# A Complex Transdisciplinary Exploration of South African Climate Mitigation Policy

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# Plagiarism Declaration

I, Emily Tyler, declare that this thesis is my own work, undertaken with the normal guidance of my supervisor.

I have specifically and appropriately attributed the ideas and words of others contained therein using the American Psychology Association (APA) 6th edition referencing style.

This work has not been submitted in whole or in part for any other degree at the University of Cape Town or elsewhere.

Signed by candidate

February 2019

> *The reform in thinking… implies a mental revolution of considerably greater proportions than the Copernican revolution. Never before in the history of humanity have the responsibilities of thinking weighed so crushingly on us.*

– Morin and Kern, Homeland Earth: A manifesto for the new millennium, 1999, p. 132

This thesis is dedicated to Alastair, for making it possible in so many ways. And to our children Abigail and Finlay – in the hope that if you read this one day, you will roll your eyes, say 'but obviously, mom', and return to living out your more equitable, more environmentally connected lives.

# Abstract

The research journey reflected in this thesis emerged from fifteen years of practice of (predominantly South African) climate mitigation policy from 2001 – 2016; from dissatisfaction with the pace and depth of progress, and a realisation that the South African climate mitigation policy community of practice approaches what we do in a particular way. Guided by a complex transdisciplinary methodology, in this thesis I explore this realm of 'approach', asking whether it is consequential for the decarbonisation policy agenda in South Africa, and considering complexity thinking as an alternative.

A four-part research question acts as the central attractor to this exploration:

1. *What is the current dominant approach to South African (SA) climate mitigation (CM) policy?*

The thesis starts by articulating the 'dominant approach' of the SA CM community of practice (CoP) observed during the research and building on my experience in the field. I reveal this approach as being influenced by the perspective of the international climate mitigation policy process, and the 'hegemonic worldview' – using Capra's (1974) term as a heuristic to convey the set of assumptions and beliefs dominant in the cultural values and form of scientific knowledge that holds power. A normative undercurrent and an environmental perspective that discounts the social realm further shape the dominant approach, an approach that has particular implications for how the SA CM CoP engages with its key policy concepts of transformative change and development.

2. *What does the dominant approach illuminate and what does it obscure about the policy issue?*

I find in the thesis that the dominant approach illuminates aspects of the climate mitigation policy issue: the greenhouse gas constraint; its macro and sectoral scale and temporal implications; technology and finance mitigation options; how various policy instruments work; with a focus on data. However the dominant approach also actively obscures other aspects: the implications of the complex, systemic and long-term aspects of the SA CM policy issue for policymaking; how policy implementation happens; the roles of power, values, culture and behaviour in transformative change; and how to engage perspectives and contestation.

3. *How can a complexity approach contribute towards revealing SA CM policy more fully?*

The thesis then turns to complexity and complex systems thinking to explore how a view from complexity opens up these important but currently obscured spaces for climate mitigation policymaking. The SA CM policy issue is described in terms of complex systems, and a complexity view is offered of: the relationship between the SA CM policy issue and policymaking, the 'mitigation-development complex', power patterns relevant to SA CM policy, the SA CM policy objectives, and deliberate transformative change. Building on this view, complex SA CM policymaking is described as a journey, reflecting a shift in focus away from content, plans and evidence towards principles, process and emergent strategies; a re-ordering of policy

priorities and leverage points, all premised on the complexity observation that top-down control of a complex social system is impossible. A set of policymaking initiatives arising from this complexity approach is offered, including the establishment of a permanent stakeholder engagement platform, a sense-making function, a dedicated strategic and political policy capacity, and a complexification of CM policy instruments and research practice.

4. *What is the usefulness of this inquiry to the SA CM Community of Practice (CoP)?*

Finally, the usefulness of the inquiry to the SA CM CoP is assessed. I conclude that 'approach' is consequential to our work, and that reflecting on our approach can reveal how it might be constraining us and support our explicit consideration of alternatives. The complexity exploration is useful in two ways. First, it offers the set of practical initiatives referred to above for the SA CM CoP's consideration as SA CM policy is advanced. Second, it offers an alternative underpinning for approaching SA CM policymaking based on rigorous science, aligned with both the complex, systemic nature of the SA CM policy issue and with the increasing complexification and pace of change of the twenty first century. Whilst the gap between the hegemonic worldview and its organisational and physical manifestations and those of a complexity approach is significant – perhaps sufficiently so as to undermine the immediate usefulness of this aspect of the research to most members of the SA CM CoP – a complexity view of transformation as non-linear and episodic proves encouraging.

The research journey traverses the territories of practice and academia, the specifics of South Africa and the breadth of global environmental and societal change, disciplines, perspectives, paradigms and worldviews. Essentially, the research comprises a heuristic move which calls attention to the relevance of policy approach in increasing the pace and depth of climate mitigation action in a development context. As required by a transdisciplinary inquiry this contribution - which lies in the realm of knowledge - has both the societal usefulness described above and academic relevance. In the academic realm the thesis opens a new, multi-disciplinary research agenda around 'approach' at the intersection of climate mitigation, energy, public policy and development studies. By scoping out a complexity interpretation of the mitigation policy issue in a development context, the research contributes to both the climate mitigation and complexity fields, and to thinking on issues of sustainable development. Finally, the thesis provides a rare example of transdisciplinary research and method in climate mitigation and energy studies. It is my hope that these transdisciplinary and reflexivity inroads will some day become paths well trodden.

# Acknowledgements

I have been guided, encouraged and supported by so many people during this doctoral journey, and have space to express my thanks here to but a few. First and foremost is my supervisor, Dr Brett Cohen, who from the first provided pragmatic, responsive and thoughtful guidance, despite my best attempts to unsettle him with an expansive topic and ideas not usually encountered by chemical engineers… It has been an absolute pleasure working with and learning from him.

My research direction was significantly influenced by Dr Lisa Kane's 2014 briefing note to the DevMit Forum, a watershed text for me at a particular juncture. Lisa became a generous and inspiring mentor, and a rare support in navigating the treacheries of non-discipline-bound research. Others who were inspirational in the early stages include Prof. Andries du Toit of the Institute for Poverty, Land and Agrarian Studies at the University of the Western Cape, Prof. Sue Parnell of the African Centre for Cities at the University of Cape Town and Dr Rika Preiser of the Centre for Complex Systems in Transition at Stellenbosch University. The MAPS Programme, run by the Energy Research Centre at the University of Cape Town and the not-for-profit SouthSouthNorth, provided a remarkably safe and enabling space for exploration and experimentation. My colleagues and friends Michelle du Toit, Marta Torres Gunfaus and Hilton Trollip in particular encouraged me that my ideas were worth exploring, with Michelle additionally acting as a valuable reviewer. Thank you all.

One of the highlights of my doctoral journey was its co-inciding with that of my sister. Although our topics are quite different, our contexts of simultaneously mothering young children are very similar - there is nothing quite like being able to rant about the difficulty of transdisciplinary literature reviews whilst holding up your end as the 'crocodile' in the chaotic game happening all around you. I will treasure those moments. Another highlight was my father's proofreading and review of the thesis: a labour of love and significant input towards the end. Both of my parents' influence and support in my getting to the point of undertaking a PhD is real, valued and deeply appreciated.

So many others supported me and tolerated my distraction particularly towards the end: Alastair, Abigail and Finlay must be acknowledged here too, as well as my mother who consistently recognised the particular challenges of undertaking a PhD journey in a family context, my brother, my friends, Wendy Annecke, the UCT librarians and inter-library loans. Thanks to Yvonne, an angel of mercy, saving me from an MS Word formatting hell.

Finally, to my climate mitigation colleagues: I have likely underemphasised what we have achieved thus far in climate mitigation policy in South Africa in order to more clearly see the potential of an alternative approach. I hope that you will forgive me this, and see past the imbalance to both appreciate the ongoing role for our existing skills and expertise within an alternative approach, and to consider the opportunities that such an approach offers.

# Table of Contents

# Abbreviations

| | |
|---|---|
| AR5 | Fifth Assessment Report (of the IPCCC) |
| CAIT | Climate Analysis Indicators Tool |
| CDM | Clean Development Mechanism |
| CGE | Computable General Equilibrium |
| CM CoP | The international climate change mitigation community of practice attending to national level climate mitigation policy issues |
| CM policy | National level climate mitigation policy |
| DEA | South African Department of Environmental Affairs (prior to 2009 known as Department of Environmental Affairs and Tourism, DEAT) |
| DEAT | Department of Environmental Affairs and Tourism |
| DEROs | Desired Emission Reduction Outcomes |
| DMR | Department of Mineral Resources |
| DoE | Department of Energy |
| DTI | Department of Trade and Industry |
| EDD | Economic Development Department |
| ERC | Energy Research Centre |
| GDP | Gross Domestic Product |
| GHG | Greenhouse gas |
| IMCCC, IGCCC, NCCC | South African Inter-Ministerial, Inter-Governmental and National Committees on Climate Change |
| INDC | Intended Nationally Determined Contribution |
| International CM CoP | The international climate mitigation community of practice attending to international level climate mitigation policy issues |
| International CM policy | Climate mitigation policy at the international level, largely concerned with responding to climate mitigation as an issue of the global commons. |
| IPCC | Intergovernmental Panel on Climate Change |
| IRP | Integrated Resource Plan |
| LTMS | Long Term Mitigation Scenarios |
| MEC | Minerals and Energy Complex |
| MPA | Mitigation Potential Analysis |
| NAMA | Nationally Appropriate Mitigation Action |
| NCCRWP | South African National Climate Change Response White Paper |
| NDP | National Development Plan |
| NPC | National Planning Commission |

| | |
|---|---|
| NT | National Treasury |
| PPP | Pollution Prevention Plans |
| REIPPPP | Renewable Energy independent Power Producer Procurement Programme |
| RSA | Republic of South Africa |
| SA CM CoP | The South African climate mitigation community of practice attending to South African national climate mitigation policy issues |
| SA CM policy | South African national climate mitigation policy |
| SA STEPE system | South African socio-techno-economic-political-environmental system |
| SBT | Scenario Building Team |
| SEA | Sustainable Energy Africa |
| SETS | Sectoral Emission Targets |
| STEPE | Socio-techno-economic-political-environmental |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WGIII | Working Group Three (of the IPCCC, on climate mitigation) |
| WWF | World Wide Fund for Nature |

# Glossary

Given the transdisciplinary nature of the research, the intention of this glossary is to assist the reader access multiple disciplinary terminologies. It is therefore presented primarily as a guide as opposed to being definitive.

