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Complex dynamic systems thinking and domestic climate mitigation policy in developing countries:
Part 2: Towards an alternative framing

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Complex dynamic systems thinking and domestic climate mitigation policy in developing countries: Part 2: Towards an alternative framing

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INTRODUCTION

Literature and work on climate change mitigation policy, and by implication domestic climate change mitigation policy in a development context (MitDev policy), is not yet organised epistemologically or substantially (Levin et al., 2010). In Part One of this paper, the author has argued that a complex systems approach may provide a useful conceptual underpinning for work on MitDev policy, which is defined as being 1) a super wicked policy problem, 2) primarily socio-economic in nature requiring nothing short of systemic transformations to effectively address it, and 3) characterised by the prevalence of particular policy-making commonalities due to the development context (Tyler, 2015b).

This paper explores and expands on this proposition. It is being written at a time when the implementation of climate mitigation action is coming under the spotlight internationally – we are running out of time to avoid catastrophic climate change. The community of practice working on climate mitigation policy in developing country contexts (MitDevCoP) has generated quantitative information about technologies (including social practices) that reduce and avoid emissions, together with information on what is required of our countries to contribute to a global effort to remain within the internationally negotiated guardrail of a two degree temperature rise limit. In addition, how these technologies and ‘development paths’ could align with current policy initiatives has been investigated. However, many of these low carbon plans and intentions remain just that (for South African examples see Trollip (2015) and Tyler & Torres Gunfaus (2015)); there is increasing urgency from the side of climate science to move from agenda-setting and policy formulation to implementation. The policy question then necessarily moves towards the ‘how’ of what the MitDevCoP does, as implementation lags. We largely know ‘what’ needs doing. However this ‘how’ has received little attention to date (Dombkins, 2014; Giddens, 2009). This contemporary context of urgency therefore informs how the complexity framing is being proposed in this paper: as potentially being able to contribute to a MitDev policy approach that must increasingly be focused on faster and more effective implementation.

There is no a priori definitive view on what a ‘complex systems approach’ is (Richardson et al., 2001; Tyler, 2015b), with generalised frameworks of complexity being described as having ‘limited scope’ and ‘exaggerated claims of universality’ (Chu et al. in Peter & Swilling (2014, p. 1596)) because generalisation necessitates a degree of simplification (Tyler, 2015b).

The approach applied here is therefore only one perspective on complexity, and as such it is itself developed by the author as opposed to being applied, determined by the particular context of MitDev policy work. Because of this, and that the complexity field remains emergent, ill-defined and fluid at the time of writing (Tyler, 2015b), the author takes licence to cast a wide net, considering all things systemic, post-positivist1, transdisciplinary, and pertaining to transformations and transitions. In addition, the boundary between the current dominant approaches used by the MitDevCoP and a complexity perspective is typical of a complex system boundary; it has been created by the author for her purposes more than being something that exists externally and separately from the issue at hand (Cilliers, 2001).

The approach that is developed is nevertheless organised and held together by the central concept, principles and observations of the behaviour of complex dynamic systems. This is aligned with the application of complexity theory to modelling and describing sustainability transitions by Peter and Swilling (2014, p. 1596), where complexity is used as a ‘unifying principle’ as opposed to a ‘unifying theory’. The contribution with regard to MitDev policy work is however intended to be primarily at the conceptual level, as opposed to an attempt exclusively to demarcate the territory under the complexity heading; the intention is practical rather than academic, to enable more effective work on this super wicked problem.

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1Post-positivism is a philosophical position that rejects the fundamentals of positivism. In the context of social study, constructivism and critical realism are examples of major post-positivist philosophical theories.
In addition, a complex systems approach for MitDev policy work does not imply that approaches and methods that have been taken to date are automatically superseded. As Geyer and Cairney note, ‘the value of complexity is not that it is new – it is that it allows us to use our knowledge of the natural and social world to understand and influence real world problems in a particular way. This may involve building on rather than rejecting, the existing literature, or at least demonstrating (rather than merely asserting), why it should replace previous insights’ (2015, p. 5).

The discussion in the paper thus draws on the complexity principles and properties discussed in Tyler (2015b), together with aspects of a complexity practice. It is organised by themes of complexity principles and properties, with a final synthesis and conclusion. The two stylistic issues outlined in Part One of the paper and repeated in the footnote on this page have equal if not greater relevance to this Part Two².

²The first issue pertains to the author: I have a disciplinary background in economics, and have operated as part of the MitDevCoP based in South Africa for over a decade. I therefore have felt, and continue to feel a strong sense of identity with this community, and have brought an economic development lens to my work. However, research for this series of papers has required that, conceptually, I take a step outside this community in order to observe ‘how we do what we do’. This artificial separation is problematic from the perspective of complexity thinking, in which the observer is central to any observation; it is not possible to take a ‘neutral view’. However, the papers also represent an attempt to bridge two approaches, and even two worldviews. Given this, and to contribute towards internal consistency in the writing, I have chosen to write in the third person. The second issue relates to the use of the abbreviation ‘MitDev policy’ to refer to ‘domestic climate mitigation policy in developing countries’. Whilst the ‘climate mitigation’ aspect is less likely to be lost given the audience and topic of the paper, the ‘domestic’ distinction may, and it is a key aspect to the analysis. The research only considers the important work being done and perspectives being brought by the MitDevCoP to the international climate mitigation policy problem as they influence the domestic policy environment. This too is an abstraction which at times is unhelpful, but which was argued in the previous paper in the series (Tyler, 2015b) to be significant. It is not explicitly written out at each instance for ease of reading, but I hope that this does not diminish its importance to the argument.
1. Unknowability, incompressibility and humility

Complexity thinking constantly cautions the analyst, researcher and practitioner of the unknowability of complex systems, where unintended consequences of interventions are rife. Complex systems are also incompressible, meaning that any description of them would end up as complex as the system itself, emphasising the danger of simple thinking when intervening in them. What do these properties mean for the way in which MitDev policy work is approached?

An obvious implication is the need for humility in what the MitDevCoP does, and how it does it. Jasanoff (2007) suggests that the development of ‘technologies of humility’ is required to engage with these types of issues. Complexity thinking debunks the modernist view that scientific knowledge is superior and that the world is ultimately knowable and something that can be controlled. Other forms of knowledge both within and outside the academic and policy making communities are equally valid perspectives on the MitDev policy challenge. This implication derived from literature is supported by Kane’s reflection on a series of conversations held between members of the MitDevCoP and South African development experts, where both the concepts of humility and disciplines were considered in response to these dialogues (2014). Responding with humility would imply developing and routinizing ways of hearing and cooperating with other perspectives and communities.

Unknowability also invites reflexivity, the task of a community of practice to ‘know itself’, and ‘how it does what it does’ (Ison, 2010). This is necessary in order to contextualise its work, to identify when it needs to bring in additional expertise or outsource aspects of it, and to acknowledge the limitations of its expertise. Also, in the face of unknowability, any one observation becomes personal – under complexity, subjectivity is inescapable, and therefore so too is the need for explicit inclusion of ethics and morality into the MitDevCoP’s work. Everything must be problematized, requiring skills of philosophy, psychology, and the critical theories.

A further aspect of unknowability in social systems is that of ‘undecidability’ (Derrida as cited in Peter & Swilling (2014)). Undecidability is the result of dualism breaking down, with a decision lying in the middle space between categories, fundamentally contradictory and defying resolution. Peter and Swilling argue that this leads to the necessity for trade-offs in sustainability transitions, with the system itself being characterised by sub-optimality at a constituent level in order to remain sustainable. According to this argument, complexity thinking highlights the need for trade-offs in the challenge of simultaneous development and climate mitigation, challenging the dominant MitDev policy approaches which search for ‘win-wins’.

