



# Climate change, human genetics, and post-normality in the UK<sup>☆</sup>

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## Abstract

Virtually intractable matters characterized by uncertainty over consequences, diverse and multiple engaged interests, conflicting knowledge claims, and high stakes, call for post-normal policy responses. This paper explores how two such responses have been implemented in the UK through the management of specific aspects of anthropogenic climate change and human genetics, which we argue can be described as “wicked” or post-normal issues. To address these, approaches require that a broader range of epistemic positions and worldviews be recognized as valid in the policy development process. We suggest that the concept of boundary organisations is well suited to examine some of the institutions that have been set up in the UK to deal with the two post-normal issues we consider here. This paper explores the extent to which the UK Climate Impacts Programme and the Human Genetics Commission respond to a post-normal policy approach and their achievements in overcoming epistemological boundaries and effecting integrated management responses. We conclude by considering the insights such an analysis offers into operationalising post-normal policy approaches. As intermediaries and facilitators, we suggest the two organisations can be considered forerunners in applying a post-normal approach to climate change adaptation and human genetics, respectively.

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## 1. Introduction

In her recent novel *Oryx and Crake*, Atwood [1] portrays a post-apocalyptic world resulting from human mishandling of climate change and human genetics. She describes the experiences of the last non-modified human, Snowman, after a genetically modified virus has killed all others of his kind. Snowman is a prophet to the naïve, genetically “perfect” Crakers in a dying world of disappearing fresh water, scarce food supplies, and blistering sun. Atwood vehemently argues that her book is **not** science fiction; she contends it is “fact within fiction. Science fiction is when you have rockets and chemicals. Speculative fiction is when you have all the materials to actually do it. We’ve taken a path that is already visible to us.” [2, p. 40].

Atwood encapsulates in one world the potential dangers that could ensue if manipulation of the climate system and our genetic makeup are left unheeded. Her account bears the question of how should these two issues be adequately managed? In public policy circles they are perceived to be of difficult solution or even intractable [3,4], partly because they are imperfectly understood. These so-called “wicked issues” [5] are considered to arise in situations defined by “uncertainty; inconsistent and ill-defined needs, preferences and values; unclear understanding of the means, consequences or cumulative impacts of collective actions; fluid participation in which multiple, partisan participants vary in the amount of resources they invest in resolving problems.” [6, p. 156]. In this paper we argue that anthropogenic climate change and human genetics represent a showcase of conflicting values and epistemic authorities; they are at the centre of a contentious issue definition process involving multiple actors and knowledge systems, in part shaped by societal choice and market imperatives. As “wicked issues”, their effective long-term management often implies challenging the complex interdependencies involved [7], which traditional methods of scientific enquiry and of governing alone cannot provide. This suggests that there may be other means through which such contentious issues may be dealt with. One such possibility that we explore in this paper in relation to human genetics and climate change is the notion of boundary organisations, institutions created to facilitate “speak” between politics and science realisms, with a view to fostering understanding and increasing constructive interaction.

This paper begins with a discussion of post-normal science as a way of addressing “wicked issues”, and considers how this may be operationalised. We subsequently expand on the comparison between climate change and human genetics, reviewing the policy approach applied to these issues, considering to what extent these can be characterized as post-normal. The paper then explores the emergence of UK institutions that go beyond “normal” boundaries of management, focusing on the Human Genetics Commission and the Climate Impacts Programme. The final section draws out implications for a post-normal approach to, and the role of boundary organisations in, addressing “wicked issues”.

## 2. Post-normal science and boundary organisations

Research in fields as diverse as medicine [8,9], climate science [10,11], ecological economics [12] and food safety [13] has recognised that increasingly issue management is based upon value-driven decisions made in the face of risk and uncertainty, coupled with calls for more suited procedures for participation in decision-making. Observations during the 1990s indicated that fundamental problems arise when new technologies or scientific

issues are managed through traditional structures and methods, such as conventional risk assessments [15,16]. The failure of conventional mechanisms to effectively govern science matters, resulting in widespread crises and controversies (such as BSE and GM in the UK), can generate distrust in experts and centralised technocratic institutions [17] and ambivalence towards complex scientific issues among people who feel excluded from decisions deeply impacting their lives. In other words, a situation develops where “science and society are coming unglued because of tensions created as scientists, social scientists and publics push in different contradictory directions.” [18, p. 699].

In 1993, Funtowicz and Ravetz [19] proposed that post-normal science (PNS) could provide a means to initiate and facilitate responses to such societal issues and tensions. Based on the theoretical work of Giddens [20] and Beck [21] and their observation of risk as the central organising principle in advanced industrial societies, science should become a multi-way process of social context negotiation, including the co-production of knowledge and learning, involving stakeholders as well as specialists. No longer should “truths” be provided by traditional science theories and methods alone. Inter-disciplinarity is a key requirement in addressing any major policy issue [63], but especially “wicked issues” [21]. More specifically, disciplinary specialization has left science ill-prepared to address uncertainties and cultural values in analysis [22]. PNS embraces complexity and uncertainty [23] based on the acknowledgement that complex problems will never be fully understood before action is taken to manage them. And this should occur, according to PNS, through inclusive governance [24, p. 743]. Addressing “wicked issues” adequately means making decisions in the context of “post-normal politics” [17], typified by decentralised public-sphere politics [21] and multilayered democratic participation. This should enable diverse knowledge and perspectives to contribute, fostering mutual learning and reflexivity, evaluation of trade-offs, uncertainties, and their distribution [18, p. 695]. The conceptualisation is somewhat similar to Barry’s “participative democracy” (described by Healy [17]) and reflects other calls in the democratisation of science and deliberative democracy literatures [25–27], including Lasswell’s policy science of democracy [64]. The methods and processes through which this may be achieved have been the subject of much analysis and debate (for a review see [28]). Healy [17], for instance, suggests that “extended peer communities” combined with a lay critique of expertise can contribute to managing uncertainty by providing a forum for debate about post-normal issues.

