



Renewing Universities in Our Climate Emergency: Stewarding System Change and Transformation

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This paper outlines climate emergencies facing universities and, by drawing on research on system transition, provides insights about how change to overcome the challenges might be stewarded. Climate change brings three interconnected and urgent emergencies for universities: (1) Manifest emergencies such as risks to operations and business models; (2) Conceptual emergencies that arise because assumptions, ideologies, systems, and structures cannot match the scale of the manifest challenges; and (3) Existential emergencies where current identities and sense of purpose are incapable of supporting the changes needed to overcome the conceptual challenges. To be viable leaders in the world, universities will need to renew their commitments to serving the public good, be dedicated to an unwavering challenge-orientation, create post-disciplinary structures, and be the change one seeks to see in the world. Importantly, universities will need to overcome the emergencies on the inside if they are to help society address the scale of the challenges on the outside, to which both universities and human capacity are seriously cognitively and emotionally ill-prepared. Fortunately, new insights from research on system transition provide helpful advice on how to steward transformational change. This work highlights that successful transformation requires strong adherence to transformational intent and, in the case of universities, working with all three emergencies simultaneously. Successful transformation will also require harnessing opportunities to disrupt the status quo; supporting an interplay of different forms of management and orientations to the future; developing appropriate infrastructure to support transformation; and rapidly accelerating the development of capacities for transformational change. By actively developing capacities for transformation on the inside universities will then be in a much better position to help and lead others beyond the halls of the academy.

Keywords: transformation, system transition, emergencies, university, climate change

INTRODUCTION

Societal transformations are inevitable as change accelerates globally. Such transformations will emerge through growing impacts of twenty-first century challenges such as climate change, artificial intelligence, obesity, pandemics, misinformation, other environmental changes, and their intersection (IPBES, 2018; IPCC, 2018; Mendenhall and Singer, 2019; Bonini, 2020; Dhimal et al., 2020; Logan et al., 2021; Tan et al., 2021) and how societies choose to respond (O'Brien, 2011). Effective responses to climate change—the primary focus of this paper—will require systemic change in and across diverse sectors, such as food, transport, and finance (Creutzig et al., 2015; Clark et al., 2020). Effective response will also require fundamental changes in structures, mindsets, and beliefs (O'Brien, 2012; O'Brien and Sygna, 2013) and a psycho-cultural shift away from dominant social paradigms that underpin unsustainable societal patterns (Berzonsky and Moser, 2017). No sector, from transport, finance, or education, will be untouched as economies shift and societal demands increase for low carbon ways of living and as the impacts of climate change accrue (Klein, 2014; IPCC, 2018). This includes institutions like universities as they themselves decarbonize and respond to changing demands for new kinds of knowledge and education (Fazey et al., 2020; Yañez et al., 2020).

Over centuries, universities have provided many benefits through their contributions to education, knowledge creation, and to major global movements and socio-political change around diverse issues such as human rights and environmental protection (Schofer et al., 2021). This has also led to the emergence of whole suite of new insights about strategies and actions for sustainability, including pathways for societies future economic development (Caputo et al., 2018a,b; Schofer et al., 2021). Universities bring major capabilities, frameworks, structures, and intellectual capital (Cash et al., 2003) and are supported by, and highly integrated within, educational and economic agendas (Frank and Meyer, 2007). They have demonstrated remarkable adaptability throughout history with rapid and continued expansion post-WWII (Frank and Meyer, 2007). This has been enabled by the way universities have shaped national and global societies, expanded professions, and established common frames (Schofer et al., 2021). While critics of the way universities have developed may argue that they have contributed to an erosion of academic “rigor” or other values (e.g., through knowledge creation being focused on more utilitarian goals), this view grossly understates the extent to which academic thought has gained prominence and affected and dominated contemporary societies (Frank and Meyer, 2007). The result has been a remarkable globalized notion of what constitutes a University as well as what counts as knowledge and ways of knowing (Frank and Meyer, 2007; Schofer et al., 2021).

Despite these benefits, capacities, and influences, there are many and growing criticisms about the limits of universities in relation to the often-underestimated threats facing humanity from environmental crises (Bradshaw et al., 2021). Universities have been criticized for their slow response (Yañez et al., 2020); for being complicit in reproducing high carbon and consumptive economies (Kläy et al., 2015); and for continuing to rely on

dominant knowledge creation approaches and pedagogies that are incapable of transcending the thinking and approaches that have led to the challenges in the first place (Sterling, 2010; Hanlon et al., 2012; O'Brien et al., 2013; Aufenvenne et al., 2014; Müller and Riegler, 2014; Lotz-Sisitka et al., 2015; Umpleby, 2016; Fazey et al., 2018, 2020; Bina and Pereira, 2020; O'Riordan et al., 2020).

Calls for new kinds of thinking and learning range from suggestions of the need for universities to focus on new competencies (O'Riordan et al., 2020; Brundiers et al., 2021) and much more fundamental shifts, such as toward forms of subversive learning (Selby and Kagawa, 2018), production of wisdom about how to act within the world (Maxwell, 2007), and developing consciousness (Woiwode, 2020). These deeper critiques highlight a wider need for a new enlightenment and “grammar of responsibility,” underpinned by a new praxis, ethic, and whole scale philosophical shift (Maxwell, 2007, 2021; Vogt and Weber, 2020). Universities, it has then been argued, need to move from being institutions of human education to becoming institutions of human development (Berzonsky and Moser, 2017; Moser and Fazey, 2021). Given the scale and seriousness of environmental challenges, if universities themselves are to survive and be a genuinely creative force in ensuring longevity of human life on this planet, they will need to undergo rapid and significant change and renewal (Maxwell, 2007; Sterling, 2009; Beynaghi et al., 2016; Fazey et al., 2020; Vogt and Weber, 2020). Thus, while universities clearly bring many benefits (Trencher et al., 2014; Fazey et al., 2020; Schofer et al., 2021), the question is no longer about *whether* universities should change but rather *to what* and *how* this change might be achieved.

This perspective paper aims to explore how change might be approached so universities can become more viable and active players within a rapidly warming world. To do this, we first explain our approach and underlying assumptions, then outline some of the changes needed in universities if they are to respond effectively to the climate challenge. This includes using a tripartite lens of three climate emergencies to draw out the kinds of changes needed. This lens, which has not yet been applied to universities, is important for drawing out the deeper issues which, if left unaddressed, threaten the perceived relevance, and very existence of our universities. After raising some of the different interconnected issues, we then draw on another set of insights from the field of system transition and transformation to explore how change might be stewarded. Overall, the paper is novel in the way it allows for more immediate and deeper issues to be understood in relationship to each other and in applying a system transitions perspective to exploring institutional change.

APPROACH

This perspective has been developed through a combination of conceptual reasoning, integration of different studies, and philosophical literature, a self-reflexive account of some of our own experiences in attempts at working within our respective organizations and in supporting re-purposing of universities. Our ideas come from authors that include researchers and teachers in senior and more junior university positions from

environmental and health fields with expertise in pedagogic multi and individual programme development for systems thinking and change making. It also includes a range of education and change-making practitioners and educators that have established alternative organizations that take a more radical approach to how they support capacity development for the complex world in which we now find ourselves, including Directors and co-founders of the International Futures Forum (IFF) and H3Uni. Much of the insights and practical know-how for working with systemic change outlined in this paper have come from these organizations rather than academia, and are now being applied by those of us working within universities. Through our various efforts, some of us have had to question our own assumptions and what makes our work meaningful within our own institutions and how this then shapes our approaches to change. Thus, while we do not claim our insights are based on empirical data, they do come from deep reflections and extensive and diverse experiences within and beyond academic circles, including about how to facilitate change.