As opposed to approaches emphasising stability, prediction and certainty as the norm, the unknowability of complex systems suggests strategies of vigilance in trying to identify the unintended consequences of any systemic intervention or development. Possible impacts outside of the focus of any one intervention must be considered as a matter of routine. In addition, any simple thinking in a complexity context should ring alarm bells, due to a complex system’s properties of unintended consequences and network causality. Single solutions, ‘silver bullets’, are highly risky (for example when carbon capture and storage and geo-engineering are promoted as simple techno-fixes, or when the issue of climate mitigation is reduced to ‘reduction of carbon dioxide emissions’ as opposed to an issue of systemic transformations (Hoyer, 2010)). The MitDev Cop should rather complexify its descriptions and narratives, scrutinising its language for...
sustainability may assist in enabling this within these disciplinary approaches.

2. Transdisciplinarity as a way of working

MitDev policy research is a multi-disciplinary endeavour, involving multi-disciplinary teams. However, it remains grounded in only a few knowledge discipline contexts, relying extensively on the disciplines of engineering and neoclassical economics and less on the qualitative social sciences and humanities (Tyler, 2015a). Methods and tools are weighted towards quantitative modelling and evidence-based policy advice including analysis of the impact of particular policy instruments. As such, MitDev policy research could currently most closely be described as taking an inter-disciplinary approach.

However, a number of authors (German Advisory Council on Global Change, 2011; Wells, 2013; Woiwode, 2013) are arguing that a transdisciplinary approach would benefit complex problems of systemic transformations such as climate mitigation. Transdisciplinarity is an emergent and contested concept, which is proposed in various strengths (Woiwode, 2013), subject to the usual cautions surrounding a new area; rigorous critique and additional work is required (Cornell & Parker, 2010, p. 27). The more radical proposals of transdisciplinarity involve a transcendence of conventional disciplines and their boundaries, and creation of knowledge centred around new ‘complex heterogeneous domains’ (Nicolescu in Woiwode (2013)). It involves being undogmatic about methods or epistemological views, and choosing methods from amongst all disciplinary approaches that best suit the research problem or question at hand. Richardson and Cilliers find that a methodological pluralism is required for complex matters (2001). Working across disciplines builds networks and communities that are better able to respond adequately to complex problems. Beyond the academy, transdisciplinarity engages with social stakeholders both in identifying relevant research questions and in the research process itself (German Advisory Council on Global Change, 2011), fundamentally addressing the relation between science and society (Jahn et al., 2012). Writers in this growing field call for more work to show how it ‘does not represent a dilution or weakening of knowledge’ (Cornell and Parker, 2010. p. 27), but also that it needs to be subject to critique.

If the MitDev policy problem is a challenge of systemic transformations, the social sciences need to be repositioned as ‘an indispensable part of reframing and understanding climate change as a social phenomena (sic)’ (Leysron, 2014, p. 359). Indeed, at an international level, a research agenda taking societal transformations under climate change as its point of departure has been developed (Driessen et al., 2013). From a MitDev policy perspective, although the MitDevCoP identifies that its development context is a defining aspect of its work, the community of practice seldom interacts, understands or communicates with its ‘development’ colleagues (Kane et al., 2014; Tyler, 2014), who are predominantly social scientists (Huq et al., 2006). We have a relatively superficial, simplistic or unexamined understanding of what we term ‘development’, and do not understand well the languages and disciplinary norms of the development community of practice. Social sciences also speak about power and political economy, a concept conspicuously absent in climate mitigation policy writings and practice (Giddens, 2009; Tyler, 2015a; Tyler & Torres Gunfaus, 2015), although as social scientists consider the issue these themes are starting to be tackled (Jasanoff, 2010; Shove, 2010b; Stengers, 2015). There is some early writing on this from the complexity perspective (Wood & Givel, 2014), but thus far the field has not yet demonstrated a strong contribution in this area (Geyer & Cairney, 2015). However, what is clear is that the social sciences need to move beyond critique to make a substantial contribution (Swilling 2015, personal communication). Complexity perspectives for sustainability may assist in enabling this within these disciplinary approaches.
The MAPS Conversations in 2014 identified that continuing to understand how to work with a large range of communities of practice is valuable and productive, both for the climate mitigation community and hopefully for others working towards development objectives (Tyler, 2014). The challenge of engaging with a development context and understanding what the world looks like from the perspective of different communities needs to be undertaken with different policy communities, of different types, and at different scales, to encourage existing frameworks and integration of approaches and opportunities. Calfucoy (2015, personal communication) finds that the co-production of evidence, a hallmark of the MAPS Programme, contributed significantly to the validity of the knowledge, with additional benefits in the form of capacity building and developing a policy community of practice around climate mitigation issues. Networks across different communities of practice will be especially necessary and useful for implementation.

Transdisciplinarity also highlights ‘the multifaceted scientific, social, economic, ethical, and political principles necessary to decipher an adequate approach’ (Wells, 2013, p. 293). Certain of these may be more relevant to the MitDev policy challenge, and this will be a task for the MitDevCoP, to identify which these are, and to become familiar with them. The interplay between science and philosophy is emphasised in a transdisciplinary approach, with ethics situated far more centrally than it currently is in climate mitigation policy work.

3. A transdisciplinary toolkit

The MitDevCoP’s dominant approaches have resulted in particular strengths in evidence building, modelling, attention to carbon constraints, policy instruments such as carbon pricing and budgets, and quantification. These are critical, and necessary foci and competencies that the community of practice contributes. They are perhaps particularly important in attending to the two degree guardrail. However, a transdisciplinary complexity approach cautions that these are only aspects of making progress on issues of systemic transformations. The MitDevCoP needs the tools it currently has, but as part of a much broader suite of tools (Morgan et al, 1999).

Choices regarding appropriate tools to use in a particular context need to be made, cognisant of changes in underlying assumptions in the face of global change problems, and with acute awareness of their limitations. Although quantitative and reductionist methods have produced many of the great scientific successes included in complexity science (Wells, 2013), a more pluralist epistemology and methodology is needed for complex systemic issues ‘in order to contextualise and comprehend more aspects and dimensions of complex social and environmental dynamics’ (Wells, 2013, p. 171). Both quantitative and qualitative tools are important and support each other (Peter & Swilling, 2014; Richardson & Cilliers, 2001; Wells, 2013). Narratives are an often-cited example of qualitative tools, providing rich description and complexification. Narratives are not objective, absolute truths, and are about ‘conveying interpretation and experience… They develop commensurate experience… of unified observer-observation complexes’ (Wells, 2013, p. 181). Allen (cited in Wells (2013, p. 197)) finds too that models improve the quality of narratives by providing structure, quantified precision, constraint and boundary conditions. They also define dynamic qualities, emerge from alternatives, and challenge the narratives on which they are based. Multi-disciplinary perspectives assist in identifying incorrect assumptions, and implausible research and modelling results. Modelling outputs have to be interpreted explicitly by tools of these disciplines and areas.

The importance of contextualisation and communication of the results of quantitative or reductionist tools cannot be underplayed in policy-oriented analysis. Sometimes it may even be beneficial not to ‘run the numbers’ if this were to provoke a political response, a lock-in or push back. A transdisciplinary approach would give perspectives on where quantification is useful, and where it is dangerous. Particularly in a context of scarce resources and constraints such as in the case of developing countries, taking a strategic look at what research or practice is most useful
becomes critical. For example, research attempting to reduce uncertainty may be less useful than research on how to build resilience in an uncertain future. There is another question here – what should be done by the MitDevCoP itself, and what is best done in collaboration with others? What does the MitDevCoP bring to a transdisciplinary research team? The community of practice has specialist knowledge of climate politics, policy and economics, and an access to climate science, in that it is slightly more literate in this than those working entirely outside the field, and has some contact with the natural scientists working on climate change. The MitDevCoP understands climate finance, technology and economic policy. It also has engineering, modelling and analytical skills. But it is far lighter on ethics, philosophy, development work, planning, social issues, governance, and other fields in the domain of the social sciences and humanities. It does not have a strong human focus (Tyler & Du Toit, 2014). The current relatively isolated and elitist characteristic of this community of practice may itself need to evolve, with a greater emphasis on interacting with other academic and social stakeholder communities. The MitDevCoP may need to include experts in transdisciplinary approaches in its teams, together with deep content expertise. Wells (2013) suggests a ratio of 1:10 of transdisciplinary to disciplinary specialists in teams. Perhaps this ratio should be higher initially in order to establish a transdisciplinary competence and orientation. The community of practice may also need to expand beyond engaging only with ‘experts’. Transdisciplinarity values all types of knowledge, and advocates involving social stakeholders at all scales in identifying the research questions themselves.

