

# Implementing Climate Change Research at Universities: Barriers, Potential and Actions

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## Abstract

Many universities around the world have been active centres of climate change research. However, there are a number of barriers to climate change research, stemming both from the nature of the research and the structure of institutions. This paper offers an overview of the barriers which hinder the handling of matters related to climate change at institutions of higher education (IHEs), and reports on an empirical study to investigate these barriers using a global survey of higher education institutions. It concludes by proposing some steps which could be followed with a view to making climate change more present and effective in university research and teaching. These include changing approaches to research, outreach and teaching to better support action on climate change.

(9000 words, including references)

## 1. Introduction

1 Many universities, or more generally institutions of higher education (IHEs), around the  
2 world have been centres of climate change research. However, there are a number of barriers  
3 to climate change research, related to both the nature of the research and the design of  
4 institutions. This paper uses a theoretical and empirical approach to identify those barriers  
5 and highlight the potential of IHEs to improve climate change research. It proposes possible  
6 actions for both those researching climate change at IHEs and the managers and  
7 administrators in IHEs. These suggestions will help universities to better support climate  
8 change research and, more importantly, support significant action on climate change.  
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10 The barriers to climate change research in IHEs are well documented in the literature and are  
11 discussed briefly below to provide some context of the issues. The following section then  
12 discusses how considering the moral dimension of climate change can highlight the potential  
13 for IHEs to better address the climate change challenge. The empirical work detailed in the  
14 next sections reveals how universities face these barriers and seek to address them. The final  
15 section draws the theoretical and empirical studies together to produce future actions for  
16 universities and other IHEs to expand their role in addressing climate change.  
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21 To begin with, it should be noted that climate change can be regarded as a ‘wicked problem’,  
22 as it is both complex and uncertain, and lacks definitive, objective straightforward solutions  
23 (Rittel and Webber, 1973). Climate change research aims to establish a detailed  
24 understanding of the effects of increasing carbon concentrations in the atmosphere, and  
25 translating those into impacts on environmental, ecological and social systems. Hence,  
26 climate change research studies complex systems, initially atmospheric, but also impacts of  
27 those changes on other biophysical and socio-ecological systems (and in turn socioeconomic  
28 systems) (Rind, 1999; Simon and Schiemer, 2015).  
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32 All of these systems are characterised by complexity – there are feedback loops (creating  
33 potential tipping points) making simple, linear cause and effect relationships hard to identify.  
34 (McGuffie and Henderson-Sellers, 2001; Rind, 1999; Shackley et al., 1998). While climate  
35 modelling has developed rapidly, there is still development needed to improve them for both  
36 research and decision-making processes (McGuffie and Henderson-Sellers, 2001; Moss et al.,  
37 2010).  
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41 This complexity means that many aspects of climate change are beyond predictive modelling.  
42 Hence, research has to rely on alternative ways of understanding these systems and testing  
43 findings that does not rely on traditional prediction and replication (Holm et al., 2013;  
44 Mooney et al., 2013; Yeh, 2015). At the same time, human systems involve values, emotions  
45 and ethical questions, especially over equity (Mearns and Norton, 2010). The increasing  
46 focus on climate change adaptation research, which focuses on the social response to  
47 biophysical climate change, highlights the complexity of climate change research (Füssel,  
48 2007; Tol, 2005). As we discuss below, this need to consider the moral and ethical elements  
49 of climate change has significant implications for the role of IHEs.  
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53 One result of this complexity is the uncertainty that surrounds climate change research  
54 (Barnett, 2001). Climate change fits the criteria of post-normal science, in that it is both  
55 highly uncertain but with very high stakes (Funtowicz and Ravetz, 1993; Ravetz, 1999). This  
56 challenges many of the established processes for doing research by requiring the inclusion of  
57 range of other knowledges (e.g. Indigenous/traditional knowledge, local knowledge, policy  
58 knowledge) into the traditional scientific process (Yeh, 2015).  
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1 This uncertainty creates challenges for communication as well: communicating that  
2 uncertainty without undermining trust in the research is a challenge (Dessai et al., 2007;  
3 Heazle, 2010; Moss, 2007). Developing climate change research that provides  
4 straightforward ‘solutions’ to problems is often impractical; researchers must balance the  
5 need for cutting-edge, theoretical research with demands for applied, ‘policy-relevant’  
6 science.  
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8 The complex nature of climate change means that any study of it requires a highly  
9 interdisciplinary approach (Olsen et al., 2013; Yeh, 2015). Climate change research has to  
10 consider the social, economic and political relationships around climate change, as  
11 recognised in the IPCC reports. The challenge of interdisciplinary research is well-known  
12 (Olsen et al., 2013; Reisinger, 2011; Yeh, 2015). Existing research silos and increased  
13 specialisation have created barriers to collaboration across disciplines. The different  
14 approaches of natural and social sciences, in particular, provide difficulties in establishing an  
15 integrated approach as they often work to different ontologies, epistemologies, and  
16 methodologies (Holm et al., 2013; Mooney et al., 2013; Yeh, 2015). Further, the post-normal  
17 nature of climate change means that interdisciplinarity also needs to include and engage with  
18 a wide range of stakeholders (e.g. policy-makers, managers, decision-makers, industry,  
19 communities etc.) as part of the research process, thereby becoming transdisciplinary  
20 (Bäckstrand, 2003; O’Brien et al., 2013). However, as we discuss below, overcoming this  
21 barrier is key to realising further potentials for climate change research at Universities.  
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23 Researchers looking to address these barriers have highlighted how pedagogical approaches  
24 can encourage learning and critical thinking about climate change. Bardsley and Bardsley  
25 (2007) described a constructivist approach to teaching and applied learning to stimulate the  
26 analysis of the potential impacts of climate change on systems familiar to high school  
27 students, resulting in students discussing possible behavioural and broader personal responses  
28 to reduce the impacts of future climate change. Aaron et al. (2013) highlighted that the  
29 challenge of climate change offers educators in science, technology, engineering and  
30 mathematics (STEM) fruitful opportunities to foster interdisciplinarity, fostering youth talent  
31 in STEM fields and enhancing multiple literacy for all students. Hence, there are  
32 opportunities for IHEs to support climate change action that is sorely needed (Leal Filho  
33 2014), but there are a range of institutional barriers.  
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35 Although there is some literature on barriers and critical success factors for the integration of  
36 sustainability in higher education (see for example Veiga Avila et al., 2017; Baker-Shelley et  
37 al., 2017), the present study provides an original perspective by focussing on research (and  
38 not on curriculum development or campus management) and by specifically focusing on  
39 climate change, which is rapidly becoming the most pressing sustainability issue.  
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### 41 **1.1 Institutional Barriers to Climate Change Research: The Challenge for Universities**