| | |
|---|---|
| Classical or traditional science | Science aligned to the reductive scientific method of Descartes and Newton. |
| Climate mitigation | A term referring to the reduction, sequestration and avoidance of greenhouse gas emissions. |
| Community of Practice | A group of people attending to a particular knowledge area. |
| Critical approach | An approach that takes nothing for granted, approaching everything critically. |
| Deliberate transformation | A transformation that is goal oriented, as opposed to one that is either emergent or responsive. |
| Deterministic | An approach based on simple causality: If the starting conditions are known, then it is possible to predict what will happen. |
| Disjunctive | An approach that is marked by separation. |
| Hegemonic scientific and cultural worldview | A term, following Capra (1974/1983), referring to assumptions, beliefs and values dominating approaches to science and culture. |
| Knowability | A deterministic principle maintaining that the future can be known if one has enough knowledge. |
| Knowledges | A term encompassing all types of knowing, whether academic or social; intellectual, physical, sensory or spiritual; accessed through traditional or other philosophies of science. |
| Managerial | A focus on top-down organisation and control. |
| Marginal approach | A consideration of something at the margin, with the result that only incremental actions or decisions are effected. |
| Materialism | The notion that all reality is derived from physical matter. |
| Metaphorical use | Using a concept at the level of metaphor or idea. |
| Mitigation-development complex | The systemically and integrally conceived set of issues associated with mitigation and development concerns. |
| Mitigation-development relationship | The relationship between mitigation and development issues as separate entities. |
| Modernism | Assumptions, beliefs and values ascendent in the second half of the twentieth century and associated with technology, industrialisation, material progress and human superiority. |
| Optimising | Aiming for maximum efficiency |
| Orthodox economic view of development | Development as equated with Gross Domestic Product, achieved through economic growth and associated with neoclassical economic theory. |
| Orthodox economics | The economic mainstream based on neoclassical assumptions and classical scientific method. |

| | |
|---|---|
| Positivism | A philosophy of science proposing that only knowledge obtained through the observation of natural phenomena through sensory experience is assumed to be valid. |
| Post-normal science | An approach to science appropriate to issues of high uncertainty and contestation, where quality of process is the goal rather than 'knowledge'. |
| Post-positivism | A philosophy of science that rejects the concept of a neutral observer, including values, biases and perspectives as essential aspects of knowing. |
| Reduction | Separating into ever-smaller parts in order to analyse or act. |
| Reflexivity | Self-reflection in the context of practice, with the potential for change and learning. |
| Satisficing | The satisfaction of minimum acceptability criteria (as opposed to optimising). |
| Technocratic | A reliance on technical expertise and traditional scientific knowledge for decision making. |
| Transdisciplinarity | An approach to science that transcends disciplinary boundaries to engage disciplinary knowledge, knowledge that is both between and beyond disciplines and social knowledges for complex contemporary issues. |
| Universalism | The philosophy that certain things have general application, as opposed to applicability being determined by context. From universalism follows the possibility of universal laws, and generalisations. |

# 1 Introduction

> *Energy and climate change raise questions of extraordinary reach and complexity, with responses that have been limited, contested and as of yet unequal to the challenges. Despite decades of effort, progress seems glacial.*
>
> – Michael Grubb et al, Planetary Economics (2014, p. 46)

> *The South African climate mitigation policy community has failed to provide domestic policy makers with a convincing case for integrating climate mitigation into development policies.*
>
> – Kuben Naidoo, Deputy Governor of the South African Reserve Bank, personal communication, 29 November, 2017

Climate change has been described as a challenge of 'extraordinary reach and complexity' (Grubb et al., 2014), one of the biggest, defining, quintessential challenges humanity has yet encountered (Fankhauser & Stern, 2016). The physical impacts of climate change are advancing apace across the globe, heightened attention is being paid to adapting to an altered future climate, and evidence of loss of biodiversity and livelihoods from climate change mount. We know that the faster we reduce the anthropogenic greenhouse gas emissions that are driving the problem, the less severe the extent of climate change will be (Stern, 2007). But this exercise is like turning the proverbial Titanic: our societal systems are oriented around the fossil fuels that are doing the majority of the damage. Historical, present and projected future responsibility for greenhouse gas emissions is both unequally distributed across the global population, and strongly correlated to material wealth and development.

In the research presented in this thesis, I abstract from this entanglement of climate conundrums just one of the four climate change themes of impact, adaptation, mitigation and 'loss and damage' articulated by the United Nations Framework Convention on Climate Change (UNFCCC): climate mitigation. Climate mitigation is defined as 'human intervention to reduce the sources or enhance the sinks of greenhouse

gases' (Intergovernmental Panel on Climate Change [IPCC], 2014a, p. 4), and is attended to at the international, national and sub-national levels. Here, I confine my focus to the national level in so-called developing countries.

It is common cause that global action towards mitigating climate change is too little, too late. Grubb et al describe responses to date as being 'limited, contested and as yet unequal to the challenges' and progress as 'glacial' (2014, p. 46). Pertaining specifically to developing countries, the Intergovernmental Panel on Climate Change (IPCC) in its Fifth and latest Assessment Report (2014) as well as its Special Report on 1.5 degrees (IPCC, 2018) finds that the extent and pace of transformation of both current and future emissions profiles is inadequate. Intimately connected to this state of affairs, if not at its heart, is the complex relationship between climate mitigation on the one hand, and developmental priorities on the other.

I have worked as a climate mitigation economist within the developing country of South Africa since 2003, and can attest to there being insufficient progress on climate mitigation in the country (Climate Action Tracker, 2015). Many of the South African climate mitigation plans and policy intentions remain just that (Boyd & Coetzee, 2013; Trollip & Boulle, 2017). I can also confirm the complex relationship between climate mitigation and development in the South African setting, and that there is insufficient progress in addressing the country's development priorities of employment creation, poverty and inequality alleviation. In the years prior to embarking on the research of this thesis, this situation had me feeling increasingly disillusioned with my work. I started becoming attuned to how my colleagues and I approached the mitigation - development relationship.

In the world of climate mitigation research, I became aware of two distinct approaches to addressing this mitigation-development relationship. The first is a macro-level approach, which is predicated on particular assumptions of what development looks like and the role of economic growth in achieving development. The second is a 'bottom-up' approach considering the interactions between development and emissions within the context of specific projects and programmes. Whilst both scales are undoubtedly important to the mitigation-development relationship, there seemed no way to reconcile them with the approaches and tools of my experience and field. At both the global and national level, theory and practical know-how of how work on mitigation and development can be oriented towards the achievement of both objectives simultaneously remains in the early stages (see for example Winkler, Boyd, Torres Gunfaus and Raubenheimer (2015)).

I began to seek out perspectives on the mitigation-development relationship outside of my immediate circle of climate mitigation colleagues, particularly in the development practitioner community which is grounded in social sciences. Whilst 'development' had been a term I used daily in my working and academic life, I began to feel that I now understood it less and less, and found little in the way of theory to assist me in understanding what development was, or more importantly, could be in the context of climate mitigation. An excerpt from an email from Professor Andries du Toit, the Director of the Institute

of Poverty, Land and Agrarian Studies at the University of the Western Cape stayed with me: 'What mediates the relationship between climate change on the one hand, and the nature and distributional impact of growth on the other is policies and politics' (Du Toit, personal Communication, 14 August 2013). I found this conceptualisation both intriguing and relatively incomprehensible from my perspective of climate mitigation economics. How did politics and policies relate to the long-term planning trajectories that framed my understanding of the future and the challenge of addressing climate mitigation and development together?

A workshop in 2013 convened under the South African Research Project on Employment, Income Distribution and Inclusive Growth[1] aimed at providing research to support the policy issue of inclusive growth unsettled me further. Here I observed talk of a development that is multi-faceted, attended by numerous disciplines, consisting of many discourses played out in different contexts, and distinctly lacking clear solutions. I was also (rather naively in retrospect) taken aback that climate change did not really feature in the discussion, and where it did, the perspectives were years out of date and highly disconnected from the discourse and content of my climate mitigation colleagues. I began to realise that I had come to approach and understand the concept of development during the course of my climate mitigation career in a particular way, and that this was both as impoverished and disconnected from those working on development issues as was their approach and understanding of climate mitigation.

In early 2014 I had the opportunity to explore some of these observations through the design of an academic conference I led under the auspices of the MAPS Programme[2]. The Forum on Development and Mitigation - 'DevMit Forum'[3] - hosted in Cape Town, was a gathering of mitigation practitioners from developing countries including India, Brazil, Chile, Colombia, Peru, Indonesia, Niger, Sri Lanka, Kenya, Ghana and of course South Africa. I used the opportunity to open up the discourse and content of the climate mitigation delegates to the critique of its development counterparts. The nine 'Development Provocateurs' participating in the Forum were South African development practitioners focusing on employment, transport, urban settlements, poverty, trade and industrial policy, land use, and energy security. The Provocateurs responded to what they had heard and encountered during the three days of the Forum both verbally through a panel session on the final day, and in written form through a series of retrospective Briefing Notes (Tyler, 2014).

Sensitised to the Development Provocateurs' perspective throughout the conference, I became even more aware of the extent to which I approached the mitigation-development relationship from a climate-centric

[1] www.redi3x3.org

[2] 'The MAPS Programme, which ran from 2010 to 2015, sought to build national scenarios to inform action towards a lower emissions future in four Latin American countries: Brazil, Chile, Colombia and Peru. The aim was to help combat climate change while fostering development, through contributing to an emerging body of knowledge with a long-term impact on policy making, planning and the institutionalisation of climate mitigation strategies' www.mapsprogramme.org.

[3] The DevMit Forum, www.devmitforum.ercblogs.co.za (and www.mapsprogramme.org/workshops/development-mitigation-forum), was a three-day event held in Cape Town from 27 to 29 January 2014 under the auspices of the MAPS Programme, the Energy Research Centre (ERC) (University of Cape Town (UCT), South Africa) and the Centre for Policy Research (New Delhi, India).

starting point, with little appreciation for the issues, contestations, discussions and paradigms at play in the development areas. Further, that which the climate mitigation community valued in terms of tools, topics, approaches and methods was not necessarily that which was perceived valuable by these development fields. These realisations were shared by many of the DevMit Forum climate mitigation delegates. Towards its close, the Forum as a whole came to consider and advocate for a shift of perspective in climate mitigation work; from a climate-centric frame to one which considered climate mitigation as one of a basket of issues which required addressing to realise a 'flourishing future' (Maps Programme, 2014), and to move beyond our traditional collegial communities to exchange perspectives. This was described as the development of a 'new conversation' in the DevMit Ideas Kit (Maps Programme, 2014), a hyperlinked, magazine style Forum output encapsulating key discussions and themes.

Further, the DevMit Forum had consolidated my realisation that both my climate mitigation colleagues and I approach the challenge of climate mitigation itself in a particular way, underpinned by implicit assumptions about how the world works and how we can understand and effectively influence it. This approach was not necessarily shared by either the Development Provocateurs nor the development practitioners I had encountered in my research and networking experiences prior to the Forum. I started to wonder whether a different approach to climate mitigation, and the mitigation-development relationship, might have any influence over the current lack of pace and depth on climate mitigation action in developing countries. At the time I reflected in a blog that the climate mitigation perspectives, tools and methods on display at the DevMit Forum were hard won and useful, 'its just the framing which is not helpful' (Tyler, 2014).

At this point I formalised my doctoral research journey to explore these emerging questions and to bring the tools of academia to bear on the 'shift in conversation' desired by the practitioner community.

# Engaging method

# 2

> *We need a kind of thinking that relinks that which is disjointed and compartmentalised, that respects diversity as it recognises unity, and that tries to discern interdependencies. We need a radical thinking (which gets to the root of problems), a multidimensional thinking, and an organisational or systemic thinking.*

– Morin and Kern, Homeland Earth: A manifesto for the new millennium (1999, p. 130)

## 2.1 An emerging research question

The questions that emerged from the individual and social experiences described in Chapter One find initial expression in three parts:

1) What is the dominant approach to national climate change mitigation in developing countries,
2) how well does it address the problem, and
3) what are the implications of using a different approach?

