Responding to climate change: The three spheres of transformation

Article · January 2013

CITATIONS
36

READS
2,327

2 authors, including:

Karen O'Brien
University of Oslo
111 PUBLICATIONS **12,185** CITATIONS

SEE PROFILE

Responding to Climate Change: The Three Spheres of Transformation[1]

By Karen O'Brien and Linda Sygna

INTRODUCTION

More and more individuals and organizations recognize that business-as-usual is an insufficient response to today's climate challenges. As a result, the concept of transformation is moving to the forefront of debates about responses to climate change (WBGU, 2011; O'Brien, 2012; Park et al., 2012). Nonetheless, there are some very different conversations taking place around transformation. Transformation can be defined as physical and/or qualitative changes in form, structure, or meaning-making, or as "the altering of fundamental attributes of a system (including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or biological systems)" (IPCC, 2012: 564). It can also be understood as a psycho-social process involving the unleashing of human potential to commit, care and effect change for a better life, or an internal shift that results in long-lasting changes in the way that one experiences and relates to oneself, others, and the world (Sharma, 2007; Schlitz et al., 2010). Folke et al. (2010) note that transformations can be deliberate or forced, depending on the level of transformability of the system. Transformability is defined by Westley et al. (2011: 763) as "the capacity to create untried beginnings from which to evolve a fundamentally new way of living when existing ecological, economic, and social conditions make the current system untenable."

Within the context of climate change, transformation is a complex process that entails changes at the personal, cultural, organizational, institutional and systems levels. It is not always clear what exactly needs to be transformed and why, how, in whose interest, and what the consequences will be. The idea of transformation can be perceived as instrumental by some and threatening by others, leading to trade-offs or conflicts that can result in real or perceived winners and losers at different scales. For example, a transformation of energy systems that involves the development of biofuels has been criticized for contributing to land grabbing and food insecurity (Harvey and Pilgrim, 2011). Strategies to reduce deforestation, such as through REDD+, can be seen as detrimental to indigenous communities and local interests (Sunderland, 2011; Beymer-Farris and Bassett, 2012). Geoengineering as a response to climate change has also raised numerous social, environmental and ethical concerns (Gardiner, 2011). Not surprisingly, many of the transformations that are currently proposed in response to climate change are poorly understood, frequently contested and often resisted.

In this paper, we discuss four approaches to transformation that are currently visible in the climate change literature. We then synthesize these approaches by presenting a simple framework that focuses on three interacting "spheres" of transformation. The three spheres, referred to as the practical, political, and personal spheres, can be used as a tool for understanding how, why and where transformations toward sustainability may take place. We consider where the four approaches fit into this framework, paying particular attention to how the relationships among the spheres together influence outcomes for sustainability.

[1] This article appears in the Transformation in a Changing Climate proceedings, reference: O´Brien, K. and Sygna, L. (2013) Responding to climate change: The three spheres of transformation. Proceedings of Transformation in a Changing Climate, 19-21 June 2013, Oslo, Norway. University of Oslo (pp.16-23). ISBN 978-82-570-2000-2.

RESEARCH ON TRANSFORMATION

Although transformation is widely talked about, there are many partial, fragmented, and even contradictory understandings of how such changes come about. Transformation means different things to different people or groups, including within the community of researchers, policy makers, practitioners and citizens working on issues of climate change and global sustainability. A result is that multiple conversations are taking place around the notion of transformation, each with different approaches, focal points, goals and objectives. Below, we discuss four broad literatures that address transformation in a changing climate. There are many similarities and overlaps among these literatures, but they can nonetheless be considered discrete approaches to transformation within the context of climate change.

Transformational adaptation

Humans have been transforming the Earth for millennia, but it is only over the past centuries that the impacts have become visible at a global scale (Turner et al., 1990; Steffen et al., 2011). Climate change, in combination with other environmental changes, is now contributing to transformational changes in the Earth system, including changes in ice cover, sea level, ecosystems, species distributions, and extreme events (IPCC, 2007; 2012). While adaptation is recognized as an important response to climate change, it is becoming clear that in some places it may be necessary to pursue transformational adaptation. Transformational adaptation goes beyond incremental approaches to climate change impacts, and may include changes in form or structure through novel, large-scale actions. It may be taken in anticipation of, or in response to observed or expected impacts, it may involve coordinated or uncoordinated actions, and it may be deliberate or inadvertent (Nelson et al., 2007; Marshall et al., 2012; Park et al., 2012). Kates et al. (2012) describe three types of transformational adaptations; those adopted at a larger scale or intensity; those that are novel to a particular region or system; and those that transform places or involve a shift in location. Although transformational adaptations are most often technological or behavioral, it is recognized that there are legal, social and institutional barriers linked to values, ingrained behaviors, and self-identities (Kates et al., 2012).