42 Before entering into the empirical elements of the work described in section 3, it is important  
43 to acknowledge the fact that the complex, uncertain and interdisciplinary nature of climate  
44 change research results in a number of institutional barriers. The complexity can test the  
45 resources of research institutions. Climate modelling, for example, requires extremely  
46 powerful (and thus expensive) computing technology to create computational models of the  
47 climate system. It is notable that most climate models as used by the IPCC have been created  
48 by centralised national scientific centres (e.g. NASA, the Met Office and CSIRO).  
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1 The need for interdisciplinary approaches also creates barriers. Departments tend to be set up  
2 around traditional subjects. Although there are increasing efforts to create interdisciplinary  
3 research centres, publishing and funding mechanisms continue to encourage a disciplinary  
4 focus. Research funding is generally assigned through a competitive process, with experts  
5 peer-reviewing proposals to identify those considered the best. Criteria are highly varied and  
6 changing, but the expert peer-reviewers are generally senior academics that have highly  
7 specialised expertise (Holm et al., 2013). Interdisciplinary projects can struggle to attract  
8 support in this environment. Although research funders recognise the need for, and want to  
9 encourage interdisciplinary approaches, there is little clear guidance on criteria for  
10 recognising interdisciplinarity. As Holm et al. (2013, p. 32) note:

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13 “The problem may be that academic research prioritises single-lens in-depth study while  
14 multi-lens perspectives need to be assessed against an excellence standard which is not  
15 available – or not in use to this point.”  
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18 At the same time perceptions of what climate change research ‘looks like’ might mean that  
19 many valuable research areas are not considered – some disciplines or research areas may be  
20 overlooked (Holm et al., 2013). The growing focus on climate change adaptation highlights  
21 how social research into vulnerability, resilience and transitions has a key role to play in  
22 responding to climate change, but it is only recently that these might have been seen as  
23 climate change science (Moser, 2010).  
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27 Importantly, interdisciplinarity is more than making use of another discipline, there must be  
28 shared knowledge production and collaboration between disciplines; especially between  
29 natural and social sciences (Holm et al., 2013). The challenge for researchers is to build  
30 collaborations across these barriers and track down existing expertise, rather than try to  
31 ‘reinvent the wheel’ in an area that is not their field. However, the time and effort required to  
32 build collaborations for interdisciplinary and participatory approaches is not always  
33 recognised within IHEs (O’Brien et al., 2013; Simon and Schiemer, 2015). The formation of  
34 a team is often done informally through social networks, and this process has to compete with  
35 the increasing demands put on academics for publishing and securing funding.  
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39 These issues are all compounded by the focus on monitoring performance and competition,  
40 and the neoliberalisation of IHEs, combined with ever restricted funding (Ball, 2012). The  
41 ‘publish or perish’ attitude encourages researchers to take the path of least resistance to  
42 getting published to ensure they are competitive, which can discourage interdisciplinary  
43 papers and approaches. Move towards focusing on impact as a measure of academic success  
44 holds potential for encouraging more researchers to work on complex and interdisciplinary  
45 issues such as climate change (Simon and Schiemer, 2015). However, an overly managerial  
46 approach focused on easily measurable targets could prove problematic (Grant, 2012; Simon  
47 and Schiemer, 2015).  
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51 Finally, the issue of politics can provide a barrier to climate change research. Although many  
52 countries have research bodies that distribute funding, research is always affected by  
53 government priorities and climate change research can be vulnerable to the politics of the day  
54 (Simon and Schiemer, 2015). Furthermore, climate change is a highly political issue, and  
55 hence climate change research attracts significant scrutiny and attention. This can make  
56 research, and particularly communicating research highly challenging (Oreskes, 2004; Pielke  
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Jr, 2002). This may limit both research and its potential impact, as well as discourage potential researchers from engaging with the field.

## 2. Potentials for climate change research at IHEs

Despite the challenges discussed above, there is substantial potential for climate change research at IHEs. The United Nations (UN) recently called for IHEs to do more to combat climate change. Article 12 of the Paris Agreement directs parties to “enhance climate change education, training, public awareness, public participation and public access to information” (UNFCCC, 2015). The Higher Education Sustainability Initiative (HESI), created for the meeting of the 20th Conference of the Parties (COP 20), called for IHEs to improve their teaching, research, community engagement, and information sharing (UN Sustainable Development Platform, 2016). Calls elicited from these highly visible international organizations suggest that there are untapped potentials for IHEs to do more to address climate change.

Rather than merely echoing these calls for more research, teaching and community engagement, this section uses a moral framing of climate change to suggest two complementary ways that Universities can do more: broadening the definition of research to include non-STEM, and especially ethical, research and the leveraging the wider cultural significance of IHEs. This discussion provides the theoretical basis for analysing some of the empirical data in the following sections.

Universities are among the world’s best institutions for producing research: they house academic presses for books and journals, which are subject to strict peer review and set the standard for knowledge production; they attract significant public and private funding for laboratory and other studies; and they confer doctoral and other advanced degrees. Because academic degrees are the gold standard of research credentials, all research travels through universities, at very least, insofar as doctoral dissertations and other capstone projects for such degree are supervised by faculty at IHEs.

Perhaps one of the most important questions to ask when considering the potential for climate change research impact is to examine what counts as research in the first place: who is qualified to do research on climate change and how should it be done? And as suggested in Section 1.2, criteria for conducting and evaluating interdisciplinary research can serve as a barrier preventing scholars from engaging in such research. There has been a longstanding trend for STEM research to receive more attention and funding when it comes to climate change; for instance, in the United States, STEM fields receive more public funding because of their greater financial returns (Cohen 2016). However, STEM fields are not the only areas of research that are relevant to climate change. The world may currently be witnessing a shift in perspective which recognizes the shortcomings of thinking of climate change solely in terms of technical, scientific or economic problems.