This initial expression was a sufficient starting point from which to begin my research journey. However, as I reflected on it from the perspective of literature, particularly that pertaining to method, the questions demanded elaboration, contextualisation and eventually translation into a formal doctoral research question. This process is documented in the first half of this Chapter (sections 2.1.-2.6.).

From the DevMit Forum discussion comes the word 'conversation' to describe discussions about the challenge of climate mitigation in a development context. The Forum further suggested the need for a 'new conversation', with 'new language and discourse'. In the Ideas Kit, this new conversation is described in terms of 'productive focus areas', both related to content (implementation, scale, cities, passenger vehicles, institutions, political economy, investment), and process ('how' policy is done, how different perspectives can be incorporated, and how the conversation can be continued) (MAPS Programme, 2014).

Kane, one of the DevMit Forum Development Provocateurs, suggested something deeper than just conversation in her Briefing Note (2014a), which was unique amongst the DevMit Forum briefing notes in its academic orientation, and which resonated with my own intellectual journey at that point. Kane introduces the concept of a 'community of practice' (hereafter CoP) of people attending to a particular knowledge area, taking into account Kuhn's thinking on scientific paradigms (1962/2012). Kuhn and others emphasise the role of the social in the production of scientific knowledge. Through education and professionalization a shared and dynamic knowledge apparatus emerges that encompasses a CoP's beliefs, values, conceptual frames, techniques and tools, assumptions, rules, understandings of what is competence, what is good practice, good research and valid concepts (Kuhn, 1962/2012; Lave & Wenger, 1991; Wenger, 2000). Whilst there are likely to be differences of approach and perspective within a CoP, this knowledge apparatus is sufficiently distinct as to be defining (Kuhn, 1962/2012). It is also largely tacit and implicit, acquired and not taught (Montuori, 2010). Becher finds that tacit knowledge 'is that particular kind of understanding which is so taken for granted by those who possess it that it is never explicitly taught, but has instead to be acquired by sustained involvement in the relevant cultural milieu' (1987, p. 262). The characteristic of 'tacitness' in CoPs makes the 'rules' of a field both difficult to see if one is inside it, but also 'confers on those 'rules' a validity which is forged through the social consensus of a closed group' (Kane, 2014a, p. 3). This suggests that these tacit knowledges may as much constrain a CoP in its work as facilitate it. Wenger finds that whilst CoPs are essential for learning, he also cautions that they can also 'learn not to learn. They are the cradles of the human spirit, but can also be its cages' (2000, p. 230).

The knowledge apparatus of CoPs is variously described across literatures: Ison (2010) coins the phrase 'how we do what we do when we do what we do'. Montuori writes of a 'dominant disciplinary discourse' in an academic context, and a 'dominant approach' (2013b) in a practitioner environment. Becker (2012) considers 'mental models' comprised of 'pre-analytical ideas, general worldviews and ontological convictions', and Montuori of the 'metaparadigmatic dimension… the underlying assumptions that form the paradigm through which disciplines and perspectives construct knowledge' (2010, p. 6). Montuori's term 'dominant approach' is used in the context of this thesis because of its alignment with my intuition from my practitioner experience and its more ready ability to translate into the social context. 'Approach' is taken to encompass the concepts of Khun, Wenger, Montuori, Ison and Becker discussed above. Accessing 'approach' requires a form of 'metacognition', a term originating in psychology (Flavell, 1979, p. 906) for 'knowledge and cognition about cognitive phenomena' and has been used, outside of the psychological and educational fields, to convey critical awareness and a consideration of how knowledge is constructed (Boix Manisilla, Dawes Duraisingh, Wolfe, & Haynes, 2009).

The emerging research question is therefore at the same time both philosophical and strongly grounded in the particularities of a contemporary and complex social issue. It emerged not from a contemplation of philosophy, but rather from a contemplation of how to progress national climate mitigation action in developing countries: It is essentially applied and action oriented. The question is underlain with a

pragmatism: is 'approach' an aspect of climate mitigation policy worth exploring in the on-going attempt to increase the pace and depth of climate mitigation action in a development context? It is also a question that is underpinned by a normative position which is variously expressed, but which essentially states that it is necessary and desirable to both mitigate in line with the recommendations emerging from climate science and to enable the development priorities of developing countries to be met.

## 2.2 From research question to methodology

From the discussion above it became clear that I needed a research methodology that enabled an engagement with 'approach'. I also needed a methodology that was well suited to a problem described in both its academic and social context as contemporary and multidisciplinary (Bhaskar & Parker, 2010; Fankhauser & Stern, 2016). Finally the method needed to accommodate the normative underpinnings of the question, together with its action orientation.

During the journey to method, it quickly became apparent that the question as it had emerged was exceptionally broad. Whilst aspects of this breadth are fundamental to the type of inquiry, certain scope restrictions were possible. The question had emerged as one involving climate mitigation generally, encompassing any climate mitigation initiative, from investment financing, to individual personal action, to civil organisation programmes, to public policy, with much lying in-between. My particular interest and experience is in public policy at the national level, as opposed to international or regional, or provincial or city-level, and the question was thus refined. The distinction of 'policy' initiatives from others is a highly contested one (Hill, 2013), and the focus on policy as a point of intervention for the climate mitigation issue in developing countries is debated. Without explicitly engaging with either of these issues, the thesis takes the position that public policy plays a particularly important role in an issue such as national climate change mitigation in developing countries. This position is affirmed and referenced in various instances as the thesis progresses.

National level climate mitigation policy is a particular field of study and a particular type of policy issue. It is often intermingled (intentionally or inadvertently) both with the remaining three areas of climate change (climate impacts, adaptation and 'loss and damage') and with international climate mitigation policy. Here I distinguish national climate mitigation policy (hereafter, 'CM policy') from this context in order to better understand aspects of it as a policy problem and to attend to how it is approached. International CM policy is always distinguished by 'international' descriptor for the purposes of the thesis, likewise the 'international' CM CoP.

Whilst I had engaged an international group of CM policy practitioners at the DevMit Forum and had a perspective of approaches to CM policy in other developing countries from my practitioner experience, the need to ground the research strongly in an empirical context became increasingly apparent as the research progressed. As I was steeped in the South African context, with deep experience in the field as a

practitioner and with particular access to the South African practitioners and researchers, making the decision to focus on the South African case was an obvious one (hereafter 'SA CM policy'). Thus the SA CM policy CoP (abbreviated to 'SA CM CoP') is differentiated from the 'CM policy CoP' attending to national climate mitigation policy issues globally, and to those attending to state and city level climate mitigation policy in South Africa or globally. Whilst I have therefore abandoned the explicit 'developing country' focus of the initial question, it remains implicit in South Africa's development context and policy priorities. These terms and their abbreviations as used throughout the thesis to improve readability are presented below to familiarise the reader; a full glossary and abbreviations list is appended to the thesis.

*Table 1: Climate mitigation policy notations introduced in the first half of this thesis*

| | |
|---|---|
| CM policy | National level climate mitigation policy |
| SA CM policy | South African national climate mitigation policy |
| International CM policy | Climate mitigation policy at the international level, largely concerned with responding to climate mitigation as an issue of the global commons. |
| CM CoP | The international climate mitigation community of practice attending to national level climate mitigation policy issues |
| SA CM CoP | The South African climate mitigation community of practice attending to South African national climate mitigation policy issues |
| International CM CoP | The international climate mitigation community of practice attending to international level climate mitigation policy issues |

These scope-restrictions are all quite artificial, imposed assuming a false set of dualisms between policy and action, developed and developing countries, adaptation and mitigation and national and international. These dualistic assumptions are acknowledged here, and drawn back in to the analysis as a generative form of tension (Haraway, 1998) in instances throughout the thesis.

CM policy is an emerging and immature field of academic inquiry (Levin, Cashore, Bernstein, & Auld, 2012), attended by multiple disciplines including engineering, economics, public policy, political science, law and environmental science. It is also closely associated with the applied research areas of sustainability and energy studies. There is little attention paid in the literature to describing the field. Levin et al. describe CM policy as an applied field, and one which they argue as not yet being particularly coherent, 'lacking consensus on either epistemological or substantive grounds' (2012, p. 124). Bhaskar et al. find that 'even those who see climate change as an urgent issue, for the most part, lack a framework for coherently integrating the findings of distinct sciences, on the one hand, and for integrating those findings with political discourse and action, on the other' (2010, p. vii). Consideration of CM policy in the development context fares no better. Dubash, Raghunandan, Sant and Sreenivas (2013) observe in the Indian context that 'there is no clear and consistent approach or framework that guides the efforts [of climate-related policy in India]'. The issue of approach does not appear to have yet been mentioned in the literature on South Africa. Much of CM policy literature remains grey, consisting of working papers associated with particular programmes and projects. Despite my being published in academic journals on

issues of energy and climate policy, this had not required my orientating myself from a disciplinary, epistemological or method perspective (my own academic career has been in economics and finance). This state of the academic field of CM policy provides support from the academic side for the relevance of the research question.

Given the lack of guidance from within the academy, I returned to a first principles approach to search for an entry point to methodology. CM policy is a long-term policy issue (Giddens, 2009; Hovi, Sprinz, & Underdal, 2009), relying on climate science to create what O' Brien and Sygna (2013) term a 'deliberate' (as opposed to 'adaptive') transformation of human economy and society in order to prevent future climate impacts. Climate change is also clearly an environmental problem, and on a global scale climate mitigation directly impacts the extent to which the climate will change in the future. However, on a national policy level, this link with environmental impact is, for most countries including South Africa, an indirect one. South Africa contributes 1.07% of global emissions (Climate Analysis Indicators Tool [CAIT], 2017), and therefore its mitigation action is relevant but not determining from the perspective of actual global emissions concentrations. Greenhouse gases (GHGs) mix uniformly in the atmosphere, with the effect of GHG emissions to the atmosphere being universal and not local (Lazarus, 2009). Conversely, the impacts of climate change are uniquely local in type and extent. This means that climate mitigation is quintessentially a global commons issue (Nordhaus, 1994), and the link between (national) CM policy and the way climate change impacts any one country is most often indirect, mediated by international diplomacy, economic and social systems, together with climate science. Individual countries' influence over these mediating systems varies, but typically it is the large emitting countries or regions such as China, the USA and the EU[4] who have a correspondingly greater influence.

On this basis, it would appear that CM policy in South Africa is not primarily an environmental issue. Rather, it is a socio-techno-economic-political-environmental (STEPE) issue (International Social Science Council & United Nations Educational Scientific and Cultural Organisation, 2013; Mukal Sanwal, 2015; Winkler, Boyd, Torres Gunfaus, & Raubenheimer, 2015). This 'STEPE' descriptor for the SA CM policy issue, one which I return to in later Chapters, implies that the issue is at heart a multidisciplinary one with a dominant role for the social sciences (Byrne, 2011) and with engineering and energy studies for technological insights. The environmental provenance and links are not irrelevant however, there is a (smaller) role for the natural sciences.