Attention to transformational adaptation is warranted in a world experiencing complex processes of change, and where climate change mitigation is not occurring at a rate that will avoid serious impacts for some. Kates et al. (2012: 5) contend that "transformational adaptations will be required in future years in some places and by some systems, given local vulnerabilities and in the face of such possible driving forces as relatively severe climate change and other stresses." Explicit to this is the idea that impacts are forthcoming regardless of human responses. Implicit is the possibility that humans cannot or will not change systems and structures that contribute to climate change, social vulnerability, and disaster risk, and thus will be forced to adapt to the consequences of climate change in a transformational manner.

Transformations to sustainability

There are diverse literature on transitions and transformations to sustainability, most of which include development pathways that stabilize emissions of greenhouse gases (Raskin, 2001; Calvin et al., 2009; WBGU, 2011; Westley et al., 2011). The literature on transformative pathways typically focus on trajectories of emissions, changing risks, cost-benefit analyses, transitions in energy systems and land-use patterns, carbon capture, technological choices, and policy approaches (Calvin et al., 2009; Thomson et al., 2011). Given the large number of potential transformation pathways, the choice of which to follow will ultimately involve weighing characteristics and considering tradeoffs with other priorities. More generally, research on sustainability transitions focus on purposeful and deep structural changes in energy, transport, agriculture and other systems (Geels, 2011). This includes

societal innovations and changes in governance, including transition management as a new mode of governance to influence long-term societal change (Loorbach, 2007). Most research on transitions is based on systems thinking and complexity science, which emphasize learning processes, adaptive management, innovation and experimentation across multiple levels, such as landscapes, regimes and niches. While non-linearity is a recognized characteristic of transitions, the process itself is considered to be long-term and gradual, often occurring over generations due to lock-in mechanisms (Geels, 2011). Importantly, there is no single cause or driver of such transitions, but rather it is seen as the result of multiple processes interacting across scales. For example, niche alternatives alone are unlikely to transform regimes, which include the deep structures that account for the stability of existing socio-technical systems (Smith, 2010; Geels, 2011).

The importance of including ecosystems and biodiversity in discussions of global sustainability is emphasized in the literature on transformations to ecosystem stewardship (Chapin et al., 2009; 2010). Drawing on many of the concepts and ideas from the study of resilience, such as adaptive cycles, fast and slow variables, feedbacks, and bringing in notions of governance and innovation (Gunderson and Holling, 2002; Walker and Salt, 2007), this literature focuses on the notion of desirable transformations, i.e., the goal of sustaining the desirable features of the current world for future generations (see Chapin et al., 2009). It recognizes that cultural, economic and governance institutions all play an important role in preventing or enabling transformation (Westley et al., 2011). While there is some overlap with the literature on socio-technical transitions to sustainability, this field of research draws attention to a fundamental need to "reconnect with the biosphere" (Folke et al., 2011). It includes recognition of the role of human agency and capacity for learning, as well as the importance of institutional entrepreneurs who often operate within shadow networks (Westley et al., 2011).

Transforming behaviors

The transformation of human behavior is considered to be an essential part of transitions and transformations to global sustainability. There is a growing literature discussing the individual and cultural dimensions of climate change, including the psychological barriers to responding (Gifford, 2011; Swim et al., 2011). Cognitive psychology shows that people have multiple strategies for dealing with the reality of climate change (Kahan, 2012), whereas cognitive anthropology puts these within the context of human belief networks to consider the cognitive prerequisites for mobilizing the subjective individual potential for collective action (Antal and Hukkinen, 2010). Social psychology emphasizes the important role that cultural values play in shaping collective responses (Crompton, 2011), and sociology draws attention to how climate change is sustained through the social construction of denial, and through the cultural management of emotions (Norgaard, 2011). A number of authors attribute climate change to nothing less than a crisis of consciousness (Speth, 2008; Rifkin, 2010).