Climate change is seen by some as a moral problem in part since its causes are connected to large CO<sub>2</sub> emissions from industrialised countries, whereas developing nations suffer the effects of these emissions. While a deeper discussion on this issue is outside of the scope of this paper, the moral dimensions of the problem should be acknowledged. Understanding and characterizing climate change as a moral problem is gaining wider currency in recent years:

1 from the most recent IPCC Assessment Report (Kolstad et al., 2014) to Pope Francis'  
2 Encyclical, *Laudato Si* (2015).

3 In its most recent Assessment Report, the IPCC Working Group 3 on Mitigation of Climate  
4 Change included for the first time a climate ethicist, John Broome, as a lead author of  
5 Chapter 3: “Social, Economic, and Ethical Concepts and Methods” (Kolstad et al., 2014). The  
6 chapter includes moral concepts such as moral responsibility, fairness, intergenerational and  
7 distributive justice, well-being, and non-human values. The chapter acknowledges that  
8 “ethical judgements of value underlie almost every decision that is connected with climate  
9 change, including decisions made by individuals, public and private organizations,  
10 governments, and groupings of governments” (Kolstad et al., 2014, 215). The moral concepts  
11 addressed by this work are for the first time receiving the same degree of publicity as the  
12 STEM fields have had over the past several decades. Broome’s material is understandably  
13 introductory and nowhere reaches the level of sophistication of similar discussions found in  
14 non-STEM forums. Nevertheless, his chapter paves the way for more substantial discussions  
15 to come.  
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21 Notably, Pope Francis has highlighted the significance of thinking beyond the technological  
22 and economic aspects of climate change. He appeals for “a new dialogue about how we are  
23 shaping the future of our planet” (Pope Francis 2015, 14). He cautions against endorsing the  
24 “extreme” positions of “those who doggedly uphold the myth of progress and tell us that  
25 ecological problems will solve themselves simply with the application of new technology and  
26 without any need for ethical considerations or deep change” (Pope Francis 2015, 60). In other  
27 words, Pope Francis’ widely read encyclical highlights the distinctly moral dimension of  
28 climate change that cannot be addressed by the STEM fields alone.  
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32 Moreover, a moral framing of climate change means that IHEs and researchers need to  
33 consider their responsibilities in ensuring that their research and its impact have positive  
34 effects. This is reflected in the growing interest in Responsible Research and Innovation  
35 (RRI) (Burget et al., 2017; Owen et al. 2012). This agenda highlights the need to ensure  
36 governance of research and innovation that is inclusive of other stakeholders and ensures that  
37 research addresses social and environmental issues (Stilgoe et al. 2013). It strongly reflects  
38 the recognition that many areas of research, including climate change, have become ‘post  
39 normal’ science.  
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43 There has been debate over whether considerations of the moral or axiological aspects around  
44 environmental issues make any substantial difference in the outcome of policies –  
45 fundamental to research having impact (Norton 1991; Stenmark, 2002). However, Stenmark  
46 (2002) shows how policy outcomes often vary widely depending on whether one adopts an  
47 anthropocentric, biocentric, or ecocentric axiological position. Similarly, Kassiola (2003)  
48 shows that if underlying social values and their by-products – e.g., the “ceaseless material  
49 consumption and the resulting overconsumption producing depletion of natural resources and  
50 environmental pollution” (Kassiola, 2003, 10) – are left unexamined, then it is possible new  
51 policies will unintentionally reproduce those values, treating the symptoms rather than the  
52 roots sources of our environmental problems.  
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57 For this reason, philosophy, and more specifically, moral inquiry, is an important tool for  
58 analysing climate change mitigation and adaptation strategies. Universities already house  
59 different departments and disciplines that conduct research into these areas in their own ways,  
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1 but there is untapped potential for these disciplines to come together to fully address the  
2 multidimensional challenges of climate change.

### 3 **2.1 Wider Cultural Significance of IHEs**

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5 Taking this consideration of moral responsibility further, aside from research and teaching,  
6 there is also potential for universities to leverage their position of cultural and social  
7 significance to help with climate change mitigation and adaptation efforts. Such institutions  
8 often have guiding mission statements that are explicit about their melioristic aims:  
9 promoting truths, improving the community, bettering the world for future generations,  
10 promoting ethical decision-making skills, and, most recently, goals regarding sustainability.  
11 These goals necessarily transcend practices found within classrooms and laboratories, and  
12 extend to the entire university or college community, as well as the larger communities  
13 within which universities find themselves.  
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18 Because of their social position and widely recognized cultural role, universities often  
19 possess a kind of moral authority when they take action. This authority is amplified when  
20 multiple institutions join efforts behind a common aim. Such networking is particularly  
21 important for addressing collective action problems such as climate change, in which no one  
22 agent or institution can do much to better or worsen the problem on its own. Two recent  
23 examples of this networking are HESI and the Fossil Fuel Divestment movement.  
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27 HESI was developed in preparation for COP 20+ in Rio in 2012, so although the initiative is  
28 committed to sustainability more generally, climate change is certainly part of its scope. The  
29 vast majority of the 300+ different organizations across nearly 50 countries are IHEs. The  
30 goals of members include providing leadership in sustainability initiatives and sharing  
31 information with other member organizations. The potential impact of these organizations  
32 grows as more institutions join, not just because more resources can be shared, but because of  
33 the symbolic and communicative effects of such commitment.  
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37 Similarly, the Fossil Free movement attracted US\$3.4 trillion in divestments by December  
38 2015 (Fossil Free, 2015). Many divesting institutions are IHEs. While some insist that  
39 divestment makes financial sense for schools wishing to maintain good returns (Dorsey,  
40 2014), the effects of divestment are not solely financial but also moral and symbolic. This  
41 was likewise the case with other divestment movements, most notably, the South-African  
42 anti-apartheid movement (Massie, 1997). Such mobilization, whether through networks of  
43 more direct action, also involves experimenting in new forms of political responsibility,  
44 which can be helpful in combating climate change as a form of ‘structural injustice’ (Godoy,  
45 2017).  
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49 Finally, IHEs also have political influence on governments, most likely because of their  
50 lobbying power as an industry. This is especially true when IHEs join efforts. Former  
51 Secretary of Education and Governor of Tennessee admitted:  
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54 “If five or six or eight of those [college] presidents say, ‘Senator Alexander, may we have a  
55 30-minute appointment with you while you’re home next month?’, I’ll do it in a minute. So  
56 will every other senator.” (Dancy and Laitinen, 2015).  
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59 Hence, the political nature of climate change is not only a barrier, as noted above, but also an  
60 opportunity for researchers and Universities to show leadership on climate change action.  
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1 This discussion highlights both barriers and potential avenues for climate change research at  
2 universities. However, addressing these challenges and tapping into the potential on the  
3 ground is not straightforward. The next section describes an empirical study to better  
4 understand these challenges and opportunities, to allow for a discussion of potential actions  
5 for IHEs and researchers.  
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### 7 **3. Barriers to implementing climate change research at universities: an empirical study**