Initial forays into social science methodologies did not however suggest a good methodological fit with the requirements of the research question. I encountered little in the social sciences that engaged with the philosophical aspects of metacognition of an applied multidisciplinary field such as CM policy, nor much oriented towards action. Public policy as a discipline finds moving significantly beyond the issue of 'prescriptive versus descriptive' policy research challenging (Hill, 2013; Howlett, Ramesh, & Perl, 2009),

[4] China emits 25.36%, the USA 14.4%, the EU 10.16% and India 6.96% (CAIT, 2017)

with the policy implementation sub-field in particular finding predictive theorising elusive (Boyd & Coetzee, 2013; Najam, 1995). Sustainability science as an alternative is problematic for this application in that it remains oriented towards the environmental rather than the social. Neither did my own academic or professional career offer clear alternatives: Economics and finance presented methodologies that would have enabled me to hone in on particular aspects of the CM policy problem, but neither offered ways of considering 'approach'.

CM policy is a highly contemporary and evolving issue, and as such I was aware that what I was looking for was more likely to be found on the outer boundaries of the human intellectual project (Wells, 2013) than closer to its well-established core. Funtowicz and Ravetz (1993, 1994) write that contemporary issues of sustainability, terrorism and security, and global connectivity are requiring the traditional disciplines to evolve and new philosophies of science and approaches to knowledge in response. It was here that I encountered transdisciplinarity.

## 2.3 Transdisciplinarity: an overview

Transdisciplinarity has emerged in response to the limitations of disciplinary science to adequately engage with contemporary complex, multi-faceted and systemic 'real-life' problems (Montuori, 2010), and an academic landscape evolved by critical theoretical traditions such as post-modernism, post-structuralism and feminism (Leavy, 2011). The term transdisciplinarity was introduced by Jean Piaget in 1970 as meaning 'beyond disciplines' (Nicolescu, 2014). Transdisciplinarity is specifically concerned with assisting with the types of complex systemic social issues the world currently faces, such as sustainability (Bergmann et al., 2012; Bhaskar & Parker, 2010; Ison, 2010; Leavy, 2011; Montuori, 2013a; Nicolescu, 2014), issues which Bergmann et al. propose are 'usually beyond the direct grasp of discipline-bound research' (2012, p. 80). The issues transdisciplinarity engages with are not new to academic debate, but rather the way it approaches them is. As such, transdisciplinarity is perhaps most usefully understood as a principle of science and research (Bergmann et al., 2012), a new way of thinking about and engaging in inquiry (Montuori, 2010), an 'attempt to deal with hybrid problems in a scientifically controlled and reflective manner' (Bergmann et al., 2012, p. 27), and definitively as one which transcends disciplinary boundaries to highlight 'the multifaceted scientific, social, economic, ethical, and political principles necessary to decipher an adequate approach' to complex contemporary issues (Wells, 2013, p. 293).

Transdisciplinarity is distinct from inter- and multidisciplinarity[5] which remain within the framework of disciplinary research (Bergmann et al., 2012; Leavy, 2011; Nicolescu, 2014). In contrast, 'transdisciplinarity concerns that which is at once between the disciplines, across the different disciplines, and beyond all discipline. Its goal is the understanding of the present world, of which one of the imperatives is the unity of knowledge' (Nicolescu, 2014, p. 187).

[5] Interdisciplinarity involves the transfer of methods from one discipline to another, whilst multidisciplinarity involves the enrichment of a research topic by incorporating perspectives from other disciplines (Nicolescu, 2014).

A feature of a transdisciplinary research approach is that it is inquiry and problem focused, as opposed to being discipline or method focused, with the research problem remaining at the heart of the research process (Leavy, 2011) and descriptively open throughout (Bergmann et al., 2012; Boix Manisilla et al., 2009; Leavy, 2011; Montuori, 2012). Research problems emerge from a rich social and empirical context, requiring translation into an 'epistemic object'. Introduced by Rheinberg in 1997 in the context of experimental natural science (Miettinen & Virkkunen, 2005), an epistemic object has been described from a transdisciplinary perspective as 'a thing' that humans can and want to know about and upon which scientists can work (Becker, 2012; Bergmann et al., 2012). This translation requires attention to the 'pre-analytical ideas, general worldviews [and] ontological convictions' within which the translation is done (Becker, 2012). Each transdisciplinary inquiry is unique. As Montuori describes it, '[transdisciplinary] inquiry involves a creative construction of a perspective on a subject on the part of the inquirer' (2010, p. 8).

Transdisciplinarity sets aside the rarefied view of academia operating apart from society, rather positioning itself at the interface of science and society (Jahn, Bergmann, & Keil, 2012) where all forms of knowledge are equally valued. The emergence of the question from a social context is important for a transdisciplinary inquiry to remain connected to the social world, and to integrate the scientific and the social as a research objective. The translation of this emergent research problem into an epistemic object generates knowledge bases to feed back into both the scientific and social processes. Whilst this social integration aspect of transdisciplinary is not emphasized by all transdisciplinary authors (Leavy, 2011), most transdisciplinary authors hold that scientific output has to be constantly re-contextualised back into society in order to test, adjust and reconfigure these 'epistemic objects', thus rendering essential society's role in raising, progressing and transforming problems. Bergmann et al. propose that the outcome of a transdisciplinary research process should be 'the production of new scientific insights, on the one hand, and practical strategies for formulating relevant solutions and implementing these, on the other' (2012, p. 42). Transdisciplinary research must be useful for society (Leavy, 2011; Montuori, 2013b).

Given the position of transdisciplinarity between the disciplines, between science and society, between action and research/theory (Montuori, 2010), and between the researcher and the researched, differentiation and integration aspects (Bergmann et al., 2012) are usefully held in constant, critical tension throughout a transdisciplinary research project. Terminologies and concepts, or at least the ambiguity and contestation surrounding their use across contexts, require clarification (Bergmann et al., 2012).

Due to transdisciplinarity's eclectic stance towards knowledge, it is particularly concerned with metacognition (Boix Manisilla et al., 2009; Montuori, 2010). The underlying assumptions and foundations of disciplines, what they are concerned with and why, and the boundaries of this concern are key points of interest from a transdisciplinary perspective (Montuori, 2010). Philosophy of science, disciplinary ontologies and epistemologies require explicit consideration in any transdisciplinary inquiry (Montuori,

2013b). Working with transdisciplinarity therefore requires a non-dogmatic positioning with regard to ontological and epistemological views. This focus on metacognition extends beyond disciplinary and social knowledge to the researchers themselves and their own 'tradition of knowledge' (Ison, 2010) or 'research paradigm' (Esterberg, 2002). As in much social science research, the awareness of the knowledge perspectives the researcher brings to the inquiry is critically important in transdisciplinary research. This includes how the researcher's perspective can change during a research project, and requires transdisciplinary researchers to foster a practice of constant self-inquiry and reflexivity (Leavy, 2011; Montuori, 2010, 2012). Acknowledging the normative aspects of the research problem is appropriate and significant (Bergmann et al., 2012). This particular emphasis on the different frames and perspectives that researchers and practitioners work with is distinct from most traditional research approaches (Montuori, 2012).

Transdisciplinarity method enriches rather than replaces disciplinary methods, bringing 'new and indispensable insights' (Nicolescu 2002 as cited in (Montuori, 2010)) to disciplinary research. In addition there is an emerging and experimental set of specific transdisciplinary methods and principles as a form of integration and synthesis (Bergmann et al., 2012), developed specifically to the needs of the research problem or question at hand. Methods to integrate knowledge are a particular focus (Bergmann et al., 2012), and 'creative inquiry' is emphasised beyond 'reproductive inquiry' (Montuori, 2012) with a strong emphasis on discovery, creativity and epistemological humility (Montuori, 2013b). Research questions and objectives are oriented towards discovery and understanding as opposed to predicting and explaining (Thomas & James, 2006), the research happening 'in vivo' as opposed to 'in vitro' following Nicolescu's (2014) phraseology. This transdisciplinary method set is one which is still being negotiated, developed and worked out through experimentation and innovation on a research project level (Cornell & Parker, 2010). In this process, an on-going challenge for transdisciplinary scholars is to show how transdisciplinarity 'does not represent a dilution or weakening of knowledge' (Cornell & Parker, 2010, p. 27), and to ensure that transdisciplinary research work is rigorous and subject to critique.

From a transdisciplinary perspective my emerging research questions, recalled below, gained validity and transdisciplinarity appeared to provide a methodological way forward.

1) *What is the dominant approach to national climate change mitigation in developing countries,*
2) *how well does it address the problem, and*
3) *what are the implications of adopting a different approach?*

Specifically, transdisciplinarity is capable of supporting the inquiry into the metacognition of SA CM policy, situating the research outside of any particular discipline. As an emerging approach to science focused on current social problems, transdisciplinarity responds to the contemporary nature of SA CM policy and resonates with its social justice 'undercurrent' (Leavy, 2011). Its positioning between science and society adds to this and also provides the action orientation required. At this point, one methodological aspect

remains outstanding, and it is required to respond to the third question: what different approach did I choose to consider? This is discussed in the following section.

## 2.4 The journey to complexity

The journey towards complexity was an intuition-led one, rather than a rational choice made at a moment in time from a number of competing alternatives[6]. The argument for the appropriateness of this intuition-led journey as a method rests partially on the focus of the emergent research question as being to consider an alternative rather than to identify the most appropriate alternative (given that the existence of a dominant approach to SA CM policy had not yet been considered in the literature), and partially on transdisciplinarity itself, which acknowledges the role of the researcher, intuition (Abbott, 2004; Becker, 2012), and the research question as central aspects of the inquiry. In addition, a number of factors confirmed my intuition in the form of 'signposts' along the route towards complexity.

The first of these signposts came in the form of the descriptors of climate mitigation in developing countries arising from the DevMit Forum as 'complex' and 'systemic' (MAPS Programme, 2014, p. 1,2), characteristics widely acknowledged in the CM policy CoP (Mukul Sanwal & Zheng, 2016; Tanner & Allouche, 2011; Winkler, 2015), although the implications of this description are nowhere comprehensively engaged with. The Development Provocateurs and development representatives in the Conversation Series (see section 2.5.2.a) below) highlighted that even just 'development' alone was complex, contested, systemic and messy (Kane, 2014c; Tyler, 2014; MAPS Programme, 2014).

The second is that initial forays into the complexity literature suggested that the approach responded particularly well to areas highlighted in the DevMit Forum (MAPS Programme, 2014) as being part of the new conversation, including the focus on social behaviour and aspirations, envisioning a desirable future society, transformative change and innovation. Complexity as oriented towards both public policy and sustainability issues is closely associated with both systems thinking and transdisciplinarity. The latter, particularly literature on transdisciplinary method, started to align more closely with my emergent, complex policy inquiry, together with my intuition as 'practitioner-researcher' as to what 'fitted'.

The third is that complexity has been identified by many as having potential to respond to issues of sustainability (Audouin et al., 2013; Cilliers, 2008; Wells, 2013) and specifically climate change (Wells, 2013; Winkler et al., 2015), complex, twenty-first century issues (Dunn, Brown, Bos, & Bakker, 2017). Complexity has already contributed theoretical tools and insights to underpin sustainability approaches and literatures (Hans de Haan & Rotmans, 2011; Peter & Swilling, 2014). It has not yet been specifically and comprehensively considered for CM policy as far as I am aware.

[6] The competing alternatives are plentiful, such as socio-technical transitions, science and technology studies, holism, evolutionary or institutional economics.

The fourth is that transdisciplinarity itself is both underpinned by complex rather than 'reductive-disjunctive' thinking (Montuori, 2012)[7], requiring a way of thinking that actively embraces complexity (Montuori, 2010), and that significant aspects of complexity are necessarily transdisciplinary (Montuori, 2013a; Wells, 2013). The two, whilst performing very different roles in the human intellectual project, share many philosophical underpinnings.