In formulating this work, and to move more quickly to questions about how change can be achieved, our paper starts from (and doesn't try to fully revisit), four important assumptions. First, we accept the broad thesis already articulated by many that universities are currently incapable of addressing the scale and urgency of challenges like climate change (Maxwell, 2007; Vogt and Weber, 2020; Moser and Fazey, 2021). Second, given the scale of challenges (Bradshaw et al., 2021), we assume renewal will require transformational changes that go beyond improving what we already have (Sterling, 2009; Müller and Riegler, 2014; Bina and Pereira, 2020). Third, while it may be possible to resist in the short term, the forces of change globally around issues like digitalization and climate change will simply be too great for universities to avoid (Bonini, 2020; Fazey et al., 2020). We therefore assume change is inevitable at some point in time as societal change more generally accelerates (Umpleby, 2016). It is then largely a choice for institutions like universities about when and how to act, not whether they need to do so. Finally, while universities face many challenges, we recognize they also have phenomenal and enormous potential (Bina and Pereira, 2020). This is partly because of the way they are already influential in global societies and the professions (Frank and Meyer, 2007; Schofer et al., 2021). If fully unleashed, this potential could help societies rapidly accelerate and advance learning and knowledge creation to support societal sustainability transitions (e.g., from research), capacity development for societal change (e.g., through teaching), and provide exemplary and moral leadership by showing how rapid but difficult decarbonization within institutions can be brought about (e.g., by focusing on change within their own institutions).

In addition to these assumptions our paper is bounded in its focus on *universities* and *climate change*. This helps us constrain some of the complexity, but then brings with it two potential limitations. First, while universities have enormous potential from the way they support globalized professional knowledge and rapid world integration, such globalization can also reinforce certain ideas about what constitutes, and the norms associated with, knowledge, knowing, and action (Schofer et al., 2021).

This can then play into neoliberal and high carbon economies, shaping notions as to what kinds of knowledge are accepted or considered useful (Lave et al., 2010; Kläy et al., 2015; Olssen, 2016). Such dynamics can then reproduce societal elites that have already benefitted most from globally common notions of professionalism and expertise (Schofer et al., 2021). For our paper, there is thus a danger that by focusing on "*Universities*" we may not be sufficiently accounting for wider sociological, ideological, and philosophical challenges regarding the nature of science and a global academy nor its potential limitations in overcoming existential threats like climate change and how it reinforces global inequalities (Carr-Chellman, 2005; Maxwell, 2007, 2021; Healy, 2011; Aufenvenne et al., 2014; Kläy et al., 2015; Fazey et al., 2020; Vogt and Weber, 2020). To get a sense of what future universities need to look like and how to get there, more of these wider issues may then need to be taken into account. We have, however, addressed some of the issues by examining deeper conceptual and existential aspects that underpin universities that partly reflect the kinds of wider societal assumptions and cultural patterns that need to change in response to a warming world.

The second limitation is our focus on *climate change*, which is integrated with many other drivers of change affecting universities, including rapid technological change (Bonini, 2020), growing debates about decolonization (Lotz-Sisitka et al., 2015), and commercialization of knowledge as part of neoliberal ideologies and economies (Lave et al., 2010; Olssen, 2016). The reality is that these synergistic forces together shape the conditions to which universities need to respond, all of which are different and highly interconnected symptoms of the current way in which societies have developed and operate. If universities want to provide exemplary leadership, for example, then they will also need to consider growing global and local inequalities, injustice and how they are part of and shape the influence of a global elite. Focusing on climate change alone, despite already being highly complex, may thus be problematic. Despite this, we have attempted to hold some of these more diverse considerations in the background as we have formulated our ideas, such as viewing the challenges facing universities as systemic. The result has been an attempt to open our thinking broadly while also providing sufficient bounds to provide a meaningful account of what needs to change and how it might be achieved. The outcome is a set of insights more directly oriented toward climate change but which also has wider generic applicability to other forms of global change.

THREE EMERGENCIES OF CLIMATE CHANGE

Universities are facing increasing challenges associated with climate change. Many universities have already taken a significant step in declaring a climate emergency (Dillon, 2019). This helps elevate its urgency and importance, but it is unclear and difficult to act on such a declaration (Dillon, 2019). A helpful lens for unpacking some of the confusion and for drawing out some of the kinds of changes needed is to view climate change as three important and interrelated emergencies: the manifest,

conceptual, and existential (Fazey et al., 2021). The *manifest* emergencies relate to more tangible impacts from climate change. These are, however, starting to become so pervasive that they require the *conceptual* foundations of universities to be questioned. The conceptual emergencies, in turn, cannot be addressed without considering the *existential*, such as changing purpose and identity. In the sections below, we explain each of these emergencies which together highlight the diversity of issues, the imperative for system change, and kinds of changes that will be needed.

Manifest Emergencies

The first of the three emergencies are the manifest, which demand a different operational and strategic orientation as the impacts of climate change accrue (Table 1). Manifest emergencies include direct, transitional, and reputational impacts. Direct impacts include extreme weather, such as bushfires and hailstorms which, together with the impacts of COVID-19, cost the Australian National University AUS\$75 million in 2019–2020 (News, 2020).

The transitional impacts (Table 1) relate to changes around decarbonization of universities themselves and to wider societal changes in economies and markets. Transitioning to decarbonization within a university can generate costs, such as when divesting from fossil fuel-based endowments, renewing the building stock, changing teaching practices, or changing faculty behavior (e.g., less conference travel) and having low carbon student bodies (e.g., finding ways to mitigate high carbon costs of face to face teaching of international students). Such issues are complex and intertwined. They often raise dilemmas, such as maintaining potential influence and reach of working with an international student body while also finding ways to mitigate carbon impacts. Working with such dilemmas will require creative solutions, new business models, and patterns of working.

Transitional risks also emerge as shifts in markets and demands in society occur more widely leading to stranded assets in terms of infrastructure, facilities, skills, expertise, and capacities (Bank of England, 2017). For universities, an example are the growing risks from changes in societal demands for different kinds of knowledge creation, training, and learning. Many of the big challenges the world now faces—climate, inequalities, health, and so on—demand less focus on understanding the problems and more on how change can be effectively stewarded. This includes a rapidly growing need for new approaches capable of working with highly interconnected, contested, and ethical issues (Table 2), as well as new modes of knowledge creation—methodologically, conceptually, empirically, and pedagogically—to support learning about how effective stewardship might be developed. New training and learning that enhance “know how” capacities are also then needed, including helping students develop practical and experiential knowledge about working with change (Box 1) (Caniglia et al., 2016, 2020; Fazey et al., 2018). Such capacity development will gain increasing and rapidly growing demand from what are now a climate change aware and solution hungry student demographic. Demand will also increase as the levels to which humanity is severely cognitively impaired

when it comes to facing the scale of the climate challenge become apparent.