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9 Previous work has focused on the relations between universities and climate change (Leal  
10 Filho, 2010), but many gaps still exist. In order to more specifically identify the extent to  
11 which some barriers are preventing the implementation of climate change research at  
12 universities, an on-line survey was performed involving the administration of universities.  
13 This section contains an overview of the empirical components of the work.  
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#### 16 **3.1 Methods**

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18 An online survey was carried out from 11<sup>th</sup> January to 11<sup>th</sup> February 2017 using Google  
19 Forms. The survey aimed to characterise the current status of climate change research and  
20 development activities, degree of awareness and integration, as well as the perceived barriers  
21 at IHEs. The survey instrument was composed of 13 questions (seven closed questions and  
22 six open questions) and structured in a way that it could gather information on the degree of  
23 priority given to climate change research, the resources made available to it, its strategic  
24 positioning at the university and the extent to which climate issues are being taught. The  
25 questionnaire survey was pre-tested by a panel of researchers from different R&D areas  
26 within sustainability at universities. A copy of the survey can be found in the Supplementary  
27 Information.  
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32 The survey was disseminated via email (in two calls, 15 days apart from each other) to the  
33 following groups: rectors and office managers of universities that participated in the Green  
34 Sustainability Metrics 2016; authors with more than 4 publications on the subject  
35 “sustainability at universities” as found through a search of the Web of Science citation  
36 indexing service between 2007–2016; and participants in the World Symposium on  
37 Sustainable Development at Universities, held in September 2016 at the Massachusetts  
38 Institute Technology in the United States of America. This yielded a total of 1,200 email  
39 addresses. The survey was sent to 48 countries spanning 5 continents.  
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43 Statistical analysis was performed on the data collected (percentages and frequencies, for  
44 closed questions). Data from open questions were analysed by content analysis (categories  
45 were ascertained) and subsequently quantified as percentages. A total of 82 responses were  
46 received and analysed. Even though the response rate was low (7%), the data are significant  
47 in the context of the population to which it was sent (i.e. worldwide top authors and  
48 science/research administrators in IHEs working on sustainability at universities).  
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52 The study had some limitations, which are as follows: firstly, the sample – with 82 responses  
53 – was relatively small when compared to other studies, partly because the study was  
54 performed with no external support and was funded by the authors themselves. Secondly, due  
55 to the difficulties inherent to international studies, the numbers obtained cannot be regarded  
56 as statistically representative. However, they provide a sufficient sample for our analysis and  
57 builds a rough profile of the trends in this field. Thirdly, the responses obtained need to be  
58 considered as limited to the sample and no major inferences can be made from them.  
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1 Fourthly, there is some geographical imbalance in the responses to the survey (African  
 2 universities and scientists are underrepresented). Finally, a further limitation was the time  
 3 scale of only a few weeks. Because of these limitations, the reliability of the data is limited.  
 4 However, since the questions were provided by scientists working on the topic and  
 5 respondents volunteered to provide their contributions, since the processing of the data was  
 6 done in a transparent way, and since the discussion of the manuscript uses cautious  
 7 formulations (acknowledging and keeping in mind the limitations of the survey), it is  
 8 believed the reliability of the survey is significant. Despite the limitations here outlined, the  
 9 data collected allow a rough profile of the current situation to be built.  
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12 A future study could complement this work with in-depth interviews to experts in order to  
 13 have a deeper understanding of the barriers, potential and actions when implementing climate  
 14 change research at Universities. However, this research shows important attributes  
 15 concerning relevance and replicability. Due to their still early stage of development,  
 16 disciplines such as education for sustainable development, climate science, sustainability in  
 17 higher education, among others, are fertile ground for the application of similar  
 18 methodologies to the one here employed.  
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### 22 **3.2 Results**

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 24 A little over half of the respondents (54%) expressed the view that his/her university had a  
 25 climate change research unit or department. The approach to climate change research was  
 26 perceived by most respondents (67%) to be inter-, multi-, trans-disciplinary and/or cross  
 27 sectoral (but 33%, considered it not to be so).  
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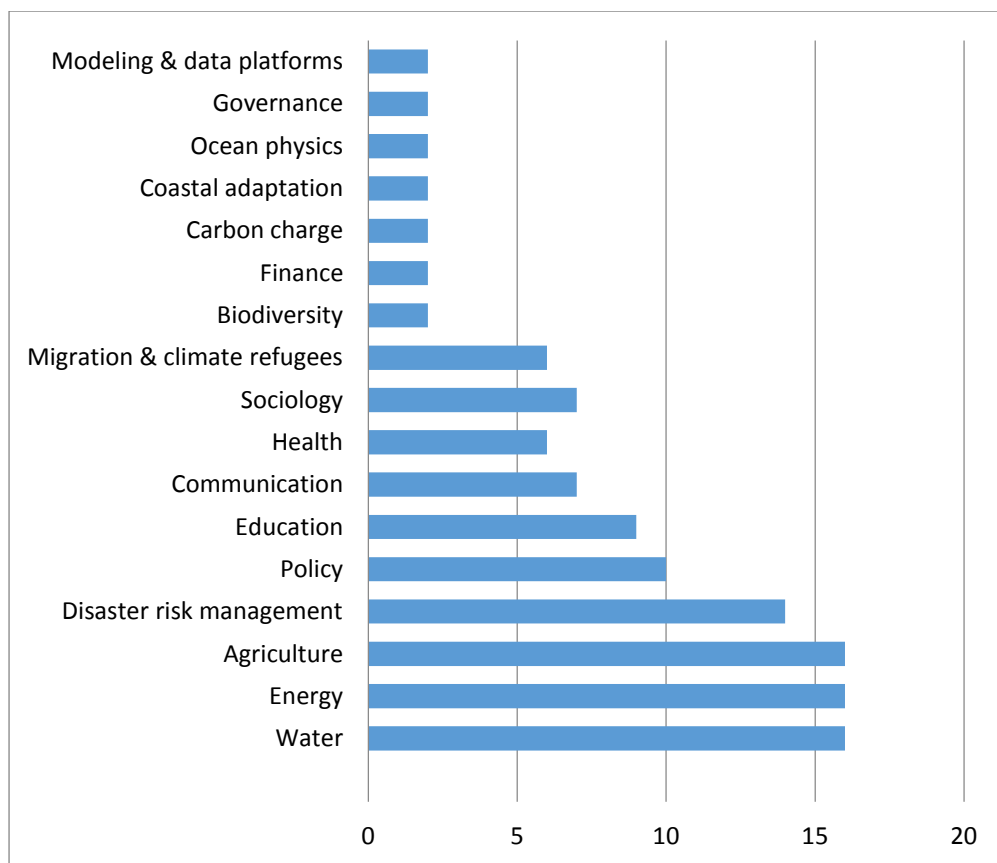
30 Within the surveyed IHEs, the current top climate change research areas were (i) water  
 31 (adaptation, 46%), (ii) energy (mitigation, 41%, and adaptation, 40%), (iii) agriculture  
 32 (mitigation, 37 %, and adaptation, 43%), (iv) forestry and biodiversity (adaptation, 40%) and  
 33 (v) climate disaster risk management (37%) (Table 1). Other significant research areas  
 34 mentioned were climate literacy and education (28%); climate change communication (27%);  
 35 health adaptation (23%); coastal adaptation (21%); transport sector (mitigation, 17%);  
 36 migration and climate refugees (15%); climate ethics and justice (11%); paleoclimatology,  
 37 climatology and modelling (9%); and geoengineering (7%). Minor research areas in climate  
 38 change research were finance, economy and business (4%); building design and construction  
 39 (2%); ocean and atmosphere interactions (1%); faith and climate change (1%); awareness and  
 40 climate change (1%); data digitalization and climate change (1%); and integrated cross-  
 41 sectoral adaptations (1%).  
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47 **Table 1** Top research areas in climate change

