scotland and the Middle East in March (with a QR code to take participants directly to the form).

#LTHE Tweetchat
On 29 March 2023 we ran the #LTHE Chat live on Twitter. A week in advance we prepared a blog to stimulate discussion. We followed the format of the event where six questions are asked over the course of an hour. Both authors posted, replying to questions about the research and stimulating the discussion in positive directions. We took a teaching-focused angle to the blog and discussion questions.

+ How are you engaging your students in the sustainability agenda?
+ How is the rest of the university (eg research, finance, estates etc) addressing the sustainability agenda?
+ What is the most inspiring example of encouraging sustainability you are aware of in higher education?
+ Where should universities be in 10 years' time on sustainability?
+ What are the obstacles to getting there? What tools or methods can we use to overcome them?
+ Some universities have made good progress towards being a sustainable institution. What three things would you most like to know about how they have achieved this?

The blog we shared to prompt discussion can be found at:

www.advance-he.ac.uk/news-and-views/serious-about-sustainability

The #LTHEChat had 150 posts; the Wakelet summarising it can be found at:

https://wakelet.com/wake/aJUssPiThXYqx6YFIHyzJ

Conferences and workshops

On the 30 March 2023 we gave a workshop at the online Advance HE Sustainability Symposium 2023: 'Top-down or bottom-up? How do we ensure all our graduates become sustainable citizens?'. Our workshop responded to the overall conference themes, facilitating a discussion about how grassroots initiatives for sustainability connect with university strategy.

The stakeholder suggestions for universities in the UK and mainland Europe fed into our longlisting process. Those we selected – Falmouth, Cardiff Met and Wageningen – all featured prominently in both the literature and member suggestions. Sharjah featured prominently in the suggestions, was prominent as a rising star in league tables, but had little presence in the literature. We found member engagement especially helpful in sourcing suggestions outside Europe.

Towards the end of the project we re-engaged with members about our initial findings. We undertook three opportunities in June and early July to share these with the Advance HE community:

+ On 6 June 2023 the project was presented at a workshop as part of the Advance HE collaborative project Aligning Organisational Strategy to the UN SDGs. The workshop participants were senior leaders in a range of key institutional roles (eg sustainability, learning and teaching, estates). Feedback from attendees was sought on draft findings from our case study analysis. The comments encouraged us to reflect more on institutional structures, in particular, how the impact of sustainability measures are evidenced and where sustainability appears within the curriculum.
+ On 20 June 2023 we presented our interim findings and sought feedback in an hour-long interactive workshop. Participants were invited who were currently taking part or who had recently completed sustainability related projects in collaboration with Advance HE. We also identified from our literature search individuals who had recently written about strategy, policy, sustainable institutions and a whole institution approach. From 40 invitations, we facilitated discussions with 25 participants using the virtual whiteboard Jamboard. We asked them about their definition of a sustainable institution; the role of strategy in a university to drive sustainability. We then sought feedback on two of our more surprising findings – the role of league tables and the role of rankings. One of the key pieces of feedback we received was the importance of the literature before 2016. Our brief was to review the most recent literature; however, we have included reference to how the key terms emerged in our definitions, with reference to this earlier work.
+ On 4 July 2023 we presented our findings at the Advance HE Learning and Teaching Conference at Keele University in a 40-minute workshop. Our discussions covered a wide range of topics, including top-down vs bottom-up approaches; workload pressures and models; impact and measurement; resourcing; the importance of place; and the risks of greenwashing.

Appendix 2: longlist for case study selection

Name	weblink	Size (FTE)	Country	Type	Reason for shortlisting
Arizona State University	https://cfo.asu.edu/measurement-and-reporting	55K	USA	Large, research and teaching, multidisc, public	From lit review and survey: resilience and collaboration framing. Consistently scores in first or second place in US sustainability scoring table. On campus – LEED buildings and renewable energy at scale; lots of applied research to address environmental issues in the state including water crisis. Student volunteering and eco-reps programme.
Bournemouth University	www.bournemouth.ac.uk/about/sustainability	17K	UK	public, teaching and research, public	From LTHE Chat and survey: worked framed by climate and ecological crisis action plan – organised around SDGs. A lot of action on campus with green buildings – BREEAM, energy management etc. Interesting use of tools – standard environmental management but also ISO50001; very strong public outreach and engagement around sustainability with NGOs, local businesses. Workshops for students about climate change – you and CO2. Embedding sustainability in all courses for 2023.
Cardiff Metropolitan University	www.cardiffmet.ac.uk/about/sustainability/Pages/default.aspx	10K	UK	Medium, teaching and research	Survey and winner 2023 People and planet table. Framing the Welsh context – Wellbeing and future generations act. Sustainability strategy organised around three themes – organising, empowering and delivering sustainability. Strong student engagement – students involved with environmental management systems, student induction involves sustainability. Repair café, refill stations. Lots of opportunities for students to develop skills. Very people focused.