The final signpost is that transdisciplinarity emphasises the demonstration of integration in a research inquiry. The application of complexity thinking to SA CM policy is an integrative conceptual activity. Complexity has interconnection as a central principle, enabling integration of research and practice, policy problem and policymaker, researcher and practitioner, development and climate mitigation, within and between disciplinary and social knowledge perspectives, and indeed of current and potential alternative 'approaches' to the issue. As such a complex and complex systems conceptual approach represents integration through 'conceptual clarification and theoretical framing' (Bergmann et al., 2012).

## 2.5 A transdisciplinary complexity research paradigm

The research design is thus framed by both transdisciplinary and complexity methodological considerations, with an overview of transdisciplinary method having been presented in section 2.3. Byrne describes a complexity methodology as 'thinking differently about the procedures and methods of …social investigation as we are already doing them' (1997, p. 3), in Braun and Clarke's (2006) terminology a 'research paradigm'. Complexity thinking will be fully introduced to the reader in Chapter Five, and therefore my use of complexity concepts in the context of methodology is meant to appeal to the intuitive understanding of non-specialist readers as an interim measure, with emphasis on showing how complexity has guided the construction of my research design. A number of complexity and / or transdisciplinary considerations characterise my research method; these are briefly introduced below, and reflected in the remainder of the Chapter.

**Reflexivity**: Finlay describes reflexivity as 'where researchers engage in explicit self-aware meta-analysis' (2002, p. 209), and observes that most contemporary approaches to methodology recognise the subjectivity of the researcher and the need for careful use of reflexivity to ensure validity of findings. In the context of transdisciplinarity and complexity, both of which are underpinned by issues of perspective and partiality of knowledge, a reflexive approach becomes the mainstay of research validity and credibility.

**Humility**: Both complexity and transdisciplinarity methods emphasise humility as being an appropriate response to multiple and partial knowledges. Research findings are contextual and transient.

[7] Morin cited in Montuori (2010) usefully distinguishes between simple thought (reduction and disjunction), and complex thought (contextualization and connection).

**Research as intervention**: Complexity thinking acknowledges that just by considering a complex system, one both becomes part of it and changes it (Cilliers, 2008). Boundaries distinguishing particular complex systems being studied are at least partially determined by the researcher in an active methodological decision. Transdisciplinarity emphasises the role researchers have as participants in their research areas, and in social change. I therefore work from the assumption that my research was influencing the SA CM CoP's approach as I studied it.

**Reality as comprised of complex systems**: A complexity view emphasises reality as systemic. As complex systems, the SA CM policy issue and the dominant approach of the SA CM CoP can therefore be known by their patterns, both historical and current. These patterns are persistent and distinct, and also 'light patterns that are hard to find as they are more discontinuous, oscillating between emergence and disappearance' (Buijs, Eshuis, & Byrne, 2009, p. 38).

**Research as contextual**: SA CM policy can be understood as an instance of CM policy operating at different scales (in different countries internationally, and also as being related to International CM policy). Therefore, patterns observed in the approach of other CM CoPs have bearing on that of the SA CM CoP and vice versa, and evidence of CM policy at other scales is relevant in considering SA CM policy. However, complexity thinking emphasises the importance of the local and contextual for understanding specific complex systems. Locally, events combine with patterns to result in the very specific and contextualised 'situated complexity' (Buijs et al., 2009); here of SA CM policy.

**Research as temporally situated**: As complex systems, the SA CM policy issue and the SA CM CoP's approach evolve continuously with a history that informs its current state; what I am researching is constantly changing, including changes that occur because I am researching it. This view has implications for how the research findings are interpreted. The 'dominant approach of the SA CM CoP' described in Chapter Three, as well as what it illuminates and obscures about the policy issue (Chapter Four) is specifically valid only for the period of observation. However, based on complexity theories, this evidence has a relevance into the future given the role of historical patterns on the future evolution of a system. Further, the chronology, or 'temporal ordering' of the research process is important in complexity method (Byrne, 1997), particularly in an iterative inquiry characterised by intuition, exploration, reflection, and articulation.

**A creative, experimental, and multiple approach to method:** With the SA CM CoP as a complex, dynamic system, its dominant approach is contingent and interconnected. This requires multiple methods to reveal, including access to different perspectives (Buijs et al., 2009), and multi-disciplinary views. In addition, transdisciplinary methodology is characterised by creativity and experimentation, including across the practitioner / researcher divide.

**Knowledge integration and synthesis**: Integrating and synthesising across knowledges is a hallmark of transdisciplinary method, and is particularly relevant for research into complex environmental and

societal problems (Bammer, 2018). Conducting research in a social context specifically requires constant navigation between the knowledge areas of research and practice (Montuori, 2013a).

**The philosophical situation of the research**: Situating the research from the perspective of philosophies of science is particularly important in transdisciplinary research, and increasingly for all research projects. Ontological and epistemological assumptions interact with the theoretical and the empirical domains and are relevant for the interpretation of the research findings. My research design has affinity for softer postmodern philosophical positions, and critical realism, a post-positivist stance. As such there is an emphasis throughout on my role as researcher and on accessing multiple perspectives as evidence. These philosophical orientations are fully aligned with - and relevant for - the complexity approach defined later on in the thesis. This said, it is beyond the scope of the current inquiry to examine these orientations in detail given its focus on breadth rather than depth; on knowledge integration rather than a detailed exposition of any one aspect.

## 2.6 Translating the research problem into an epistemic object

The research problem that emerged from the social context was central in motivating for a transdisciplinary inquiry. However, from a transdisciplinary position this question itself requires translation into an epistemic object, an iterative and evolutionary process occurring over the length of the research journey. In many senses, this was an important theme within the research itself, that of understanding and articulating an expanded role for science and research (in the broad sense of academic knowledge) in assisting with the complex issue that is SA CM policy.

One of the underlying principles of transdisciplinary inquiry is 'context-dependence' (Bergmann et al., 2012). The grounding of the inquiry in the South African case was a direct response to this, with the first part of the research question evolving from: *what is the dominant approach to national climate change mitigation in developing countries?* to: *what is the current dominant approach to SA CM policy? (*The differentiating focus on policy from all climate mitigation initiatives in the revised question having been described earlier in the Chapter). Whilst my findings are specific to South Africa, the research draws on the broader area of CM policy in other developing countries, specifically addressing the issue of the climate mitigation–development relationship, with the potential to speak back into this broader context. In focusing on South Africa, I realise that I lose explicit mention of the term 'development' in the research question. Whilst I lament the loss of a hook for this in the research question itself, this loss is bittersweet given that I find both the development descriptor and its in-country categorisation problematic. The theme of approaching CM policy in a development context nevertheless remains central to the research analysis and findings in the thesis.

Becker (2012) calls for attention to the mental models that are operational in the transformation of a societal problem into an epistemic object. At the beginning of the research journey my mental models were steeped in the dominant scientific and cultural worldview (Capra, 1974/1983). However as the

research progressed I (unknowingly initially) simultaneously embarked upon a re-education to appreciate aspects of a complexity worldview. This re-education has been as much a personal journey as an intellectual one, an experience which is recognised in encountering transdisciplinarity (Montuori, 2010). Suffice to say, my performance of transdisciplinarity and complexity within this thesis is both hard-won and likely inconsistently done. Through the research inquiry I have travelled from a field dominated by a particular approach to knowledge, practice and being, to a place that demands a very different approach. I am not yet fully comfortable in this new territory, and it is likely that this is reflected in the text. And yet perhaps this is appropriate, as a reflection of my position 'in-between', no longer fluent in either language, and from a transdisciplinary viewpoint, tasked with working generatively with this tension. Thinking systemically and utilising complex as opposed to simple thinking is an ongoing, deepening practice. However I am also aware that my years of practising CM policy from the dominant worldview, together with my time in this 'in-between' space, has provided me access to insights about the approach to SA CM policy that I may not have gained through an alternative route.

The research has also been undertaken in the context of a South Africa that has been undergoing substantial introspection and reframing of its 1994 'democratic miracle', and in a twenty-first century world whose empirical manifestation is increasingly stretching the validity of a positivist, modernist explanatory paradigm. This context is a messy, confusing but also enabling backdrop to the SA CM policy inquiry, and one that constantly calls attention precisely to the fit between the world as it is being experienced, and the paradigms through which it is viewed. I have been as much challenged in my thinking during the research journey by broader societal developments as by the empirical consideration of SA CM policy.

Therefore as my complexity re-education advanced it became clear that I also needed to restate the research question from a complexity paradigm. This was both due to my evolving mental models, and the action orientation of the research. Hence the second two parts of the research question required a different expression. For part two: *how well does the dominant approach address the problem?* it became clear that the 'problem' was itself dynamic, normative, an issue inseparable from either its context or those attending to it, and therefore not able to be 'addressed' (see Chapters Four and Six for fuller discussions of this). Therefore a more appropriate formulation is one which acknowledges perspectives of the issue, and the utility of various paradigms in enhancing an array of understandings of it. Following Montuori (2013b), therefore, part two of the research question becomes: *what does the dominant approach illuminate and what does it obscure about the policy issue?*

Part three of the research question can also be restated specifically, having identified complexity as the alternative approach I wish to explore. So from *what are the implications of using a different approach?* the question becomes: *what are the implications of using complexity thinking as an alternative approach?* As it stands now though, I find this articulation at odds with the transdisciplinary research paradigm articulated in 2.5. above, specifically its partial approach to knowledges and emphasis on exploration and

humility. The current articulation assumes that 'approaches' are discrete wholes that can be interchanged at will. Instead, I prefer an articulation that is more aligned with a partial and humble view, thus: *How does a complexity approach contribute towards revealing SA CM policy more fully?* A deeper account for this articulation is provided by my engagement with - and use of - complexity thinking, in Chapters Five to Seven.

Whilst this is now a satisfactory expression of the question as it emerged from practice, my engagement with complex transdisciplinary method suggested that transdisciplinary research outputs should be useful to society (following Leavy, 2011 and Montuori, 2013b). 'Society' is taken here as the SA CM CoP. Contextualised by the research focus on 'approach', this usefulness will likely be situated in the realm of knowledge. Here however, this aspect of the research question is expressed simply: *What is the usefulness of this inquiry to the SA CM CoP?*

The full research question is therefore restated as:

1) *What is the current dominant approach to SA CM policy?*
2) *What does the dominant approach illuminate and what does it obscure about the policy issue?*
3) *How can a complexity approach contribute towards revealing SA CM policy more fully?*
4) *What is the usefulness of this inquiry to the SA CM CoP?*

Because transdisciplinary research has no disciplinary boundary, the research question itself provides the reason, direction and boundary of the research throughout what is typically a recursive rather than linear research journey (Montuori, 2010), which demands flexibility in terms of process. Using complexity terms, the research question is described as acting as a 'central attractor' in the inquiry (Montuori, 2013b).

Bergmann et al. (2012) describe the overall objective of transdisciplinary research as being one of problem transformation. The re-statement of the research question is a step towards this, one that opens up the area of metacognition or approach as one where progress in climate mitigation implementation in a development context can be made.