	Adaptation	Mitigation
Water	46	
Energy	40	41
Agriculture	43	37
Forestry and Biodiversity	40	
Coastal	21	
Health	23	
Transport		17
Climate disaster risk management	37	

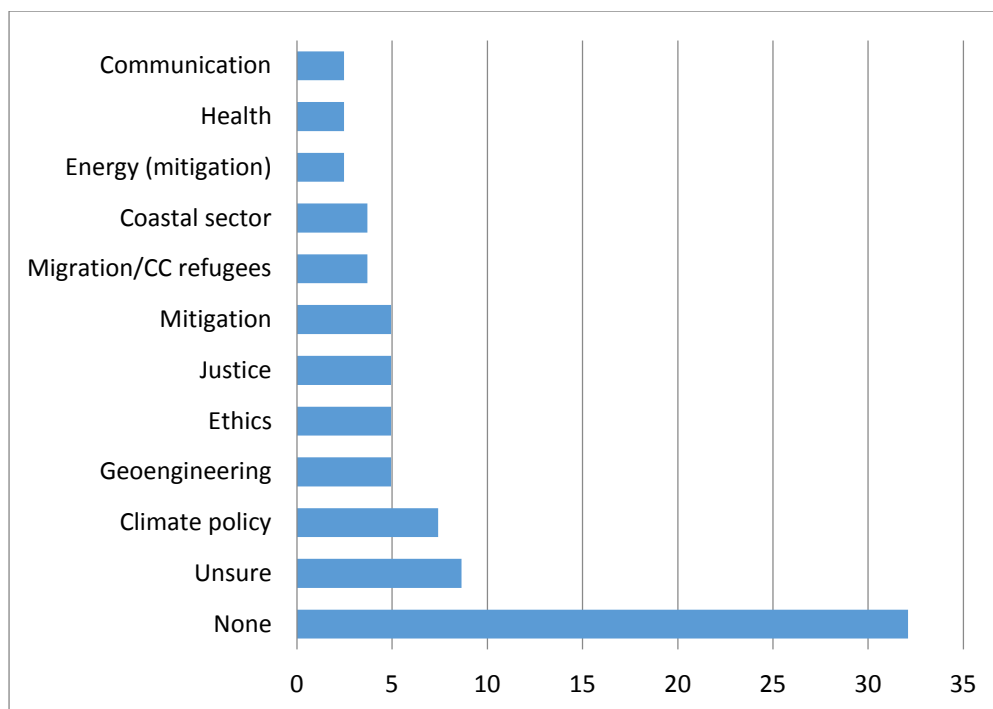
Climate literacy and education	28
Climate change communication	27
Migration and climate refugees	15
Climate Ethics and justice	11
Paleoclimatology	7
Climatology and modelling	7
Finance, economy and business	4

Research in climate change was perceived by the vast majority of the respondents to likely gain relevance in the future (96%; against 4% who expressed that it would likely lose relevance). Among the research fields that were expected to gain relevance in the future, 19% suggested adaptation in general compared to 11% for mitigation in general, however many respondents focused on specific sectors. The main sectors identified by the respondents to likely gain relevance were agriculture (adaptation and mitigation), water (adaptation and mitigation) and energy (adaptation and mitigation), all identified by 16% of respondents, with disaster risk management identified by 14% (Figure 1). The areas of biodiversity (ecosystems and forestry), policy and education were perceived as gaining relevance, respectively, by 11%, 10% and 9%. Communication, sociology of climate change and health relating to climate change were perceived as likely gaining relevance by under 10% of respondents (7%, 7% and 6 %, respectively). Other areas of minor relevance also referred to were: finance (4%), carbon charging, coastal adaptation, ocean physics, governance (all 2%) and carbon sequestration, transport, justice, technology development, modelling, data platforms, outreach and multidisciplinary research (all 1%).



**Figure 1** Main fields of Climate change research likely to gain relevance

Most of the respondents answered that none of the identified research areas were likely to lose relevance in the future (32%), although some had no opinion or were not sure (9%) (Figure 2). However, some research fields were thought to be more likely to lose relevance in the future, including climate policy (7% of the respondents), geoengineering, ethics, justice, mitigation in general (all 5%), migration & climate refugees, coastal sector (both 4%), energy mitigation, the health sector and communication (all 2%). Furthermore, 1% of the respondents suggested that agriculture adaptation, disaster and risk management, transport, industrial pollution and waste treatment would likely lose relevance, as climate change research fields, presumably reflecting the small number of people that though climate change would lose relevance in general.



