



Representing climate change in museum space and places

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Museums and science centers hold a unique position in the media and political landscape as trusted information sources and are emerging as key players in climate change debates. The modes of engagement with audiences, visitors, and publics allow museums to provide sensorial and affective experiences through the agency of objects and immersive environments, which facilitate an active role on the part of audiences in cocreating narratives around climate change. This article draws on the research findings of an Australian Research Council Linkage project, *Hot Science, Global Citizens: the agency of the museum sector in climate change interventions*. Hot Science was an international, interdisciplinary project that interrogated the roles of museums and science centers in climate change as places to provide information, activate and broker discussions, and decisions around climate change issues, locally and transnationally. We put forward nine propositions, distilled from the project research findings and the sector-wide views presented during a symposium held in 2011. We use these propositions to look critically at the ways in which climate change challenges the established concepts and practices of museums and science centers as places of influence, relevance, and certainty in an uncertain world. This includes, for example, the way science is produced, represented, and communicated. Recognizing the complexity and multiscale nature of climate change entails building more effective responses that translate into action. The big task of the museum sector is not only to inform publics on the science of climate change but also to equip citizens with tactical knowledges that enable participation in actions and debates on climate change that affect their futures. © 2012 John Wiley & Sons, Ltd.

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INTRODUCTION

Museums and science centers are emerging as key players in climate change action. They have unique communicative, affective social qualities and promote intergenerational learning outside the classroom. All these characteristics and activities can be purposefully deployed and critically developed to enable them to have agency in climate change governance in many different ways. In contrast, for example, to more politically defined sectors, research

indicates that museums hold a unique position in the media and political landscape as trusted information sources, second only to science organizations and way ahead of the mainstream media and government as places to communicate climate science and raise awareness of climate change.¹ Museums are also one of the few civic venues in Western societies where strangers can gather.² They are perceived by audiences as impartial, ‘safe’, places that increasingly enable conversations and social interactions.^{3,4} For many, they are powerful places to challenge and change views on social issues, as long as visitors can engage them on their own terms.⁵ The ability of museums to provide sensorial or affective experiences through the agency of objects and immersive experiences can also facilitate an active role on the part of audiences in cocreating narratives around climate change.⁶ Social media has

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also opened up new, exciting opportunities for the museum sector to network and dialogue with broader communities and engage diverse interests and points of view⁷ across vast distances, beyond the museum's walls, and become part of new conversations and decision processes on the topic of global warming.

Yet, messy problems such as climate change pose a whole new set of challenges for museum institutions in their ongoing struggle to be relevant and purposeful in a contemporary world, because of the many ambiguities, complexities, and uncertainties, and the scale and pace of the phenomenon. This article deals with the achievements of this sector, and new opportunities that could be grasped by dynamic institutions. At the same time, this review encourages the sector to recognize the unevenness of these developments, and the problems that still impede progress. Many of these problems and solutions are similar to those in other sectors seeking to affect attitudes and policies toward climate change. This fact hopefully will only add to the value of this review for other sectors as they grapple with analogous problems.

The museum sector has a long history of re-inventing itself in the context of new environmental and social trends and challenges through both academic theorizing and experimentation in museum practice. The new museology movement begun in the 1970s was founded on new critical and reflexive approaches to museum philosophy and practice concerning the social roles and purposes of museums in society, the politics of representation in exhibitions, and collecting.⁸ The need to foster pluralist approaches to visitor and community engagement articulated through the notion of the museum as forum⁹ was one of the drivers of this movement over the last 2 decades.^{8,10,11} Coupled with political and economic pressures, many museum sector institutions have since shifted their focus from their collections toward visitors and the concept of institutions as forums.

Calls for relevance, and the re-invention of the museum institution, remain an ongoing quest in a contemporary, turbulent world. Science center leader Emlyn Koster¹² challenges the sector to take a 'greater role in exploring the things that profoundly matter in the world'. Museum scholar Bob Janes urges institutions to develop new goals that respond to local and global social concerns as places for civic engagement, as agents for social change,^{13,14} and as spaces where the complexities of the social world can be articulated and played out. As a result, in recent years, an increasing number of exhibitions on topical subjects of societal significance have emerged on topics from

homosexuality, sexual and racial violence, terrorism to drugs, and massacres.¹⁵

This article draws on the research findings of an Australian Research Council Linkage project, *Hot Science, Global Citizens: the agency of the museum sector in climate change interventions*. Hot Science was an international, interdisciplinary project that interrogated the roles of cultural institutions in climate change as places to provide information, activate and broker discussions, and decisions around climate change issues, locally and transnationally.⁴ The project aimed to develop new knowledge about what constitutes effective action around climate change, the critical roles that institutions can play, visions for the future of museums and science centers, and innovative programming ideas that could be used as experimental interventions.

In this article, we put forward nine propositions, distilled from the project research findings and the sector-wide views presented in the project's concluding symposium in Sydney on May 5, 2011. We use these propositions to look critically at the ways in which climate change challenges the established concepts and practices of museums and science centers as places of influence, relevance, and certainty in an uncertain world, including, for example, the way science is produced, represented, and communicated. We take account of the temporal framing of institutions in the past and future, alongside older foundations of trust and legitimacy. We also re-evaluate them as pedagogic, hierarchical institutions and places of reform within governance arrangements and suggest the many new roles museums can play in political and decision processes.