Deakin University	www.deakin.edu.au/about-deakin/vision-and-values/sustainability	60k	Australia	Large, teaching and research, public	From lit review. Carbon neutral ambition by 2025. Significant research activity in carbon reduction engineering (eg solar power for transport, hydrogen buses, renewal energy microgrid). Very helpful paper on whole institutional approach. Strong evidence of living labs approach being well developed and significant use of campus environment for teaching eg stormwater ponds. Sustainability a core value. Recognition for climate education for executives.
Falmouth University	www.falmouth.ac.uk/sustainability	7K	UK	Small, liberal arts, public, teaching and research	From survey: sustainability policy organised across three key themes: Learning & Teaching, Environment & Operations and People & Behaviours. Sustainability learning Outcomes (SLOs). Falmouth Curriculum Ladder for Sustainability (FCL-S) is the tool we'll be using to embed climate education and broader sustainability themes across the entire curriculum. Following an extensive piece of climate education research, we've identified nine key sustainability themes and principles to incorporate into our teaching. Collaborations with charities to help students and staff monitor own carbon footprint and address eco-anxiety. Some novel ideas.
Goucher College	www.goucher.edu/environmental-sustainability/	2K	USA	Small, teaching focused, Liberal arts, private	From LTHE Chat: core curriculum focused on solving complex problems, including social and environmental injustices; and in curriculum skills you learn and effect positive change through our Community-Based Learning Program. Solar PV installation on campus

Keele University	www.keele.ac.uk/about/sustainability/	10K	UK	Medium, research and teaching, multidisc, public	From lit review and survey: nexus approach which views the university as a small community, as well as contributing to global sustainability through their education, research and the operation of their own estate. Estate as a Living Lab – at scale energy demonstrator of energy generation, distribution, storage, forecasting and energy balancing intelligently carried out across different energy sources. Embedding sustainability in curriculum from 2016.
Lafayette College	https://sustainability.lafayette.edu/	3K	USA	Small, teaching focused, Liberal arts, private	From lit review: strategic action plan for University 2.0 to address climate change. Greening Lafayette programme to create an ethos of sustainability among students and staff; focus on organisational capacity and sustainability of the activity; physical campus measures including LEED buildings, renewable energy, and on-campus farm. National recognition for work on sustainable food – for students and with community; Partnerships between students and community groups focused on environmental justice.
Leuphana Universitat Luneburg	www.leuphana.de/en/university/history/sustainable.html	9K	Germany	Medium, Teaching and research sciences and liberal arts	From lit review: structured through the Senate Commission on Sustainability – developed strategy. Teaching, all students take the module Responsible Action, which focuses on the topic of sustainability. Post grad teaching and research in sustainability in law, management, psychology as well as sciences. Lots of activity to traffic calm campus and promote cycling; good all round sustainability performance addressing waste, fair trade, recycling.

Lincoln University	www.lincoln.ac.uk/abouttheuniversity/sustainability/	16K	UK	Medium, teaching and research, multidisc, public	From LTHE Chat: framed around three Cs Sustainable Campus; Sustainable Culture; and Collaboration for Change. Biodiversity action on campus and living walls in new buildings. Research centre for ecological justice.
Lund University	www.sustainability.lu.se/sustainability-lund-university	29K	Sweden	Large, research intensive, multidisc public	From lit review: activities nested within Contemplative Sustainable Futures Program – experimental learning lab, professional knowledge network, and more integrated sustainability research; in teaching, students involved in co-creation of learning related to sustainability.
Maastricht University	www.maastrichtuniversity.nl/about-um/sustainability	22K	Netherlands	Large, research focused, multidisc, public	From lit review integrate sustainability in the DNA of the entire organisation by 2030. Strong use of SDGs in teaching and research. Funding reallocation to support initiative – sustainability grant for module and course development; sustainability seed funding to promote interdisciplinary research. Physical space, sustainability hub to promote collaborations.
Manchester Metropolitan University	www.mmu.ac.uk/sustainability	40K	UK	Large, teaching and research, multidisc, public	From lit review and survey. Responsible Futures Programme to embed sustainability in the curriculum, close working with student union; other teaching initiatives through the Centre for Learning and Teaching support informal, non-formal and formal aspects of Education for Sustainable Development; including ecological arts for 'capable futures'. Carbon literacy for staff and students. In top three of People and Planet every year since 2013.

National Pingtung University of Science and Technology	https://sustainability.npust.edu.tw/en/sdgs-analysis/sdgs-seminar/	9K	Taiwan	Medium teaching and research multidisc, public	From lit review. Ranked No.1 in Taiwan as well as the third place in Asia according to the GreenMetric World University Ranking. Big focus on university as an outdoor classroom. Set in a National Park; has Rescue Center for Endangered Wild Animals on campus; improve on-campus biodiversity; solar energy and biomass energy using organic waste, grass cuttings etc. Rural location pushes up transport emissions- addressed through electric buses and bike hires.
Newcastle University	www.ncl.ac.uk/sustainability/	27K	UK	Large, research focused multidisc	Survey and ranked 2022 Times Higher table. Strong climate change focus – through action plan. A lot of work on the estate – environmental and energy management systems including ISO50001. Green energy including solar PV, CHP, heat network, BREEAM certification for buildings. Teaching under 'one planet' umbrella. One planet programme for PhD training; writer in residence.
Nottingham Trent	www.ntu.ac.uk/about-us/strategy/sustainability	35K	UK	Large, teaching and research, multidisc	From survey: sustainability in the strategic plan. Separate Carbon management Group. Works in partnership with Uni. Notts through climate action panel. Staff and Student Ambassadors. Sustainability Employability Award; cross institutional modules (Sustainability in Practice). Works with local SMEs to explore carbon footprints. Has green awards app like Oxford for logging green activities and getting prize / recognition through points
Politecnico di Torino	www.polito.it/en/polito/sustainable-campus	35K	Italy	Large, research intensive, technical	From lit review: strategic plan for sustainability including partnerships, funding and teaching. Teaching uses SDGs, and students work on live projects with city/region & interdisciplinary learning. Green business incubator.