Nonetheless, in discussing how climate change is managed in the UK, Hulme and Turnpenny [29, p. 113] observe a move towards PNS research in new institutions being created to enhance society’s capacity to respond to climate change; however, there is an expectation that these are to be “academically rigorous and policy useful”. This raises questions regarding the operationalisation of such characteristics as it is conceivable that some of these new institutions may face tensions between maintaining independent research whilst being policy relevant, with obvious resource implications. These tensions have been recognised for decades, and some argue it may in fact not be possible for research organisations to bridge boundaries [30]: the production of knowledge for concrete, real-world problems may lead to an institutional split of science into an academic branch and into a managerial, public policy branch.

We propose in this paper that there may be other new organisations, different from research institutions, which may facilitate the transition to a post-normal approach, by acting as intermediaries among two or more perspectives, contributing to the policy process. Whilst boundary work originally focused on the delineation of the sphere of

science with respect to non-science [31], it has since developed to refer to “the strategic demarcation between political and scientific tasks in the advisory relationship between scientists and regulatory agencies” [32, p. 399]. The main concept underlying the extensive boundary literature is that boundaries define disciplines in terms of their language, behaviours, practices, methods, knowledge generation and other conventions. Clearly demarcated boundaries also help maintain disciplines or bodies of knowledge (e.g. [31,33] on the role of science in policy). However, in a situation where different disciplines and paradigms are brought together with a view to co-operation, such as in policy development, bridging boundaries is of key importance to stave off impasse. Boundary organisations therefore facilitate cooperation to achieve a shared objective or the “co-production of mutual interests” [32, p. 405], by (a) creating scientific and social order through, for instance, a physical output (e.g. a commercial innovation); (b) acting as agents of both politicians and researchers [34, p. 105]. The utility of boundary organisations lies in their distinctive functions, which could not be performed solely by any of the sides they bring together. Such organisations facilitate stabilisation by existing on the frontier of different worlds whilst maintaining accountability to all. The success of a boundary organisation lies, according to Guston [32,34], in meeting the requirements of the various sides it mediates, whilst maintaining its bridging position irrespective of the external forces that may be interested in reshaping it. Undeniably, however, the boundary will be continuously renegotiated thus moulding the organisation itself. Boundary organisations may resort to co-opting members of external groups into their decision-making processes, as a means to deal with external pressures [32, p. 402]. In situations where matters may have complex social consequences, involving risks and multiple views, boundary organisations may go beyond science and policy, bringing together various other functions, values and worldviews. In these cases, boundary organisations may neither have a clear relationship to policy outcomes nor a direct responsibility for the delivery of policy. However, the communication and deliberations they foster influence problem definition and prioritization of responses.

These considerations raise the question of whether there is any evidence of a PNS approach being adopted, through the use of boundary organisations, to manage post-normal issues in the UK. We explore this in the two sections below, assessing if and why climate change and human genetics can be considered “wicked issues”, and how these have been governed in the UK. We examine the role of the UK Climate Impacts Programme (UKCIP) and the Human Genetics Commission (HGC) as boundary organisations. Although these bodies have different functions and responsibilities in the policy context, they are alike in that they provide a site where different values and perspectives can together negotiate the social and the scientific. We suggest these organisations result from recognition of the inadequacy of existing structures to foster multi-way communication, understanding and negotiation, and propose themselves as new institutional forms, albeit functioning within, and subject to, the current system.

### 3. The “wicked issues” of climate change and human genetics in the UK

#### 3.1. *Climate change*

In just under two decades, climate change has risen to the status of a nationally recognised concern [29] although at an individual level the importance of climate change is

generally secondary to that of other personal and social issues [35,36]. The current Prime Minister Tony Blair has demonstrated to be keen in taking action “now” on “the world’s greatest environmental challenge” [37]. Officially, the UK government accepts international scientific opinion that human-induced climate change is already a serious threat, with potentially disastrous consequences for the near and far future if greenhouse gas emissions are not curtailed (mitigation) and responses not enacted to deal with the climatic changes already in the pipeline (adaptation). Practically, however, contention lies in what action can and should be taken. Whilst Blair actively promotes Britain as an intermediary on mitigation agreements among the most powerful nations in the world,<sup>1</sup> the UK itself is progressively falling short of its domestic target of reducing CO<sub>2</sub> emissions by 20% below 1990 levels by 2010, although it is on course (just) to meet its Kyoto Protocol commitment [38]. As the Prime Minister himself acknowledges, climate change is a social problem, in its causes and solutions. Through inherent dependency on fossil fuels, every citizen contributes to climate change. However, its management is contested by a multitude of societal actors. For all, the stakes are high: discourses draw upon either the substantial short-term to medium-term changes to current lifestyles, economies and potentially world order if mitigation and adaptation were undertaken heeding scientific advice; or, conversely, the potential short-term to long-term dangers from climate change if societies do not adequately respond to the threat. Such tensions are at the root of the difficulties in managing climate change. Whilst it is impossible herewith to provide a detailed account of all the actors involved, given the sheer pervasiveness of climate change, we outline the most relevant in managing the issue from UK policy and stakeholder perspectives, especially in relation to adaptation, based on interviews and literature reviews.