We also ask what institutions need to do to become agents of change in these complex arrangements posed by climate change. In other words, how do institutions like museums or science centers adapt their operations rapidly across different scales, and give rise to polycentric responses? How do they form new cross-sector allies, build new relationships with audiences, and extend networks bringing together disparate people, ideas, and institutions across social and geographical distances? How can they foster new complex modes of communication and deal more effectively with dissent and conflict in transnational and cosmopolitan formations? How do they bring the past, present, and future together as a focus for concern, and as modality for formulating creative thought and action? We interweave general statements of principle with concrete examples of initiatives that illustrate a range of innovative programs and collaborations that have led to effective action on climate change across the sector. Together, these reflections

and programming examples challenge institutions to become deeper, braver, more empowering, and philosophically useful spaces¹⁶ to meet the new challenges that climate change poses.

NINE PRINCIPLES FOR MUSEUMS AND SCIENCE CENTERS AS AGENTS TO PROMOTE UNDERSTANDING AND ACTION ON CLIMATE CHANGE

Climate Change Is Too Important to Deny, Too Complex to Reduce to a Single Analysis or Problem

The museum sector like all bodies concerned to promote better understanding and action on climate change need to recognize that it is a vast, complex, heterogeneous set of phenomena. It presents challenges and invites solutions over many scales of time and space, from personal to global, from the Earth's past to humanity's future. It involves many components and aspects, impinging on biological and social life, economics, politics, and culture, stretching all disciplines beyond current limits. Those who reject its importance are living in denial, but advocates of a single analysis and solution also fail to recognize the scope of the challenge.

Museums should not aim at one definitive exhibition, to be repeated for the rest of the century. Different analyses of climate change may generate a continuous series of different exhibitions, creative responses to emerging senses of climate change, and what can be done. Rather than concentrating interpretation on the subject of climate and environmental change in one specific exhibition, the Liberty Science Center, Jersey City, NJ, USA, continues to weave this issue into different exhibitions where feasible and where related to the interpretation of the subject.¹⁷ By seeing climate change and the impacts humans are having on the environment as a pervasive theme that threads through nearly all aspects of science, technology, and society, this institution can make relevant connections to content and situations that may be close to the visitor. Second, it allows the pervasiveness of the subject to be seen. So far, this Science Center has presented the topic in several exhibitions: *Skyscraper*, *Achievement and Impact*, *Our Hudson Home*, *Breakthroughs* to aspects of food and cooking in *Cooking: the exhibition*.

Climate change challenges the way in which institutions situate themselves in time, and formulate themselves as places to offer certainty and security. Institutions have tended to focus on the past, with an eye on the future. Lessons from the past are seen as

able to provide a script for the future, and in the case of science centers in particular technological innovation provides the necessary vision. Conventional narratives of the future and climate change in museums and science centers are dominated by attempts to control the planet's climate by reducing levels of greenhouse gases in the atmosphere through behavioral change. Others use narratives of fear and catastrophe as a lens. Hulme¹⁸ views climate change not as a problem to be solved but as a creative opportunity that offers us new resources and new insights to innovate, change, and diversify.¹⁹ New scenarios in exhibition development, as seen with the exhibition *Science of Survival* from the Science Museum in London and the exhibit, *Climate Change, Our Future, Our Choice* at the Australian Museum, engage visitors to imagine different future climate and lifestyle scenarios in 2050, all directly linked to risk forecasting and modeling used in the climate science, finance, and insurance sectors.

Museums and science centers can engage a future-oriented, forward thinking frame, as places to link the past to the far future through projections of what might happen as places to offer practical governance options and as places to present long-term temporal trajectories. They offer an antidote to short-term thinking and the failure of governments to act, by presenting the variable dispositions, ideologies, and governance options, thereby constructing a mediated view of the future as a series of creative pathways.¹⁹

Shifting the temporal framing of an institution can happen, if taken slowly and linked to institutional branding. Museums and science centers can engage the future through programming by using creativity and imagination as a lever for cultural improvisation. Creativity as a mode for change must work alongside a critical and reflexive analysis of our views and values, thereby demonstrating how all these things are linked to climate change.¹⁹

The Museum Sector Needs to Draw on Its Heterogeneity to Respond to the Challenges of Climate Change

All museums and science centers have their own histories, traditions, resources, and connections, differences as well as links, which are part of what they bring to the task.

'Classical' forms coexist with 'new' ('second'/ 'third'/fourth generation), added or grafted on to allow new complex strategies. Museums old(er) and new(er) can be 'safe places for unsafe ideas'.² Museums need to integrate old and new in strategies to excite, engage, and inform citizens.