RMIT University	www.rmit.edu.au/about/our-values/sustainability	95K	Australia	Large, research and teaching, public but large endowments	From lit review. Strong climate change framing – carbon neutral by 2030. Sustainability committee sitting within VCs office Lots of on campus activity – green rated buildings, retail guide for products on sale on campus, bike hubs, hydration stations (min bottled water) and lots of other water actions; green events guide; engagement programme through ambassadors and green impact; climate adaptation for extreme weather; SDGs embedded in curriculum, module in staff development; interesting use of tools including GRI reporting – good 'all rounder'.
Sharjah University	www.sharjah.ac.ae/en/Administration/Sustainability/sc/Pages/scc.aspx	18K	UAE	Large, multidisciplinary, teaching focused with some research, private	First university in the Arab World to earn a Sustainability Tracking, Assessment and Rating System (STARS) Gold ranking, Sustainability learning circles approach, moved beyond energy-estates focus from 2018. Educating future sustainability leaders.
Swansea	www.swansea.ac.uk/sustainability/	20K	UK	Large, teaching and research, multidisc, public	From LTHE Chat: strategy focuses on four main themes: The Climate Emergency, Our Natural Environment, Our Working Environment and Our Travel. On campus, solar research and active (energy positive) buildings; strong energy management systems and district heating system; physical work on estates linked to behaviour change programmes. Outreach and engagement with schools; reduce the impact of scientific labs and get them zero carbon.

Tsinghua University	https://link.springer.com/article/10.1007/s12564-022-09797-y	50K	China	Large, research focused, multidisc, public	From lit review and survey: Framing: Making the sustainable university is a central entrepreneurial endeavour of our age. Teaching. Centre for Student Global Competence Development in 2018 as a nexus to develop an extensive network of courses, co-curricular and extracurricular activities by mobilising and coordinating resources across the University and beyond. This Centre has prioritised intercultural, interdisciplinary, and sustainability competencies; certificate programmes open to all students to promote interdisciplinary studies which focus on national priorities and global challenges – latest is the Certificate in Carbon Neutrality. Strong record of interdisciplinary research into sustainability, resulted in may spin out companies in green technologies. Thinktank role supporting government policy.
Universitat Politècnica de Catalunya	https://is.upc.edu/en	30K	Spain/ Catalunya	Large, research intensive, technical	From lit review: Embedding SDGs in curriculum; linking teaching, estates and research to green the campus. Net zero energy buildings and living walls; trials of sustainable mobile learning; university teaching links to tourism sector and sustainability needs of professionals.
University Catholique Lille	www.lavie.fr/actualite/ecologie/biennale-de-la-catho-de-lille-ecoposs-est-un-element-de-reponse-a-lecoanxiete-des-etudiants-85031.php	37K	France	Large, research and teaching, multidisc, private	Survey. Strategic involving teaching, research and service to society. Strong emphasis on climate change – some funding from Paris agreement sources, pressure from students via ‘Grenoble agreement’ which was a student driven initiative later adopted by universities. Strong student engagement and the need to empower students to address eco-anxiety – five-day event involving workshops, talks, creative interventions. Some issues accessing plans and documents. interventions. Some issues accessing plans and documents.

University College Cork	www.ucc.ie/en/greencampus/	20K	UK	Large, research and teaching, public, multidisc	From survey and Green Gown. Framed around green campus programme. University's Saver Saves Scheme for energy reductions, the development of an SDG teaching toolkit, badges to link students formal curriculum learning to SDGs, the establishment of a Green Campus Living Laboratory Programme, the decision to rewild most of the green space on campus and student climate assemblies. Also strengths in energy management ISO50001.
University of Bristol	www.bristol.ac.uk/sustainability/	31K	UK	Large, research intensive, multidisc public	From lit review: In teaching – Bristol Futures, a challenge based module open to all students, uses innovative teaching multimedia platforms, blended learning and flipped classrooms. Also a large scale project to re-vision student volunteering to mobilise more students and community partners. University sustainability governance linked to wider Bristol Green Capital initiative; SDGs important and underwent process of 'translation' to localise them.
University of British Columbia	https://sustain.ubc.ca/	70K	Canada	Large, research intensive, multidisc	From lit review + survey: Strategic approach, work all nested within 'University Sustainability Initiative': student sustainability council; sustainability ambassadors; living lab (SEEDS); green scholars' programme -collaborations between University and City.
University of Campinas	https://campus-sustentavel.unicamp.br/en/about-campus-sustentavel/	31K	Brazil	Large, research intensive, multidisc public	From lit review: Sustainable campus project, electric buses, local solar generation, electrical efficiency improvement, governance and education; Living lab project with utility company.