While wider societal transitions and shifts in markets relating to such training and learning may feel like a long way off, recent experience of the pandemic has taught us just how quickly change can occur. The pandemic has led to stranded assets such as empty student halls, conference venues, and services as students stayed away from campuses (Bolton and Hubble, 2021). Here, it is important to recognize that transitional risks emerge because of changes of perceptions of actors operating within markets, not necessarily because something is “real” or “important.” From a carbon reduction perspective, the inevitable economic transition to low carbon is thus likely to happen in unpredictable ways, and possibly suddenly or very rapidly as investors jump on bandwagons or become afraid of being left behind. Thus, given the timeframes of turnover of staff, expertise, estates, and infrastructure in universities relative to emerging critical tipping points around climate action, the transitional risks to universities, and their business models are real and urgent.

These risks then extend to the reputational, such as when universities are perceived to be failing to reduce carbon emissions or contribute to the kinds of social dialogues needed to build a broader public mandate for change (EAUC HEBCON, 2019) (Table 1). These reputations are core to maintaining trust and support from governments, recruit students and quality staff, and for attracting partners such as businesses or government departments. Here, reputation is closely related to both how well a university “walks the talk” and shows relevance to the climate challenge. Many civic authorities, NGOs and public bodies, for example, still have the perception that the knowledge created and the learning within universities is a long way off from being relevant to the big and practical challenges they face. Universities will thus need to be much more proactive in civic engagement and demonstrate that meaningful change is possible if they want to be viable in a rapidly changing world and be legitimate stewards and leaders.

Manifest emergencies—as increasingly lived realities—can help push universities toward taking climate change seriously (Adey and Anderson, 2012). They help focus attention, enable quicker decision-making, and garner wider social and political support for action. Yet despite being urgent relative to the time needed to shift investments and expertise, climate change is still often not viewed as high-priority. Such inaction and avoidance partly comes from a sense of uncertainty and other psychological barriers (Gifford, 2011; Slawinski et al., 2017). Yet, if universities are to survive the societal upheaval that climate change brings, then they will need to find ways to make responses much more immediate. This may include embedding climate change, and elevating the manifest impacts into risk registers, business models, operational processes, and decision-making. Importantly, however, as the direct, transitional, and reputational impacts of climate change grow, it will become increasingly difficult to overcome them by simply adapting or improving what exists now. At some point, more fundamental kinds of change will be required.

TABLE 1 | The three emergencies of climate change facing universities.

Emergency		Explanation	Domain of change	Domain of learning
Manifest	Direct	Impacts facing universities worldwide from changing weather, such as floods, storms, water shortages, or financial crises or commodity price collapses affecting investments (e.g., pensions) that result in emergencies. Slowly changing stressors may culminate toward critical thresholds (e.g., unaffordable or undesirable university fees for some students).	Actions, behaviors, technologies, decisions, investments, policies, and programmes.	Single-loop learning that asks: "Are we doing things right?" (e.g., learning to improve methods of knowledge creation, teaching, developing new technologies).
	Transitional	Emergencies associated with shifts in society toward low carbon, such as in rising costs (e.g., old high carbon energy) or market shifts leading to stranded assets (e.g., empty student halls if low carbon online teaching prevails). Demands for staff with new expertise and skills (e.g., for bringing about societal change).		
	Reputational	Emergencies facing universities if they fail to act or are seen to be greenwashing, or through failure to adapt to changing notions of value in society by not playing a key role in developing a wider mandate for change.		
Conceptual	Conceptual foundations	Emergencies where new concepts, approaches, tools and capacities are needed for working with complex, highly interconnected issues, across social scales, values, and goals, and with anticipatory forms of knowledge and transcend the problems created by past approaches and thinking. Critical pedagogical shifts will be needed to develop capacities for working with complex integrated challenges. New concepts will be needed to support Universities' own transitions.	Systems, structures, formal and informal rules, norms, strategies, approaches, modes of governance, assumptions, mindsets.	Double-loop learning with change in strategies and approaches. It involves asking "What are the right things to be doing?" (e.g., re-structuring departments to be networked rather than siloed, or developing new kinds of rules and governance).
	Systems and structures	Emergencies relating to the way current systems and structures are unable to support uptake of new behaviors, technologies, concepts, and approaches (e.g., silo based disciplines can make integrated working difficult). Structural issues need to change to enable alternative research and teaching, to emerge.		
	Rules, norms, and models of governance	Emergencies arising from limited capacity of existing informal and formal rules, norms, and modes of governance to support change and new practices. Current business and planning models, for example, support old patterns, limiting possibilities for novel configurations or ways of working.		
	Mindsets, worldview, assumptions	Emergencies arising from mindsets and assumptions that limit new patterns and concepts. Examples include assumptions of what constitutes learning, teaching, education, knowledge, knowledge creation, progress, or development. Many models of research and teaching, for example, are underpinned by assumptions that effective knowledge creation comes from distant observers standing on the outside looking in, which limits possibilities for including other kinds of knowledge, ways of knowing, or learning.		
Existential	Values and ethics	Emergencies arising from past values and ethics no longer congruent with a rapidly changing world. For example, universities have developed over the last three centuries alongside high carbon and fossil fuel-based economies, notions of colonial power, or knowledge and expertise. Societal shifts, e.g., in millennials, about what is considered "right" and "whose voice matters" mean that implicit values and ethics are increasingly under question.	Values, ethics purpose, cultures, identity.	Triple-loop learning with changes in higher order processes. It involves askings: "What is right?" (e.g., ethical issues associated with purpose of a university, and how these change as societal needs change)
	Cultures, identity, and purpose	Emergencies arising from a threat to the maintenance of a way of life, a culture, in a particular place that challenge a sense of "who we are" or "role and purpose." For universities, relevance in a world of climate change is increasingly being challenged, and there is a risk of being perceived as outmoded or anachronistic. To be viable, universities will need to re-purpose toward being institutions more focused on the public good.		
	Psychological well-being	Emergencies striking at an ability to make sense of and work effectively in the world. A core requirement for health is a sense of coherence, yet people are becoming overwhelmed by rapid change and complexity and struggling to fathom their place within it. Universities need to consider to what extent they themselves are an extractive-industry. Can an academic system that burns out staff and students survive in the mid to longer term? A regenerative approach to education will need to cultivate well-being not just as a "nice to have" but as a critical enabler of quality and performance.		

TABLE 2 | Examples of some of the core competencies needed for societies if they are to successfully navigate twenty-first century challenges (based on Wiek et al., 2011; Hodgson, 2013; Leicester et al., 2013; Beynaghi et al., 2016; Fazey et al., 2018; Bina and Pereira, 2020; O’Riordan et al., 2020; Brundiens et al., 2021).