Institutional authority can be reframed, building on and establishing new concepts of trust and

legitimacy. Climate change means different things to different people in different locations, based on their ideologies, values, and views of the world, of nature, of the economy, their ethical frameworks, and perceptions of what is at stake, including consumption, economic growth, sovereignty, species extinction, the poor or distant others, their predicaments, and our responsibilities.¹⁸ This is the reason why many come to feel they cannot agree on what to do, if anything. These dynamics of fragmentation and contradiction alongside a lack of reliable scripts for action have deep implications for museums and established practices. Established ways of engaging climate change based on mitigation are limiting. A single-minded emphasis on scientific statements about levels of greenhouse gas emissions is not enough as a means to persuade people to change their behavior. Thinking of this kind does not treat climate change as a complex system where the diverse ideologies, views, and values that people hold about the way to live in the world are tightly coupled with climate change.

A reflexive (deep) critical analysis of these diverse views, values, and ideologies about the way we live in the world, and how these views and practices contribute to climate change, is an integral first step in formulating and activating plural governance strategies. Without such an awareness of complexity the situation is paralyzing for museums and science centers because they are conflict adverse (engaging different world views can lead to disagreement) and do not deal well with complexity. Museums and science centers need to acknowledge that climate change as an idea and as a phenomenon is shaped by many different human actors, non-human actants and institutions.¹⁹

In a complex approach to climate change, a deep, critical, and reflexive analysis of the values, ideological systems, and practices that underpin the way we currently live in the world can act as a lever for action and to frame different governance projects according to these world views. This situation requires a reframing of institutional practices from being seen solely as authoritative information sources to also offer expertise that acknowledges plural actors and perspectives, and engages with deeper, more reflexive frames.¹⁹ The Hot Science research findings confirm the pivotal role museums and science centers have in communicating up-to-date science to inform personal positions and actions.²⁰ Respondents, however, felt museums and science centers should be doing more. For many respondents, museums and science centers are viewed as sites for presenting opposing scientific positions on the climate crisis where institutions were seen as having a role in representing all views. In

instances where uncertainty or conflicts arose between different expert opinion and future predictions, the contextualization of those positions was important: 'you've got to take both sides into consideration... you can't unequivocally say one's right and one's wrong, you've got to lend different weights to different theories'.²¹ Because debates move quickly and are often conflicting, audiences cited judgments about the relative credibility of sources as amounting to new institutional forms of quality assurance. This is in contrast to more traditional, authoritative, objective content with a strong disciplinary tone.^{19,22} Here, audiences conceive institutions' potential in media and communication networks as part of systems of extended peer review and express a new formulation of institutional trust and credibility in the 'to be informed mode' as peer reviewers.

Systems of peer review in the museum context contribute to the research assessment process through a two-tiered procedure. The first procedure involves the presentation of climate change as a complex, social, cultural scientific, and economic issue. The second procedure is the contextualization of the research informing these debates. This involves reviewing the evidence and the credibility of the debates/research in regards their history; how knowledge underpinning the debate is produced; and weighting the various debates and sources in regards their levels of acceptance and what is at stake for each of the actors.¹⁹

Science knowledge production can also be subject to a reflective process. Such a process can illustrate how science and scientific practices have changed; the types of science and science production processes that are used to form views; how these are linked to the emergence of different world views and differing governing strategies; how scientists weight evidence and deliberate; practices of expert deliberation around climate change and deep uncertainty, and how scientific knowledge gets used in society.^{18,19} Science therefore becomes just one of the many kinds of knowledge informing climate change action and public policy debate, and knowledge that will always be partial, conditional, and uncertain.¹⁸

On the other hand, the Hot Science qualitative research findings show that people understood climate change as a complex and a highly controversial battleground of different ideologies and philosophies of life each having a profound influence on attitudes toward climate change and courses of action.²⁰ For these reasons, participants expressed a desire to hear about differing views, practices, and courses of action. They wanted to know about the competing interests and agendas that cross-cultural divides, sectors, scales,

and disciplines, and for institutions to weight these views and values as part of peer review process.²⁰ Many felt that these views must be presented in a way that leaves space for visitors to come 'to their own decisions'²³ thereby enabling them to formulate their own values, moral position, and emotional responses to the topic. Impartiality and balance is reworked within this deliberative frame as a range of views to be expressed.¹⁹ Yet, it was also seen as important that the museum expressed their own position on any contesting representations.

Climate Change Is Multiscalar in Space and Time, and Needs a Multiscalar Response

Climate change and responses to it are aspects of a linked phenomenon, yet local sites and personal spheres of action have their own features. Geological time is hard to see or represent as an experience. The future does not yet exist, and is even harder to represent or experience. To be moved to act on climate change, citizens and scientists alike must 'see' across all these scales, be able to put past, present, and future together, and connect personal circumstances and neighborhoods, the fate of their country and the planet. For instance, a strict definition of 'climate' as an abstract scientific entity to be contrasted with and emphasized over 'weather' can create problems of understanding and engagement for many citizens, who feel they understand weather but not 'climate'. If museum visitors respond to 'weather' but not 'climate', then 'weather' in all its changes over many scales of time and space, including extreme events, can be used to make climate change threats and responses more vivid and comprehensible. Museums operate in many different spaces, which can act in systematic ways on and in multiscalar space.

Climate Change Responses Should be Polycentric, Using Networks

Faced with the complex, dynamic challenges of climate change as an interlocking set of environmental, social, and political forces, museums and other agents of change need to be able to adapt rapidly across different scales and to identify new allies and resources to cope with new or old problems. Networks allow relations across vast social and physical distances that need to be recognized and incorporated into cohesive responses.