The role of human agency in transformation processes has gained considerable attention through a wide range of literatures. Research on values, worldviews, beliefs, self-efficacy and ecological citizenship focus on the potential of individuals and groups to become agents of change (O'Brien and Wolf, 2010; Hedlund-de Witt, 2012). A more recent body of research, discussed by Rowson (2011), emphasizes 'neurological reflexivity', which includes self-awareness that is capable of shaping the social and biological conditions that underpin actions. Reflexivity involves an understanding of the underlying beliefs, assumptions and other factors or drivers associated with an activity or experience, which results in the power to influence or change it (Siegel, 2007). Such an approach differs from 'nudging' sustainable behaviors, which "changes the environment in such a way that people change their behavior, but it doesn't change people at any deeper level in terms of attitudes, values, motivations etc." (Rowson, 2011: 16). Nonetheless, a focus on "attitude, behavior and choice" has been criticized for ignoring the underlying systems of provision, and the extent to which options and possibilities are structured by institutions and governments (Shove, 2010).

Social transformations

There is a wide recognition that the types of transformations necessary to avoid dangerous climate change involve more than new technologies, better management, improved policies or behavioral changes. They also call for transforming the political, economic, and social structures that maintain the systems associated with increasing risk and vulnerability intact. Manuel-Navarrete (2010), for example, calls for challenging sociopolitical structures and the realist agenda of global environmental governance and regimes, and draws attention not only to the need to address power relations, but also to humanist ideals of emancipation, which emphasize intentional human agency and creative power. Swyngedouw (2010) critiques the non-political and non-partisan nature of environmental populism and its implicit acceptance of the inevitability of capitalism and a market economy as the only organizational structure of the social and economic order. Absent from this is a "politics of the possible" and a naming of different socio-environmental futures that may introduce difference, conflict, and struggle (Swyngedouw, 2010).

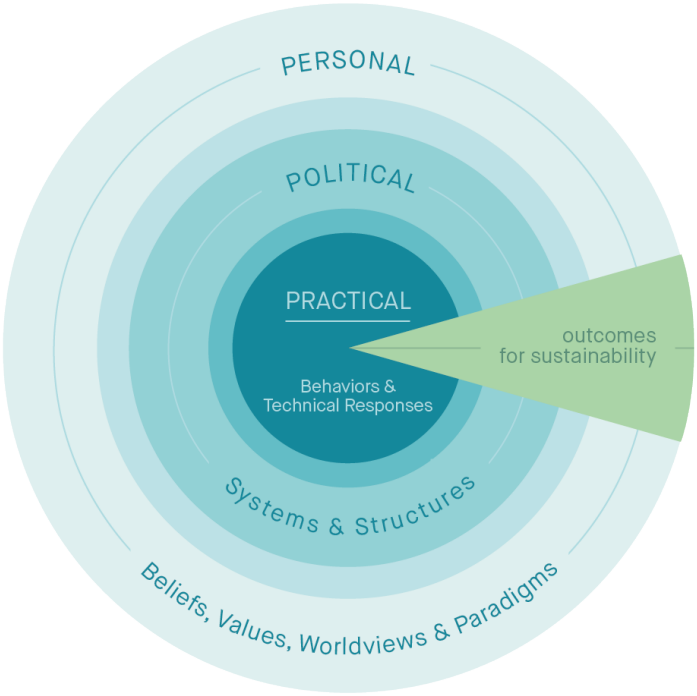
In discussing transformation as a type of adaptation, Pelling (2010) describes a central challenge for systems analysis: placing the system itself as the object of observation. He notes that the resilience of a system is often maintained by focusing on the proximate causes of undesirable outcomes, rather than the root causes of vulnerability that lie in the social, cultural, economic and political spheres. From within the system, these causes can appear naturalized, or "part of the way the world is" (Pelling, 2010: 86). When vulnerability is attributed to local issues, such as unsafe buildings or inappropriate land use, adaptation will be seen as technical problem that can be addressed through improved housing standards, land use changes, and other managerial strategies. However, Pelling (2010: 97) stresses that "if vulnerability is framed as an outcome of wider social processes shaping how people see themselves and others, their relationship with the environment and role in political processes, then adaptation becomes a much broader problem. It is here that transformation becomes relevant."