Core competency	Explanation
Creative development of solutions and new approaches	Strengths in universities tend toward critical analysis of problems and less on creative development of solutions or enacting them. This applies to both research and teaching. Universities will need to foreground learning (teaching and research) that leads to design or creation of new ideas or solutions, such as new policies, ways of working or approaches, and how to bring about change through collaborative action. Stewarding change cannot be learned just from books or lectures and requires learning by experience. Creating new ideas or solutions also often comes from trial and error, and is thus often not separate from implementation. Shifts toward more engaged action-oriented research and teaching is needed to help develop such capacity.
Working with uncertain and desired futures	Rapid development of futures consciousness is needed to work with twenty-first century challenges. Most universities focus on knowledge creation methods that rely on an evidence base from the past or present. This is important, but can be akin to driving forwards while looking through the rearview mirror. Relying on evidence alone limits understanding of, or actions for, bringing about change and how the complexity, rapidity, extent, and uncertainty associated with the environmental changes hurtling toward us is navigated. Research and teaching needs to rapidly enhance development of competencies for working with the future in co-creative ways. This can include futures tools (e.g., scenario planning, visioning, stretch goals), creative and active learning processes, and working with deeply held assumptions about how change occurs.
Working with complex, interrelated challenges	Urgent development of new approaches is needed to work with ill-defined problems, complexity, and inter-related issues. Very few environmental challenges are easily defined, and most are complex, dynamic, and cross many disciplinary fields. Developing ability to understand, surface, and make sense of complexity and inter-relations is important, as are understanding underlying dynamics and how subjective experience of those dynamics shape the way people respond. “Interdisciplinary” approaches, problem-based learning or systems thinking are often suggested as a solution. But these approaches are rarely given serious attention. New integrative approaches are also needed to transcend the kinds of thinking that have led to twenty-first century challenges like climate change, including through new fundamental research to develop the kinds of knowledge creation and teaching that can help societies work across interconnected challenges.
Navigating highly contested issues	New competencies are needed to work with diverse subjective, normative, contested, and ethical or moral aspects of change. Most change is contested, but there is still insufficient emphasis on how to work with, for example, conflict, negotiation, mediation, or dilemma resolution or how to surface and work with different values. Most students who leave university face such issues, especially when engaged in environmental sustainability related work but usually have not received any training in these areas. Developing such competencies takes time and requires personal work on “the inside” to enable more effective working with “the outside.” Culture shifts and new competencies in staff will be needed to support the development of more nuanced change or solution-oriented research and teaching that are underpinned by greater attention to the personal transformations that are needed to enhance one’s effectiveness in working with change.
Stewarding transformational change	Effective societal change in relation to issues like climate change cannot be achieved without addressing systems and structures, cultures, values, and mindsets that underpin them. Realizing the Sustainable Development Goals, for example, needs systemic change. New research and training to develop competencies for bringing about transformational change as a distinct form of change is essential.

Conceptual Emergencies

The second kind of climate emergencies are conceptual. These arise when merely improving existing ways of working is insufficient to deal effectively with the scale or speed of the manifest emergencies and when new approaches or ways of thinking about problems and solutions are required. Working with the manifest requires re-evaluating “*what are the right ways of doing things*” while the conceptual requires re-evaluating “*what are the right things to be doing*” (Table 1). At some point the extent or scale of manifest emergencies will mean that they cannot be addressed without deeper or more fundamental changes, and the urgency and importance of the conceptual emergencies come to the fore.

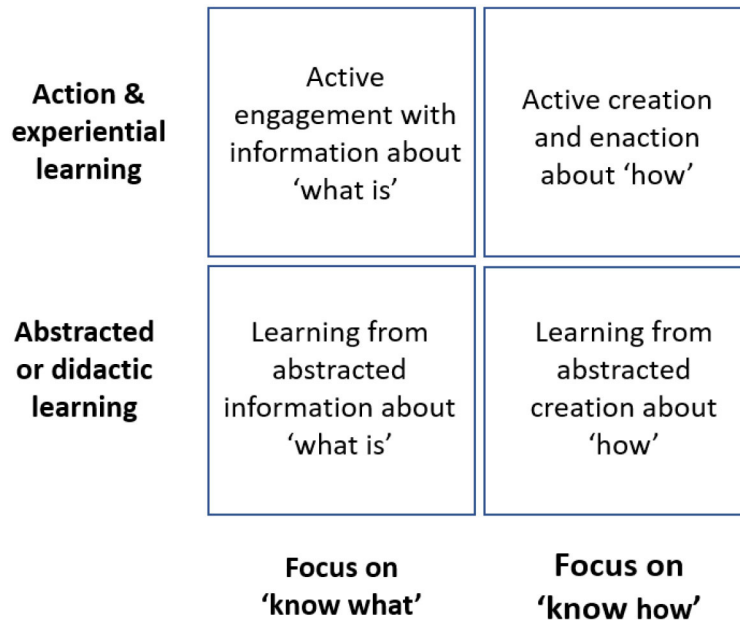
For universities, conceptual emergencies are diverse (Table 1). They include the need for new ideas, framings, and thinking and demand appropriate enabling environments, such as overcoming silo-based structures in universities to allow for more integrative and holistic approaches to teaching and research. This in turn requires different norms, rules, and modes of governance. In the UK for example, 5-year national research assessments continue to

have a powerful effect on reinforcing disciplinary structures even though government research funding is shifting toward larger, interdisciplinary, system oriented, and collaborative projects. Existing structures, norms, and formal or informal rules thus make it difficult to develop the new thinking and ways of working—more holistic, integrative, co-creative, action-oriented, and reflexive (Hanlon et al., 2012; Kläy et al., 2015; Umpleby, 2016)—that are needed to respond to the changing societal demands that climate change brings.

To support systemic and structural changes, shifts in mindsets, worldviews, and assumptions that underpin existing patterns is then also required (Table 1) (Sterling, 2004; O’Brien and Sygna, 2013; O’Brien et al., 2013). One of the most pervasive assumptions underpinning universities is that researchers can and should be separate from what they observe (Aufenvenne et al., 2014; Umpleby, 2016). This is largely a fallacy given that researchers are never independent nor value free (Vogt and Weber, 2020) and are instead deeply embedded in, and shaped by, the societies and cultures which define what questions are asked or what gets funded (Midgley, 2000; Aufenvenne et al., 2014; Umpleby, 2016).

BOX 1 | Active creation and enaction forms of learning

Rapidly advancing capacities for working with twenty-first century challenges needs extensive focus on action-oriented forms of learning that develop know-how for working with change in practice. Learning from abstract information about what exists in the world (e.g., papers or lectures on the nature of social and bio-physical phenomena) currently dominates most teaching in universities (see figure below). Considerable learning also occurs from students actively developing practical skills in analysis allowing them to develop new information about the world (e.g., learning practical skills in analysis from doing lab experiments or conducting fieldwork, writing dissertations). Some learning also occurs from analyzing attempts to create solutions and enact change. Rarely, however, does learning occur in the active creation and enaction quadrant, such as by learning to actively create and test solutions or through trying to enact change. This is needed to develop embodied know-how for working with climate change (e.g., to help create change and rapid carbon reduction). Much greater attention is then needed on active creation and enaction.



The active creation and enaction quadrant can be applied to many areas of knowledge creation and learning. It is particularly needed in five areas where knowledge advances and capacities are currently very limited and which are needed in most professional settings or environmental studies (see **Table 2**):

- Creative development of solutions and approaches (e.g., learning from trying to bring about change, creative development of designs and possible solutions, and the complex human social challenges involved);
- Working with uncertain and desired futures (e.g., learning how to apply futures methods and supporting actions to bring desired futures into being, which requires very different kinds of orientations and considerations of what constitutes evidence or truth, and developing futures consciousness and new practices around different orientations to time);
- Working with complex interrelated challenges (e.g., developing know-how to engage with and intervene in complex systemic challenges);
- Working with highly contested issues (e.g., developing know-how by actively applying dilemma resolution, mediation practices, or deliberative democracy processes such as citizen assemblies);
- Stewarding systemic and transformational kinds of change (e.g., developing know-how from actively working to try and instigate transformative outcomes or stewarding system transition in the real world).