At the level of UK government, the overall responsibility for mitigation and adaptation policies lies within the Department for Environment, Food and Rural Affairs (DEFRA). In particular, the Global Atmosphere Division (GA) deals with mitigation policy, whilst the UK Climate Impacts Programme (UKCIP), in conjunction with DEFRA GA, sources information, and coordinates support, on adaptation. DEFRA has to negotiate with other government departments in promoting environmental considerations. For instance, it published jointly with the Department of Trade and Industry (DTI) the reference for the nation’s energy policy [39]. The DTI also interacts with the Climate Change Projects Office (CCPO) whose mandate is to represent the concerns and interests of business pursuing opportunities arising from climate change mitigation. The business sector exerts considerable influence on government departments, whilst at the same time being regulated at national and international levels. Turnpenny et al. [40] argue that this “loop” of influence detrimentally affects action on climate change. This uneasy state of affairs reflects in the “messy” and often contradictory policies and initiatives on climate change at national and local levels on transport infrastructure and provision, energy management and future sourcing, housing siting, and water supply/demand. These can also be constrained by political limitations.

The responsibility for implementing and enforcing government policies on climate change lies with the environment agencies and devolved institutions (such as the Welsh

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<sup>1</sup> Blair had clearly set out climate change as one of the main issues to address during the UK’s presidency of the G8 and the European Union in 2005. Disappointingly, but as was to be expected, the G8 climate change discussions resulted in common ground on low-emission technologies and energy efficiency as agreeable solutions [62].

Assembly and Scottish Parliament) and regional and local authorities. These institutions have varying degrees of autonomy, which can cause friction with the centralised polity. Scotland and Wales, for instance, have produced their own climate change programme and strategy [65]. They have the power to alter energy decisions and planning arrangements, thus delivering adaptation, but they are subject to national and European Union (EU) policies. This can be contrasted with English regions, whose autonomy, in comparison, is more limited. On a smaller scale, Local Authorities (LAs) are often regarded by central government as the fulcra through which climate change policies will be translated into locally relevant initiatives and action. Not surprisingly, however, LA responses have been varied as a consequence of their local realities. Some LAs have been very proactive and succeeded in implementing farsighted policies; others, in comparison, lag behind [41] due in great part to time and resource constraints [42]. For these actors, several bodies provide advice on mitigation (e.g. Energy Saving Trust, DEFRA) and on adaptation (e.g. UKCIP, regional climate change partnerships, and the Office of the Deputy Prime Minister—ODPM). In particular, UKCIP has come to occupy a prominent position on the UK scene and internationally by developing a world-recognised innovative approach to fostering adaptation, focused on promotion of stakeholder-led assessments of climate change impacts, and the development and implementation of adaptation in public and private sectors. It does so by liaising with research institutions, which provide the scientific and technical information on climate change. It interacts closely with those responsible for fostering successful responses to climate change, including the policy community (from whom UKCIP receives its mandate) by providing scientific information and encouraging studies that reflect stakeholder interests. In other words, UKCIP lies at the interface of various perspectives on climate change, fostering practical responses to short-term and medium-term climate impacts. These operational characteristics appear to be hallmarks of a post-normal science approach. They would suggest UKCIP operates as a boundary organisation, as an intermediary between science, policy and politics. If this is so, it raises the question of the effectiveness of such an approach, in view of the challenges arising to such an institutional structure from attempting to address a “wicked issue”. We discuss these questions in relation to UKCIP’s role and PNS in Section 4.

### 3.2. *Human genetics*

The political significance of human genetics is illustrated by a press conference called by British Prime Minister Tony Blair and then—US president Bill Clinton in June 2000, heralding the success of the International Human Genome Sequencing Consortium. The genome was published in *Nature* in February 2001 [43]. Even before this momentous event, researchers in academia and industry were anticipating the implications of this “map of life” for the advancement of scientific knowledge and, of course, for commercially viable applications. Debates around genetic determinism, human cloning, and designer children also captured the imagination of the film and television industries, fiction writers like Atwood, media pundits—and as a consequence, the “average citizen”. Public attention to human genetic technologies, in the wake of controversy attached to the commercialization of genetically modified (GM) crops, contributed to awareness in UK government that some aspect of human genetics had the potential to follow GM crops down a rocky policy path. The stakes were indeed high: for industry, which required government support to develop and profit from health-related genetic technologies; for government, which



recognized the potential contribution to the British economy of genetics for the biotechnology and pharmaceutical industries; for people living with genetic disorders, who saw in genetics either the potential for cure or an excuse to subject them to discrimination; for pro-life activists who saw the pull of genetic determinism arguments as impacting on abortion decisions; and the list goes on. Further, many scientists engaged in genetic research became alarmed that predictions regarding the social implications of genetics had, in the public sphere, far outpaced the speed at which the science could be developed. Many implications of advancing research associated with genetics—including, for example, human reproductive cloning—became commonplace in press coverage. Yet some of these applications are still decades from being a viable reality, in part because of how poorly gene function is still understood. The financial, ethical, social and legal implications of scientific knowledge around the human genome engaged a variety of actors in the policy process. All were sensing the urgency of inserting their discourse, their values, into the policy process; all were seeking to influence the policy agenda before irrevocable decisions were made. In the arena of human genetics, the conditions of post-normality—high stakes, emphasis on values, and uncertainty—were all present.