University of Nottingham	www.nottingham.ac.uk/sustainability/	37K	UK	Large, research intensive, multidisc public	From lit review: Sustainability teaching to change student behaviours; Partnership between business school and SMEs where students help companies reduce carbon footprint; sustainability future proofing degrees with employer and alumni input; Sustainability MOOC; use of Green Metric sustainability tool for campus/estate.
University of Plymouth	www.plymouth.ac.uk/students-and-family/sustainability	18K	UK	Large, research and teaching, multidisc, public	From lit review and survey: integrated approach that encompasses teaching and learning, research, and campus and operations. Sustainability hub- physical, collaborative space to bring together research, teaching and partnerships. Centre for Sustainable Futures works to embed sustainability into the curriculum across educational courses, focus on carbon literacy for staff and students.
University of the West of England	www.uwe.ac.uk/about/values-vision-strategy/sustainability	36K	UK	Large, teaching and research, multidisc, public	From lit review and survey: pilot university for of NUS Responsible Futures certification scheme. Also a large scale project to re-vision student volunteering to mobilise more students and community partners. Green Team where students support pro-environmental behaviour among peers; Integrate sustainability into ICT and computing.

University of Tuebingen	https://uni-tuebingen.de/en/university/profile/values-and-visions/sustainable-development/governance/competence-center-for-sustainable-development/	27K	Germany	Large, research intensive, multidisc, public	From lit review: pilot university in government research programme (BMBF) to address what culture of sustainability at universities might look like and how it can be promoted. Curriculum change so that by 2030 all students acquire the knowledge and skills necessary to promote sustainable development; Education for SD integrated into lecturer training. Lots of on campus activity with green energy; use of art and culture to promote behaviour change.
University of Utah	https://sustainability.utah.edu/	32K	USA	Large, research intensive, multidisc, public	From literature review: Pan-campus Sustainability Office coordinates and promote all activities. Introduction of interdisciplinary sustainability certificates at the undergraduate and graduate; levels systems thinking assessment tool to advance sustainability and equity in teaching; Large-scale research project to look pro-environmental attitudes among students and implications for estates and curriculum; Hydrotopia interdisciplinary module partners with NGOs and city government; solar and geothermal energy on campus.
Wageningen University	www.wur.nl/en/sustainability.htm	12K	Netherlands	Medium, research technical, public	Survey and winner of GreenMetric. Very ambitious on campus sustainability windmill turbines, thermal storage on campus and solar panels. 109% of the energy consumed was generated using sustainable methods. Sustainable procurement, on campus catering. Change in teaching traditional science disciplines to focus on nature-based solutions 'Wageningen Approach'. SDG mapping and integration into teaching. Also uses GRI tool. Strong all rounder.

Western Sydney	https://westernsydney.edu.au/sustainable-development	48K	Australia	Large, research and teaching, multidisc, public	Survey and winner of 2022 Times Higher. Framed in terms of SDGs, just transition, and climate resilience. Resilience linked to new transdisciplinary minors that embrace indigenous knowledge. Introducing other C21 sustainability minors in Climate Justice, Water for Life, Urban Evolution, Global Sustainability, Equitable Technologies, Eco-Socially Conscious Design. Clear strategic approach through CORE (Curriculum, Operations, Research and Engagement). Research and engagement in local and regional climate impacts – bush fires and flooding.
Wharton	https://esg.wharton.upenn.edu/	5K	USA	Small, research and teaching, business-focused	Survey. Unusual framing using ESG. Research centres on business ethics, climate change and impact investing. Strong youth/ school outreach programme. Not clear if there is sustainability on all mainstream business programmes??
Wingate University	www.wingate.edu/life-at-wingate/common-good	4K	USA	Small, teaching focused, health and other professional private	From lit review – approach framed Collaborative for the Common Good - participatory process and emphasis that we do not do “to” or “for” but “with” others. Hub on campus where students, faculty, and staff, as well as community members, develop their ideas for innovation (eg products, services, systems, programmes, events) and entrepreneurial attitudes and skills. Ecological literacy core to all programmes.
York	www.york.ac.uk/about/sustainability/	19K	UK	Large, research focused, multidisc	From survey: activity across campus, teaching, research, community boxes etc but integration less clear. Relates sustainability to the founding principles of the university. 100% fossil fuel divestment. Students can be green impact auditors – trained and work with the green impact team.

Appendix 3: case study interview questions

+ Please can you tell me a bit about your role and how long you've been working at XX University.
+ Why do you think it is important that your university acts on sustainability?
+ Can you describe and explain how your university moved from standalone sustainability initiatives, to a more strategic and integrated approach.
+ Can you say a bit about the main internal drivers to take action on sustainability? (prompt for students and staff if not mentioned)
+ And what about the external drivers (prompt for government education funding, research funders, community stakeholders)
+ Is your university experiencing the impacts of the climate and ecological crises already? (prompt for how and what, is your sustainability activity connected to organisational resilience?)
+ In this research project, we are using the term 'sustainable institution' – we are curious what that term means to you?
+ Is your university a member of any networks that you find useful informing your sustainability work (prompt with EAUC or AASHE if they are not sure what this means)
+ Does your university benchmark its sustainability progress against others?
+ How have you used sustainability assessment tools (SATS) to help you? (prompts: reflections on tools, how useful they are, are they reporting and measuring or driving change)
+ How is sustainability framed in your University's organisational vision? (prompt on SDGs if not mentioned, prompt on any non-western forms of knowledge)
+ How is sustainability implemented through the organisational strategy?
+ How did you achieve alignment between your university's organisational vision, values and strategy?
+ How was the university community – students, teaching staff, professional staff involved in creating the vision and strategy? (Prompt on how top down and bottom up activities meet, note potential overlap with q4)
+ What do you think the main challenges are to taking a strategic and holistic approach to sustainability? (prompt, some universities have met a 'glass ceiling' they have got so far with their sustainability and struggle to take it to the next level, something we saw in those we looked into short listing, reflections on how to maintain momentum? As well as bringing in new practices that are sustainable, what are your experiences of stopping unsustainable practices – if not sure prompt – research that supports fossil fuel industry, investments in fossil fuels)