**Figure 2** Main fields of Climate change research likely to lose relevance

Concerning curricula, 56% of the respondents perceived that their IHE included an inter-, multi-, trans-disciplinary and/or a cross-sectoral approach to climate change; 44% of the respondents perceived that this approach was absent from their university’s curricula. Also the majority of the surveyed universities (70%) had neither a policy nor a plan for capacity building (professional development) of teachers to better understand climate change, to develop and strengthen curricula, and for R&D activities to ensure developing competencies for climate change. Only 30% of respondents identified that such a policy or plan was in place at their university.

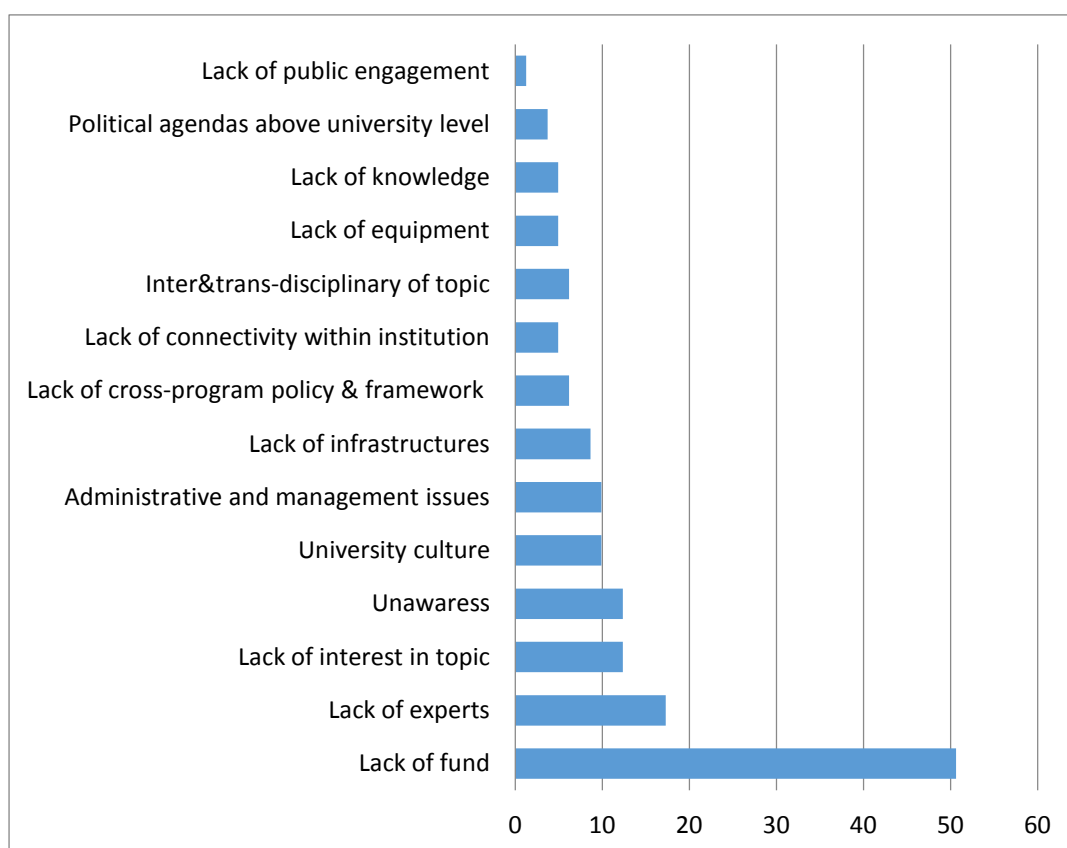
Also, 54% of the respondents stated that their university did not have a strategy or policy for communicating or disseminating results of their research on climate change; only 46% stated that their university had such a strategy or policy. Additionally, most university rectories or administrations did not have low carbon instruments, strategies, or policies for climate change mitigation and adaptation (58%), compared to 42% that did.

The main barrier to climate change research identified by the respondents at their universities was “lack of funds” (51%) (Figure 3), reflecting the increasingly limited funding for IHEs generally in many parts of the world. Some respondents also indicated “administrative and management issues”, the “lack of infrastructure” (10%, in both cases), and the “lack of equipment” (5%) as barriers to climate change research (all of which are likely to be, at least partly, related to lack of funds). Interestingly, the “lack of experts” (teachers and or researchers) was pointed out by 17% and lack of knowledge on the topic was identified by 5% of the respondents as another barrier to climate change research, perhaps suggesting a shortage of climate change specific talent, likely related to the lack of capacity building noted earlier in the results. This is an issue not addressed in the literature directly but perhaps reflecting the lack of interdisciplinary researchers.

The “lack of interest in the topic”, “unawareness of the importance of climate change” (by lecturers and researchers, but more importantly by the “higher positions in IHE” and by the “university management”) were also perceived by 12% of respondents (in both cases) as barriers to climate change research, reflecting the institutional barriers discussed above. Also in line with these, “university culture” was mentioned as a barrier by 10% of the respondents due to a variety of factors that inhibited academics to research and publishing (e.g. “research is still largely undervalued in the evaluation system”).

The absence of a cross-program approach “policy and framework for climate change” and the “lack of connectivity within the university units (groups, people)” was also referred to by 6% and 5% of the respondents, respectively. Similarly, the complex nature of climate change and the inter-and trans-disciplinary nature of climate change research was also pointed out as a barrier by 6% of the respondents (e.g. “monodisciplinarity appears easier” and “the trans-disciplinarity of climate change research is a challenge”). Again, this reflects the discussion of barriers above.

In 4% of the cases, political agendas above the university level (i.e. Ministries and national agencies) were also identifies as strong barriers to climate change research, e.g. as this issue “was not a priority in terms of research politics and agendas” or “climate change issues were led by national agencies and ministries and not universities”, perhaps highlighting the political nature of the issue in some places.