A timely policy response seemed imperative; but the situation was complicated. First of all, although it was clear that existing governance arrangements could not address all the new and potential applications of genetics, there were some structures which dealt with overlapping issues and were seen as able to step up to the new challenges. In terms of formal structures, much of the policy development responsibility in this area falls to the Department of Health (DH), the Department of Trade and Industry (DTI), and the Office of Science and Technology (OST). Beyond this core policy community, the technology's connection to reproductive science and embryology places it under the remit of the Human Fertilisation and Embryology Authority (HFEA). The HFEA was created under the Human Fertilisation and Embryology Act of 1990. Its role is to license and monitor research and clinical practice for all technologies covered by its remit, in particular those related to assisted human reproduction (such as in vitro fertilisation). Some advisory bodies had also been set up to deal with issues arising from genetics, but by the end of the 1990s, after science-advice crises such as GM crops and bovine spongiform encephalopathy (BSE), the time had come to organize a coherent framework for human genetics governance—one which could deal with emerging political pressures.

As the first step towards a policy response, the Cabinet created the Ministerial Committee on Biotechnology and Genetic Modification (SCI(BIO)) to “consider issues relating to biotechnology” [44]. One of SCI(BIO)'s first decisions was to undertake a review of the governance arrangements for biotechnology [45]. Its report noted that the regulatory arrangements at the time neglected to take into account the breadth of perspectives and value systems existing in the British public. There was also a sense that the policy community (for biotechnology, at least) needed to operate more openly, in order to restore the public's faltering faith in the accountability of their government. As a consequence of these interpretations the 1999 review recommended a somewhat radical action: the creation of new strategic, non-statutory Commissions, including the Human Genetics Commission (HGC). Markedly different from the earlier Human Genetics Advisory Committee, the HGC's remit was to engage with the public through consultation and public education activities; to advise Ministers on biotechnology governance issues; to consider a variety of perspectives on human genetic science in producing policy advice; and to operate transparently. The HGC's mandate covers a range of issues, but it does not

operate in isolation; it sits in the centre of a collection of specialist committees, some of which pre-existed it: the Genetics and Insurance Committee (GAIC), the Gene Therapy Advisory Committee (GTAC), the UK Xenotransplantation Interim Regulatory Authority (UKXIRA), and of course the HFEA.

In many ways, it is possible to observe the post-normal fingerprint on the situation leading up to the 1999 review, and in the HGC as the post-normal policy response. The review outwardly acknowledged a failing trust on the part of the public in the existing governance arrangements for biotechnology. An analysis of the policy discourse leading up to the 1999 review and continuing into its aftermath reveals that this failure of trust was attributed to a variety of factors. These include a perception that the system would be incapable of dealing with the rapid growth of scientific discovery and applications in this field—a field which was increasingly riddled with the potential for conflict of interest, as blurred lines between industry- and publicly funded research become more and more the norm. The discourse further suggests that the favoured solution for shoring up faltering public trust would be a greater commitment to public consultation and transparency [66].

The creation of a body combining so-called lay and expert interests, charged with the task of continually scanning a variety of value systems as they engage with the applications of biotechnology, is evidence that the tensions characterising the policy environment of the 1999 review had to some extent permeated the government's consciousness. Towards democratising a formerly closed a branch of science policy, the HGC is a site for transparent negotiation of worldviews: that is, it provides a site where disciplines and values are bridged in the complex task of policy development for socially and technically complex matters. In effect, it operates as a *boundary organisation* to address the “wicked issues” of human genetics. However, the establishment of a post-normal policy process in the midst of an entrenched closed system may not have solved the problem, as we will see in Section 4.2.

#### 4. Evidence of PNS through boundary organisations

##### 4.1. “Brokering” climate change adaptation

Partly as an acknowledgement by the UK government that its research on climate change was not reaching potential users and that therefore responses based on this information were limited, in the spring of 1997, the UK Department of the Environment instituted the Climate Change Impacts Programme (UKCIP), funded through the then Environmental Change Unit and Environmental Resources Management at Oxford. This followed the publication of the second assessment of climate impacts in the UK by the Climate Change Impacts Review Group [46]. As an academic review of the best available knowledge at the time, the Group's report also underlined the need for increasing accessibility to, and communicating, data and information on climatic changes, their impacts and potential adaptive responses to those who were being given the responsibility of implementing them.

UKCIP's philosophical underpinning was more closely related to the notions of participatory integrated assessment [29], driven by bottom-up demands, than a conventional top-down policy approach. UKCIP was designated originally to: (i) provide information to stakeholders, through research which would be directed, administered and funded by them; (ii) coordinate, guide and promote climate impact studies—this was later



widened to include adaptation [47], with a view to producing a national integrated impact assessment. UKCIP currently also facilitates interaction among studies. Two important features of UKCIP already emerge here.