## 2.7 Using literature

In transdisciplinary inquiry, literatures are utilised in the employ of the research problem, as opposed to being determined based upon discipline as per traditional scientific research (Montuori, 2013b; 2010). Here the use of literature is characterised as thin and broad across disciplines and applied fields, rather than deep, and often accessed from a climate mitigation / global change / sustainability entry point. Inevitably, this will have resulted in a superficial treatment of many fields and thinkers, and therefore opens up much scope for further work. (The (partial) exception to the broad and thin approach is the overview of complexity thinking in Chapter Five, where this particular field is examined as a field in and of itself, albeit from the perspective of the field oriented towards the present research problem.) Montouri

advocates using multidisciplinary literatures to access the different perspectives on any one approach to knowledge that they afford – 'situating the inquirer in an ecology of ideas' (2013b, p. 45), and I found this a useful conceptual aid for navigating the literatures for both parts one and two of the research question. I searched for literature by subject, iteratively expanding and modifying my searches as I learnt how different terminologies were used across disciplines and in different contexts. The point where I discovered the particularity of the set of terms utilised by the CM CoP, and that a number of alternatives existed providing additional perspectives on the issues we attended to within the CoP, was a breakthrough one. Language is complex, active, constraining, generative (Becher, 1987).

A tension between breadth and depth in my use of literature required constant management: whilst the research problem demanded breadth to provide an adequate description of what the dominant approaches illuminate and obscure, together with an adequate conceptualisation of the complexity alternative, sufficient depth was required for the integrity of the results (Montuori, 2010). This was a challenge of assessing 'what is *pertinent* knowledge for the inquiry, and learning how to navigate across disciplines in search of that knowledge' (Montuori, 2010, p. 7)[8]. Another tension operating within this was that of maintaining a balance between foundational and newer experimental texts in any one field; the former provided key points in the development of a field and therefore integrity and depth, whilst the latter was where I found greater connection with complexity. In addressing this tension I found overviews of different fields particularly valuable.

I found a small but significant literature predominantly in the social sciences and interdisciplinary applied fields (including complexity, sustainability, systems thinking, development, transitions, and science and technology studies[9]), which commented directly on the CM policy CoPs approaches, including core concepts and terminology, upon which I relied heavily. However there was very little written specifically on these approaches as they pertained to CM policy in a development context[10].

The secondary literature of the SA and global CM policy CoPs particularly enabled an account of what is illuminated by the current dominant approach. To consider what is obscured meant relying more on literature being written from outside of the CM policy CoPs[11], together with recent and exceptional examples of where CM CoP members are explicitly applying additional disciplinary lenses to SA and broad CM policy, including science and technology studies, transitions literatures, political economy and an institutional account.

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[8] Italics appear in the original quotation.

[9] Specifically, social scientists (Leyshon, 2014; Shove, 2010), interdisciplinary authors or author teams (Bhaskar & Parker, 2010; Levin, Cashore, Bernstein, & Auld, 2012), science and technology studies (Jasanoff, 2007; Stengers, 2015), and the development field (Boyd, Grist, Juhola, & Nelson, 2009; Huq, Reid, & Murray, 2006).

[10] The only literature specifically considering the dominant approach of the SA CM CoP of which the author is aware is the compendium of DevMit Forum Development Provocateur briefing papers (Kane et al., 2014), although a growing number of authors note aspects of this in complementary research (Death, 2014; Forti, 2013; Hallowes, 2008; Rafey, 2013).

[11] Including the fields of psychology, public policy, urban planning, development policy, systems thinking, socio-technical transitions, ecological economics, management and the social sciences.

For responding to part three of the research question, how a complexity approach can contribute towards revealing SA CM policy more fully, I relied heavily on complexity literature, particularly that of complexity in the social sciences and complexity for public policymaking.

## 2.8 Approach to data

### 2.8.1 An emergent, qualitative and iterative methodological approach

The Introduction described the emergence of my doctoral journey, and the unexpected role the DevMit Forum played in this: Kane's Development Provocateur briefing note (Kane, 2014a) afforded me the first glimpse of the SA and broad CM CoPs from an outsider or reflexive perspective, a perspective that I both intuitively knew and increasingly explored and articulated. The Forum focused widely on a bottom-up articulation of the SA CM policy issue, that which the Ideas Kit terms the 'devmit challenge: The challenge of having an emissions constraint in a development context' (MAPS Programme, 2014).

After the Forum, the year 2014 involved a relentless pace of emergence and learning occurring simultaneously in both the social and scientific spheres. I formally registered as a doctoral candidate at the end of 2014, and worked part-time in the MAPS Programme reflective research team during both 2014 and 2015. MAPS represented a partnership between academia and civil society that focused on 'developing countries exploring pathways to climate compatibility'. The MAPS International Team (of which the reflective research team was a part) was based in Cape Town, institutionalised across the Energy Research Centre (ERC) of the University of Cape Town (www.erc.uct.ac.za) and the non-profit organisation SouthSouthNorth Projects Africa (www.southsouthnorth.org).

I proceeded with empirical observations as the opportunity for these arose from within the MAPS Programme and guided by my emerging research questions. This meant that I was simultaneously identifying a methodological or knowledge frame as I was collecting and inevitably analysing my data. This is a typical social science and transdisciplinary research experience, especially when working with complexity, 'mess' and real-world problems (Abbott, 2004; Law, 2004). For me this experience was hightened by my most recent education having been in financial management (my Masters degree, 2008) and more distantly mainstream economics (Honours, 1998). From neither did I gain a solid disciplinary methodological training, and my education on qualitative methods was particularly superficial. However, I did come to my research inquiry deeply immersed in a practical field, and armed with an intellectual curiosity and a strongly reflective personal style, both of which support a transdisciplinary inquiry and method.

Whilst the majority of my evidence was collected in 2014, its analysis was iterative over the following three years as I went between my data and literature in a process of discovering concepts and terminology of metacognition and approach and then comparing them to what the data was revealing for 'fit'. Abbott acknowledges recursiveness in the context of social science research; 'figuring out what the

puzzle really is and what the answer ought to look like often happen in parallel with finding the answer itself' (2004, p. 83).

My research design was therefore purposefully 'loose' (Miles, Huberman, & Saldana, 2014) and relatively unstructured up front, enabling me to be responsive to what emerged. What was in place from early on though was my choice of case study as the principle methodological tool for observing the complex system that is the SA CM CoP. A case study is a typical and useful method for researching social complexity (Byrne, 2009), and useful for thinking about different approaches to problems (Yin, 1994).

Most of the data collection methods used are standard in the social sciences (focus groups, interviews and ethnographic fieldnotes), whilst the Development Provocateur method was experimental, which is typical in transdisciplinary research. I relied heavily on participant-observation, as part of the MAPS Programme team with particular roles in the events I participated in and where I made my observations. I used both more and less structured methods - from ethnographic field notes in SA CM CoP events - to a series of focus groups I designed specifically to engage with 'approach' (the Conversations). The use of qualitative data was an obvious choice for this work: qualitative approaches are advocated as being well positioned to support description, highlight contextual conditions and explore both a new area and human processes alike (Miles et al., 2014). Qualitative inquiry is about discovery and understanding (Thomas & James, 2006), and a feature of qualitative data 'is their richness and holism, with strong potential for revealing complexity' (Miles et al., 2014, p. 11).

My aim in data analysis was the identification of the patterns that describe the SA CM CoP's dominant approach, and the SA CM policy issue. This was done through thematic analysis, a technique rendered distinct by Braun and Clarke for 'identifying, analysing and reporting patterns (themes) within data' (2006, p. 6). Thematic analysis is a flexible analytical tool, applicable in a number of methodological paradigms. I am using it here within my complex transdisciplinary setting as a 'contextualist' method, which Braun and Clarke describe as 'sitting between the two poles of essentialism and constructionism, and characterised by theories such as critical realism…' (2006, p. 9). Further, the type of thematic analysis I use to identify the SA CM CoP's dominant approach is that which is typically used at the latent level, which 'starts to identify or examine the underlying ideas, assumptions, and conceptualisations – and ideologies – that are theorised as shaping or informing the semantic content of the data' (Braun & Clarke, 2006, p. 13). This necessitates that the development of the themes themselves requires interpretative work.

### 2.8.2 Data sources: collection and analysis

Given my objective to access multiple perspectives on my topic, I utilised six data sources, each of which generated vast amounts of primary data (for example I had over 36 hours of audio recordings for two of the sources alone). Relevant data points were typically very thinly spread across these sources. A summary of my final 'data corpus' (Braun & Clarke, 2006) is presented in the table below.

*Table 2: Final data corpus*

| Data sources | Method description | Data description | Dates |
|---|---|---|---|
| **1. Development Provocateurs** | An experimental method, involving the inclusion of a multi-disciplinary grouping to comment on the approach of the SA CM CoP and discuss the SA CM policy issue at the DevMit Forum. | Ethnographic notes; miscellaneous DevMit Forum data sources; Provocateur Briefings. | October 2013 – February 2014 |
| **2. Conversation Series** | A series of facilitated multi-disciplinary focus groups to consider the SA CM CoP and development practitioner approaches, together with both development and CM policy challenges. | Audio recordings; ethnographic notes; emails | September – November 2014 |
| **3. LTMS Interviews** | Secondary analysis of interview data for SA CM CoP approach. | Audio recordings; ethnographic notes. | August – November 2014 |
| **4. Ethnographic research notes** | Researcher ethnographic fieldnotes and reflective journaling throughout the research journey. | Ethnographic field and reflective notes. | 2013 to December 2017 |
| **5. Primary policy documentation** | Interrogation of policy documents (final written policy and policy analysis) of the SA CM CoP and the SA government. | Policy documents relevant to CM and development fields. | |
| **6. Exploration of a complexity approach to SA CM policy with the SA CM and development CoPs** | Engaging with the SA CM CoP on the evolving research during the research journey through presentations and seminars; and an interview series (the 'Bogota Interviews'). | Ethnographic field and reflective notes; participant emails; audio recordings (for the Bogota Interviews). | February 2015 – September 2017 |

The entanglement of research and practice is evident in this data corpus: The first two data sources (Development Provocateurs and Conversations) together with the Bogota Interviews of source six were undertaken as MAPS activities. The LTMS Interviews were undertaken as part of a MAPS Programme research project, although the secondary analysis (of approach) was a revisiting of this data in a purely academic capacity. The Bogota Interviews, conducted during a MAPS workshop held in that city, informed two MAPS working papers I authored: *Complex dynamic systems thinking and domestic climate mitigation policy in developing countries Part 1: Theoretical Background* (Tyler, 2015a) and *Part 2: Towards an alternative framing* (Tyler, 2015b). The remainder of data source six was a mix of lecturing and engaging with SA CM CoP practitioners in my capacity as a member of the SA CM CoP.

In line with my inquiry generally, a broad rather than deep approach to data analysis prevailed as I searched for high-level and often latent patterns (themes) prevalent across sources one to five to identify and describe both the dominant approach of the SA CM CoP and the SA CM policy issue. Source six was

utilised only to explore the usefulness of my inquiry to the SA CM CoP, in response to the final part of my research question.

My approach to thematic analysis can be characterised as emergent, iterative and interpretative (Braun & Clarke, 2006). Data revealing the nature of the SA CM policy issue together with that revealing the SA CM CoP's dominant approach were interconnected and entangled right from the start. Awareness levels of approach within the SA CM CoP differed, and the perspectives of the development informants were also non-homogenous. In addition, awareness was changing as my research progressed. My inclusion of the Development Provocateurs at the DevMit Forum (described in detail below), together with its innovative and facilitative design (Borland, 2015), contributed towards the SA CM policy CoP gaining a degree of reflexive awareness and expressing the need for a 'new [CM policy] conversation' at the Forum.