THREE SPHERES OF TRANSFORMATION

Transformation is becoming an important concept in discussions and debates on how to address complex global environmental problems. The diverse conceptual and theoretical frameworks discussed above can guide research, policy and practice, and contribute to deeper understandings of transformation within the context of climate change. However, there is also recognition that a more comprehensive approach to transformation is needed: "a regime shift cannot occur without changing worldviews, institutions, *and* technologies together, as an integrated system" (Beddoe et al., 2009: 2484). Yet still there is no comprehensive understanding of how deliberate transformations towards sustainable outcomes come about.

In this section, we synthesize and integrate the conversations on transformation discussed above by conceptualizing transformation as a process that takes place across three embedded and interacting spheres. These three spheres, referred to in shorthand as the practical, political and personal spheres of transformation, are implicitly or explicitly alluded to in each of the conversations on transformation, but with little attention to the interactions and interrelations. By viewing the spheres together, it is possible to see the breadth and depth of transformations, as well as the multiple entry points for sustainability outcomes.

The three spheres of transformation are drawn from the work of Sharma (2007) and illustrated in Figure 1. The practical sphere represents both behaviors and technical solutions to climate change. These include behavioral changes, social and technological innovations, and institutional and managerial reforms. The political sphere includes the social and ecological systems and structures that create the conditions for transformations in the practical sphere.



Figur 1 The three spheres of transformation (after Sharma, 2007)

The personal sphere includes individual and collective beliefs, values and worldviews that shape the ways that the systems and structures (i.e., the political sphere) are viewed, and influence what types of solutions (e.g., the practical sphere) are considered "possible". While the spheres come across on paper as flat, two-dimensional circles, they are embedded within one another, with the practical sphere at the center, surrounded by the political and personal spheres. The ordering of the three spheres is significant; the practical sphere is at the core, where the targets or goals are located; the political sphere represents the enabling/disenabling conditions; and the personal sphere captures individual and collective "views" of systems and solutions. Transformations within any one sphere can facilitate changes in the others, although some interventions are more powerful and effective than others (see Sharma, 2007).

The practical sphere

We first focus on the practical sphere that represents the core of transformation; this is where outcomes have an observable and measurable influence on climate policy goals such as mitigation, adaptation, or sustainable development. Not surprisingly, this is where most attention is currently focused; it is within this practical sphere where "technical" responses to climate change take place, including changes in management practices, the introduction of new technologies, and socio-technical and cultural innovations. It also includes changes in strategies, practices and behaviors. Transformative pathways towards emissions stabilization are typically focused on this sphere, and this includes many climate policies aimed at cost-effective emissions reductions through changes in the energy technologies or through carbon capture and storage (Thomson et al., 2011). Most adaptations to climate change also take place in the practical sphere.

The practical sphere can be considered the "outcome" sphere, where the numbers, parameters, and indicators are most often measured (e.g. the Human Development Index, the Red List of Endangered Species, ecological footprints, etc.). However, as Meadows (2009) notes, attention to parameters and numbers is one of the least effective leverage points for systems change, as many such changes push the system in the wrong direction. Indeed, without addressing the larger systems and structures,

practical solutions may create unexpected outcomes and new problems. The line between business-as-usual and transformation is easily blurred within this sphere. For example, although electric cars may replace petrol cars, mobility systems are not necessarily transformed (see Urry, 2011). Frantzeskaki et al. (2012) discuss the inherent tensions between ambitions for radical transformations and the practical need for specificity, implementation, compromise and incremental steps. More often, the responses that emerge in this sphere are influenced by transformations in the larger political, economic, and cultural systems and structures associated with the political sphere.

The political sphere

The next sphere is the political sphere, which represents the systems and structures that define the constraints and possibilities under which practical transformations take place. The political sphere includes economic, political, legal, social and cultural systems; it is here where politics and power influence the rules of the game, where social movements, collective action campaigns, lobbying, electoral politics, and revolutions respond to them, and where threatened interests resist or quash pressures to change. It is in this sphere where both problems and solutions are identified, defined and delimited, and where conflicts of interest must be resolved (Forsyth, 2003). Research on socio-technical transitions and social practices often focus on this sphere to understand how and why transformations at the practical levels occur or do not occur, and draw attention to the importance of political sphere for facilitating or enabling responses that promote sustainability (e.g., Geels, 2002; Shove, 2010; Frantzeskaki et al., 2012).