Firstly, UKCIP's intermediary role. Whilst extending beyond the boundaries of its government funder (DEFRA),<sup>2</sup> the Programme was set up to embrace UK science community (which would provide it with the in-depth knowledge and peer-reviewed bases), and attract the interest (and eventually participation) of stakeholders in adaptation as a potential option to circumscribe the effects of climate change. The UKCIP was not to produce cutting edge science or undertake research; these would still lie within the UK research institutions set up for this purpose. Rather, as stated on its website, "UKCIP provides support and guidance throughout the process for both stakeholders and researchers, and provides a **bridge** [our emphasis] between researchers and decision-makers in government organisations and business." [48]. These traits, and even the wording used, point to UKCIP as a boundary organisation. In facilitating studies of how organisations in different sectors and regions may be affected by climate change and how they may prepare for those impacts through devising adaptation strategies, UKCIP strives to promote communication and mutual learning among the actors it brings together. Indeed, UKCIP itself refers to its stakeholders' characterisation of an "honest broker" [49, p. 31]. Furthermore, according to Guston [34, p. 105] a characteristic of boundary organisations is to co-produce "boundary objects or standardised packages" that contribute to "create the combined 'scientific and social order'". UKCIP does supply analytical (e.g. risk, decision and uncertainty framework; methodology for costing the impacts of climate change; Adaptation Wizard) and scenarios-based (e.g. of climate and socio-economic change) tools to stakeholders for undertaking impact studies.

Secondly, the Programme's continuous evolution. Throughout its seven-year lifespan, UKCIP has continuously been redefined, itself adapting to its surroundings, reflexively attempting to satisfy its clients' needs, whilst observing the steerage and guidance of its funder. As the Programme's mandate was broadened from its early rather centrally led phases to receiving more direction from stakeholders, it resulted in some effective processes of engagement, which also contributed to raising UKCIP's public profile [47]. UKCIP is renowned as a world-leading climate change impacts programme, focused on defining methods and processes through which organisations can make their own decisions on adaptation. In contrast, programmes in other countries such as Canada and New Zealand adopt a vulnerability-based approach, resulting in more practical advice [47]. The UKCIP is increasingly strengthening its established stakeholder working relationships—aiming to tailor parts of the Programme to their needs—although it also recognises that there is wide scope for further engagement, especially for promoting adaptation activities where these are currently low, as also identified in the review of the Programme [47]. Thus, during its second 5-year phase up to 2010, UKCIP is envisaged to become more strategic. It is set to build upon its "honest broker" image, knowledge, and expertise in user engagement to overcome the barriers that stakeholders face in pursuing adaptation [49, p. 31]. Constraints identified by UKCIP include stakeholders' perceptions of climate change and uncertainty, paucity of legislative and regulatory guidance, lack of funding, absence of useful

<sup>2</sup>UKCIP receives funding from DEFRA and the Devolved Administrations as part of their climate change programme for its staff and premises. The financial support for research projects is derived from stakeholder contributions, a set-up designed to encourage stakeholder buy-in and participation.

best-practice examples of adaptation, case-specificity of adaptation options, and limited business interest in adaptation [42]. Evidently, some of these constraints are externally defined (e.g. by policy) which suggests that sections of the regulatory system pose limitations to organisations interested in adopting a PNS approach. Moreover, to encourage consistent and transparent engagement with government departments and institutions, and deliver a part of its objectives in the form of fostering further adaptation, internally to government, as well as externally, UKCIP proposed to develop a UK Adaptation Policy Framework (APF) setting out roles, responsibilities and activities across different levels of government and private sector to foster and coordinate preparedness [49, p. 29]. In agreement with UKCIP's mandate, the APF is being drafted with stakeholders, which have indicated their support for this project. The influence of the various actors behind the boundaries brought together by UKCIP is being defined, as DEFRA increasingly bears a considerable say in the definition of the APF [49, p. 32], envisioning it as a structure from which to diffuse on a wider scale the tools and guidance already developed by UKCIP, and as a means to integrate adaption into policies [39]. DEFRA is currently coordinating the development of the APF, which will be developed in three phases up to 2008, following a recent public and stakeholder consultation.

These changes suggest that boundary redefinitions will be occurring throughout UKCIP's future, affecting the structure and stance of the Programme itself. Already on the horizon is the re-emergence of the CCIRG, the Group that originally proposed addressing information dissemination issues which now form part of UKCIP's work sphere, will be reconvened and mandated to update its 1996 assessment, in a third report drawing upon the latest modelling and impacts research [39,49,50]. UKCIP is willing to inform this effort by contributing relevant and extensive experience and knowledge accumulated over the past seven years of work, when consulted [49,51]. Thus it seems that UKCIP will be working closely with CCIRG but the relationship is not clear yet. It is curious that CCIRG will be reinstated, given the UKCIP was originally set up to take over from this group. This may suggest that some areas of work, perhaps beyond the remit of UKCIP, could be covered by the research-driven impacts-focus of the CCIRG, working alongside and in collaboration with UKCIP. Another example clearly shows how UKCIP's work, and therefore intermediary role, is redefined through steerage from other organisations. DEFRA Flood Management and the Environment Agency have indicated that they will deal with climate change research in the areas of flood and water resources management [49, p. 12], directing UKCIP's work to "communicating and making links between this natural systems research and other sectors". UKCIP reshapes itself as other institutions make their boundaries less permeable or respond to the changing role of the Programme.