> The current conversation has been instigated and dominated by the international mitigation policy perspective. As such, and given the complexity of the DevMit challenge, this conversation is unlikely to support and enable the transition to a co-created, inclusive, prosperous, low-carbon future on its own (MAPS Programme, 2014, p. 1).

Simultaneously, the Forum started to explore what this new conversation might look like, thereby both revealing aspects of the SA CM policy challenge and also aspects of the SA CM CoP's current dominant approach:

> The emergent conversation included a strong focus on consumption and aspirations, on visioning a future world that is necessarily low carbon but that also fulfils human desires of a good life, the 'Buen vivir'. Scenarios, back-casting and social compacts were proposed as additional tools, engaging with other communities of practice a necessary approach. Achieving 'multiple benefits' was spoken of as the overarching objective, met on multiple scales, through innovation and transformative change. (MAPS Programme, 2014, p. 1)

This entanglement, fluidity and messiness of the data revealing the CM policy issue and the SA CM CoP approach remained throughout the data collection and analysis process and across the five data sources, although the two aspects were weighted differently in each source. Whilst the nature of the SA CM policy issue was described explicitly in the data by development and SA CM CoP respondents alike, the CoP's approaches were more often implicit, and had to be interpreted.

The DevMit Forum provided many of the initial theme descriptors. Using the data sources arising directly from the Forum (my ethnographic notes, a twitter stream, video interviews with speakers and the Provocateurs, questions left on a central whiteboard, and then the notes taken during the official events), and working with my colleague Michelle du Toit of the MAPS Programme, we teased out key phrases which we used to organise and communicate the essence of the DevMit forum discussion in the Ideas Kit (MAPS Programme, 2014). The Ideas Kit process could therefore be described as a collaborative reflection

emanating from a societal process. The key words and phrases of the Ideas Kit then constituted my initial set of themes (shown in Box 1 below), and at the time gave best expression to an inquiry which was intuition rather than theory or hypothesis led. In a way these initial themes represented a 'messy' starting point for the analytical process: the DevMit Forum encouraged an unusual (for the SA CM CoP) degree of reflexivity and consideration of the nature of the CM policy issue. I describe the Forum as an experimental research / practice method or intervention, one which was fairly different to the typical SA CM CoP dialogue and events. As is often the case in a complex transdisciplinary inquiry, the complex case I wanted to observe was changing as I observed it and because I was observing it.

*Box 1: Example themes emanating from the Ideas Kit analytical process:*

Framing shift; entry points; co-creating our future; defining 'development'; visioning; transformational change; time aspect; consumption; integrating communities of practice; expertise; tools and methods; implementation; scale and cities; passenger vehicles; institutional form; political economy; mitigation policy; investment and investors; co-ordinated planning; different perspectives; continue the conversation; integration; multiple objectives future.

This theme set was then taken forward iteratively into my analysis of the remaining data sources. Additional themes emerged, and gradually, as I engaged with literature from the second year of the research (2015), these were interpreted and refined. As such, the data went through numerous analytical and translational processes (Palmer, Fam, Smith, & Kent, 2018). How 'key' a theme was depended on its ability to capture a particular element or feature of the policy issue, or dominant approach. Writing was an important part of the analytical process, and I wrote continuously throughout the research process to interpret and articulate my findings; blogs, grey literature, journaling and endless chapter drafts. Extracts of these are employed throughout this methods section to demonstrate the evolution of my thinking. I also extract a selection of particularly compelling illustrative segments from the data to assist in the articulation of my argument.

The termination of my analytical process occurred when I felt I had reached saturation point and little new was emerging (Braun & Clarke, 2006), together with a sense that what the analysis had generated was sufficiently rigorous, credible and useful for society. Given the extent of my data there was much more I could have done, although the time afforded to data collection and analysis is considered appropriate to the research question, and balanced against other research priorities.

An account of each data source and its analysis is given below, presented chronologically, although there is a lot of overlap between the sources. The early theme sets in particular influenced the articulation of subsequent theme sets. The Appendix contains data collection details including interview schedules, ethical consent processes and the names of respondents and events.

## (a) Development Provocateurs (October 2013 – February 2014)

The inclusion of the Development Provocateurs in the DevMit Forum programme was an experimental method aimed at opening up interdisciplinary and practice reflections and discussion, together with prompting an awareness of dominant approach and discourse. Mine was an unusual move within the CM CoP at the time, as the CoP did not typically engage substantively beyond its own members. The Provocateur role was a paid one, with each Provocateur contracted in their personal capacity under the MAPS Programme (See Document A.1. of the Appendix for the Provocateur Terms of Reference). Essentially, the Provocateurs were tasked to consider the discourse at the Forum from the perspective of their particular field and its norms, assumptions, framings and objectives. They reported back on these reflections both in a panel discussion on the final day and in the form of a written briefing note. In these notes the Provocateurs identify the priorities and elements of discourse pertaining to their expertise in comparison to that of the climate mitigation discourse, mapping overlaps, connects and disconnects and other points of contact. Each note also considers areas where further work on alignment between the two fields could be productive for one or both, and how each discourse could enrich and influence the other.

In this method I used the SA CM CoP's development context as a more concrete 'hook ' for revealing something as abstract as approach. Based on my early investigations into the development field, I knew that I wanted both a spread of development topics and stakeholder groupings represented. The Provocateurs needed to be sufficiently senior to respond to the brief. In identifying and contracting the Provocateurs I was aware that I was managing a practical tension: the Provocateurs had to be sufficiently interested in climate mitigation to commit three days of their time to attend the Forum, but I ideally wanted them to have as little prior experience of climate mitigation as possible in order that they could more clearly see the peculiarities of the field. I also preferred a geographical spread. The MAPS Programme was able to support some travel, enabling individuals from outside Cape Town to be included. I used my networks, social and professional, together with the networks of my South African MAPS Programme colleagues to identify the sample of potential Provocateurs. In some cases Provocateurs themselves provided me with names of others which I welcomed, as it increased the likelihood of there being more distance between the SA CM CoP and the Provocateur. I typically contacted Provocateurs by telephone, introducing the invitation to them. Once the Provocateur had confirmed, they were contracted. As with all my data sources, I therefore used a combination of convenience and purposive sampling (Russell & Gregory, 2003).

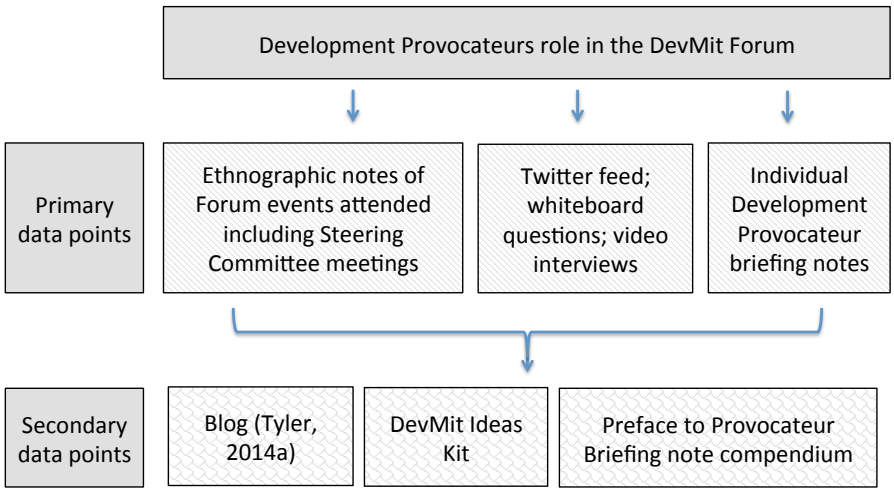
The final Provocateur group is provided in table three. Whilst the group could have ideally included a greater number of non-Capetonians together with representatives from organised Labour and Government, it generally performed well against my requirements.

*Table 3: DevMit Forum Development Provocateurs*

| Development Provocateur | Sector | Development Topic | Location |
|---|---|---|---|
| Yash Ramkolowan, DNA Economics. | Consultant | Trade and industrial policy | Pretoria |
| Len Verwey, Independent Consultant | Consultant | Public financial management | Cape Town |
| Anthony Black, Economics Department, UCT | Academic | Employment | Cape Town |
| Lisa Kane, Sustainable Transport Consultant | Consultant | Transport; and Mitigation as applied science | Cape Town |
| Emmanuel Sulle, Institute for Poverty, Land and Agrarian Studies, University of the Western Cape | Academic | Land-use | Cape Town |
| Hilton Trollip, ERC, UCT | Academic | Energy security | Cape Town |
| Rashmi, Mistry, Oxfam | Civil society | Poverty | Johannesburg |
| Philip van Ryneveld, Hunter van Ryneveld (Pty) Ltd | Business | Cities | Cape Town |
| Aditya Kumar, Community Organisation Resource Centre | Civil society | Informality and urban poverty | Cape Town |

In addition to the briefing notes, published individually and in a compendium by MAPS (Tyler, E., (Ed), 2014), the Development Provocateurs generated a wealth of data through their participation in the DevMit Forum. A graphic description of these primary data points together with secondary data points generated by my initial analysis is shown in Figure 1 below.

*Figure 1: Development Provocateur data sources and analysis*




After the Forum, I analysed the individual Provocateur data points (the middle row of the figure above), identifying themes to add to those emerging from the Ideas Kit development (Box 2 below). The Provocateur data contributed specifically with regard to observations of the SA CM CoP approach, although it also generated additional themes on the nature of the SA CM policy issue.

*Box 2: Additional themes emanating from the Development Provocateur analytical process:*

Multi-faceted; short-term long term; synergies; norms; assumptions; framings; urban space; applied science; reflexive; the world as knowable; empowerment; moral superiority; economic growth as not equating to development; lacking heart; implementation as being about deal-making and negotiation; motivating action; learning from development practitioner experience; cross-cutting; multi-dimensional; comprehensive green industrial policy; relationship between employment and carbon; multi-faceted set of benefits; change agents; perspective; experiment; intertwined and systemic; innovative, forward-looking

For a long time the set of emerging themes (Boxes 1-5) represented a jumble of aspects related to both the SA CM policy issue, the SA CM CoP approach, and possible alternative approaches and priorities. Structuring this into a coherent argument became my primary analytical challenge.

At this point I also started to interrogate the themes I had by writing, including: the preface for the Provocateur Briefing Note compendium (Tyler (ed), 2014); editing the official academic Conference Proceedings (Jooste et al, 2014), and writing a blogpost on the Forum event (Tyler, 2014a). Later, my MAPS Programme paper 'Reflecting on climate mitigation policy in a development context: how do we do what we do' (Tyler, 2015) continued this analytical and interpretive work. Of the Provocateurs, I reflected:

> 'The results of this [the Development Provocateur] experiment were somewhat uncomfortable, but simultaneously energising. The provocateurs held up a mirror to the climate mitigation community, showing us up as a fairly inward-looking bunch, who rely heavily on the data, models, rationality and linearity of science (Tyler, 2014a).
>
> 'Their [the Development Provocateurs] reflections highlighted that our approach is one of an applied science; that mitigation enters the domestic policy environment from an international and environmental perspective, and that it is conceived as an issue separate to that of 'development ' or even 'sustainable development (Tyler, 2015).