Importantly, the political sphere also involves the management of "natural" systems, such as ecosystems, the climate system, water systems, and so on. Earlier in history, transformations in these "natural" systems were considered to be outside of the realm of human agency (Hulme, 2008). However, in an era where human activities now rival global geophysical processes in transforming the environment, the direction, rate and scale of the transformations to these systems has become a matter of collective choice, and hence must be addressed within the realm of politics (Steffen et al., 2011). The dominant systems and structures have been established by societies through time and often reflect past and present beliefs, values and worldviews.

The personal sphere

Outermost is the personal sphere; it is here where the transformation of individual and collective beliefs, values and worldviews occur. Changes in this sphere can lead to different "action logics", or ways of understanding and interacting with the world (Torbert et al., 2004). Discourses and paradigms emerge from the personal sphere, and influence the framing of issues, the questions that are asked or not asked, and the solutions that are prioritized in the political and practical spheres. Changes in the personal sphere often result in "seeing" systems and structures in new ways, e.g, with different boundaries and different factors considered as "endogenous" and "exogenous". For example, while ethnocentric worldviews may prioritize systems and structures that help a particular group adapt to climate change, worldcentric worldviews are more likely to place attention on actions that benefit all humans and species, with an emphasis on both mitigation and adaptation. Changes to beliefs, values, and worldviews can influence the types of actions and strategies considered possible in the practical sphere.

Transformations in the personal sphere are considered to have more powerful consequences than in other spheres; paradigms can be considered the sources of systems, and beliefs and assumptions can influence the quality of connections with larger groups (Torbert et al., 2004; Meadows, 2009). Yet while there are considerable discussions about the need to change values, beliefs and worldviews as a response to climate change, transformations in this sphere cannot be forced. Although indoctrination has been used in the past to influence beliefs and worldviews, ethical arguments suggest the most

legitimate transformations in the personal sphere may come through transformative education or through voluntary changes by individuals or groups who are interested in expanding their own "spheres of influence" (Schlitz et al., 2010; O'Brien, 2013).

TRANSFORMATIONS AND OUTCOMES FOR SUSTAINABILITY

The "three spheres" framework described above and illustrated in Figure 1 can be used to situate diverse approaches to transformation in response to climate change. Each of the four approaches discussed earlier fall within one, two or three of these spheres. The transformational adaptation literature focuses on the practical sphere, while recognizing that changes in the political sphere are necessary to facilitate changes of the scope and scale required. It also draws attention to the personal sphere, for example noting that factors such as place attachment and occupational identity may be potential barriers to transformational adaptation (Marshall et al., 2012). The transformations to sustainability literature operates within both the political and practical spheres, exploring how the larger landscape for technological innovation and change creates conditions for innovation and industrial transformation. The transformations to ecosystem stewardship approach draws attention to all three spheres, emphasizing the importance of a worldview that sees social and ecological systems as interrelated or coupled.

Research on behavioral transformations is aimed at understanding and enabling changes in the practical sphere, where outcomes can be observed and measured (e.g., reduced meat consumption, increased use of public transportation, lower carbon footprints, etc.). The social practices literature emphasizes the links between behaviors and the political sphere, arguing that behaviors such as showering or driving a car to work are not about personal choice, but rather about the social systems and cultural practices that have collectively emerged (Shove and Walker, 2010). The social transformations literature places an emphasis on the political sphere, drawing attention to the crisis of capitalism and the challenges of institutionalizing new paradigms (Carson, 2012; Pelling et al., 2012).

Most of the literature on transformation acknowledges multiple spheres, but seldom recognizes the important interactions among the three spheres. The three spheres framework can contribute to a better understanding of the dynamics of transformation processes. It can also be used to identify leverage points in support of non-linear transformations. The notion of leverage points or "trim tabs" for systems change has been discussed by Fuller (2008), Meadows (2009), Senge (1990) and many others working with systems thinking. Systems thinking itself is considered to be a powerful leverage points for social transformation (Senge, 1990; Naberhous et al., 2011). Potential intervention points for transformation may be found within each of the spheres, but it is the interactions across the spheres where the greatest potential for generating non-linear transformation lies. Without attention to the outer circle, there is often an assumption that a particular sustainability solution is suitable for everyone, and value conflicts are likely to result. Without attention to the inner circle, attention may be focused on abstract ideals and goals, without producing practical, actionable outcomes. Importantly, without attention to the middle circle, large-scale transformations are unlikely to take place at the rate and scale called for in response to issues such as climate change. Systemic changes are critical to achieving outcomes consistent with global sustainability.