Transitioning to a fully transdisciplinary approach for the MitDevCoP would include working within a more multi-disciplinary knowledge context appropriate to the development situation, engaging with expert and non-expert social stakeholders in the development of research questions and in discovering ways forward, becoming familiar with different epistemologies and methods, and developing the ability to utilise these where the particular problem aspect requires this, all the while acknowledging that from different disciplinary perspectives certain assumptions counteract each other, and developing methods to deal with this. The extent to which this work happens within the MitDevCoP itself, as compared to the MitDevCoP connecting and networking with its academic and social contexts, is likely to be a source of experimentation.
DEVELOPMENT AND MITIGATION VIEWED AS AN INTEGRAL, COMPLEX SYSTEMIC CHALLENGE

4. From dualisms to systems thinking

Complexity thinking warns that dualisms, whilst seductive and sometimes necessary for decision making, are not helpful in understanding complex systemic problems which require integral thinking and integral solutions. Separateness is a construct and does not exist in the messiness of reality (Tyler, 2015b). The MitDevCoP’s conceptualisation of development as something separate from climate mitigation, with a separate vocabulary (Tyler, 2015a) is such a dualism, which may now be restricting the community of practice’s vision and agency. The MitDevCoP has become aware of its mitigation-centric worldview, and has started to counter this with a ‘development-first’ approach to mitigation (Winkler et al., 2002), and more recently a move to consider them both together (Winkler et al., 2015). However, the constraints of modernist thinking and the MitDevCoP’s dominant approaches continue to constrain its ability to move towards a truly integral understanding of the challenge. This has resulted in it failing to provide domestic policy makers with a convincing case for integrating mitigation into development policies (Naidoo 2013, ERC seminar), especially in the world of politics and political economy.

For the complex social, economic, environmental, physical and political (SEEPP) systems (Peter and Swilling, 2014) that developing countries are to be sustained in a morally acceptable form, systemic transformations are required. This is apparent from the perspective of climate mitigation, other environmental constraints, and the prevalence of poverty and inequality. The problem is integral in its conceptualisation, and must be integral in its solution. It demands that the whole system be considered, including (critically for the purposes of climate mitigation), the central fossil fuel based structures. This strongly counteracts the institutional tendency to split climate mitigation off to the environment or corporate social responsibility departments, or the ‘green economic sectors’, implicitly assuming that the issue can be addressed on the periphery. It also places the different vocabularies of the various communities of practice attending to the issues of mitigation and development as secondary to the common goal of systemic sustainability.

This approach is not necessarily a welcoming or manageable one, particularly for practitioners schooled in modernist thinking and reductionist analysis. The glimpse of the ‘development’ aspects of the South African SEEPP system that was achieved through the 2014 MAPS Conversation series showed a system that is complex and dysfunctional, very human, spatial and messy, and involving lots of experiments, wide-ranging failure, and pockets of success. There is a lot of interconnectedness, and many moving parts (Tyler, 2014). This is likely to evoke a ‘simplify and control’ response under the currently dominant approaches of the MitDevCoP, in order to avoid being overwhelmed.

5. The nature of change 1: rethinking ‘development’

In a previous paper in this series, the quintessentially-contested concept of development was discussed in a climate mitigation context (Tyler, 2015a), noting a lack of explicit reflexivity by the MitDevCoP in how it approaches or uses the term, to the extent that the author questioned whether the term ‘development’, along with ‘sustainable development’, remained helpful in defining MitDev policy work. They may be constraining in their generality; we think we understand what is being meant, whereas they are adding to confusion rather than clarity. At the heart of the issue is the concept of
economic growth, which tends to trump both the social and environmental pillars of sustainable development politically\(^3\), more so as the development need increases. Policy makers and politicians in developing countries could appear to be caught in a constant and complicated balancing act between a policy direction of pursuing growth at all costs, and that of allowing for the human, social and environmental aspects of development at different scales and timeframes. In some countries, for example China, Chile and Peru, development considerations beyond growth appear only to become a more serious policy objective once a level of growth and prosperity has been achieved. Even then, the focus on growth remains and seems to intensify in the face of an economic downturn. The MitDevCoP’s implicit approach of overlaying climate mitigation objectives onto sustainable development objectives (which by definition include social and environmental considerations), or even onto development objectives (potentially only considering social or just economic factors) without acknowledging this core political reality is therefore problematic, and something it is loathe to face up to, perhaps understandably, given the community of practice’s lack of competencies in the social sciences.

The concepts of ‘development’, ‘sustainable development’ and ‘economic growth’ are foreign to a complex systems perspective. Rather, the language is about system evolution, transitions or transformations, considering the conditions for system sustainability and moral acceptability. A complex systems view of developing economies and societies bypasses the development versus climate mitigation discourse, one which is perhaps so steeped in ideology as to be unhelpful in finding a way forward for low carbon development within the timeframes implied by climate science and hard infrastructure development in developing countries (Tyler, 2015a). It further warns us that some of the concepts and tools used under a development approach, such as the Environmental Kuznets Curve, Maslow’s hierarchy and Forster Lloyd’s tragedy of the commons are simple views of the relationship between development and the environment (supported by the research of Ostrom (2015) and Piketty (2014)). Certainly, the nature of economic growth (in social solidarity and biodiversity) and contraction (fossil fuels) in different areas is still very relevant. But a complexity approach emphasises its context (time and place) specificity. On a policy level, growth finds its expression in industrial, environmental, infrastructure and welfare policies and investments at the macro level, and poverty alleviating, social and environmental projects and programmes at the local scale. It is similarly so with human development objectives. How these various policies and programmes are co-ordinated and cohere in a socio-economic system is important, and there is very seldom a definitive, one-size-fits-all solution that lasts for any length of time. The nature of (economic) growth and ‘development’ themselves, and how to achieve them is fiendishly complex and often locally determined, involving interactions of the social, political, economic and natural worlds.

The emergent properties of a sustainable SEEPP system will include low carbon practices and physical form, and also ‘development’ traits that may look very different to the current profile of the ‘developed world’. Redefining development is likely to be one of the challenges of these systemic transformations, and one which will involve a diversity of stakeholders, most of which are not currently familiar to the MitDevCoP. A current South African example of this is the 2015 student movement protesting for free higher education along with a raft of other issues which amount to radical societal transformation, overthrowing the racial inequalities of the past. How does the MitDevCoP connect with this movement? This is a task very different to those the South African MitDevCoP has set itself in the past, but perhaps one which a complex systems perspective would advocate as being highly authentic, context-specific and potentially transformative?

\(^3\)See Jacobs (2012) for a critique of the sustainable development concept in relation to low carbon initiatives, although this author suggests that the concept of green growth he advocates is also likely to be found lacking from a complexity perspective.
6. The nature of change 2: complex dynamic system sustainability

There appears to be a paucity of theorising about complexity and the sustainability of SEEPP systems. The literature and theoretical frameworks for system transitions to sustainability itself has been characterised as recent, emergent, and as relying on superficial conceptualisations of complexity (Peter & Swilling, 2014). If the current global SEEPP system is unsustainable, the need for change is implied. From the perspective of complex systems thinking, it remains unclear to the author how ‘sustainability transitions’ and systemic change is best conceptualised. In complexity theory, the oscillation of a system towards ‘attractors’ within an ‘attractor basin’ is described. This suggests that the system may have many states which lend themselves to sustainability. How can humans as part of the system, with our abilities to learn, strategise, reason and plan (Wells, 2013) influence whether the system remains within a preferred ‘attractor basin’? Complexity science has also observed that systems can transition from one phase or state into another through a ‘phase transition’. What then are the properties of sustainable SEEPP complex systems? What are the properties of these systems in transition (or transformation, evolution, phase state change, shifting attractor basins or chaos)? To what extent are the principles of the complexity science that have emerged from physics and the natural sciences applicable and relevant to SEEPP systems?