While being extremely powerful in generating certain kinds of knowledge, the dominant assumption of observer-independence as being the hallmark of “robust” knowledge has led to reduced acceptance and production of other knowledges (Fazey et al., 2018). The assumption has, for example, contributed to greater emphasis on the value of abstract epistemic knowledge presentable in written form. This has been at the expense of embodied knowledge needed to support change, including “technical” know how (*techne*) and knowledge about what constitutes ethically “good” or “right” ends and ways to get there in a particular time and place (*phronesis*) (Vogt and Weber, 2020). While emphasis on episteme is not inherently

wrong, it has led to a focus on analyzing problems rather than how to shape societal change toward addressing them, as highlighted in the work presented in most scientific global environmental reports (e.g., IPBES, 2018; IPCC, 2018). Developing the kinds of knowledge and capacities the world urgently needs, including the critical thinking and capacities for stewarding transformative change in our graduates (e.g., **Table 2, Box 1**), will require learning from being actively involved in “doing” or “making” (Boiral, 2002; Johannisson, 2011). Yet such knowledge is often not accepted or supported because it violates the assumption that “good” science comes from standing apart from the object of study, looking at it from

the outside rather than learning from within (Fazey et al., 2018).

The assumption of observer independence underpins many aspects of how our universities have developed and what is supported and emphasized. In the USA, for example, universities in the 1960s were developed explicitly to be separate from practice because of beliefs that maintaining distance enhanced creation of more robust and value-free knowledge (Gordon, 2014). The assumption is also linked to implicit theories of the relationship of knowledge and change, such as the idea that change occurs by first creating knowledge independently then disseminating it to other “users,” rather than from much more nuanced forms of sensemaking, co-creation, action, and social learning where researchers are just one of many kinds of knowledge creators (Wittmayer and Schöpke, 2014; Fazey et al., 2018).

The assumption also partly explains the prevalence of didactic approaches to teaching, where knowledge is assumed to be something produced independently which can then be passed on in inert form (Fazey et al., 2014) as opposed to something developed through complex interactions between tacit and explicit understandings and developed through experience (Nonaka et al., 2000; Boiral, 2002; Johannisson, 2011). Prevalence of particular notions of knowledge and learning limit our ability to bring in alternatives, such as learning from all of our senses rather than primarily from the sharing of codified understanding of the world produced by someone else or of what is already known (Jinan, 2014). Modern notions of learning can make it difficult to step out of existing systems and paradigms (Jinan, 2014) and doing so, such as moving beyond high carbon paradigms, then greatly depends on what we think cognition, knowing, and learning is and how it occurs. Transformations in cognitive science and understanding of the mind are paving the way for new paradigms of learning (Eyre and Fazey under review¹), but this new understanding is still a very long way off from being embedded in education.

Acceptance of the validity of assumptions about observer-independence or particular notions of knowledge, knowing, or learning has also enabled certain kinds of structures and business models in our universities. Large lecture halls designed for mass delivery of information and teaching in quantities, for example, has been enabled by assumptions that education is possible as a process of transmission rather than, for example, competence development (Wilhelm et al., 2019). Instead, students need to develop practical experiential knowledge and opportunities for more co-creative learning so they can be more effective change-makers (Caniglia et al., 2016; Wilhelm et al., 2019). Imagine an alternative to the transmission model: empowering students from different programmes to collectively and creatively establish low-carbon practices within a university. Such an approach could unlock one of the biggest and most abundant resources available to a university (its students) while also stimulating the development of a very different kind of knowledge and student experience. To do this, however, requires challenging existing

notions of learning, teaching, structures, and business models (Perello-Marín et al., 2018) as well as the assumptions, conceptual foundations, and values underpinning current practices (Freire, 2014; Lotz-Sisitka et al., 2015; Shephard et al., 2017; Lambrechts et al., 2018). It also requires overcoming the wider societal trends toward commercialization of education based on neo-liberal ideals that harness mass education and science as part of knowledge based economies (Lave et al., 2010; Olszen, 2016).

The prevalence of particular assumptions about knowledge and knowing are just some of the kinds of conceptual foundations of modern universities that will probably need to be challenged if we are to be able to respond effectively to manifest and more operational emergencies. Overcoming the conceptual challenges is not easy because the underlying assumptions are so deeply entrenched within students, staff, and the wider education, sociological, and economic circles of influence in which universities are embedded. There are, of course, many examples of innovations seeking to challenge a variety of assumptions (Rodríguez Aboytes and Barth, 2020). Yet many fail to result in change more widely or dissipate when a particular innovative faculty member moves on. For universities to provide the global leadership that climate change demands, bold and strategic systemic action will be needed that challenges ideologies and dogma that hold current patterns in place. To do this then requires universities and their leaders to address critical existential challenges that climate change brings.

Existential Emergencies

In addition to manifest and conceptual emergencies, universities now face existential climate emergencies (Table 1). In general, existential climate emergencies include threats to physical existence (e.g., of a species, or family), but also to cultures, identity, and psychological well-being. Examples of existential emergencies include impacts from climate change on indigenous cultures (Jaakkola et al., 2018), city identities (Bremer et al., 2020); threats to actual existence, such as from sea level rise and land loss (Connell, 2016; Bengé and Neef, 2020); and the psychological, such as the growing mental health issues emerging as climate change threatens notions of who we think we are (Middleton et al., 2020) and the challenges of trying to make sense of oneself in a world of rapid change, increasing uncertainty, and sense of uncontrollability (Panu, 2020).

When faced with such challenges the question “what are the right things to be doing?” is replaced with a need to re-evaluate “what is right?” and more existentially “who am I?”. This applies to individuals and organizations with some CEOs of fossil fuel companies, for example, beginning to advocate for a fundamental identity shift from being an industry of conservative upholders of the status quo—arguing they are important because they support an energy dependent society and economy—to being aspirational leaders of the global change (Schuller, 2020). Such shifts are being driven partly because of a need to navigate direct threats facing the oil industry: a growing population of environmentally concerned millennials, environmental activism, and racial and social justice movements (Schuller, 2020). Universities also face similar threats, as well as others relating to wider societal shifts in the extent to which they are perceived to be of value, and

¹Eyre, L., and Fazey, I. (under review). Perception as a domain of transformation. *Sustain. Sci.*

especially in relation to the way society is struggling to make sense of twenty-first century challenges like climate change.

Importantly, the conceptual emergencies, such as responses to the need for new forms of knowledge creation or teaching, cannot be achieved without a shift in sense of purpose, role, and of whom one seeks to serve. For example, to facilitate the kinds of learning that leads to the development of wisdom about how to act in the world rather than just understand it (Maxwell, 2007, 2021), re-purposing universities for human development that attends to the whole person, including the emotional, spiritual, and embodied knowledge as well as the cognitive and technical is required (Moser and Fazey this issue). Very few courses or universities do this, and doing this well requires a new ethic of responsibility, philosophy, identity, and sense of purpose.