Goals are particularly important, as they define the purpose or function of the system and influence material and information flows, feedbacks, and self-organizing behaviors (Meadows, 2009). According to Meadows (2009), resistance to systemic change can be attributed to the bounded rationality of actors within a system, each with a different goal and metrics of success (e.g., national security, economic growth, resilience, sustainability). When it comes to the types, rates and scales of transformations that are called for in response to global challenges, it is clear that there are conflicting goals and visions for the future. Not every transformation is equally ethical, equitable or sustainable, and the normative dimension to transformation cannot be ignored (Meadowcroft, 2009).

CONCLUSION

Climate change calls for new understandings of transformation – understandings that in some cases may challenge fundamental beliefs and assumptions about the way that change comes about or is created. This paper reviewed some of the literature on transformation and presented a framework for understanding how, where, and why transformations to sustainability take place. The three spheres framework shows that realizing outcomes for sustainability in the "practical" inner sphere calls for the transformation of systems and structures in the central "political" sphere, which are often driven by individual and collective transformations in the "personal" outer sphere. This suggests a need for transformations from both the "outside-in" and the 'inside-out' (O'Brien, 2013). As Pelling (2010: 88) notes, "perhaps the most profound act of transformation facing humanity as it comes to live with climate change requires a cultural shift from seeing adaptation as managing the environment 'out there' to learning how to reorganize social and socio-ecological relationships, procedures and underlying values 'in here'." As a result, identifying the links between practical, political and personal transformations may be important for achieving ethical and equitable outcomes for sustainability at the rate and scale that are called for in response to climate change.

REFERENCES

Antal, M. and Hukkinen, J.I. (2010) The art of the cognitive war to save the planet. *Ecological Economics* 69(5): 937–943.

Beddoe, R. Costanza, R. Farley, J., Garza, E., Kent, J., Kubiszewski, I., Martinez, L., McCowen, T., Murphy, K., Myers, N., Ogden, Z., Stapleton, K. and Woodward, J. (2009) Overcoming systemic roadblocks to sustainability: The evolutionary redesign of worldviews, institutions, and technologies. *PNAS* 106(8): 2483-2489.

Berkhout, F., Verbong, G., Wieczorek, A. J., Raven, R., Lebel, L. and Bai, X. (2010) Sustainability experiments in Asia: Innovations shaping alternative development pathways? *Environmental Science and Policy* 13: 261-271.

Beymer-Farris, B. and Bassett, T. (2012) The REDD menace: resurgent protectionism in Tanzania's mangrove forests. *Global Environmental Change* 22: 331-341.

Calvin, K, Edmonds, J., Bond-Lamberty, B., Clarke, L., Kim, S.H., Kyle, P., Smith, S.J., Thomson, A. and Wise, M. (2009) 2.6: Limiting climate change to 450 ppm CO2 equivalent in the 21st century. *Energy Economics* 31(2): 107-120.

Carson, M. (2012) Paradigm shift in US climate policy but where is the system shift? In M. Pelling, D. Manuel-Navarrete, and M. Redclift (eds) *Climate Change and the Crisis of Capitalism*. London: Routledge: 69-84.

Chapin, F.S. III, Kofinas, G.P. and Folke, C. (2009) *Principles of Ecosystem Stewardship: Resilience-based Natural Resource Management in a Changing World*. Berlin: Springer.

Chapin, F.S., III, Carpenter, S.R., Kofinas, G.P., Folke, C., Abel, N., Clark, W.C., Olsson, P., Stafford Smith, D.M., Walker, B.H., Young, O.R., Berkes, F., Biggs, R., Grove, J.M., Naylor, R.L., Pinkerton, E., Steffen, W. and Swanson, F.J. (2010) Ecosystem stewardship: Sustainability strategies for a rapidly changing planet. Trends in *Ecology and Evolution* 25: 241-249.

Crompton, T. (2011) Finding cultural values that can transform the climate change debate. *Solutions* 2(4): 56-63.

Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin T. and Rockström, J. (2010) Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society* 15(4): 20.

Forsyth, T. (2003) Critical Political Ecology: The Politics of Environmental Science. London:

Routledge.