One example of science center interventions in awareness raising and transnational network building is the transnational program, *International Action on Global Warming* (IGLO). This initiative was launched on March 1, 2007, to coincide with the start of

the International Polar Year. It is a project of the Association of Science-Technology Centres (ASTC) 'designed to raise worldwide public awareness about global warming'. IGLO's focus was on the Polar Regions and their influence on 'the Earth's climate, environments, ecosystems, and human society'. It aimed to educate 'world citizens' on these issues and coordinates its activities through an extensive website. This site operates as a forum and as a repository for materials concerning the communication of climate science. It includes a 'toolkit' for developing programs to which members have contributed and collaborated.²⁴ IGLO has realized several ambitious projects. Two of these are particularly noteworthy.

The Albedo Experiment brought public attention to the role that polar surfaces play in maintaining planetary temperatures.^{25,26} Established in May 2008 as a collaboration across 21 countries, between 19 science centers and numerous schools, the Experiment engaged 1870 people in the manufacture of large white surfaces. These 'mock polar ice caps' sought to highlight the Albedo effect: the effect produced by the reflection of solar radiation off the earth's surface. Here, the whiteness of the polar caps is significant in deflecting heat, thus cooling the planet. NASA satellites produced striking images of the simulated ice caps.

Another initiative in the IGLO suite of programs is DECIDE. This is a table game to be played in small groups.²⁷ It aims to facilitate discussion and insight into science and technology issues facing communities. DECIDE was initiated by the European Science Centre and Museum Network (ECSITE) in response to surveys and media reports that suggested people were concerned about the latest scientific and technological developments and wished to have greater input into science and technology policy. For ECSITE the game presented an occasion for science centers to act as fora for discussions on complex ethical issues accompanying these developments. When DECIDE was first launched in January 2006, there were six versions covering, respectively, xenotransplantation, nanotechnology, stem cells, genetic testing, neuroscience/brain enhancement, and HIV/AIDS. Each provided an opportunity for participants to inform themselves on one of these subjects, to discuss issues arising, and, finally, to negotiate a shared policy option with fellow players. The resulting decision was then uploaded to the DECIDE website, where outcomes of each game were aggregated on a country-by-country basis for comparison.

In collaboration with the ASTC/IGLO, the game's subjects were expanded to include climate change.²⁸ This edition of the game was rolled out

in a number of regional and language versions and served as the central piece to a major IGLO event: Conversation on Climate Action, October 4, 2007. Overwhelming numbers of respondents in the US dialogues cited the need for stricter energy regulations and attitudinal and behavioral changes to consumption.²⁹ In Italian science centers and schools, the policy deemed most compelling was investment in renewable technologies followed by education.³⁰ The Indian dialogues similarly identified the most important policy initiative to be education around climate change matters from which citizens can make informed decisions, followed by renewable energy and planting trees and protecting ecosystems.³¹

While museums are already networked organizations as demonstrated through these initiatives, this capability will grow more diverse and extensive, able to include many who are currently excluded. Institutions must act as part of large and small centers and as part of collectivities around plural governing projects. Margit Fischer, First Lady of Austria, made a case for a science center and museum partnership with the United Nations at the Planet Under Pressure (PuP) conference in London on March 29, 2012.³² Science centers and museums are ready to drive public engagement in the Rio+20 process, Fischer says, and she makes a case for a strategic plan to channel the energy of science centers and museums into a UN public outreach strategy.

Relations between climate change, science, culture, and social practices need to be reframed. Current approaches to representing the science of climate change in museums and science centers are based on a separation of the science from its social and cultural dimensions. Climate change must be embedded in all programs. Climate change as a phenomenon is now part of the ecology of life, and it must be embraced as a fundamental element of living in the contemporary world.¹⁹

The relationships between nature, science, culture, social practices, and world views need to be reformulated acknowledging the complex relations and entanglements between all these elements and focusing on how climates and societies interact.¹⁹ In the Our Connected Earth interactive game as part of the Atmosphere exhibition at the Science Museum, London, developers sought to present climate change as an ecosystem in human and non-human elements such as people, land, ice, and oceans are contingent on each other. This example is the first step in articulating the hybrid and relational nature of human and non-human forces in climate change.

Museums can be seen as media within larger communicative ecologies. Museums engage in the

communication of climate change as producers of experiences (not just as displayers of objects), and therefore their role has to be considered within a broader structure of communication and information. Each instance of communication or information takes place within an already existing communicative ecology, where new media articulate and integrate with 'older' media. Social media are a means to an end, to engage people in climate change issues rather than an end themselves.³³ An interesting museum exhibition worth mentioning is *Mission Gaia*, an interactive immersion game designed and produced by TRAM MÉDIA in Canada as part of a large multimedia installation that focuses on issues of sustainability and development. The game is based on offering players an experience of a dystopic future affected by uncontrolled consumption, social injustice, and ecological degradation with the aim of making visitors aware of the urgent need for action.