**Figure 3** Barriers for climate change research perceived at universities.

The empirical data suggest that climate change research is likely to be of growing importance, especially in particular sectors. However, it also supported the argument that there was significant untapped potential in IHEs, with only around half having strategies

1 around teaching, capacity development, communication and action within the institution.  
2 Crucially, many of the barriers highlighted in the discussion above were borne out by the  
3 empirical work. Although lack of funds was the main barrier highlighted (a common feature  
4 of challenges faced by IHEs), the complex and interdisciplinary nature of the research clearly  
5 challenged IHEs. Notably, a lack of expertise was highlighted as important. Although climate  
6 change has been a significant issue for decades, it seems that research is still struggling to fill  
7 the knowledge and expertise gap.  
8

#### 9 **4. Moving forward**

10 This theoretical review and empirical analysis of barriers to climate change research and the  
11 potential of IHEs suggests concrete strategies and guidelines that universities and other IHEs  
12 can employ to enhance their roles in addressing climate change. In particular, we highlight  
13 several recommendations that could support climate change research in IHEs  
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#### 16 **4.1 Promoting a Broader Perspective for Climate Change Research**

17 Climate science is still an ill-defined term. Climate (change) relevant science encompasses  
18 much more than climatology, and climate change research, in general (as discussed in Section  
19 2.1) extends beyond the STEM fields to the social sciences, philosophy and the humanities.  
20 As seen in the survey results, climate-relevant research spans multiple sectors, including the  
21 water-energy-land use nexus, health, education, communication, ethics, justice, finance,  
22 economics and business. Thus, universities have the unique role to push for wider dialogue,  
23 recognize diverse approaches and forms of research to enrich the climate change discussion,  
24 and, beyond that, contribute to concrete solutions.  
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27 There are clear potentials for universities to greater highlight the moral dimensions of climate  
28 change. Only 11% of respondents understood ethics and justice to be top research areas, and  
29 these categories are identified among those likely to lose relevance in the future. This is  
30 problematic since nearly all aspects of climate change research have a moral dimension: for  
31 instance, geoengineering (Preston, 2013), climate migration (Nawrotzki, 2014), and health  
32 (Macpherson, 2013) to name a few. As mentioned above (section 2) unexamined values that  
33 underlie merely technical solutions risk treating symptoms rather than root causes.  
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36 Climate-relevant research can also be conceptualized more broadly to foster cross-  
37 fertilization with the highly dynamic field of sustainability science (Hugé et al., 2016). Many  
38 universities have embarked on action plans towards the implementation of and support for  
39 sustainability science to address the pressing need for sustainable (and equitable)  
40 development. This creates opportunities to address climate change issues in a novel and  
41 innovative way. In order to understand and develop actions regarding climate change,  
42 multiple types of knowledge need to be recognized. These include: (i) diagnostic knowledge  
43 (with regard to the causes leading to climate change); (ii) explanatory knowledge (with  
44 regard to the interactions between social activities and sustainability impacts); (iii) orientation  
45 knowledge (with regard to normative justification arguments); (iv) knowledge for action  
46 (with regard to finding solutions to ‘un-sustainable’ situations) (Wooltorton et al., 2015).  
47 Knowledge that aims at addressing climate change needs to analyse a system’s deeper-lying  
48 structures, (diagnostic and explanatory knowledge), it needs to project into the future  
49 (orientation knowledge), it needs to assess the impacts of decisions (explanatory, orientation  
50 and action knowledge), and it has to lead to new strategies for solutions (knowledge for  
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1 action) (Hugé et al., 2016; Waas et al., 2010). Such knowledge requires the participation of  
2 different disciplines, and though more difficult to generate, creates the potential for more  
3 lasting impacts.

#### 4 **4.2. Re-structuring Research and Outreach**

5  
6 A broader perspective also highlights that engaging with climate change as a moral issue  
7 means engaging beyond academia, as noted in the RRI literature (Burget et al., 2017; Stilgoe  
8 et al. 2013). The types of knowledge envisioned necessarily call for an inter-disciplinary and  
9 trans-disciplinary approach. However, research is still too often discipline-oriented rather  
10 than problem- or issue-oriented. In many cases, research takes place in silos both in terms of  
11 departments within the academe, and in terms of the academe as an actor in a larger  
12 community of stakeholders. This can largely be influenced by the incentive structure for  
13 advanced studies and research. Thus, career evaluation criteria may end up discouraging  
14 inter- and trans-disciplinary work, particularly for young researchers seeking tenure.  
15 Universities can address this challenge by re-structuring career evaluation criteria to duly  
16 acknowledge inter- and trans-disciplinary initiatives and achievements.  
17

18  
19 On a more organizational or administrative level, IHEs can work towards developing and  
20 funding inter-disciplinary hubs or research centres on climate change to facilitate dialogue  
21 and coordination across the different disciplines within the university, and to actively work  
22 on establishing linkages with external stakeholders. These hubs can appoint research and  
23 administrative coordinators for drafting and managing inter- and trans-disciplinary projects  
24 with regard to climate change, thus lowering the barrier for those who fear that collaborative  
25 work might take more time and effort. Such hubs can also house and stimulate  
26 interdisciplinary Master and PhD thesis projects, and fund pilot studies focusing on climate  
27 change in an inter- and trans-disciplinary context.  
28

29  
30 Additionally, only 42% of the administrations represented in the survey have low carbon  
31 instruments, strategies or policies for climate change mitigation and adaptation. Here we find  
32 significant space to promote the joint creation of strategies and policies in climate change  
33 research and campus operations at the university level, through hubs and centres created for  
34 this purpose.  
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#### 36 **4.3 Re-structuring Teaching**

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38 Teaching is a central mission of IHEs: teaching students the intricacies of multidimensional  
39 climate change issues and teaching them methods and tools to address complex inter- and  
40 trans-disciplinary problems is essential to foster systems thinking and to conduct policy-  
41 relevant research.  
42

43  
44 In our survey, 44% of the respondents stated that an inter-, multi-, trans-disciplinary and/or a  
45 cross-sectoral approach to climate change was absent from their curricula, and that 70% had  
46 neither a policy nor a plan for capacity building of teachers. This indicates a gap between  
47 what is deemed desirable and necessary regarding climate change teaching and literacy, and  
48 what is happening ‘on the ground’. This situation probably reflects both the pervasive under-  
49 valuation of teaching compared to research output (e.g. publications), and the intrinsic  
50 difficulties of teaching complex matters crossing disciplinary boundaries. In turn, this reflects  
51 the lack of expertise highlighted as a barrier to climate change research in the survey.  
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1 There are several options for IHEs to act upon this. Grant mechanisms can be expanded to  
2 include not just projects for research but also projects for capacity-building and even for  
3 interdisciplinary climate change-focused scholarships. A climate change professorship or  
4 research chair can be established. Common climate science courses can be developed across  
5 curricula, and ‘cross-fertilization’ can be encouraged by allowing students to select elective  
6 courses in other faculties to hone interdisciplinary reflexes when dealing with ‘wicked’  
7 climate change issues (Morgado et al., 2017). This will, in time, help overcome expertise  
8 shortages in climate change research and teaching.  
9