+ Role-specific questions:
  - How does research at the university contribute to the strategic approach to sustainability? (prompt for practices that reduce environmental impacts of research, mapped against SDGs)
  - How does teaching at your university relate to the strategic approach to sustainability? (prompt for embedding across programmes, how they did that, any tools they used?)
  - How do the civic engagement activities by your University relate to the strategic approach to sustainability (prompt for links to teaching and research, green skills gaps in their locality)?
  - How does the work by your university on outreach and widening participation relate to the strategic approach to sustainability?
+ How does the work of the estates team connect with the strategic approach to sustainability (prompt for links to research, teaching, civic engagement, widening participation).
+ What are the main pieces of advice you would give to other universities who are at an earlier stage in embedding sustainability into their institution?

12 References

Aboelnagah, H. & Metwally, W. Collaborative learning in practice; enhancing students' involvement in sustainability and 2030 transformational plan: PSU go green campaign as an example. Proceedings of the International Conference on Industrial Engineering and Operations Management, 2019. 219-229.

Abubakar, I. R., Al-Shihri, F. S. & Ahmed, S. M. 2016. Students' assessment of campus sustainability at the University of Dammam, Saudi Arabia. *Sustainability (Switzerland),* 8, 59.

Alsyouf, I. Sustainability Circles: the way to Sustainbility Excellence in Institutions of Higher Education. Advances in Science and Engineering Technology International Conferences (ASET), 2020. 1-6.

Amaral, L. P., Martins, N. & Gouveia, J. B. 2015. Quest for a sustainable university: a review. *International Journal of Sustainability in Higher Education,* 16, 155-172.

APM. 2023. *What is project management?* [Online]. Available: www.apm.org.uk/resources/what-is-project-management/what-is-programme-management/ [Accessed 28/10/23].

Appleton, E. 2017. Next Generation Sustainability Strategy and Structure: Whole-institution approaches to sustainability in universities and colleges. EAUC.

Bauer, M., Niedlich, S., Rieckmann, M., Bormann, I. & Jaeger, L. 2020. Interdependencies of culture and functions of sustainability governance at higher education institutions. *Sustainability (Switzerland),* 12, 2780.

Bauer, M., Rieckmann, M., Bormann, I., Kummer, B. & Niedlich, S. 2018. Sustainability Governance at Universities: Using a Governance Equalizer as a Research Heuristic. *Higher Education Policy,* 31, 491-511.

Bessant, S. E. F., Robinson, Z. P. & Ormerod, R. M. 2015. Neoliberalism, new public management and the sustainable development agenda of higher education: history, contradictions and synergies. *Environmental Education Research,* 21, 417-432.

Block, M., Braßler, M., Orth, V., Riecke, M., Lopez, J. M. R., Perino, G., Tan, W. H. & Lamparter, M. 2016. Dies Oecologicus—How to Foster a Whole Institutional Change with a Student-Led Project as Tipping Point for Sustainable Development at Universities. In: FILHO, W. L. & PACE, P. (eds.) *Teaching Education for Sustainable Development at University Level.* Cham.

Boell, S. K. & Cecez-Kecmanovic, D. 2015. On being 'systematic' in literature reviews. *Formulating Research Methods for Information Systems: Volume 2,* 48-78.

Buckler, C. & Creech, H. 2014. *Shaping the future we want: UN Decade of Education for Sustainable Development.,* UNESCO.

Burbridge, M. 2017. If Living Labs are the Answer - What's the Question? A Review of the Literature. *Procedia Engineering,* 180, 1725-1732.

Caeiro, S., Hamón, L. A. S., Martins, R. & Aldaz, C. E. B. 2020. Sustainability assessment and benchmarking in higher education institutions-a critical reflection. *Sustainability (Switzerland),* 12, 543.

Cebrián, G., Grace, M. & Humphris, D. 2015. Academic staff engagement in education for sustainable development. *Journal of Cleaner Production,* 106, 79-86.

Congreve, C. & Cross, I. D. 2021. *Responding to climate change in teaching* [Online]. Available: https://wonkhe.com/blogs/responding-to-climate-change-in-teaching/ [Accessed 7/10/23 2023].

Cortese, A. D. 2003. The critical role of higher education in creating a sustainable future. *Planning for higher education,* 31, 15-22.

Cownie, F. 2021. *Could universities be guilty of "greenwashing"?* [Online]. Available: https://wonkhe.com/blogs/could-universities-be-guilty-of-greenwashing/ [Accessed 4/8/23 2023].