Pueyo notes that long-lasting complex systems can only function in a state ‘between order and chaos’ (2014). Too ordered, and a system becomes brittle and hence vulnerable. Too chaotic and it becomes chaos itself. Complex systems science indicates that there is an optimal level, or levels, of complexity within which a system will be sustained, the opposite of sustainability being collapse (Wells, 2013). Complex systems are dynamic, and therefore are constantly self-organising and complexifying, within the physical and social constraints to sustainability that are both internal and external to the system itself. According to these authors the ability of a system to counter over-complexification is an important indicator of sustainability, and could be supported by for example withdrawing from aspects of globalisation as an example of reducing complexity in our current global economic system (Pueyo, 2014).

Pueyo develops an approach to sustainability transitions drawing from ecological succession examples, and suggests that attention should be paid simultaneously to building new infrastructure and dismantling old, to the information that will be needed under a new system, and the types of incentives and disincentives that will be required. Specifically, a strategic approach to the public rescue of failing firms is required (is the firm a part of the new system?), and attention should be paid to reducing mechanisms that support the propagation of fluctuations (such as debt in economic systems). Vulnerable people will need to be supported in a ‘flexible but ordered’ approach. Pueyo’s approach suggests that ‘taming’ the self-organisation of a system is a way of nudging it towards a more moral and sustainable state (2014).

Peter and Swilling’s work on complexity principles for organising theories of transitions to sustainability argues that complexity principles are necessary to integrate sustainability transitions theories, enabling a movement beyond deterministic frameworks. They find that a complexity perspective advises a probabilistic, integrative, inclusive and adaptive approach to supporting sustainability transitions. Their work also points to trade-offs as being a complexity entry point to sustainability challenges: system sustainability trade-offs are required between these dual objectives, throughout the system. In fact, sub-optimality at a sub-system level is found to be a pre-requisite for sustainability in complex dynamic

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1In the beginnings of theory development on the sustainability of economic systems drawing from complexity work in statistical physics, Pueyo (2014) rejects equilibrium economics as being out of sync with the reality of economic systems that are constantly in a state of flux. He observes that complex systems behave in a particular ways when approaching a ‘second phase transition’ or ‘supercriticality’ which precedes collapse, such as demonstrating scale invariance and the prevalence of long-range connections.

2This principle of complexification explains aspects of our systems such as decreasing marginal returns on increased costs, increase in the number of loopholes in policies and regulation, tendencies towards ever-increasing energy demands, and the degradation of democracies (Wells, 2013), particularly in referring to Tainter’s work in this area.
system (Richardson as referred to in Peter & Swilling (2014). This is significant; the MitDev policy literature still hopes for an optimal outcome for development and mitigation at both system and sub-system (sectoral) levels (Winkler et al., 2015), whereas a complexity view suggests that sub-optimal system component outcomes are what we should be explicitly aiming for instead.

The literature is also unaligned as to whether a sustainable SEEPP system is necessarily a morally acceptable one. Pueyo (2014) presents evidence against this, showing that feudal systems operated between order and chaos, i.e. sustainably, yet these were not morally acceptable systems. Pueyo also finds evidence of our current global economic system as operating sustainably, and that it may continue to do so even as it experiences significant ‘shocks’ as it comes up against numerous environmental constraints. These shocks will primarily impact the vulnerable and hence, despite the system itself being sustainable, Pueyo argues that this outcome is morally unacceptable. Wells, however, suggests that a SEEPP system characterised by inequality is not inherently sustainable (2013). Certainly, the feudal system evolved substantially, although it is not clear that inequality has reduced since these times. Are the entry points and levers to support system sustainability different to the work to transition a system to one that is more morally acceptable? Is moral acceptability, like environmental sustainability, a constraint in the system, but one created by social norms? These questions are key in that they deal with two pressing issues faced by developing countries (and the developed world as well): climate change and inequality. Work is needed to explore this.

One thing, however, that emerges clearly from the discussion above, is that a complexity approach highlights the ethical problems associated with complex social systems (Abrahams in Richardson & Cilliers (2001)), and the central role of ethics in guiding policy making for systemic transformations, if not ‘sustainability’. Explicitly identifying a moral frame for the future we desire becomes a part of the challenge of a systemic transition. Pueyo, for example, invokes the concepts of inclusiveness and fair distribution (2014). The tools of ethics and philosophy are critical for navigating this, and its incorporation into policy. Recent developments in ethics, looking at ethics of care (Parker, 2010) and pragmatist ethics (Wells, 2013), could contribute. Woiwode (2013) writes of evolving planetary consciousness to one of ‘us’ as opposed to ‘I’.

The articulation of change in a complexity perspective could certainly benefit from further work, directed at the potential to support emergent properties aligned to SEEPP sustainability and a moral frame. From a MitDev policy perspective this is critical in assisting the work of the MitDevCoP on supporting the emergence of low carbon ‘development’ in the contexts in which it works. How can human action and decision making influence this at the pace and depth required?

For now, complex dynamic systems thinking for sustainability and change ‘compels us to face our humanity, our subjectivity, agency, and responsibility’ (Wells, 2013, p. 124). An approach to change based on control and manipulation is no longer valid under complexity given that each observation of a system arises from only one perspective. Rather, complexity thinking suggests that change requires an ongoing culture of community co-operation (Ostrom, 2015), strengthens solidarity in an interconnected, networked world (Wells, 2013), and underpins the importance of democracy (Pueyo, 2014; Wells, 2013). Perhaps this is sufficient indication for us as to where we should focus for now, together with pursuing how to work with the centrality of trade-offs, and identifying how to aim for sub-optimality throughout the system.
7. Conceiving the future

Another significant departure of a complexity perspective from current dominant approaches to MitDev policy pertaining to how systems transform and how we imagine the future, is the absence of a ‘Business As Usual’ (BAU) concept. The majority of models used to consider energy and climate mitigation futures rely on the construction of a BAU trajectory, and then describe deviations from this. However, this BAU is a clear simplification and abstraction (New Climate Economy, 2014), despite its use in modelling terms. A complexity approach advises to be aware of the implications of this simplification; the MitDevCoP is perhaps not yet sufficiently so. It advocates for ‘Business Unusual’ as the only way forward in an emissions constrained future, and yet immediately constrains its thinking by identifying a BAU. Work on biomatrix theory (Dorstal et al., 2005) describes the concept of an ‘ideal future’, which represents and arises out of a different and higher order logic than that of the present. Backcasting from that ideal future then determines the types of strategies and policies needed to get to this desired future. Given that the world is likely to require a new definition of ‘development’ to remain within the two degree global warming guardrail, the MitDevCoP is required to unfetter itself from what development has meant over the past few decades. Much of the work here will be social, values-driven, about connecting to basic drivers of the ‘buenvivir’ (good life), and enabling these within an emissions constrained future (Tyler & Du Toit, 2014; Winkler et al., 2015).

The Three Horizons model (Curry & Hodgson, 2008) provides a framework for working with futures that appears compatible with complexity approaches. This model emphasises that seeds or pockets of the future are existent in the present. These may be the small innovations or perturbations in the system that cause fundamental systemic re-organisation. Perhaps the MitDevCoP should be putting greater focus on identifying and supporting the seeds that align with an ideal future, and containing those that don’t?6

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6The ‘Seeds of Good Anthropocenes’ project [www.goodanthropocenes.net], a collaboration between the Stockholm Resilience Centre and a Future Earth funded project, ‘Bright Spots’, is an example of this type of endeavour.
APPLYING SPECIFIC COMPLEX SYSTEM PROPERTIES TO MITDEV POLICY WORK

In addition to the implications of a broad complexity perspective explored in sections two and three above, the properties of complex systems provide a number of specific entry points and tools for thinking about systemic transitions. An initial selection of these is briefly explored below for MitDev policy work.