The trends, however, are starting to point toward an emerging shift. The University of York, UK in which some of the authors of this paper are based, for example, is exploring how to renew its commitments to being a university for the public good (Box 2). There are also many others struggling with an identity crisis and how they can overcome challenges of sunk costs, outdated models of learning and research, and old notions of purpose. New online universities are emerging with a more clearly defined purpose, such as Ubiquity university, which is a new accessible online University providing fully accredited degrees in global caretaking (<https://www.ubiquityuniversity.org/>). This brings together different kinds of provision from different places, but with the goal of supporting a flexible education focused on capacity for action and personal development. The online model, for all the strengths and weaknesses this might bring, also allows for diverse contributions from across the world and reduced high carbon travel. Another example is the London Interdisciplinary School, being developed in partnership with the UK government, that has a distinct challenge-oriented purpose, with degrees on issues like climate change as opposed to disciplinary-based subjects (<https://www.londoninterdisciplinarityschool.org/>). While still in development, it is intended that its structures will be based around challenges, not around disciplinary based models from the past.

These examples might be seen as disruptors taking up new emerging market opportunities given shifts in demand and potentially creating space for other, more radical innovations to emerge. There are also more radical initiatives that represent deeper value base shifts. Clark University (Worcester, MA, USA) has launched a university-wide participatory dialogue, called the *New Earth Conversation* (newearthconversation.org) asking how they should educate now for the world they wish to see. This has included introducing innovative transformative pedagogical forms and practices across the curriculum, asking students, faculty, and staff involved to enter a deep reckoning about the past, the present, and responsibility toward the future. Another is H3Uni (University of the Third Horizon) (<https://www.h3uni.org/>) and closely affiliated IFF (<https://www.internationalfuturesforum.com/>) which support development of know-how about working with complexity and transformational change. These radical innovations have significantly different value orientations to existing educational patterns, such as H3Uni and IFF being based on values of knowledge accessible to

all, presenting their work through open-commons licenses. They have emerged as potential pockets of the future in the present and explicitly external to existing universities in part because the current systems and structures would not support what they have been attempting to do. These smaller, more radical, innovations paint a particular visionary picture about the potential for a new kind of university for the public good in a future world with a different ethic, ethos, and value base.

Importantly, all of the examples—both disruptive and potentially more transformative—have considerable clarity about their purpose and mission that reflects a sense of how a shift in the wider social and economic landscape is changing. Rather than starting from a purpose based on a more general view that education is good or that producing more of the same kinds of knowledge is enough, they explicitly focus on addressing societal challenges and/or goals. The examples are also often underpinned by a deep foundational ethic—not just market-oriented values—about how they engage with society and those seeking to bring about change. This often includes recognition they may be as much a part of the problem as a solution and that transformations personally or institutionally may be required if transformations are to be achieved more widely. By addressing existential issues, changes in the conceptual domain then become possible, such as having a more explicit orientation towards the public good in a world of change leading to new assumptions about the kinds of capacity development needed for graduates, the kinds of education needed to achieve it or the way in which researchers may see themselves as co-creators of change, not just knowledge. In essence, while universities need to simultaneously work with all three kinds of emergencies, without addressing the existential issues, the systemic changes that will be needed for universities to be viable in the longer term will not come about.

HOW CAN UNIVERSITIES RENEW THEMSELVES IN THE FACE OF CLIMATE EMERGENCIES?

All three emergencies exist for universities in the present. It is an extremely important step to acknowledge their existence and that they can only be overcome by working with all three simultaneously. This is because this recognition leads to an inevitable conclusion that current patterns and ways of working will not be viable and that viability will only be achieved through transformation. The core challenge facing universities is thus to move from discussions about “what change” to asking “how” system transition might be brought about. There are many useful insights from the rapidly growing field of system transition and transformation that can help such stewardship, including a diverse array of frameworks and studies (Geels and Schot, 2007; Westley et al., 2011; Markard et al., 2012; O’Brien and Sygna, 2013; Feola, 2015; Fazey et al., 2017; Victor et al., 2019). We do not draw on all of this work here and instead focus on recent research on the different ways system transition can occur (archetypes of system transition) (Leicester and Fazey under review²). This

²Leicester, G., and Fazey, I. (under review). Archetypes of system transition and transformation. *Energy Res. Soc. Sci.*

BOX 2 | The University of York's search for a new identity

The University of York is currently undergoing a re-evaluation of purpose, driven by visionary leadership. This has included using a guiding goal to renew the University's commitment to being an institution for the public good (<https://features.york.ac.uk/vision-for-york/>). The University of York is exploring how partnerships and contributions can be strengthened locally while also expanding how our University serves and has impact nationally and globally. This deep revisioning has included divesting from fossil fuels and developing carbon emission targets, as well as beginning to try and work out how to tackle wider complexities associated with responding to climate change. The renewed commitment to being a university for the public good has provided a helpful frame around which conceptual issues can begin to be explored, such as new structures that help work across traditional boundaries. This, in turn, is surfacing some of the limits of disciplinary thinking and other conceptual challenges involved and raising challenging conceptual issues around how best to cohere activities to generate outcomes greater than the effects of the individual parts.

recent work is particularly helpful because it provides some core lessons for how change might be stewarded and how different aspects relating to all three emergencies might be considered together. Four of these archetypes are presented and explained in relation to universities in **Box 3**.

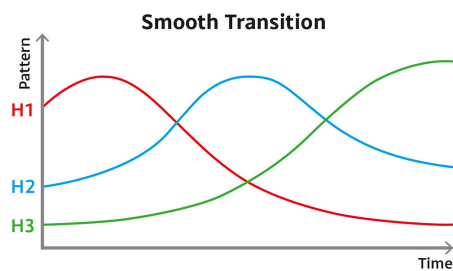
To appreciate the relevance of the archetypes to universities, it is important to understand the basic heuristic, which is called Three Horizons (see "Smooth Transition," **Box 3**) (Leicester and Fazey under review², Sharpe et al., 2016). In this heuristic, the future is viewed as emerging through three overlapping horizons. The first horizon (red line) represents the existing pattern of technologies, behaviors, systems, norms, modes of governance, cultures, values, identities, skills, or orientations (reflecting the different components of all three emergencies). This first horizon pattern naturally begins to decline as the wider landscape or context changes, such as due to climate change, shifting markets, or changes in digital technology. The third horizon (green line) then represents a pattern of an envisioned system that would be viable in the future. The second horizon (blue line) is the intermediary transition space where disruptive innovations and actions help create space for the third horizon pattern to grow. In the heuristic, all three horizons exist simultaneously—in the present, medium, and longer term—albeit to greater or lesser extents. Elements of the first horizon pattern are, for example, maintained in the future third horizon dominated pattern, highlighting that not all is thrown out in a process of system transition. Examples of the third horizon may also exist as pockets of the future in the present which are often perceived as radical because they are underpinned by a different value base and do not fit the norm. Again—while there are many theories and three horizons has its limitations—we have found the simplicity of the heuristic to be very helpful for actors trying to understand how present actions can strategically and more effectively be used to bring about systemic kinds of change and for enhancing their consciousness about relations between present and future (Sharpe et al., 2016; Fazey et al., 2020).