Frantzeskaki, N., Loorbach, D. and Meadowcroft, J. (2012) Governing societal transitions to sustainability. *International Journal Sustainable Development* 15(1/2): 19-36.

Fuller, R.B. and Snyder, J. (2008) *Operating Manual for Spaceship Earth*. Baden: Lars Müller Publishers.

Gardiner, S.M. (2011) *A Perfect Moral Storm: The Ethical Tragedy of Climate Change*. Oxford: Oxford University Press.

Geels, F.W. (2002) Technological transitions as evolutionary reconfiguration processes: A multilevel perspective and case study. *Research Policy* 31(8/9): 1257–1274.

Geels, F.W. (2011) The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions* 1: 24-40.

Gifford, R. (2011) The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist* 66(4): 290-302.

Gunderson, L. H., and Holling, C.S. (2002) *Panarchy: Understanding Transformations in Human and Natural Systems*. Washington: Island Press.

Harvey, M. and Pilgrim, S. (2011) The new competition for land: Food, energy and climate change. *Food Policy* 36: S40-S51.

Hedlund-de Witt, A. (2012) Exploring worldviews and their relationships to sustainable lifestyles: Towards a new conceptual and methodological approach. *Ecological Economics* 84: 74–83.

Hulme, M. (2008) The conquering of climate: discourses of fear and their dissolution. *Geographical Journal* 174(1): 5-16.

IPCC (2007) Climate Change 2007: The Physical Science Basis. Summary for Policymakers. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.

IPCC (2012) Glossary of terms. In C.B. Field, V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds) Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge, UK, and New York, NY, USA: Cambridge University Press: 555-564.

Kahan, D. (2012) Why we are poles apart on climate change. *Nature* 488: 355.

Kates, R.W., Travis, W.R., and Wilbanks, T.J. (2012) Transformational adaptation when incremental adaptations to climate change are insufficient. PNAS 109(19): 7156-7161.

Loorbach, D. (2007) *Transition Management: New Mode of Governance for Sustainable Development*. Utrecht: International Books.

Manuel-Navarrete, D. (2010) Power, realism, and the ideal of human emancipation in a climate of change. *WIRES Climate Change* 1: 781-785.

Marshall, N.A., Park, S.E., Adger, W.N., Brown, K. and Howden, S.M. (2012) Transformational capacity and the influence of place and identity. *Environmental Research Letters* 7.

Meadowcroft, J. (2009) What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences* 42: 323—340.

Meadows, D.H. (2009) *Thinking in Systems: A Primer*. (edited by Diana Wright). London: Earthscan.

Naberhaus, M., Ashford, C., Buhr, M., Hanisch, F., Sengün, K. and Tunçer, B. (2011) SMARTCSOs: Effective change strategies for the Great Transition - Five leverage points for civil society organisations. Conference Background Paper, WWF & Smart CSOs.

Nelson, D.R., Adger, W.N. and Brown, K. (2007) Adaptation to environmental change: Contributions

of a resilience framework. *Annual Review of Environment and Resources* 32: 395-419.

Norgaard, K.M. (2011) *Living in Denial: Climate Change, Emotions, and Everyday Life*. MIT Press.

O'Brien, K. and Wolf, J. (2010) A values-based approach to vulnerability and adaptation to climate change. *Wiley Interdisciplinary Reviews: Climate Change* 1: 232-242.

O'Brien, K. (2012) Global environmental change (2): From adaptation to deliberate transformation. *Progress in Human Geography* 36(5): 667-676.

O'Brien, K., Pelling, M., Patwardhan, A., Hallegatte, S. Maskrey, A., Oki, T., Oswald Spring, U., Wilbanks, T. and Yanda, P.Z. (2012) Toward a sustainable and resilient future. In C.B. Field, V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds) Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge, UK, and New York, NY, USA: Cambridge University Press: 437-486.

O'Brien, K. (2013) The courage to change: Adaptation from the inside-out. In S. Moser and M. Boykoff (eds) *Successful Adaptation: Linking Science and Practice in Managing Climate Change Impacts*. London: Routledge.

O'Brien, K.L. and E. Selboe (eds) (forthcoming) *The Adaptive Challenge of Climate Change*. Cambridge: Cambridge University Press.