Another interesting development in UKCIP's role is encapsulated in the process for updating the climate change scenarios for the United Kingdom, the most recent produced for UKCIP in 2002 by two research bodies, namely the Hadley Centre and the Tyndall Centre for Climate Change Research [52]. Their use among a broad range of stakeholders has been mainly to inform decision-making.<sup>3</sup> However, the UKCIP would like the updating of the scenarios due around 2008 to become a more participatory process, enabling the consideration of stakeholder/user requirements (i.e. scenarios contents and

<sup>3</sup>The perceived difficulty, mainly in terms of inadequate resources, among many stakeholders, of transposing the socio-economic scenarios from their national scales to regional contexts, also favoured the exclusive use of the climate scenarios [49, p. 36; 42, p. 61].

presentation<sup>4</sup>) and the specifications of the Customer (i.e. DEFRA) in addition to encompassing the expertise of UKCIP, the Hadley Centre, and other organisations involved in the delivery [49]. This suggests that in UKCIP's case the "extended peer community" that Healy [17] refers to is represented in a limited way by the stakeholders with an interest in climate change, rather than a fully representative sample of society. Furthermore, this aim raises questions of how such a process may develop, given the potentially different preferences for scenario definitions and contents among the policy, science and stakeholder communities. It will also be interesting to observe how UKCIP may broker the process, ensuring a fair representation and participation of the actors identified as having a stake in the output.

#### 4.2. "Watchdogging" human genetics governance

The HGC is in an interesting position. As an organisation often referred to in the press with such epithets as "the government's genetics watchdog" [53], it has the potential to influence both the policy environment and public perceptions of genetic technology (and, arguably, has done so). However, despite its prominence in the human genetics policy arena, it retains no statutory powers. In part this has to do with its relationship with another "watchdog" [54], the Human Fertilisation and Embryology Authority (HFEA)—the policy-making, statutory body which clearly bears the brunt of controversy in its field.

A great deal of the HGC's advisory remit is relevant to the activities of the HFEA, and the two bodies are frequently compelled to work together on specific issues. Until recently, the HFEA has enjoyed a reputation as a powerful governance model, influential internationally in the construction of regulatory frameworks for reproductive technologies. Although in many ways it is linked with traditional science policy approaches, the HFEA has made some significant changes over the last few years, focusing more on its public image and liberalising its framework. Early on in this process, and probably because of it, it faced one of its biggest challenges: the case (quite literally) of human cloning. In 2001, the Pro-Life Alliance launched a legal challenge to the Human Fertilisation and Embryology Act. Occurring so soon after the implementation of the open government framework for biotechnology, this challenge illustrates the inadequacies of traditional governance approaches for coping with post-normal issues.

It all began with the government's intention to develop a framework supportive of stem cell research. This expert-informed process hit a snag in November 2001, when a group known as the Pro-Life Alliance (PLA) launched a High Court challenge to the Human Fertilisation and Embryology Act. In order to expose flaws in the existing regulatory framework and stall the new policy, the PLA charged that the original Act, which defined an embryo as an egg fertilised by a sperm, did not have authority over embryos produced by cell nuclear replacement (CNR). The High Court ruled in favour of the PLA and the UK was left (temporarily) without a governance framework for stem cell research. Naturally, there was intense media interest in the wake of this decision. In the centre spotlight was Dr Severino Antinori, the Italian fertility expert referred to by HFEA Chair Suzi Leather as a "cowboy cloner". Although he and his fellow cowboys have yet to produce a human clone, Antinori claimed that he would exploit the loophole and set up a

<sup>4</sup>By the time of writing, UCKIP had already initiated a consultation process among users to identify specific needs that may be met by the new scenarios.

clinic in the UK. Emergency legislation was enacted, the House of Lords issued a report in support of the new position, and the government's approach to the Court of Appeals to overturn the High Court's decision was successful. The focus then shifted from reproductive to therapeutic cloning; an entirely different matter, to the UK policy community. In 2001 the Human Fertilisation and Embryology (Research Purposes) Regulations were added to the existing HFE Act, to allow therapeutic research on human embryos up to 14 days old. The UK is now the only EU nation which allows embryonic stem cell research. In an interesting move to enhance the legitimacy of the new policy, the actual issuing of licenses by the HFEA to conduct embryonic stem cell (ESC) research was made contingent upon a review of stem cell research by the House of Lords Select Committee [55]. On 13 February 2002 that review concluded that embryonic stem cell research was justifiable and two weeks later the HFEA issued the first licences for such research to proceed. In statutory terms, the UK had created the most liberal regulatory regime for human embryo research in the world. In this process there was no room for a post-normal approach to offer a viable solution.

The state likely considered the matter closed after applying a technocratic approach to close ranks around this issue. However, in the aftermath it seems clear from our interview data<sup>5</sup> that both the “usual suspects” in civil society, and the policy community at large, now question the long-term viability of a closed system. The court case occurred during a transitional period for the HFEA: just as the first stem cell research licenses were being granted, the Chairship of the HFEA changed from Ruth Deech to Suzi Leather. In the new Chair's vision for HFEA practice, openness, consultation, responsiveness to the media, and lay representation feature prominently—a marked difference from its previous operating strategy, where public consultation occurred but the decision was seen to ultimately rest with the Authority, according to our respondents. This has resulted in a changed relationship with the HGC, the centre of open biotechnology governance. Early in the HGC's tenure, the online publication of minutes (per HGC practice) of a joint HFEA/HGC meeting caused tensions which were attributed by observers as characteristic of an organisation not yet comfortable with open governance. However, in recent years the “opening up” of the HFEA and its now cooperative association with the HGC has, despite some cynicism still present in our interviews, resulted in an HFEA which is overall received more positively. Despite the “scrapes” it has experienced in recent years, the HFEA will doubtless remain an internationally respected governance precedent. However, it still faces challenges on both the supranational and domestic level. The UK's endorsement of therapeutic cloning was not received favourably by its colleagues in the European Union (EU). Many member states have already banned cloning, and the European Parliament's 2000 resolution on human cloning directly calls on members of the UK Parliament to “exercise their votes of conscience” and disallow therapeutic cloning. In 2004, the European Parliament and Council issued Directive 2004/23/EC, the Tissues and Cells Directive [56], which places limits on stem cell research. The directive as a whole was originally intended to be implemented by April (2006) [57], but the difficulty in achieving consensus among member states on all issues has delayed the process. At the national level,