8. Interconnectedness

Interconnectedness is a defining aspect of complex dynamic systems where a connection or relationship between elements of the system (hubs and nodes) is more relevant to the characteristics of the system and its emergent properties than are the elements themselves. Interconnectedness is what produces emergence and makes these systems non-reducible to the sum of their parts; in other words: complex. The networked characteristics of complex systems imply that causality is a network phenomenon; it is transmitted, and augmented or dampened through networks.

MitDev policy (and economic policy more generally) typically considers a SEEPP system from the perspective of system components, such as sectors, companies, government departments, producers and consumers. Using sectors as an example, mitigation actions are identified sectorally, and analysed sectorally. The interactions between sectors, and spatial and temporal aspects of emission reductions are seldom considered. Complexity theory would suggest that it is precisely these interactions that determine a system’s emergent properties. Thus, according to a complexity perspective, the primary focus for MitDev policy should perhaps be on the nature of existing interactions from the perspective of a developmentally desirable, low carbon future. At least the impact of actions in one sector should be analysed systemically, and interconnections considered routinely. The current MitDev policy focus on cost and technological feasibility is a static and isolated one. System-wide policy interventions such as a carbon tax or emissions trading scheme are typically assessed with Computable General Equilibrium economic models, increasingly interacting with energy sector models. These capture important aspects of the systemic implications of low carbon interventions, most often on GDP, investment flows and the relative growth of individual sectors, and in some cases on welfare and employment indicators. However, the limitations of these models in the face of the complexity of SEEPP systems is well documented, and appreciation of the interrelatedness of all aspects of the underlying system could be more comprehensively approached and considered through expanding and complexifying our analytical descriptions and toolkit.

This is no small challenge. A starting point would be a systematic identification of the issues and linkages across the system. What interactions are apparent? At what scales do these occur? What are the constraints inherent in the system (noting that a sectorally organised society is itself a constraint)? Which are the nodes, which are the more critical hubs? Where are the likely tipping points and thresholds? The objective of this analysis is in the first instance on understanding. Once an understanding is gained, we can consider how to work within these parameters (Calfucoy 2015, personal communication). Hubs and vicious and virtuous cycles within systems can be identified and supported or restrained given their role in transmitting desirable or undesirable cycles, feedback and emergent properties.

Some examples of possible entry points for low carbon development policy taking interconnectedness into account include the localization of food production and reduction of food miles, low income housing, and electricity subsidies. Some areas of MitDev policy are more advanced in recognising and working with this. Cities, themselves complex
systems, routinely work with interconnectedness, as does the transport sector. Land use and governance are cross-cutting issues with high relevance for the emergence of low carbon development (MAPS Cities Conversation, 2014).

Some connections and networked pathways are more critical than others in a complex system. Consideration of this may lead to some conclusions that are not aligned to the MitDev policy’s current focus areas. Perhaps education or female health care are critical ‘hubs’ with significant implications for low carbon and developmental emergent properties of a system? In a keynote at Our Common Future Under Climate Change conference (2015), Jasanoff reflects that we need to ‘be attentive to systemically neglected issues’. Approaching the challenge from the perspective of complex interconnectedness may thus reorientate our policy efforts, and change the nature of the policies we advocate. Different interventions or actions can be approached in different ways, in order to work with all the apparent connections and linkages (this point links to the concept of ‘sticky’ policy making, addressed in section five below).

9. Uncertainty and non-linearity

Much has been written on uncertainty in policy making, and some for climate mitigation policy (see for example Heal & Kriström (2002)). Complexity thinking takes uncertainty as a normal aspect of complex systems and engages with this uncertainty through the language of risk and probabilities. A complexity perspective for climate mitigation in a development context would then normalise policy based on the probability of risk, rather than denying and isolating uncertainty.

A complex systems perspective also highlights that all parts of the system are in constant flux, something that the MitDevCoP’s dominant approaches perhaps underplay. For example, the equilibrium assumption of neoclassical economics is far from the observed reality of our economic systems (Pueyo, 2014). The reality of constant change and ubiquitous uncertainty leaves a significant role for people to change in response to their changing circumstances. Leaders in particular do not make all their decisions at one point in time, but rather make decisions constantly, having the capacity to incorporate new information and respond.

Non-linearity is one of the underlying drivers of uncertainty in complex dynamic systems, suggesting that there will always be surprises, where small external changes or internal developments can re-organise the entire system. Current mitigation policy approaches do not routinely assess for this type of change, the ‘black swans’ described by Taleb (2007). The oil price fluctuations of this century and the financial crisis of 2008 are good examples of ‘external’ factors which have significant mitigation impacts but which the MitDevCoP’s climate mitigation models and scenarios of the future do not assess for.

Whilst there will always be surprises in terms of what emerges in a complex system, some emergent properties can be predicted using tools such as models and qualitative assessment (Pueyo, 2014), assuming that the context does not change, which is a strong assumption (Richardson et al., 2001). A unique aspect of complexity (beyond dynamic systems theory) is that any system component, sub-component, or actor can rise to dominance and change system behaviours.

There is a significant literature on policy making under uncertainty. The focus is on the type of policies and even projects. Linear projections become less useful in contexts of high uncertainty, suggesting that this type of approach to MitDev policy should be used with caution. Planning under uncertainty is by its nature non-linear planning, requiring a different set of tools to those that are currently routinely used by the MitDevCoP. Ranger and Garbett-Shiels find that policies should be designed for robustness and resilience (2012). This may include design to cope with a variety of futures, those with the ability to be easily adjusted in the future, strategies that sequence actions over time, and mechanisms...
to reduce the lifetime of decisions. Steyn (2014, Energy Research Centre) advocated flexibility through the incorporation of many small projects, rather than just one large one, into a programme. This approach values diversity, and the ability of stakeholders to learn over the lifetime of the programme. Further, ethical approaches can assist in areas of high uncertainty, such as pragmatist ethics (Wells, 2013).

An example of a tool for explicitly responding to uncertainty in decision making is real options analysis. This approach captures the value of policy maker expertise and flexibility and the dynamic nature of decision making by identifying a value associated with optionality. For example, the option to delay a decision will be valuable in an environment where technology is advancing quickly; the option to contract a facility should regulations change also has a value. Real options analysis caters for time series links between decisions, where one decision opens up another, and also for strategic thinking. The value of real options also lies in identifying what types of options exist, how and why the option value changes, and how to capture their value. Such an approach, although resource intensive if the options are fully calculated, may have particular value for the MitDevCoP when applied as a conceptual tool.

10. System constraints and critical pathways
The SEEPP system, from the perspective of climate mitigation and development, has both hard and soft components. Hard infrastructure can act as a constraint or enabler on the evolution of the system, representing an investment in a particular set of hubs and networks. In South Africa this is particularly apparent, with the term ‘Minerals and Energy Complex’ having been used to describe the political and economic networks characterising the country’s particular development model.

Critical pathway analysis, a project management technique dealing with rate-determining steps, is seldom applied in MitDev policy work at the conceptual level. The MitDevCoP’s analysis is largely static, presenting a snapshot at a particular point in time. Temporal aspects such as rate-determining steps and the ability of decision makers to respond as a situation unfolds are not routinely considered. However, MitDev policy work is clearly time-bound: the more quickly countries reduce emissions, the less the future climate impact. But also, the smaller the investment in fossil fuel orientated hard infrastructure in developing countries, the better placed these societies are able to emerge properties of low carbon ‘development’ without negative social and economic cost. The complex system characteristics of networked causality, interconnectedness, tipping points and thresholds drive this.