However, dystopic visions of the future must be balanced with optimistic perspectives in which action is seen as plausible and possible. One-off museums exhibitions are in many ways like one-off campaigns. They come and go and focus on a target output. What is required from the museum sector is a consideration of how to be part of developing long-term processes of social change. In this regard, museums and science centers must consider the opportunities of connecting with existing local networks, where the museum or science center becomes part of a larger ecology (social and technological) of communication. Programming options should take into account these challenges and prospects. An overview of programming in museums and science centers shows that effective communication of climate change that inspires action is the result of an engagement with publics inside and outside the museum/center, across a wide range of practices: exhibitions, hands-on exhibits and science demonstrations, educational labs and pedagogical materials, workshops with school groups, lectures and debates involving scientists and the general public, forums and citizens' conferences, film and video festivals, digital storytelling workshops, digital games, and using social media tools and P2P networks.³³ In other words, the agencies of museums and science centers in climate change deliberations are strengthened when these institutions are open to connect with broader communication ecologies and civil society initiatives.

A relevant example is the *ACCENT project*, a 1-year long initiative that took the form of a European participatory campaign—called *I do*³⁴—where 15 museums and science centers exchanged their

experiences under a common framework to address the complexities of public communication of climate change. The premise of the project is not dissimilar to that faced by most institutions engaging with climate change communication. That is, how can institutions create and develop interactive and participatory communication tools amidst huge amounts of scientific data and the interplay of differing interests and knowledge practices, in order to engage with a wider number of publics 'based on dialogue and public involvement rather than on "pure" information'.³⁵ These new methods included hands-on exhibitions, participative games, local citizens forums, and other formats, which were used by science centers and museums to find ways for publics to be effectively engaged in climate change issues.

A significant challenge that emerges from these experiences is how to engage the public while inside the institution's space, but also outside its walls where dialogue may be established among scientists, stakeholders, and the public.³⁵ *ACCENT project* activities involved the partnership of over 34 national and international network organizations in which local citizens' debates played a pivotal role. Three relevant outcomes of these debates were that citizens became aware of the need to change lifestyles, production, and consumption patterns; the need to value the interconnections between the local dimension of behaviors/choices and global consequences; and the need to promote education through alliances between schools, the world of research, NGOs, and science centers.³⁵ In terms of evidence of impact of initiatives like these, it is worth considering the number of visitors to the science centers and museums involved in the project, which including teachers, students, and the general public accounted for 2.6 million people across the 15 countries. These visitors were able to experience rich exhibitions on climate topics as well as citizens' debates and expert seminars. The project leaders estimate that of these number of visitors, about 200,000 people were directly and actively involved in activities such as science demonstrations debates and participatory activities.³⁵

Climate Change Responses Need Porous Boundaries, 'Liquid' Organizations, and 'Clumsy' Solutions

For museums to be more effective communicators of climate change issues, conceptual walls and barriers, as well as physical walls and barriers, need to allow and negotiate flows and exchanges in dynamic systems. Solutions need to be provisional, right for problems as they present themselves. Distinctions

between inside and outside museums, visitors and other citizens, local and overseas, younger and older, more or less well educated, and different cultures and backgrounds need to be better recognized and managed. Most boundaries that museums recognize will still exist in some form, but all can be negotiated to better serve the role of museums as agents of change. To respond like this, museums and the sector will need to rethink many assumptions and forms of organization.

Liquid museums are conceptual and strategic simplifications to help museums act more meaningfully in a fluid, turbulent and complex world. Using concepts of assemblage and liquidity, institutions can be thought of as made up of material components (buildings, people, computers, exhibitions, collections, geographical location, funding, etc.) and expressive forms (practices and capacities such as institutional mission statements, expressions of legitimacy, expertise, trust, authority, networks, dispositions, aspirations, contracts, and brand). Liquid museums operate as, and in, dynamic, gathering or assembling, and disassembling processes that transcend national boundaries. The concept of the 'liquid museum' is a useful tool to consider institutions and their capacities as agents in the contemporary world as embedded entities within complex climate change governance arrangements. Processes and events are relationally interdependent, and institutions act as part of and within open-ended collectives.¹⁹

Museums have new opportunities to operate in between communities and formal politics as deliberative spaces, and in processes of collective intelligence, thereby opening up new spheres of influence and relevance. Museums and science centers have the potential to be more influential in the political field, and in collective action, helping to formulate and influence different types of interventions. Just taking political decisions on policy is no longer enough. Rather for policies to be made effective and viable the formal political process must develop forums to strategize with citizens.³⁶ Citizens have different expectations, capacities, and skills than before, due partly to the rise of the internet and social media.³⁶ They are also less trusting of governments, better at governing themselves, and less amenable to be governed.³⁶ By operating in new ways in governing climate change, such institutions act as deliberative spaces—reviewing various generic policy options and bringing diverse stakeholders together in processes of collective intelligence. One of the valued assets of institutions is their ability to promote longer term thinking, beyond the short termism of government and the profit-driven interests of the private sector.³⁷