<sup>5</sup>Interviews were conducted between 2001 and 2003 with individuals in the policy community, civil society organisations, and the science media as part of the study “Reforming the governance of human genetics: the politics of public trust” directed by Brian Salter (ESRC Innovative Health Technologies Research Programme, L218252002).

a 2004 review of arm's length bodies resulted in the decision to expand the HFEA to include a proposed regulatory authority for human tissue, and be renamed the Regulatory Authority for Fertility and Tissue [58]. In 2005 the House of Commons Science and Technology Committee (HCSTC) issued a scathing report calling for the HFEA's dissolution and characterizing it as an ineffective and obsolete mechanism [59]. Finally, in late 2005 a review and public consultation regarding the HFEA was conducted by the Department of Health. The HFEA's future as a central instrument of governance in its policy realm is uncertain—like much about biotechnology.

Although the HGC was effectively not part of this process, it has by example provided an interesting contrast. The HGC has in many ways attempted to live up to its transparency remit. Its membership is novel within its domain; a variety of (sometimes conflicting) professional, ethical, and advocacy positions are represented, including for example a disabled people's advocate and a patient advocate. The Chair, Baroness Helena Kennedy, is a well-known human rights lawyer. The HGC holds its plenary meetings in public and publishes minutes on its website. In 2004, it also made available online entire meeting transcripts. It instigated a consultative panel, consisting of over 100 representatives of patient (and related) groups from across the nation which is regularly consulted about issues that arise under its remit. Finally, the HGC's remit is advisory and non-statutory; Commissioners have asserted often during their meetings that they prefer this status, as it provides them the ability to remain at arm's length, and critical distance, from the policy process itself (hence the "watchdog" label). It has used this status to challenge the policy status quo and influence policy in a very real way.

Three examples illustrate this. First, the HGC was instrumental in the negotiations of the 2001 moratorium for the insurance industry on the use of genetic testing. When the length of the moratorium was under dispute between relevant government bodies and the Association of British Insurers, the HGC chose to take a very strong position by publicly (through the media) calling for a five-year moratorium—which eventually became the agreed period. The HGC's position on this may have been only one contributing factor to the final decision, but some of our respondents from NGOs and other consumer groups felt the public call to be instrumental in this regard. Second, it used its consultation remit to make the recommendation that the use of DNA identity without permission be made a criminal offence—a recommendation that was taken up in policy. The third example concerns the Medical Research Council (MRC), which has been severely critiqued for its role in the support of UK Biobank. This proposed project, a population-based genetic database of 500,000 British citizens between the ages of 45 and 69, received a large proportion of its startup funding from the MRC, despite concerns that the project had not undergone appropriate peer review and was of questionable scientific merit [60]. The HGC was asked to submit evidence on its opinion of the funding council to the House of Commons Science and Technology Committee, which subsequently produced a critique on the work of the MRC [61], in which it drew a fair amount from the HGC's assessment. In various ways, the HGC has demonstrated that its lack of statutory powers has not precluded it from policy influence. Many observers of the HGC's operations have expressed a sense that the HGC's capacity to influence policy outcomes via publicity renders it, in some ways, even stronger than a body with statutory powers but limited in what it is allowed to say in public.

On several occasions the HGC has demonstrated its commitment to opening up decision-making in UK science policy, even at the risk of irritating other sectors of the

policy making apparatus. One of the more interesting examples of this is the exposure of a gaffe in the policy process, when the HGC was left out of the Department of Health's Green Paper (later a White Paper) on genetics in the National Health Service (NHS). A committee was established to write a Green Paper on genetics in the NHS—without informing the HGC, whose mandate covers all issues related to human genetics policy. This appears to have been merely the consequence of poor to non-existent lines of communication between what were operating as, at least in this instance, two separate policy cultures. Upon the discovery that such a committee was struck without their involvement, the HGC tabled it for discussion at a public meeting and published the fact online in their minutes. Some members of the NGO community engaged in these issues had not known of the existence of the Green Paper prior to that.

Overall, it is difficult to determine exactly how successful the HGC as a boundary organization has been or will be in providing a post-normal solution in a post-normal policy arena. Although many of our respondents expressed approval at the new transparency measures and the membership in the HGC, there was still lingering cynicism that any real progress had been made in addressing concerns about rampant biotechnology. Phrases like “rearranging deckchairs” and “window dressing” occurred with some regularity. However, the concrete actions of the HGC to engage the public and the policy community in a different way, have had enough minor successes to suggest that a post-normal response could be a way forward to re-establishing public trust in this occasionally volatile arena.