A critical path analysis suggests that climate mitigation actions differ materially in addition to cost and technology. Some act as hubs, catalysing other action and transmitting a particular type of emergent property through a system. Others have the capacity to ‘tip’ existing system characteristics into a vicious or virtuous cycle. Others only appear as options at a particular point in time. If the choice of a coal fired power station is made above a fleet of nuclear plants or wind farms, it locks in carbon emissions but also governance capacity, institutional structure, and down and upstream economic linkages. The option is not available beyond this point. Key points of irreversibility and non-renewability in systems could be identified, prioritised, and strategies put in place to withdraw from these thresholds and tipping points of non-return (Wells, 2013).

1Types of options include to switch (technology), to scope-up (to related, cleaner industries), to contract (reduce the size of emitting operations), to abandon, or to delay (until cleantech is more advanced). Factors that drive the value of real options are: time to expiry (the longer the time, the greater the value), the risk of the project (the riskier, the greater the value), exclusivity of ownership (the more exclusive, the greater the value); the greater the importance of the uncertain portion of the cash flows to the overall project value, the greater the options value (Tyler & Chivaka, 2011).
Constraints also exist in complex systems in the form of social norms and laws. Pueyo (2014) suggests that inequality could possibly also be targeted in this way by establishing maximum and minimum income constraints. A particular income distribution and emissions profile could then be an indirect, emergent result. In addition, the type of state itself acts as a constraint on the system given its silo structure, the way funding flows, how planning and measurement happens and how goals are determined (Calfucuy 2015, personal communication).

11. Focus on the present

MitDev policy sets its sights firmly in the medium term (which it describes as 2030) and long term (2050). But complexity thinking originates from an alternative perspective, one that is more focused on the present, on the responsive evolution of a complex system as opposed to linear or cyclical processes (Richardson & Cilliers, 2001), on multiple scales, and on a norm of dynamics and change as opposed to stability. ‘Development pathways’ or ‘low carbon scenarios’ do not feature in a complexity perspective for mitigation policy in a development context; neither do the concepts of ‘top down’ or ‘bottom up’ make any sense. Rather, and informed by futures thinking, seeds of possible futures are contained in the present system. Bernstein et al., cited in Levin et al., argue that rather than engage in prediction, a more appropriate goal of policy-relevant social science is the ‘identification and connection of chains of contingencies that could shape the future’ (2010, p. 9). Human agency can support the emergence of different types of future systems.

From a complexity perspective, time itself is not linear, but a ‘marvellous tangle’ from which ‘at any moment, points can be selected and solutions invented without beginning or end’ (Bo Bardi as cited by Fataar 2015, Urban Future presentation). ‘Development’, or building a flourishing society is a present challenge, not a future one, concerning the identification and fostering of virtuous cycles in the direction of a desired future. As Wells expresses it, ‘the point is not about planning utopias, the point is about practicing them...’ (2013). The two approaches do not contradict each other, but rather demonstrate different emphases, which the MitDevCoP may benefit from paying attention to.

The present-embedded perspective of complexity thinking may align better with the urgency of the climate mitigation challenge, and particularly with the near term opportunity of hard infrastructure development in the developing world, than the current approach. It may also reframe the issue of mitigation ambition from a number in the future to the ‘how’ of fostering an ongoing appetite for change. It also reminds us that there will be surprises, good and bad. ‘One thing that between order and chaos teaches us is that social transformations will not be fully planned, that some of its key features will have originated in the least expected corner and that the most reliable policies will have undergone a process of learning through the everyday interaction with realities that someone is trying to adapt to or to modify’ (Pueyo, 2014, p. 70). Transforming societies is an effort requiring a huge array of approaches, entry points, disciplines, and scales of actors. It is also a nonlinear enterprise – the ‘change tipping point’ can come suddenly and from a surprising angle (Wells, 2013).

The challenge, however, is to bring a future perspective to the present. How can the ‘irrational preference for the present’ that is particularly associated with this super wicked problem in a development context be engaged with? Perhaps this is particular to the MitDevCoP, as its timeframe is something that makes climate change mitigation distinct from many other development challenges. Is this then something we bring to the general task of system transformations?

12. Scale and fractals

Dominant approaches in the MitDev policy literature and practice focus on the national policy scale, on policy instruments, and sectoral- and technology-led approaches, and tend implicitly to assume the effectiveness of a linear form of national planning in a future that is more predictable than uncertain (Tyler, 2015a).
They deal with the concepts of ‘top-down’ (being a national level policy commitment cognisant of whether it is sufficient from the perspective of climate science) and ‘bottom up’ (identifying detailed opportunities for climate change mitigation from what is currently conceivable).

When considering causality, complexity approaches caution us to perform ‘some kinds of basic scalar checks on our explanations, particularly with respect to more local human possibilities for action within a globalised economy’ (Cornell & Parker, 2010, p. 33). Context specificity is an important aspect of complex systems, together with consideration for how systems are articulated through nested hierarchies occurring at various scales and with different granularities throughout the system. This relates back to interconnectedness. It is important also to note that things happen at a different pace at different scales, and to consider actively how this could be important from a policy perspective. Questions need to be asked from a scalar perspective, and answers interpreted similarly. Fractals (non-linear patterns occurring at different scales) may provide insights as to how policy interventions may evolve elsewhere in the system. Currently, the concept of scale is much better articulated for adaptation than mitigation (Ruiz 2015, personal communication).

13. Innovation

It has been argued that climate mitigation policy literature has not focused sufficiently on innovation to date (Aghion & Hepburn, 2014), nor has it engaged sufficiently with an application in a development context. A complexity perspective for MitDev policy emphasises the role of experimentation, learning, and innovation relating both the social and the technical; ‘solutions might emerge from unsuspected corners and be broadly applied in unplanned manners’ (Pueyo, 2014, p. 55). Complexity focuses the policy maker on micro-diversity, exploration and continuous learning (Allen in Richardson & Cilliers (2001)). A high level of innovation in a system contributes to its resilience by contributing the necessary chaos to balance order and structure (Pueyo, 2014). The concept of ‘seeds’ of the future discussed in section three as being present at a small scale in the present is aligned to the importance of experimentation.

How can innovations be systemically encouraged, and also assessed for desirability under a low carbon inclusive future, including feasibility at scale, and testing for unintended consequences? This is especially pertinent when we are subjected to the ‘ticking clock’ pressure of needing to act urgently (Oliviera 2015, personal communication). There are vast literatures on innovation, innovation policy and innovation for sustainability which could be assessed for their applicability under a complexity perspective. Geyer and Cairney suggest that top down targets appear unhelpful compared to policy approaches affording more local freedom to experiment, encouraging trial and error pilots to respond to uncertainty, treating errors as sources of learning; they encourage systematic use of these approaches (2015).
A complexity perspective is discussed in two distinct ways in this section. The first is the concept of complexity in the process of policy making itself. MitDev policy could be described as a complex policy making challenge as it is cross-cutting in its policy implications, and relies on many governmental departments for its implementation. The second is a focus on two policy aspects of the super wicked problem of climate mitigation itself: the prevalence of certain policy aspects of the development context, and the interaction with international climate change policy.

14. Complex policy making

Traditional policy development and management methods, where planning is completed by experts and then sequentially implemented and delivered, relying on performance-based indicators (Dombkins, 2014, p. 24), tend to dominate in climate mitigation policy formulation. These traditional approaches to policy making are likely to be inadequate for super wicked problems (Dombkins, 2014; Geyer & Cairney, 2015; Levin et al., 2012). However, aspects of this are not new; complex thinking for policy issues has been advancing under different terminologies for decades. Shove (2010a, p. 11) writes that ‘across the policy landscape there are sites, niches even, in which more systemic analyses of change and more subtle theories of innovation, path dependence and co-evolution are already more comfortably at home, public health and planning being two such locations.’ These analyses suggest the importance of different actors, coalitions, spheres and levels of policies and processes; contextualisation and mainstreaming are key. Network theory in public policy and administration studies has considered aspects of complex thinking, with some suggesting that policy implementation itself is a complex networked issue (Milne 2014, personal communication).