#### 10 **4.4 Promoting Communication, Engagement and Networking**

11 As already discussed, IHEs have the potential to generate multiple types of knowledge which  
12 can all serve as input to evidence-informed decision-making (Rose, 2014, Hugé et al., 2016).  
13 IHEs can promote more robust solutions and policies by helping clarify complex systems,  
14 broadening the climate change debate, striving to characterize and address multiple  
15 uncertainties, targeting key priorities of communities and funders, and connecting disciplines  
16 and stakeholders. However, the potential significance of universities in catalysing action will  
17 not be realized without stronger communication and engagement strategies across different  
18 stakeholders. The results presented here show that only 46% of the survey respondents had a  
19 strategy or policy to communicate or disseminate climate change research.  
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21

22 To be effective, engagement of non-academic actors to deal with the complexity of climate  
23 change should be more systematic. Such engagement must also engender dialogue rather than  
24 a one-way dissemination of results, especially since climate change is a highly politicized  
25 issue (Morgan, 2017). Co-creation of knowledge should be encouraged, e.g. by way of  
26 societal peer review rather than just academic peer review, and IHEs should provide  
27 incentives for researchers who are able to bridge stakeholders. Generating knowledge for  
28 action means crossing the gap from research into outreach, i.e. actually implementing the  
29 solutions recommended, and establishing a mechanism for continued monitoring and  
30 evaluation. Furthermore, the innovation potential of climate change research also engenders  
31 the inclusion and development of entrepreneurs and start-ups, creating the need for  
32 participation of technology transfer offices at universities.  
33  
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35 Inspiration can be drawn from the vast body of literature and experience regarding education  
36 for sustainable development (e.g. Annan-Diab & Molinari, 2017). Academic change agents  
37 can contribute to climate change-related research at various levels by engaging in different  
38 ways and by promoting different kinds of formal and non-formal learning. Van Poeck et al.  
39 (2017) identify different types of change agents based on their level of involvement vs.  
40 detachment, and based on their open-ended vs. instrumental objectives.  
41

42 Furthermore, as noted in the discussion, the influence of IHEs in their local and regional  
43 communities can be further strengthened through using networks to leverage their positions.  
44 These networks are key to IHE involvement in challenging moral issues, such as climate  
45 change, as they mobilise collective action. In addition to HESI and the Fossil Free movement  
46 noted above, the existence of highly visible international organizations and networks, such as  
47 the American College & University Presidents Climate Commitment (ACUPCC) and the  
48 International Sustainable Development Research Society (ISDRS), among others, suggest the  
49 potential for further development of similar networking initiatives. For example, ACUPCC  
50 signatories, which are around 600, commit to measure and report their greenhouse gas  
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1 emissions, take immediate actions to reduce them, and develop and implement a plan to go  
2 climate neutral. The ISDRS organises yearly conferences, and HESI has over 300 signatories  
3 and accounts for more than one-third of all the voluntary commitments that came out of Rio  
4 +20.

5  
6 Therefore, there is potential for IHE to deepen their commitment in terms of climate change  
7 to diversify and interlink existing networks, to combine the strengths of overarching  
8 networks, and to create more thematic networks (e.g. on climate-smart agriculture, low-  
9 carbon technology, on-campus climate change commitments, nature-based solutions, climate  
10 ethics, climate change training, etc.).

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12  
13 This discussion has shown that there is much space for moving forward when implementing  
14 climate change research at universities. The main recommendations developed from the  
15 present study are the following:  
16

- 17 • The need to promote inter-disciplinary and trans-disciplinary approaches in research,  
18 including in new or existing journals, through the recognition of broader approaches  
19 and definition of climate change research.  
20
- 21 • Greater recognition and acceptance of inter- and trans- disciplinary research in IHEs  
22 and journals (resulting in well-known and high impact factors journals). This will  
23 require both IHEs and existing journal editorial boards to challenge well-established  
24 disciplinary structures.  
25
- 26 • Work towards developing inter- and trans-disciplinary hubs on climate change in all  
27 dimensions of IHEs to facilitate collective actions. This could include: (i) promoting  
28 the joint creation of strategies and policies in climate change research and campus  
29 operations at the university level; (ii) developing plans for capacity building of  
30 teachers; (iii) strengthening communication and engagement strategies across  
31 different stakeholders, where co-creation of knowledge among the various actors  
32 involved should be encouraged.  
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38 Crucially, it is important that systematic, institutional approaches are used to implement these  
39 recommendations as opposed to ad hoc ones, as is largely the case today.  
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## 41 **5. Conclusions**

42  
43 As centres of research and teaching, higher education institutions are often in a position to  
44 significantly contribute to current climate change mitigation and adaptation efforts. As this  
45 paper has shown, there are a number of barriers of various natures, which prevent them from  
46 engaging in effective climate change research. In order to overcome these barriers, there is a  
47 need to better communicate the value of research efforts on climate change mitigation and  
48 adaptation. It is not sufficient for researchers to simply perform research: their outputs should  
49 be more widely communicated. Researchers at universities ought to move away from  
50 narrowly focusing on restricting access to research results to specialist journals, and more  
51 towards using research findings to influence public discussions about climate change e.g.  
52 through the media, policy networks and to interested communities. This will need researchers  
53 to develop new skills, which will need to be supported by universities. Finally, climate  
54 change communication needs to be placed in the context of wider aspects of climate change  
55 research. Future studies will need to further investigate the potential for institutional research  
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1 on climate change adaptation, including greater focus on the integration of matters related to  
2 climate change in the curriculum, or the perceptions of students and staff on climate change  
3 mitigation and adaptation.  
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## **Implementing Climate Change Research at Universities: Barriers, Potential and Actions**

### **Highlights**

- A theoretical and empirical study of barriers to climate change research in universities was conducted.
- Barriers included institutional and capacity issues.
- The need for inter- and transdisciplinary research calls for new approaches to research and teaching.
- The article highlights opportunities to advance climate change research for universities to overcome some of these institutional and capacity barriers.

## Survey Questions

[Click here to download Data File: Survey for Implementing Climate Change Research at Universities.pdf](#)

Published draft in Journal of Cleaner Production available at: <http://www.sciencedirect.com/science/article/pii/S0959652617320954?via%3Dihub>