Park, S.E., Marshall, N.A., Jakku, E., Dowd, A.M., Howden, S.M., Mendham, E., and Fleming, A. (2012) Informing adaptation responses to climate change through theories of transformation. *Global Environmental Change* 22: 115-126.

Pelling M. (2010) *Adaptation to Climate Change: From Resilience to Transformation*. London: Routledge.

Pelling, M., Manuel-Navarrete, D. and Redclift, M. (eds) (2012) *Climate Change and the Crisis of Capitalism*. London: Routledge.

Rifkin, J. (2010) *The Empathic Civilization.* London: Polity.

Raskin, P., Banuri, T., Gallopín, G., Gutman, P., Hammond, A., Kates, R. and Swart, R. (2002) Great Transition: The Promise and Lure of the Times Ahead. SEI,Tellus Institute.

Rowson, J. (2011) Transforming Behavior Change: Beyond Nudge. RSA. Online. Available HTTP: http://www.thersa.org/__data/assets/pdf_file/0006/553542/RSA-Transforming-Behaviour-Change.pdf

Schlitz, M.M., Vieten, C. and Miller, E.M. (2010) Worldview transformation and the development of social consciousness. *Journal of Consciousness Studies* 17(7–8): 18–36.

Senge, P. (1990) *The Fifth Discipline: The Art and Practice of The Learning Organization*. New York: Doubleday.

Sharma, M. (2007) Personal to planetary transformation. *Kosmos Journal*. Online. Available HTTP: http://www.kosmosjournal.org/articles/personal-to-planetary-transformation (accessed 22 March 2011).

Shove, E. (2010) Beyond the ABC: Climate change policy and theories of social change. *Environment and Planning A* 42: 1273 – 1285.

Shove, E. and Walker, G. (2010) Governing transitions in the sustainability of everyday life. *Research Policy* 39: 471-476.

Siegel, D.J. (2007) *The Mindful Brain: Reflection and Attunement in the Cultivation of Well-being*. New York: WW Norton and Company.

Smith, A. (2010) Translating sustainabilities between green niches and socio-technical regimes.

Technology Analysis & Strategic Management 19(4): 427-450.

Speth, J.G. (2008) *The Bridge at the End of the World: Capitalism, the Environment, and the Crossing from Crisis to Sustainability*. New Haven, CT: Yale University Press.

Steffen, W., Persson, A., Deutsch, L., Zalasiewicz, J., Williams, M., Richardson, K., Carole Crumley, C., Crutzen, P., Folke, C., Gordon, L., Molina, M., Ramanathan, V., Rockström, J., Scheffer, M., Schellnhuber, H.J. and Svedin, U. (2011) The Anthropocene: From global change to planetary stewardship. *Ambio* 40: 739–761.

Sunderland, T. (2011) 'Win-win' Is Too Simplistic a description for REDD+- and Possibly Wrong. CIFOR, Indonesia.

Swim, J.K., Stern, P.C., Doherty, T.J., Clayton, S., Reser, J.P., Weber, E.U., Gifford, R. and Howard, G.S. (2011) Psychology's contributions to understanding and addressing global climate change. *American Psychologist* 66(4): 241-250.

Thomson, A.M., Calvin, K.V., Smith, J.S., Kyle, P.G., Volke, A., Patel, P., Delgado-Arias, S., Bond-Lamberty, B., Wise, M.A., Clarke, L.E. and Edmonds, J.A. (2011) RCP4.5: A pathway for stabilization of radiative forcing. *Climatic Change* 109: 77-94.

Torbert, B. and Associates (2004) *Action Inquiry. The Secret of Timely and Transforming Leadership*. Berrett-Koehler Publishers, Inc.

Turner, B.L.II, Clark, W.C., K*Subject:*ates, R.W. Richards, J.F. Mathews, J.T. and W.B. Meyer, W.B. (eds) (1990) *The Earth as Transformed by Human Action*. Cambridge, UK: Cambridge University Press.

Urry, J. (2011) *Climate and Society*. London: Polity.

Walker, B. and Salt, D. (2006) *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Washington: Island Press.

Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D. Thompson, J., Nilsson, M., Lambin, E., Sendzimir, J., Banerjee, B., Galaz, V. and van der Leeuw, S. (2011) Tipping toward sustainability: Emerging pathways of transformation. *AMBIO* 40(7).

WBGU (2011) World in Transition: A Social Contract for Sustainability. German Advisory Council on Global Change.