Two authors on policy making for complex problems will be considered in more detail for their contributions to climate mitigation policy, and their insights interpreted from a complexity perspective for domestic climate mitigation policy in developing countries.

Firstly, Levin et al. define climate mitigation as a super wicked problem. They find that climate mitigation policy literature tends to focus either on paradigmatic change or politically possible policies, with the former risking unleashing countervailing forces and the latter being ‘woefully inadequate’ (2010). As such, they propose that a new class of policy analysis techniques is required to address the particular characteristics of super wicked problems, focusing foremost on creating sticky, entrenched, positive path dependent policies that expand their support base over time, binding our collective selves to preferred paths (Levin et al., 2012). Consequently, the authors invert the path dependence policy literature to propose that creation of positive path dependence by ‘unleashing path dependent causal processes’ should be a primarily objective of the super wicked policy maker. This policy class, described as ‘applied forward reasoning’ and ‘progressive incrementalism’ (Levin et al., 2010), would support the still-important, paradigm-changing policy interventions.

The focus of their approach is entirely different from current dominant approaches to MitDev policy, and similarities with complexity perspectives are inferred in the way it addresses the ‘how’, particularly how through policy design our future selves can gain sway over our present selves. They suggest that the policymaker’s response should be to concentrate on three aspects of the policy process: 1) to create policy stickiness (irreversibility), 2) to entrench existing support groups, and 3) to expand the policy to additional support groups.
The second author is Dombkins (2014), who writes explicitly on complex policy making. Dombkins presents a detailed methodology for navigating the variations of these types of policy situations which would appear amply to accommodate domestic climate mitigation policy in a development context. Again, Dombkins’ focus is on the ‘how’ rather than the ‘what’ of policymaking, and sustainable development policy making in particular. He argues that complex policies (as pertaining to but distinct from complex policy problems) are emergent, with policy formulation and implementation intrinsically linked such that policy outcomes may change during implementation. They often operate as a ‘system of systems’, requiring a separate ‘meta-policy system’ to bring all the component policies together towards the complex policy’s goal. Flexibility and responsiveness, together with a collaborative rather than controlling approach, are important elements.

The expanded policy community is a feature of Dombkins' approach, and he writes of developing stewardship between the policy owner, component policy owners and agents as being ‘a critical aspect for the journey management of complex policies’ (2014, p. 41). Politics and power are explicitly addressed, with the asymmetric behaviours used by those impacted by policies to avoid, mitigate or distort the intent of the policy noted, and as such he suggests that complex policies are constantly re-designed by the multiple players interacting within a ‘systems-of-systems environment’ (Dombkins, 2014) rendering policy process governance an important feature.

These complex policy authors suggest useful considerations of how to prioritise the ‘how’ of policy making rather than the ‘what’. Dombkins’ framing of the policy process as one of governing a policy system of systems towards a meta-objective (emergence of low carbon development), is well aligned to the challenge of integrating mitigation and development policy areas and emphasises the importance of both the ‘component policy owners’ and agents on the policy journey.

15. A complex policy problem

Context specificity

A specific focus on policy making has emerged from within the complexity field in recent years, emphasising managing for contexts rather than for outputs (Allen et al. as cited in Wells (2013)). The issue of policy making and its broader socio-political context requires specific consideration. The social sciences address the ‘how’ of policy making, and this important aspect requires more attention than it has been given to date by the MitDevCoP. The MitDevCoP needs to consider, for example, that actions with concentrated benefits and dispersed costs are easier to implement, and that those standing to lose by a particular policy will push harder the closer the policy gets to implementation (Hovi et al., 2009). Interactions between policy areas is key, and policy baskets are more productively considered than individual policies. Institutions, history and politics need to be embraced, rather than avoided. Both Hill (2009) and Thomas and Mohan (2007) suggest that policy process (together with social mandate) is particularly important in a development context. Writers using ‘southern theory’ emphasise the context specificity of developing countries, suggesting that a ‘theoretical recalibration’ is required in these contexts given the hegemony of the north in knowledge production (see for example Connell (2007) and Parnell and Robinson (2012) as cited by Kane et al. (2015)).

Some authors have argued for a return to planning in the face of the climate change mitigation challenge (Giddens, 2009; Klein, 2014), arguing that the market is inherently incapable of responding to the need to internalise the costs of greenhouse gas emissions sufficiently quickly. However, this argument often underplays the issue of government failure

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*This phenomenon is well documented in policy literature; see for example (Najam, 1995).*

*The ‘Journal on Policy and Complex Systems’ inaugural volume was published in the Northern Hemisphere spring of 2014, and a Handbook on Complexity and Public Policy (Geyer & Cairney, 2015) has recently been published.*
Planning and regulation require a strong, capacitated and resourced government, and even so this does not guarantee sufficient response. In a development context, governments are typically far weaker, less well resourced and skilled. Pueyo (2014) speaks directly to this issue from a complexity perspective, suggesting that both the market and regulatory interventions are part of a sustainable and moral complex system.

Complexity’s focus on context specificity elevates the importance of a context specific climate mitigation policy work, always testing the general principles of mitigation policy instruments and approaches against local conditions for unintended consequences, interactions and networked causalities.

It is necessary here to note too that ‘developing country’ is itself a major simplification10. From China to Zambia to Bolivia, there are many different types of ‘developing country’. For example, development in different stages will have different demands and different responses, and there are different citizen-government relationships, and different models of government.

A complexity perspective on the domestic-international climate mitigation policy interaction

Domestic climate mitigation policy in a developing country has a complex and important interplay with international climate mitigation policy. This is a distinctive feature of climate mitigation as seen against most other development policy issues, and one which perhaps has not been sufficiently studied (Centre for Policy Research & Mitigation Action Plans and Scenarios (MAPS) Programme, 2013).

In Tyler (2015a) the author argues that the way climate change mitigation has entered the developing country domestic policy space through an international framing, whilst possibly unavoidable, does not necessarily facilitate a domestic policy response commensurate to the issue. The evolution of international climate policy has been shown both to support and undermine its domestic counterpart (Tyler & Torres Gunfaus, 2015). The question posed in this paper is what a complexity perspective might bring to the challenge.

From a complexity perspective the international process could be understood as being either an aspect of the larger global system of which the developing country is a part, or as a process interacting with the domestic system. As a start, this mega system would require description in order to understand some of the interconnectivity, networks, hubs and nodes characterising the issue. This may lead to the identification of causal pathways not yet highlighted. It would appear important that the full SEEPP system, at least at the domestic level, is described, and not just the climate mitigation policy aspects. It may be that the details of other foreign policy and global environmental and trade issues may also be relevant in realising connections and levers that may prove conceptually productive.

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10These papers use the term given that it is a current departure point for the MIseDeCoP; but further, they use it extensively to bound and frame the analysis, in direct contradiction of complexity principles. This is a clear example of the tension between simplification for the purposes of analysis and departure from the complexity of reality. It is considered justified given the different worldviews and communities of practice the author is attempting to bridge.
SUSTAINING THE CLIMATE MITIGATION PRACTITIONER

There is a relatively unexamined, largely unacknowledged cost to working on climate change. All of those working within the MitDevCoP realise the implications of the lack of progress it is making, particularly for developing countries, which have underdeveloped governance systems. Climate change impacts will be substantial and likely overwhelming for most developing countries. This understanding is not shared generally amongst colleagues and friends who do not work in this area. For many within this community of practice this leads, in greater or lesser degrees, to feelings of despair, fear, depression and panic about the future, as well as a huge sense of anger, often expressed against those we perceive to be selfishly benefiting in the short term from the current fossil fuel based economy (Goldberg, 2012). Members of the community of practice often operate based on a shared value-laden view of these people and institutions as ‘evil’. Operating out of these feelings is unlikely to contribute to clear thinking on how to proceed.