While the heuristic can be applied at various scales, for this paper we generally imagine it to represent how a single university might undergo transformation. This process is then imagined to be occurring within a wider educational and societal landscape or context, which itself is undergoing significant change in response to, and with, a changing climate. How actors act within and around universities shapes the systemic transition

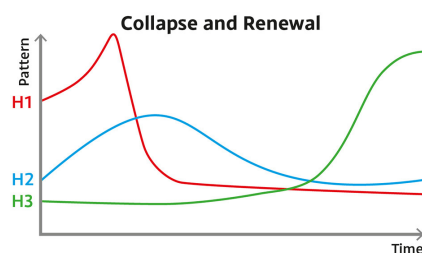
of a particular institution (**Box 3**). The four major archetypes (including the Smooth Transition) all represent a process leading to a new systemic pattern. But each archetype also differs in how system transition emerges, how fast, and how much pain is experienced along the way. Specific lessons can be drawn from each archetype as explained in **Box 3**. Here, however, we focus on the wider lessons that come from considering all of the four archetypes together.

The first wider lesson from the archetypes is the need to maintain transformational intent. Without doing so it is very difficult to support smoother transitions. Transformational intent stems from recognizing the existence of all three emergencies. This leads to an inevitable conclusion that being viable can only be achieved through transition to a fundamentally new pattern that includes shifting identity and purpose (addressing existential issues) and then cascading this down to operations. The example of the University of York is a good one here. While it is still in its very early stages of change and very many challenges remain, its shift to renewing a commitment as a university for the public good is deeply significant. It then, however, requires continued transformational intent and active management of this process. This includes recognizing transformation is a qualitatively distinct form of change compared to, for example, adjustments or reforms which generally involve keeping a system the same. Maintaining a focus on transformation can be helped by strategically scanning for changes in the wider landscape and active alignment to this, such as using emergence of lower carbon economies to stimulate changes in structures, estates, pedagogies, or operational models. Decarbonization can thus be viewed as a powerful opportunity for disruption and renewal rather than just another issue on a long list of difficult things to do.

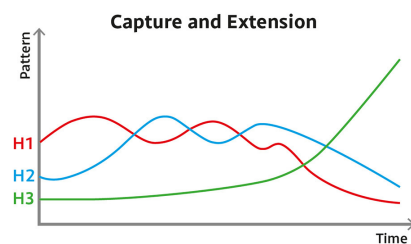
The second lesson is that stewarding renewal requires actively overcoming powerful existing patterns through gradual re-allocation of resources from the old to a new pattern. Failure to actively steward this process may result in delay (Capture and Extension, **Box 3**) or even collapse (Collapse and Renewal, **Box 3**). Active re-allocation can be achieved through rigorous experimentation and innovation while slowly decommissioning the existing dominant system over time. Successful system transition will, however, only be achieved if there is a general core commitment to the eventual vision and active support from those at the highest levels within an institution who are

BOX 3 | Archetypes of system transition for a University and different ways renewal might emerge

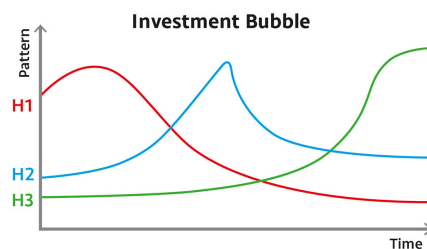
Smooth Transition involves a relatively orderly change through gradual dissolution of the old pattern, reconfiguration of its resources, and then creating something new. In this archetype the need for fundamental change and re-purposing is recognized early. Innovations that actively seek to disrupt current patterns and thinking are actively established. For example, rather than simply restructuring departments to enhance efficiencies, restructuring a University would also focus on disrupting disciplinary silos, creating novel configurations, and allowing for gradual transitions in faculty expertise or shifts in teaching. Opportunities for disruption might also be actively sought, such as using ambitious carbon emission targets that force structural and other kinds of change. At the same time, more radical innovations representing pockets of the future in the present (H3 innovations), would be purposefully encouraged and protected, to allow emergence of a fundamentally new pattern to grow with support from disruptive second Horizon innovation.



Collapse and Renewal arises when the existing system is under threat and the response is to double-down to protect and reinforce the status quo. Collapse follows when resistance to forces of change becomes impossible. Here, relatively successful incumbents may not acknowledge their model is failing as faculty and students seek something more meaningful elsewhere. Disruptions to student life through the current pandemic, for example, may lead to greater questioning of the value of a university education. A wide range of non-radical innovation is also likely, such as in better marketing of existing programmes, targeting higher student numbers or more profitable market segments, or broadening the income portfolio by building new student accommodation. None of these innovations fundamentally address the changing pattern of what students need to learn or what faculty might most valuably research, and how. The collapse scenario will likely arise in the sector as a whole rather than the failure of single institutions as forces of change overpower obsolete models. While this scenario suggests renewal after collapse, renewal is not guaranteed.



Capture and Extension occurs because of a strong gravitational pull of the dominant pattern and the way market mechanisms and government higher education policy are primarily concerned with maintaining and improving existing systems, rewarding efficiency, and supporting incumbents. Here, new, potentially disruptive second horizon innovations begin to emerge but these are co-opted to support the existing first horizon pattern and the maintenance of the status quo. The result is a delay of the emergence of the third horizon pattern. Initiatives to promote inter- or trans-disciplinary research, for example, typically fail to achieve their full potential because of the enduring strength of the structures of incentives that keep siloed, individual disciplines in place. Commitments to become “carbon neutral” also tend to be managed so as not to disrupt the status quo too dramatically, such as by drawing narrow boundaries around what is taken to fall within the university’s responsibility. As with Collapse, the ultimate outcome is a delay of the transition, with lost time, energy, effort, and resources.



The Investment Bubble emerges through herd phenomena where there is a rush to a “silver bullet” solution. Attention and investment is drawn toward a single idea or innovation which cannot bear the weight of expectation and eventually disappoints, releasing resources for redistribution elsewhere but delayed eventual emergence of a new pattern. Examples of silver bullets could include a rush to technology to support virtual and blended learning following the pandemic, a new set of measures or indicators for an institution’s carbon emissions in the race to zero, or shorter, cheaper degree courses in response to student attitudes to debt in a recession. Each of these might come to attract considerable attention offering significant short term gains. Those gains, however, may be short lived as other, more significant factors, come to prominence and attention inevitably shifts.

willing to make difficult choices and resist the lure of quick wins that reinforce the existing pattern. To date, promising second or third horizon transformative innovations in universities, such as those attempting to change operations, pedagogies, and conceptual foundations associated with manifest and conceptual emergencies, are easily suppressed or drawn back to maintain the existing dominant system. The Capture and Extension archetype (Box 3) is particularly common in universities because they, like many public bodies, are held in check by a strong public mandate, such as societal dependence on universities to maintain certain patterns of employment and education. Active focus on re-allocation of resources and bold and strategic leadership that attends to all three emergencies is thus needed for successful transformations to occur.