Cross, I. D. & Congreve, A. 2021. Teaching (super) wicked problems: authentic learning about climate change. *Journal of Geography in Higher Education,* 45, 491-516.

Díaz-Iso, A., Eizaguirre, A. & García-Olalla, A. 2019. Extracurricular activities in higher education and the promotion of reflective learning for sustainability. *Sustainability (Switzerland),* 11, 4521.

dos Reis, A. H. S., de Oliveira, A. L. M., Fritsch, C., Zouch, J., Ferreira, P. & Polese, J. C. 2023. Usefulness of machine learning softwares to screen titles of systematic reviews: a methodological study. *Systematic Reviews,* 12, 68.

Drobinski, S. 2019. *Understanding policy success and failure in contemporary English higher education: a study of three policy episodes.* PhD, University of Sheffield.

Dyball, M. C., Wang, A. F. & Wright, S. 2015. (Dis)Engaging with Sustainability: Evidence from an Australian Business Faculty. *Accounting, Auditing & Accountability Journal,* 28, 69-101.

EHRC 2014. What equality law means for you as an education provider - further and higher education. Equality and Human Rights Commission.

Erlandsson, L., Molthan-Hill, P., Arntsen, A. & Smith, A. 2017. Combating climate change through the estate and curriculum – A whole-institution commitment at Nottingham Trent University. *Higher Education Institutions in a Global Warming World: The Transition of Higher Education Institutions to a Low Carbon Economy.* River Publishers.

Fia, M., Ghasemzadeh, K. & Paletta, A. 2022. How Higher Education Institutions Walk Their Talk on the 2030 Agenda: A Systematic Literature Review. *Higher Education Policy,* 36, 599-632.

Fischer, D., Jenssen, S. & Tappeser, V. 2015. Getting an empirical hold of the sustainable university: a comparative analysis of evaluation frameworks across 12 contemporary sustainability assessment tools. *Assessment & Evaluation in Higher Education,* 40, 785-800.

Gamage, K. A. A., Ekanayake, S. Y. & Dehideniya, S. C. P. 2022. Embedding Sustainability in Learning and Teaching: Lessons Learned and Moving Forward-Approaches in STEM Higher Education Programmes. *Education Sciences,* 12, 225.

Garrecht, C., Bruckermann, T. & Harms, U. 2018. Students' Decision-Making in Education for Sustainability-Related Extracurricular Activities—A Systematic Review of Empirical Studies. *Sustainability* [Online], 10.

Gramatakos, A. L. & Lavau, S. 2019. Informal learning for sustainability in higher education institutions. *International Journal of Sustainability in Higher Education,* 20, 378-392.

Hamdan, A., Hamdan, S., Alsyouf, I., Murad, N., Abdelrazeq, M., Al-Ali, S. & Bettayeb, M. 2024. Enhancing sustainability performance of universities: A DMAIC approach. *Systems Research and Behavioral Science,* 41, 153-172.

Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R. E., Mayall, E. E., Wray, B., Mellor, C. & van Susteren, L. 2021. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *The Lancet Planetary Health,* 5, e863-e873.

Högfeldt, A. K., Gumaelius, L., Berglund, P., Kari, L., Pears, A. & Kann, V. 2022. Leadership, support and organisation for academics' participation in engineering education change for sustainable development. *European Journal of Engineering Education,* 48, 240-266.

Holst, J. 2023. Towards coherence on sustainability in education: a systematic review of Whole Institution Approaches. *Sustainability Science,* 18, 1015-1030.

Jiménez-Elizondo, A. 2023. Whole Institution Approach to Sustainability and Transdisciplinarity. *Earth Charter Magazine,* 1, 32-42.

Joyner Armstrong, C. M., Hustvedt, G., LeHew, M. L. A., Anderson, B. G. & Hiller Connell, K. Y. 2016. When the informal is the formal, the implicit is the explicit: Holistic sustainability education at Green Mountain College. *International Journal of Sustainability in Higher Education,* 17, 756-775.

Kapitulčinová, D., AtKisson, A., Perdue, J. & Will, M. 2018. Towards integrated sustainability in higher education – Mapping the use of the Accelerator toolset in all dimensions of university practice. *Journal of Cleaner Production,* 172, 4367-4382.

Kelly, A. M. 2023. Adopting an institutional approach - moving from silos to mainstreaming inclusion. In: KELLY, A. M., FLEMING, B. & PADDEN, L. (eds.) *Making Inclsuive Higher Education a Reality: creating a university for all.* Oxon: Routledge.

Kirby, A. 2023. Exploratory Bibliometrics: Using VOSviewer as a Preliminary Research Tool. *Publications,* 11, 10.

Kohl, K., Hopkins, C., Barth, M., Michelsen, G., Dlouhá, J., Razak, D. A., Abidin Bin Sanusi, Z. & Toman, I. 2022. A whole-institution approach towards sustainability: a crucial aspect of higher education's individual and collective engagement with the SDGs and beyond. *International Journal of Sustainability in Higher Education,* 23, 218-236.

Lang, D. W. & Lopers-Sweetman, R. 1991. The Role of Statements of Institutional Purpose. *Research in Higher Education,* 32, 599-624.