Museums can help to forge connections in debates on generic policy options (as opposed to specific policy proposals that might be seen as too political) by critically reviewing the debates and options against the research and by examining their implications for various social futures scenarios through systems of peers, open review, and quality assurance processes. They can act as congregational spaces, bringing cross-sectoral stakeholder groups and audiences together with the research, and by facilitating and brokering deliberations around the various options and testing these against various disciplinary, lay expertise, and local knowledge. They can facilitate inputs into potential policy positions as a mechanism for detailing future scenarios and ways to live in the world differently under the conditions of climate change.³⁷ Museums and science centers can feed the ideas that emerge from these deliberations into other governing agencies as a precursor for action and as plural governance projects.³⁷

One such program was the global initiative *World Wide Views on Global Warming* (WWViews) held on September 26, 2009 in the lead up to United Nations Climate Change Conference (COP15) in Copenhagen. Many museums and science centers and their communities participated in this global forum. This action gave citizens all over the world an opportunity to define and communicate their positions on issues central to the negotiations at the United Nations Climate Change Conference (COP15) in an effort to influence the COP15 negotiations. While the COP15 negotiations failed to meet the expectations of many in formulating a global agreement on emissions reduction, WWViews sent vital messages about climate policy from citizens to decision makers and it set a path-breaking precedent by demonstrating that citizens' opinions have merit and their views should be included in global political processes.

Evidence suggests that there are major gaps in the knowledge and communication of climate change (between global/local and expert/lay sectors). Dominant climate change narratives are usually presented as emphasizing the power of global climate systems (and the voice of scientists) over threatened, at-risk, and vulnerable local communities (with little or no voice of their own). International research suggests that there is more information at a global level, but much weaker information at a local level. Failure to understand the causes and consequences of climate change makes it hard for people to connect the phenomenon to their own lives. Responses to climate change are better understood in relation to emerging notions of citizenship than to climate change crisis narratives. Learning how to cope/deal/adapt/act on

climate change in specific local contexts may not be transferable to other local contexts.

The public understanding of science frameworks used in many museums and science centers often works to displace lay, indigenous, or other knowledge systems and may weaken civic action. The notion of 'cognitive justice'—the dialogue between the different knowledges and perspectives, and the right for different forms of knowledge to coexist without being marginalized by official, state-sponsored forms of knowledge—may help create and develop processes of public engagement and climate justice.³³ For museums and science centers, there are challenges and opportunities in acknowledging and actively promoting indigenous peoples' knowledge and local community adaptation strategies; whether these be in order to contribute to building awareness of valuable traditional adaptation and mitigation practices or for creating interfaces through which synergies between expert and lay knowledges may be recognized and implemented into real-world solutions. In this regard, engaging with local communities is significant because it is primarily within local contexts where adaptation, mitigation, and action on climate change actually take place.³³

Engaging Citizens Need 'Thick' Communication, Interaction, Dialogue, Trialogue—Not Monologues from the Powerful

The unquestioned authority that both science and museums once relied on can be counter-productive if the task is to empower new generations. Such authority can alienate, rather than generate trust. New media alongside old can enrich the range of means of communication, but only if the form and intent of the communication is democratic and respectful. Dialogic models lead to mutual change over time. Trialogic models expand the awareness of social complexity at every level. Scientists can be consciously aware of, and learn about, museum perspectives and the needs of publics, and publics can be given insights into the distinct perspectives of science and museums.³⁸

Exhibitions can have a clear focus but not a single message. Planning, designing, and changing exhibitions and displays should be informed by many voices organized as trialogues. Kinds of media, collections, written texts, and electronic media should interact with each other. On-site, off-site, and on-line sites should be in a trialogic relationship.³⁸

Museums and science centers across the world are coming to terms with the idea that climate change should be presented as a story based on

experiences worth listening to, not just as disembodied information without a storyteller. Ways of knowing about climate change cannot be disembodied as abstract information (as is often presented by the mainstream media), but must be rich in feeling, in intuition, and connected to larger social, historical, and ecological contexts. For this reason, community engagement is essential for museums. A politics of engagement must also include a serious concern for climate change education and literacy, a public pedagogy of climate change, which often does not take place through other cultural institutions.³³

For museums and science centers, there are challenges and opportunities in engaging with civic-driven initiatives for social change and climate justice. This entails looking beyond the broadcasting model of communication into community, alternative and citizen's media models, and connecting/relating to social movements on the ground. Together with a better understanding of how citizen media practices offer alternative and participatory models of civic-driven change, the museum sector may benefit from connecting more efficiently with climate action groups, as climate-change actions are no longer confined to activism in the public policy domain. There is a new focus on facilitating learning and change in household and consumer domains, and museums are well positioned as connectors and catalyzers.³³ Once again we could mention the ACCENT project that assessed the outcomes of 25 local citizens' debates in order to deliver reliable data on the European citizens' opinion on climate change issues and their perception of them. In these citizens' debates, over 670 people were invited to discuss matters of concern with over 150 experts and with decision makers and other relevant stakeholders. Some of the outcomes of these citizens' debates are indicating that publics are aware of the need to change lifestyles and consumption patterns and are of the opinion that the local dimension of behaviors/choices has global consequences. There is a high level of awareness of the need to promote education through alliances between schools, science research, NGOs, and science centers and museums.³⁵

A Dirty War Has Been Declared, but It Should Be Resisted, Not Fought

Vested interests with access to huge political, organizational, and media resources have reframed the debate about climate change in ways that disturb scientists and museum staff who believe in the power of reason and respect for truth.³⁹ Spokespeople are threatened, specious arguments are presented as truths, and a lack

of logic proclaimed as superior reason. Yet, adopting the same standards or ignoring 'sceptics' is counter-productive. It fails to engage with substantive issues.