The third lesson then stems from the second, which is that effective transformation requires stewarding an effective interplay between three qualitatively different kinds of innovations: First horizon innovations to support existing systems and avoid collapse; second horizon innovations to create disruption and space for more transformative innovations to grow; and third horizon transformative innovations that embody a new value, identity and conceptual foundation that becomes the desired and envisioned future. As highlighted above, the focus in most universities is on “improving” kinds of first horizon innovations to overcome the manifest emergencies. This leads to a very powerful first horizon capable of continued reproduction and overcoming questions about “what are the right ways of doing things.” However, it is not capable of

addressing the more difficult issues around “what are the right things to be doing” or “what is right.” The result is considerable innovation to improve existing systems and some innovation that may be disruptive, but very little attention to how this genuinely supports or hinders systemic change. Instead, improving and disruptive innovations need to be part of a much more explicit strategy that also recognizes the need for transformative innovations and integrating all three kinds of innovations in ways that lead to a major pattern shift.

Fourth, system transition requires effective interaction between three different orientations to the future. These include first horizon managers who are essential to ensure the system doesn't collapse; second horizon entrepreneurs who tend to be interested in seizing on opportunities available to help disrupt the status quo; and third horizon visionaries who tend to see the longer-term vision and are interested in helping more transformative innovations emerge and establish themselves. Enabling smoother transitions, for example, requires a careful collaboration between first horizon managers and third horizon visionaries to actively enable re-allocation of resources over time. Here managers need to maintain a diversity of approaches, be open to new thinking, not get locked into a dogmatic or ideological set of assumptions or identities, and be encouraged to see their actions as vital for change, not just resistors of it. The visionary innovators need to maintain integrity of the future vision and find ways to work with other actors who do not see or share their vision so resources can be gradually re-allocated. In effect, recognizing and working with different orientations to the future and change—ontological shifts in relation to time and action (Hodgson, 2013)—is an example of how new conceptual understandings and practices associated with the conceptual emergencies needs to be applied back into our universities if system transition is to be successful.

Fifth, four modes of governance and infrastructure are needed to simultaneously support smooth transitions (Leicester and Fazey under review²). Smooth transitions are generally rare, and when they do exist it is more common in technology and commerce. Here, governance and infrastructure exist for: (1) managing stable and less risky activities in the first horizon (e.g., pension funds); (2) start-ups and disruption in the second horizon (e.g., by markets that are generally open to risk and failure); (3) exploratory third horizon innovations (e.g., government or other research funding); and (4) overarching support to help govern the interplay between the three other forms of governance and infrastructure. All four, for example, were critical in transitions from horse drawn carriages to automobiles (Geels, 2005) and creation of the National Health Service in the UK (Rivett and Blair, 1998). In universities, there is extensive knowledge and infrastructure for governing the first horizon and for the second through innovation and seed funding. However, what is almost always lacking are mechanisms to support and enable transformative third horizon innovations and higher level strategic management that re-allocates resources from the first to the third horizon. Thus, while there is often

a huge intellectual resource and many ideas about the need to address existential emergencies, the infrastructure and different understandings of governance itself are rarely present to enable shifts to occur. Without building all four kinds of governance, supported by active acknowledgment of the existence of all three emergencies and transformational intent, smooth transitions do not occur.

Finally, as with most organizations, capacity is also generally lacking around how to stimulate system transition within universities. Skills and capacities needed for introducing the new in the presence of the old, for skilful and creative disruption, and for effective transition requires active development of new management, communication, engagement, governance, policy, and finance capacities. Core to this is recognition of the qualitatively different kinds of change involved; the need to support personal development among actors to transcend old patterns, habits, and thinking; and abilities to work with systems as a whole. Universities, as institutions squarely in the domain of knowledge creation, have an advantage given their extensive internal expertise. Yet the capacity limitations for internal change are often the same for the limits universities have for supporting change externally (e.g., capacities outlined in **Table 2**). Importantly, the more actors can be involved in developing understanding of how to work with transition, the quicker, more effective, and less painful any transition will be. Universities thus need to develop a range of initiatives within their institutions specifically oriented to support transformations that are different to traditional personal development training that tends toward management of the status quo.

In summary, universities are being required to respond to a rapidly growing combination of manifest, conceptual, and existential emergencies while experiencing them at the same time. The tendency is to try and innovate, but many innovations are not sufficiently oriented toward supporting the dynamics of creative destruction and renewal or are not sufficiently directly oriented toward addressing conceptual and existential issues. The first horizon pattern is also usually highly pervasive because of the way staff and students continue to participate within and reproduce them. Models of leadership training are designed for good management not transformation, and there is usually very limited appreciation of how to unleash capacities for creative destruction and renewal. Universities do, however, have an advantage in that they are relatively unique in being both part of the transition to a more viable world while also being a potential catalyst for transformation beyond their institutions. Yet it is here in which a major irony lies: To effect change in the outside world universities will have to change on the inside and overcome the same kinds of conceptual emergencies facing society more widely to which humanity's capacity is seriously cognitively and emotionally ill-prepared. Universities will therefore need to match a renewed sense of purpose in society by rapidly accelerating development of new approaches and thinking that enable them to authentically bring change into being for themselves. They will then be in a much better position to be able to enact change on the outside.

CONCLUSIONS

Universities are some of the longest standing human institutions on the planet, with the oldest surviving being the University of al-Qarawinyin in Morocco, founded in AD 859. The endurance of universities over the centuries has largely been possible by holding together established communal practices of inquiry, communities of scholars and students, and governance structures to support them. Forms of inquiry have adapted to the times, such as shifting from dialectical argument around a disputed question to involving processes of empirical observation, induction, hypotheses testing, and experimentation (Jenkins, 2018). These methodological advances, which developed over the last three centuries, have been and will continue to be incredibly important. Yet the world is entering a new era in which universities in their current form do not provide what human civilization now needs for a sustained and thriving existence on an endangered planet. Universities urgently need a renewed sense of being an institution serving the public good in a world of existential challenges. They need an unwavering challenge-orientation, post-disciplinary thinking, and an action-orientation. They need to employ experiential pedagogies and forms of knowledge creation that overcome the thinking and practices that have led to our current societal challenges while authentically being the change they seek to bring to the world.

Given the extent of global changes, major change and transformation of universities—including collapse for some—is inevitable. Assuming humanity survives climate change, there will also be an inevitable and eventual emergence of a new enlightenment of science based on a new “grammar of responsibility” (Vogt and Weber, 2020). Yet, as highlighted by research on sustainability transitions even when the need for change is accepted, how, when, and the extent to which individual institutions choose to engage greatly matters. Smooth transitions are far from guaranteed and many universities will not survive the great changes that will occur in society from climate change.

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Effective stewardship is thus required for successful transition to occur, including maintaining transformational intent; harnessing opportunities to disrupt the status quo; supporting effective interplay of different forms of innovations and understandings the present and future; and developing new modes of governance and capacities. A good place to begin renewal is thus to accept the inevitability of climate change and strategically work with transitions to low carbon as an ally to stimulate structural, conceptual, and existential change while also surfacing and addressing head on deeply held assumptions, ideologies, dogma, and sacred cows. By actively developing capabilities to support transformative change toward low carbon on the inside, universities will then be in a much better position to help and lead others in the world beyond the halls of the academy.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

IF was the primary author of the manuscript, with conceptual development, and writing contributions input from all other authors. All authors contributed to the article and approved the submitted version.

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