## 5. Discussion

Post normal science suggests that climate change and human genetics, as “wicked issues”, can only be adequately addressed by recognising that new instruments are needed to foster wider participation in assessments of scientific findings and in decision-making processes. To this effect, we argue in this paper that boundary organisations, such as UKCIP and the HGC, provide a “bridge” among at least some of the varied stakeholder perspectives, encouraging interaction, collaboration, negotiation and mutual learning, with a view to developing more effective and accountable policy outcomes. Nevertheless, the differences between the two, we argue, are salient.

As boundary organisations, the HGC and UKCIP share a keen awareness of their remit; they assign high importance to understanding the influence of values in decision-making and to the role of reflexivity in shaping effective action on difficult issues; and take great care in assessing their impact on trustworthiness and accountability. Note, however, boundary organisation theory does not stipulate function. Although both the HGC and UKCIP act as intermediaries, they perform different roles. The HGC deals with cases that are of much public interest and that can result in profound consequences for the wellbeing of society as a whole. However, most rest within a specialist debate, one step removed from day-to-day living. As a new site of negotiation for human genetics policy issues, the HGC is relatively influential on policy even in the absence of statutory powers. It has the markings of a boundary organisation applying a post-normal policy approach: it represents a variety of epistemic and value positions, it operates openly, it has some reflexivity with regard to its role in the policy arena. However, in the case of the challenge to the HFE Act, the HGC could not provide the necessary solution—and in fact, was more or less irrelevant in the turn to conventional mechanisms of legislation and regulation.



As a world-recognised Programme, UKCIP set out to bridge the boundaries delineated by stakeholder interests, providing for the needs of science, policy, public and private sectors in fostering climate change adaptation. In working towards redefining climate change from a publicly perceived distant and “un-situated” phenomenon to one requiring concerted attention, interest and effort, some of its operations have been (de)limited by the “normality” of the societal and political structure within which it functions. Having acknowledged the resistance among stakeholders in engaging with impacts or relevant policy options, UKCIP finds its hands partly tied. It can only work with the existing structures and agents, many of which have limited powers to act upon climate change. Changes in planning are subject to OPDM, for instance. Adapting buildings to reduce vulnerability of some sectors of society depend upon modifications to the building regulations and are linked to the role of the Department of Health. UKCIP bravely intends to overcome this by effecting policy change, partly through more targeted interaction with stakeholders, increasing understanding among the sectoral interests, building and improving relationships upon trust and transparency.

Furthermore, unlike UKCIP, the HGC does not facilitate research, for instance, whereas it interacts closely with position advocates with a view to fostering trust in the government’s management of the particularly thorny aspects of human genetics. On the other hand, UKCIP’s mandate has to date mainly focused on providing tools for the practical implementation of adaptation options, while the HGC has worked closely within legislative spheres to exert policy influence. Nevertheless, both strive to enact dynamic and open processes to deal with the post-normal character of both issues: the widely recognised challenge lies in reconciling uncertainty in science and in scientific opinion, whilst taking into account the high stakes and value judgements that affect decision-making.

In the case of human genetics, scientific uncertainty remains attached to many applications of genetic knowledge. In part this is due to the fact that, as most scientists operating in the field would admit, it is still early days (genomically speaking) and there are many things humans need to learn about their own make-up. This is especially true for issues like cloning, where it has already been shown that regular mammalian reproductive cloning, via cell nuclear replacement, cannot work in humans for reasons that are still not entirely understood. Interestingly, there is at least as much uncertainty about the social role of genetics as there is scientific uncertainty. In the case of climate change, whilst the science is relatively well understood, stakeholders’ perceived uncertainty about scientific projections and the desirability of more contextually relevant information have in part constrained the implementation of adaptation actions. Partly for these reasons, UKCIP has explicitly stated its interests in widening the engagement process (e.g. of the forthcoming climate scenarios), with a view to enabling the co-production of knowledge and buy-into possible solutions.

Both these issues have implications for virtually every individual, and yet not everyone has the time, interest, or resources to invest in understanding their implications. The beauty of the post-normal approach is that it recognises this uncertainty by confronting it. As an approach it is geared towards enabling people to contribute and reflect upon knowledge, so as to make informed contributions to determining their society’s future. Amongst others, boundary organisations have the role of enabling such processes to take place. However, their operations have to contend with constraints, such as being perceived as accessible, policy-friendly and publicly acceptable, in addition to the practical difficulties of implementing new tools. The stakes for the HGC and UKCIP, as intermediaries and enablers, are high.

## 6. Conclusions

With the assistance of two illustrative examples, this paper has explored the post-normal policy approaches to “wicked issues” in the UK governance context, within the areas of human genetics and climate change. Considering in particular the role of the Human Genetics Commission and the UK Climate Impacts Programme, we have argued that, as boundary organisations, they perform the role of forerunners in implementing a post-normal science approach to dealing with these issues. Whilst the HGC and UKCIP were designated to counterbalance distrusted “science” driven policy by embracing varied perspectives in the decision-making process, these very perspectives at times set the permeability of the boundaries within which the organisations perform. We conclude that the HGC and UKCIP are evidence of a PNS approach to address climate change adaptation and human cloning in the UK. Under the lens of boundary organisation theory, differences between the two are clearly apparent. Such diversity is key as it encapsulates the variety of responses, based on the same principles, which constitutes the tenets of PNS—one size cannot fit all. However, it is clear that practical difficulties still lie ahead, some represented by the reticence of current structures in facilitating processes intended to address these issues in constructive ways. The practical challenge, therefore, for the HGC and UKCIP is to survive the stormy seas of opposition and contribute towards mollifying some of the wickedness in genetic testing and climate change respectively.

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