Incorporating these voices into the space of museum is a risk that needs to be taken. Good scientists are true sceptics. This complex point must be made in publicity materials and in programs. Museums and science centers can act in mediascapes by providing different perspectives than the media, opening up debates to include other points of view beyond mainstream positions. These institutions can operate as moderators, intermediaries, and commentators, providing reports, analyses, and comments. New forms of quality assurance, trust, and legitimacy can be framed around an institution's agency, including systems of peer review, and as expert reviewers, along with others in complex debates.¹⁹ Balance is reworked within this deliberative frame, as a range of views to be expressed and examined.¹⁹

Social media and alternative reality gaming network technologies can be used to assemble the ideological positions and interests of stakeholders and audiences, activate systems of peer review in conjunction with systems of public review, through interactive discussions with publics that can be fed into the review, weighting, and quality assurance processes. By looking at climate change as a complex issue that involves many different values and world views, museums and science centers can open up a space to consider climate change as a contemporary social and cultural condition from which diverse governmental positions and options might emerge.¹⁹

Give Art a Go

In tapping deep movements of cultural sentiment, art can be 10 years ahead of the curve, engaging with new media as well as old. Its oblique communication gets highly complex messages across. Feelings, emotions, and affects play a complex role in the dynamics of human action, in science, and museums as in other spheres. They can be mobilized through art and other strategies to connect with imagination and creativity. As McKibben⁴⁰ says, 'you don't build movements with bar graphs. You build them, in part, with art. With painting and with music and with graffiti and with dance and with concerts and with everything that engages the right brain. Or that engages the heart, trusting that where the heart leads the head will follow'.

There are several other initiatives worth mentioning where artists and cultural institutions have partnered. A relevant project in this area of art science collaborations is *Creative Climate*, a 10-year

project between 2010 and 2020 launched on the BBC world service in December 2009 and coordinated by the Open University in partnership with the BBC. The web-based project features diary entries where individuals can record their impressions in order to chart personal experiences with environmental change over a decade. Visualizing future scenarios of climate change on the planet is certainly one area of particular interest where artists and institutions also collaborate. One interesting initiative worth mentioning is Metis Media's *3rd Ring Out*,⁴¹ a multimedia and multidimensional scenario-building project developed by Zoë Svendsen in the UK in 2010–2011. Involving public performance and installation, audiences were asked ethical questions 'splicing recognizable images of the UK with projections of possibility' and invited to vote to decide 'how to respond to a developing scenario of climate-changed future'.⁴¹

Well-informed publics is a first step to acknowledge that we are living through a tipping point phase in our existence in this planet. However, as we have mentioned before in this article, museums need to rely less on presenting audiences with information and more on creating and designing richer experiences. The emotions they aim at should have range and balance, encompassing joy, wonder, and delight, rather than just pressing the buttons of fear and guilt. There is a huge potential for museum and science centers to partner with local and global climate change arts initiatives. One such example can be seen in the activities of 350.org, a non-profit organization of volunteers working across 188 countries, which aims to develop a global grassroots movement on climate change action through online campaigns, grassroots organizing, and mass public actions. Using online tools to facilitate strategic offline action, 350.org aims to become a global laboratory for best practices in strengthening a global climate movement and catalyze transformation around the world. Some of their actions to date include 5200 simultaneous rallies and demonstrations in over 180 countries during October of 2009. In 2010, 350.org launched EARTH,⁴² the world's first ever global satellite art project. In over 16 places around the world, the public collaborated with artists to create art so large it could be photographed from space. The art pieces highlighted a local climate change issue or solution. In September 2011, they also organized 'Moving Planet', a massive day of action to move beyond fossil fuels.

Build New Relations to New Publics

Climate change is everybody's business. The science and museum sector need to address the exclusions that

have been part of their history and identity, which still continues in spite of the efforts of many. This is a task for new media, including the social media, plus concerted efforts to go beyond the walls of museums. It requires a broader idea of citizenship, including marginalized citizens and indigenous people in Australia and elsewhere. The current museum sector is better positioned to respond to this challenge than it has ever been, but there is still much to do.

It is necessary to think about audiences differently, as valued actors. Traditional relations between museums and audiences are based on disciplining them—telling them to change their behavior and become good ecological citizens. New relations must be formulated with audiences that are more respectful of their own skills, capacities, and opinions. Cocreation and codiscovery become key themes.¹⁹

The role of museums and science centers is not to prove the science of climate change but to improve the communication of climate change. For museums and science centers, there are challenges and opportunities in moving beyond the notion of informing visitors and audiences (a vertical dissemination of data and messages) to engaging with publics (a horizontal process of dialogue and participation), where communication entails developing processes for strengthening participation mechanisms, not just enhancing organization visibility. Museums must not only inform citizens but also equip them with tactical knowledges to enable participation in actions and debates on climate change.³³