Leal Filho, W., Ozuyar, P. G., Dinis, M. A. P., Azul, A. M., Alvarez, M. G., da Silva Neiva, S., Salvia, A. L., Borsari, B., Danila, A. & Vasconcelos, C. R. 2023. Living labs in the context of the UN sustainable development goals: state of the art. *Sustainability Science,* 18, 1163-1179.

Leal Filho, W., Salvia, A. L., Frankenberger, F., Akib, N. A. M., Sen, S. K., Sivapalan, S., Novo-Corti, I., Venkatesan, M. & Emblen-Perry, K. 2021. Governance and sustainable development at higher education institutions. *Environment, Development & Sustainability,* 23, 6002-6020.

Levin, K., Cashore, B., Bernstein, S. & Auld, G. 2012. Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change. *Policy Sciences,* 45, 123-152.

Mallow, S. & van't Land, H. 2020. Integrating Sustainable Development into the Whole Institution: Can the SDGs Bridge the GAP? In: SENGUPTA, E., BLESSINGER, P. & YAMIN, T. S. (eds.) *Teaching and Learning Strategies for Sustainable Development.* Emerald Publishing Limited.

Mapar, M., Bacelar-Nicolau, P. & Caeiro, S. 2022. Sustainability Assessment Tools in Higher Education Institutions. *The Wiley Handbook of Sustainability in Higher Education Learning and Teaching*.

Martel, M. & Bhandari, R. 2016. Social Justice and Sustainable Change: the impacts of higher education. Institute of International Education.

May, H. & Bridger, K. 2010. Developing and embedding inclusive policy and practice in higher education. Higher Education Academy.

McConnon, R. 2020. Measures to facilitate the scale-up of education for sustainable development in higher education. *International Journal of Sustainable Society,* 12, 36-50.

Mogren, A., Gericke, N. & Scherp, H.-Å. 2019. Whole school approaches to education for sustainable development: a model that links to school improvement. *Environmental Education Research,* 25, 508-531.

Morphew, C. C. & Hartley, M. 2006. Mission Statements: A Thematic Analysis of Rhetoric across Institutional Type. *The Journal of Higher Education,* 77, 456-471.

Mushtaha, E., Alsyouf, I., Hamad, R., Elmualim, A., Maksoud, A. & Yahia, M. W. 2022. Developing design guidelines for university campus in hot climate using Quality Function Deployment (QFD): the case of the University of Sharjah, UAE. *Architectural Engineering and Design Management,* 18, 593-613.

Niedlich, S., Bauer, M., Doneliene, M., Jaeger, L., Rieckmann, M. & Bormann, I. 2020. Assessment of sustainability governance in higher education institutions—a systemic tool using a governance equalizer. *Sustainability (Switzerland),* 12, 1816.

Nunes, B. T., Pollard, S. J., Burgess, P. J., Ellis, G., de los Rios, I. C. & Charnley, F. 2018. University contributions to the circular economy: Professing the hidden curriculum. *Sustainability (Switzerland),* 10, 2719.

O'Neill, K. & Sinden, C. 2021. Universities, sustainability, and neoliberalism: Contradictions of the climate emergency declarations. *Politics and Governance,* 9, 29-40.

OfS 2020. Reducing higher education carbon emissions. Office for Students.

Ouzzani, M., Hammady, H., Fedorowicz, F. & Elmagarmid, A. 2016. Rayyan — a web and mobile app for systematic reviews. *Systematic Reviews,* 5, 210.

Peart, D., Rumbold, P. & Fukar, E. 2023. Student engagement through partnership: a literature review. AdvanceHE.

Porter, S. 2023. *How to decolonise the sustainable development agenda* [Online]. Available: https://wonkhe.com/blogs/how-to-decolonise-the-sustainable-development-agenda/ [Accessed 15/10/23 2023].

Ramísio, P. J., Pinto, L. M. C., Gouveia, N., Costa, H. & Arezes, D. 2019. Sustainability Strategy in Higher Education Institutions: Lessons learned from a nine-year case study. *Journal of Cleaner Production,* 222, 300-309.

Ramos, T. & Pires, S. M. 2013. Sustainability assessment: The role of indicators. In: CAEIRO, S., FILHO, W. L., JABBOUR, C. J. C. & AZEITEIRO, U. (eds.) *Sustainability assessment tools in higher education institutions: Mapping trends and good practices around the world.* Springer Cham.

Rath, K. & Schmitt, C. T. 2017. Sustainability at Universities: Degrees of Institutionalization for Sustainability at German Higher Education Institutions—A Categorization Pattern. In: FILHO, W. L., BRANDLI, L., CASTRO, P. & NEWMAN, J. (eds.) *Handbook of Theory and Practice of Sustainable Development in Higher Education.* Springer Cham.

Robinson, Z. P. & Laycock Pedersen, R. 2021. How to Repurpose the University: A Resilience Lens on Sustainability Governance. *Frontiers in Sustainability,* 2, 674210.

Schoeps, A. & Hemmer, I. 2018. Participation of student authors in reports on sustainability. *International Journal of Sustainability in Higher Education,* 19, 249-265.

Shields, R. & Lu, T. 2023. Uncertain futures: climate change and international student mobility in Europe. *Higher Education,* https://doi.org/10.1007/s10734-023-01026-8.