So how do the members of the MitDevCoP continue to do their work, aware of the huge challenges and the likely chance of failure, whilst maintaining healthy, functional lives? This is a question which has preoccupied this author for a number of years, and a complexity approach appears to provide some response to this. Complexity thinking encourages us to look for seeds of a ‘good’ or ‘better’ Anthropocene in the present. It may also ‘contribute to diminishing hubris in human thinking and worldviews, reducing alienation, and contributing to a revival of wonder, awe, and the sense of enchantment’ (Wells, 2013, p. 164), enabling us to reclaim our curiosity and fascination with the world around us. Elevating ethics and values to a central position provides a real role for the concept of hope in MitDev policy work, an antidote to the hopelessness so often embedded in linear projections and the barriers to these being taken up within the current political economy and consciousness of developing countries. This in turn may provide the intellectual rigor and sustenance required to allow the focus of the MitDevCoP’s work to expand to the pioneering and experimental initiatives within its own local contexts which, whilst seeming small and insufficient to the task, may yet provide the ‘small perturbation that changes the system’ (Byrne, 1998). There are a number of initiatives which are starting to do this, both specifically in the climate mitigation space, and closely aligned to it (for example, the ‘Seeds of Good Anthropocenes’ project mentioned above, and the Flow project in South Africa (www.flowafrica.org)). Further, the emphasis on strengthening solidarity and deep collaboration in an interconnected world may itself be sustaining, and adopting humility in the face of the essential unknowability of our world also lessens the burden of responsibility of any one community of practice (Wells, 2013).
Complexity emphasises unknowability, incompressibility, and undecidability. However, for the MitDevCoP there is a very clear window of opportunity within which it needs to influence action. Many of the complexity responses outlined above are clearly very time and resource intensive, particularly in that we have almost no experience as a community of practice in these approaches. They also have the danger of potentially encouraging analysis at the expense of action. As Sandoval asks, “How can a complexity perspective change our inability to act?” (2015, personal communication).

A balance has to be struck, and there is literature that speaks to this. Reductionism and ‘faking stability’ (Richardson in Wells (2013)) have their place, as long as this is done consciously with purpose, acknowledging the cost of the reductionism in the particular context. Simultaneously, ongoing work to explore and understand complex systems with the hope of revealing integral solutions should not be neglected. Whilst complexity brings to the fore aspects to our practice that are ‘common sense’, such as pluralism, critical reflection, and creativity, it is these that we constantly put aside because they are so hard to be and do (Richardson et al., 2001).

Finally, there is the opportunity to practise a complexity perspective in MitDev policy work. Ison (2010) argues for the value of practising systems thinking in the face of the climate change challenge, and southern theory speaks to the importance of practice as an approach to generating knowledge authentically ‘southern’ and therefore appropriate to the issue of MitDev policy (Connell in Kane et al. (2015)). What might a complexity practice for MitDev policy work look like?
CONCLUSION

This paper has explored what a complex dynamic systems approach for MitDev policy - a super wicked policy problem concerned with systemic transformations and defined by particular policy making commonalities due to the development context (Tyler, 2015b) - may look like. It is the second part of a two-part paper; the first provided a theoretical background on complexity thinking, and motivated for its application to the MitDev policy challenge.

What then does a complexity approach offer to advancing work on MitDev policy? The discussion in Part Two of this paper suggests that there are at least two main aspects to this, aligned with a loose division between complexity principles on the one hand, and properties of complex dynamic systems on the other.

The principles underpinning a complexity approach constitute a paradigm-level change in thinking about our world. Some have described this as the ushering in of a new, post-positivist worldview (Wells, 2013; Woiwode, 2013). This paradigmatic shift is not specific to the field of complexity thinking, but can be observed across many areas of disciplinary enquiry and beyond, into non-academic society. The world is changing rapidly, with the positivist paradigm that dominated thinking in the twentieth century increasingly at odds with the unfolding of the twenty-first. Woiwode argues that this shift requires a critical and fundamental review of existing frameworks, concepts, methods and practices (Woiwode, 2013, p. 385).

Complexity principles provide an approach within which to undertake intellectual work in this new, post-positivist worldview. This complexity approach provides a means of articulating between the natural and social sciences, and is argued to be able to contribute towards working with change at a practitioner level (Peters and Swilling, 2014; Wells, 2013).

The application to MitDev policy work of many of the complexity principles articulating this approach have been explored in this paper. Some highlights of this exploration are briefly recalled here: the principle of unknowability demands a humility and acknowledgment of the limitations of any one perspective or set of analytical tools. For the MitDevCoP, it is not a matter of just getting the policy mechanism right, or identifying the appropriate technology, or setting emissions constraints at the right levels. There is so much that the MitDevCoP doesn’t know about how the system will respond, and cultivating an awareness of this unknowability may sensitize the community of practice to other ways of perceiving, and to different levers for change. Unknowability may also point towards the need for inner reflection and the awareness of individual community of practice members are in the world, and what they can and can’t bring to the challenges they face. That each observation of a complex system is unique requires a transdisciplinary way of working that draws on many disciplinary perspectives, expertise and ‘non-expert’ social knowledge. This uniqueness of any point of observation emphasises context specificity and problematizes generalities. The objective of accreting truth must give way to an objective which complexifies knowledge and description, knowing that there is no end to this. Perhaps most significantly, a complexity approach emphasises the role of ethics, values, and an explicit moral frame as guidance to both what the MitDevCoP does and how it does it.

The second aspect a complexity perspective can offer to MitDev policy work is a conceptual shift in how the MitDev challenge is considered. MitDev policy has been characterised in Part One of this paper as a super wicked problem of systemic transformations, and therefore a complex systems approach should define how this problem is approached. Properties of complex systems discussed in Part Two of this paper, such as interconnectiveness, non-linearity, uncertainty, scales and fractals, experimentation and innovation and a focus on the present suggest the need to reprioritise and expand the current foci and practices of MitDev policy work. Further, the complexity emphasis on context specificity demands an authentically ‘developing country’ (or ‘southern’) response grounded in the
realities of the development context. It may be that such an approach might have relevance beyond the ‘south’ as the extent of transformations demanded of the world by climate change are increasingly realised.

Taking this second aspect further, it appears that additional work to explore the relationships between different concepts relating to change and a complexity perspective may be valuable. Systemic transitions, transformations, the concept of sustainability, sustainable development and development are all problematized under a complexity approach. Pueyo’s proposition that a complex system can be sustainable but not equitable is challenging, and points ever more closely to the centrality of values and a moral frame. (Sustainable) development for whom? (Sustainable) development of what? Developing countries are arguably more dynamic and in a more rapid state of evolution in comparison to their developed counterparts. This could speak to the existence of greater momentum and energy for change, and fewer structures of the ‘old’ system that require dismantling (Pueyo, 2014). A complex dynamic systems perspective for MitDev policy work would prioritise questions around how this could be captured to expedite and direct the transformations that are required.

The discussion in this paper has also started to consider what a complex perspective to MitDev policy work might mean for the way policy development is approached. More research is required on this, with the application of complexity to policy generally also in its infancy. However, it would appear that a complexity approach is capable of paying at least equal attention to the ‘how’ of policy making as to the ‘what’. It may be that a central objective of policy work under complexity is to demonstrate complexity to the policy maker, rather than to propose policy directions.

Finally, implicit in the discussion is that a complexity approach is not an easy one to adopt. There are reasons why the MitDevCoP has not taken the ‘common sense’ observations of complex thinking for analysis (Richardson et al, 2001) on board more fully yet. And awareness of the balance between analysis and action must be closely maintained in the MitDev policy context, give the window of opportunity developing countries have to respond proactively to challenges. Despite this, the paradigmatic shift which complexity has been argued to exemplify may be more truly hopeful and life-giving in its focus on the present and the wonder of our complex world, regardless of what the future may hold – and this future is something complex thinking warns that we, both as individuals and in our various communities of practice, ultimately have very little real control over anyway.
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