In a complex climate changing world, and in the context of social media, audiences become subjects for action having capacities, desires, expectations, talents, expertise, reflective, reflexive, and creative capabilities with variable powers to act, within a mobile, open, interacting museum system.¹⁹

Relevant innovations in this field include, for example, the conceptualization and prototyping of 'public interactives'⁴³ in museum contexts. These are devices that are designed to engage people in conversations with digital media for the purposes of information exchange, education, entertainment, and cultural memory and therefore can serve as interactive experiences in museums—and other public outdoor settings—as ways to enact novel forms of public communication.⁴⁴ These tools become relevant within networked distributed learning environments created through the connections among different nodes, where museums and science centers can be connected to homes, schools, and other public institutions. Thinking about the 'distributed museum'⁴⁵ as an institution distributed across multiple media platforms and physical space, museums and science centers can

really capitalize on the opportunities of becoming relevant nodes within a larger technocultural assemblage of physical and virtual spaces that open up opportunities for social interactions and for developing information resources and communication platforms.⁴³

Evidence indicates that lack of public understanding is a major obstacle, inhibiting action on climate change. Informing audiences about the science of climate change is a different matter to communicating with citizens on climate change issues. Most media only inform, they do not communicate. Information refers to a one-way diffusion of messages, whereas communication is a dialogic and triologic process of creating meaning and sharing values. In many countries, the mass media is the main source of information about climate change. Focusing on disseminating recycled scientific information, most news media frame climate change in ways in which preferred discourses and dominant narratives are imposed. While the degree of certainty about many aspects of climate change among scientists is high, the media portray a context of uncertainty and scepticism about the real incidence of human-induced climate change or highlight the political and economic costs of deep policy reform. Raising awareness of the existence of climate change will have little effect if there is no creation of processes for social and behavioral change.³³

CONCLUSIONS: REAL CHANGE, DEEP AND SUSTAINABLE, IS STILL THE AGENDA

Recognizing the complexity and multiscalar nature of climate change is not giving up on climate change action, but offers a way to build more effective responses that are understood and endorsed by many more people and groups. This includes, for example, the modes through which museums and science centers have a responsibility to engage with other knowledges of climate change such as indigenous knowledges. Achieving real change needs real pressure, exerted on those with effective power. The status and authority of science and scientific institutions, as of the museum sector, have influence, but so far this has not translated into transnational policy action. Science is important, but not 'scientism'. Scientism is exclusive reliance on the authority of science, through the production of science statements cleansed of their controversial or uncertain elements and offered merely as a lever to tell people to reduce their own personal carbon footprint. Similarly, 'economism' and 'technologism', the exclusive reliance on economic or technological fixes and technology as saviors, are deficient. The

museum sector is not autonomous—it has to heed the views of funding bodies. Governments listen, but only to matters within a limited range. Big business exercises power through many means, including ownership and influence of media, lobbying, and misinformation.

Sustained change in attitudes, behaviors, and policies around climate change requires museums and others to build coalitions and diversify forms of action, to challenge and change deep and persistent frames and to shift tectonic plates of public opinion. It is not about winning a particular debate or mounting one successful exhibition. Adequate and sustainable responses to climate change require that we think how we can effect substantial changes in the system of production. This is the implication drawn from many scientists who have put into question the continuance of a fossil-fuelled global society. Every consumer, every product, every species, every forest, is concerned in this, together with every river, every glacier, and ocean current.

But museums would be profoundly mistaken if they took this vision and diagnosis as one that was shared by everyone, including scientists. If they assumed that this version of reality prevailed everywhere, they would have nothing to say to those that do not hold that assumption. They would have nothing to say to those that remain committed to other versions of reality. Rather, the museum's task is to contribute to the slow and different work of building a common world, of composing a world that we all, humans and non-humans, come to share. For the museum, a common world cannot be its beginning—it must be its horizon. For this is what has to be composed if human living is to accommodate a soon to be 9 billion people within a habitable planet earth.⁴⁶

NOTES

⁴⁴The project Hot Science, Global Citizens: the agency of the museum sector in climate change interventions was led by Fiona Cameron as lead Chief Investigator with Chief Investigators, Bob Hodge, Brett Neilson, and Juan Francisco Salazar from the Institute for Culture and Society, Jann Conroy from the Centre for Plant and Food Science, and David Karoly from Earth Sciences, University of Melbourne, with PhD candidate Scott East. Research support staff included Ben Dibley, Carol Farbotko, Teresa Swirski, Ann Deslandes Anne Newstead, and Rebecca Giggs. Institutional and representative partner investigators include Museum Victoria and audience advocate Carolyn Meehan; Australian Museum with Lynda

Kelly, Manager Web and Audience Research; the Powerhouse Museum with Sebastian Chan, Head of Digital; Questacon (the National Science Centre, Canberra) and director, Graham Durant; Liberty Science Center, Jersey City, NJ, USA and Wayne LaBar, Vice President, Exhibitions; and Richard Sandell, Head, School of Museum Studies, University of Leicester, UK.

^bPlaces to communicate the up-to-date science. This agency was seen as one of the largest gap roles for Australian and US museums with 51 and 50%, respectively, agreed that institutions currently communicate the up-to-date science, while 76 and 74%, respectively, believed museums should be taking on this role.

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