SOS. 2020. *2020 Survey: "Students, sustainability and education"* [Online]. Available: https://sos.earth/survey-2020/ [Accessed 10/10/23 2023].

Stein, S. 2023. Universities confronting climate change: beyond sustainable development and solutionism. *Higher Education,* https://doi.org/10.1007/s10734-023-00999-w.

Sterling, S. 2003. *Whole systems thinking as a basis for paradigm change in education: explorations in the context of sustainability.* PhD, University of Bath.

Sterling, S. 2013. The Sustainable University: Progress and prospects. In: STERLING, S., MAXEY, L. & LUNA, H. (eds.) *The Sustainable University: Progress and prospects.* Oxon: Taylor & Francis.

Tercanli, H. & Jongbloed, B. 2022. A Systematic Review of the Literature on Living Labs in Higher Education Institutions: Potentials and Constraints. *Sustainability (Switzerland),* 14, 12234.

Trahan, E. R., North, L. A., Gripshover, M. M. & Huss, J. M. 2017. Campus sustainability tours: exploring an uncharted tool. *International Journal of Sustainability in Higher Education,* 18, 908-922.

UNESCO. 2014. *UNESCO roadmap for implementing the global action programme on education for sustainable development* [Online]. Available: https://unesdoc.unesco.org/ark:/48223/pf0000230514 [Accessed 20/10/23].

UNESCO. 2017. *Greening technical and education and training: a practical guide for institutions* [Online]. Available: https://unevoc.unesco.org/up/gtg.pdf [Accessed 20/10/23].

UNESCO. 2022. *Knowledge-driven actions: transforming higher education for global sustainability* [Online]. Available: https://unesdoc.unesco.org/ark:/48223/pf0000380519 [Accessed 20/10/23].

UNESCO. 2023. *What you need to know about education for sustainable development* [Online]. Available: www.unesco.org/en/education-sustainable-development/need-know [Accessed 20/10/23].

Van der Mierden, S., Tsaioun, K., Bleich, A. & Leenaars, C. H. C. 2019. Software tools for literature screening in systematic reviews in biomedical research. *Altex,* 36, 508-517.

van Eck, N. J. & Waltman, L. 2007. VOS: A New Method for Visualizing Similarities Between Objects. In: DECKER, R. & LENZ, H. J. (eds.) *Advances in Data Analysis.* Springer.

van Eck, N. J. & Waltman, L. 2010. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics,* 84, 523-538.

Verhoef, L. A., Bossert, M., Newman, J., Ferraz, F., Robinson, Z. P., Agarwala, Y., Wolff, P. J., Jiranek, P. & Hellinga, C. 2020. Towards a Learning System for University Campuses as Living Labs for Sustainability. In: FILHO, W. L., SALVIA, A. L., PRETORIUS, R., BRANDLI, L., MANOLAS, E., ALVES, F., AZEITEIRO, U., ROGERS, J., SHIEL, C. & DO PAÇO, A. (eds.) *Universities as Living Labs for Sustainable Development; Supporting the Implementation of the Sustainable Development Goals.* Springer Nature.

Vogel, M., Parker, L., Porter, J., O'Hara, M., Tebbs, E., Gard, R., He, X. & Gallimore, J.-B. 2023. Education for Sustainable Development: a review of the literature 2015-2022. AdvanceHE.

Winfield, F. & Ndlovu, T. 2019. "Future-proof your Degree": Embedding sustainability and employability at Nottingham Business School (NBS). *International Journal of Sustainability in Higher Education,* 20, 1329-1342.

Winter, J. & Cotton, D. 2012. Making the hidden curriculum visible: sustainability literacy in higher education. *Environmental Education Research,* 18, 783-796.

Yarime, M. & Tanaka, Y. 2012. The issues and methodologies in sustainability assessment tools for higher education institutions: a review of recent trends and future challenges. *Journal of Education for Sustainable development,* 6, 63-77.

Contact us

All enquiries

Email: communications@advance-he.ac.uk

Website: www.advance-he.ac.uk

@AdvanceHE

Advance HE helps HE institutions be the best they can be, by unlocking the potential of their people.

We are a member-led, sector-owned charity that works with institutions and higher education across the world to improve higher education for staff, students and society. We are experts in higher education with a particular focus on enhancing teaching and learning, effective governance, leadership development and tackling inequalities through our equality, diversity and inclusion (EDI) work.

Our strategic goals to enhance confidence and trust in HE, address inequalities, promote inclusion and advance education to meet the evolving needs of students and society, support the work of our members and the HE sector.

We deliver our support through professional development programmes and events, Fellowships, awards, student surveys and research, providing strategic change and consultancy services and through membership (including accreditation of teaching and learning, equality charters, knowledge and resources).

Advance HE is a company limited by guarantee registered in England and Wales no. 04931031. Company limited by guarantee registered in Ireland no. 703150. Registered as a charity in England and Wales no. 1101607. Registered as a charity in Scotland no. SC043946. Registered Office: Advance HE, Innovation Way, York Science Park, Heslington, York, YO10 5BR, United Kingdom.

To request copies of this report in large print or in a different format, please contact the Marketing and Communications Team at Advance HE: communications@advance-he.ac.uk