My articulation of the SA CM CoP approach remained grounded in empirical evidence at that stage, 2014 was a year of intensive data collection, I had not yet engaged with literature.

### (b) Conversation Series (September – November 2014)

My ongoing process of analysis and reflection led to my conceptualising the MAPS Programme Conversation Series in mid 2014. Whilst the Series, consisting of eight focus groups and a reflective conversation, was embedded in a practitioner programme, I explicitly associated it with my PhD research (unlike the DevMit Provocateur method), which at this stage had been formalised. In the context of the MAPS Programme, the Conversations were intended to take the mitigation-development discussion

arising from the DevMit Forum further. In the context of my research, I intended to access additional perspectives on the SA CM CoP approach and policy issue, and the development context.

Each Conversation was themed: cities, adaptation, consumption, employment, finance, poverty, economic growth and transport. The themes were derived from the areas that emerged from the Forum as being possibly productive from the perspective of a 'multiple-benefits future'. I again used the 'hook' of exploring mitigation-development as a vehicle for revealing approach.

Each two hour Conversation involved up to three participants from a particular development field (usually one practitioner and one academic), three or more climate mitigation researchers from the MAPS Programme International team, myself and a facilitator. A final, less formal conversation was held at the ERC as one of the regular lunchtime discussions, referred to in this thesis as the SA CM CoP Reflections Conversation. I invited all who had been part of the Conversations together with other interested individuals to reflect on the Series.

Similarly to the Development Provocateurs, the Conversation development participants were identified through my own personal and professional networks, together with those of the MAPS International team. They were all South African, 80% were academic, and 20% from civil society. Each development participant was approached telephonically or via email to ascertain their interest and availability and then formally invited via a letter which including an informed consent component as required by the UCT ethics committee. The intention was to bring together people who already shared a working language to some degree. It proved difficult to allocate the MAPS climate mitigation researchers to the various themes, which were defined from a development perspective; the languages used by the different fields are not aligned. The Conversation sampling method was therefore identical to that of the Provocateurs, a mix of convenience and purposive sampling. A full set of Conversation participants (Table A.1.) and the invitation letter (Document A.2.) is provided in the Appendix.

Two facilitators were chosen from the MAPS International team based on their experience in facilitation and their interest in my doctoral research inquiry. Dr Lisa Kane facilitated the first three Conversations, and the final two. Dr Brett Cohen, my doctoral supervisor, facilitated the middle three. This choice of facilitators reflected the dual drivers for the Conversations, research and practice, as well as the dual development (Lisa) and SA CM CoP (Brett) perspectives, helping to bring out different aspects of the discussions (Buijs et al., 2009).

As researcher I was present in all Conversations in a participant observer capacity, and disclosed both my roles as doctoral researcher and MAPS Programme practitioner. I held the continuity of the Series by providing comprehensive facilitator notes to Lisa and Brett at the start of the Series, and a 'stocktake' report on the 6 November after Brett had concluded his facilitation (both provided in the Appendix, as Documents A.3 and 4).

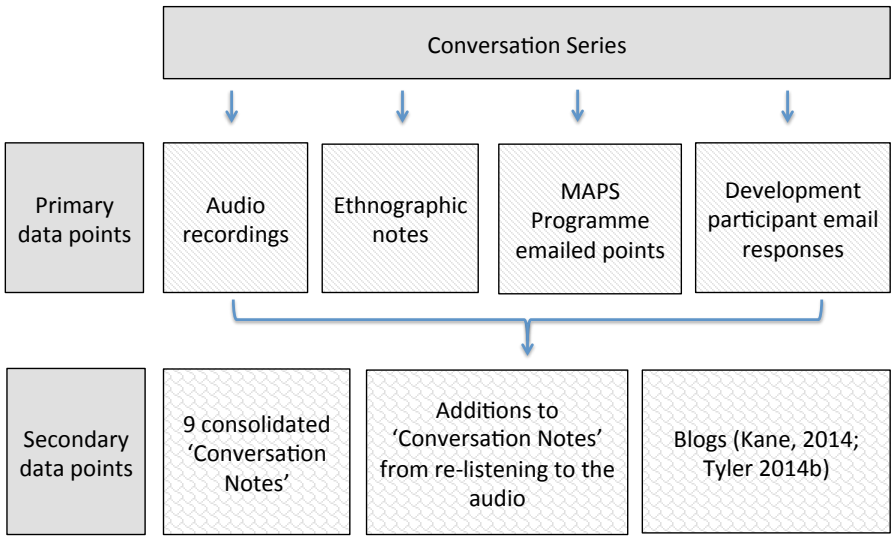
The letter of invitation outlined the Conversation's provenance and objectives beforehand as follows:

1. *To expose both groups (climate mitigation and 'other development') to each other in a neutral setting.*
2. *To scope out the space in-between the two areas of expertise, and to allow for cross-pollination of ideas and understanding of each other's world.*
3. *To potentially identify productive areas for further exploration in the (shared) objective of working towards a 'multiple benefits' future as suggested by the DevMit Ideas Kit.*

To start each Conversation I offered the conceptual framing (replicated in section 2.9. below) as that which had emerged from my analysis of the DevMit Forum discussions and data. The facilitator then structured the Conversation in an open-ended way based on the facilitator notes. Having set up the Conversations to address the mitigation-development questions emerging from practice and tasked the facilitator specifically with this objective, I felt free to observe the unfolding discussions for what they revealed of approach. At times I asked questions or directed the conversation towards this research goal. Sometimes I was aware that I was too strong in this, with my interventions feeling out of sync with the Conversation, and I pulled back. At others I got caught up in aspects of the mitigation-development discussion myself. I recall feeling frustrated when the discussion remained on issues of content – something which happened often under the broad theme of 'how do we save the world' - and I was reminded of the invisibility of the issue of approach to most participants. The Conversations enabled me to observe more and go deeper into the different development perspectives that initially surfaced at the Forum. Krueger and Casey (2009, p. xv) find focus groups to be useful in accessing 'how other people think and feel and why'.

Each Conversation was recorded, and I took notes during each. These notes were typed up as the basis for a formal record of each event. The MAPS Programme participants were asked to email me key points they had taken from the Conversation in which they participated. I emailed some of the development participants for clarifications in some instances and got (some) replies. The full set of Conversation data points and the analytical process are captured in Figure 2 below.

*Figure 2: Conversation data points*




My analytical process commenced as follows: I augmented my field notes with the MAPS Programme participants' research points, any emailed responses, and by re-listening to the audio recording. (Whenever the Conversations are referenced in the thesis, the reference is to these augmented ethnographic notes). I identified additional themes (to those from the Forum and Provocateurs in Box 1 and Box 2), and noted the prevalence of existing themes. Both Lisa and I wrote blogs of our experience in the Conversations (Kane, 2014c; Tyler, 2014b). In some cases, I re-listened to the audio file much later on in the research process (in 2015), writing up an additional set of notes.

After the Conversations the themes related to each research question started to emerge with greater clarity. I therefore began experimenting with grouping the themes into three sets (Box 3). Nevertheless, contradictions within and overlaps between these sets persisted.

*Box 3: Themes emanating from the Conversations analytical process:*

1. Revealing the SA CM CoP's approach

Simplification; dualistic thinking; insularity, lack of communication; lacking in a clear vision of what the future should look like; solutions focused; insular; lots of jargon; view of development as high-level, lacking in granularity; poor communication; perception of threat; lack of feeling; generalising; naïve; ignore interconnections; fail to understand development; continuous, gender inequality (energy poverty); disjunctive; isolated; split between knowledge making and knowledge communication; reliance on expertise; normativeness; a desire to create simplicity out of mess (engineers).

2. Describing the mitigation – development policy issues

Spatial; political economy; structural; systemic; lots of experimentation; disillusioned with expertise; seeing a particular role for models; long-run planning space; a need to look beyond models; complex; local specificity; multi-disciplinary / interdisciplinarity; temporal; counter-intuitive; political; need to inhabit others perspectives; points of systemic intervention; whole system view; conceptual simplifications (shaping growth); culture; interconnections; complexification; trying to effect change.

3. Revealing the approach of development practitioners

Innovative; scalar; differentiated view of economic growth; understanding decision making, contracting and financing, have an appreciation of specificity; value of targets; non-systemic; experimenting; urgent; lacking in an economic vision; complex; temporal appreciation; role of beliefs and hope; messy; needing to understand social change; process above content; interdisciplinarity; multiple futures; politics; capacity; interconnection; non-rational drivers of human behaviour; leadership; values; rights; habits; morality; context specificity; beliefs; trust; diverse; interconnection; path dependency; particular role for evidence; interconnections; lack of integrated policymaking; social; context; responsive; politics; context specificity; tipping points; continuous.

Despite similar themes having emerged across the Conversations, they were far from homogenous. The differences between the SA CM CoP and development participants are far more striking in the Adaptation and Cities Conversations, for example, than in that of Employment or Economic Growth (where economists were in the majority). The Consumption and Cities Conversations were strongly grounded in the social world, whilst Poverty and Finance often veered into the ideological realm. So too, there was a strong difference between individuals within the CoP and the development CoPs. Some development individuals had participated in CoP programmes and work, and therefore adopted the CoP's jargon and terminology, adding to the 'messiness' of the data.

Nevertheless, certain Conversations seemed to contain particular themes. The Finance Conversation highlighted how broad the field of 'finance' is, with each speciality (such as municipal financing) having its particular features. The Consumption and Cities Conversations alerted the SA CM participants to how little the SA CM CoP understands of these areas. We were described as 'arrogant' (Cities Conversation, 2014) and 'naïve' (Consumption Conversation, 2014). Both the Transport and Adaptation Conversations contained power discussions on the complexity of these fields, a feature that the development participants were actively engaged with. The Adaptation practitioners described their work in complexity terminology, speaking of projects and context specificity, of connectedness of people and messiness. The Poverty Conversation emphasised the similarities between the climate mitigation and poverty fields, both of which were described as being involved with 'changing the world' (Poverty Conversation, 2014). Interestingly the approach of the economists was more closely aligned to that of the SA CM CoP than to some of the other development fields.

Reflections on the Conversations (both during the Conversations themselves and in subsequent email correspondence) were revealing of the Conversations as a research and practitioner method. This is described briefly in Box 4 below.

*Box 4: SA CM CoP reflections on the Conversation Series method:*

The Conversation method was described as being unusual and useful, that it created spaces rarely encountered in the course of either academic or practitioner experience. The Conversations had practical outcomes: participants reported how they enabled a better understanding of interconnections; that it was good to have the space to think and explore; the Conversations educated participants about each other's

fields, they were 'enlightening'. The SA CM CoP participants said that in future they would pay greater attention to the details of a development field, getting below the aggregate, for example how employment models really work (Employment Conversation, 20 October, 2014). The Conversations were described as highlighting that the development – mitigation space was a new research area, that the Conversations achieved a shift in perspective. However, there was also a collective reflection on the difficulty of the method, both practically and on a personal level. The Conversations were time and logistics intensive. It was challenging for busy senior academics and practitioners to dedicate two hours to an unbounded 'discussion', with no particular 'outcome'. Personally, participants reflected that the Conversations were at times uncomfortable and tense. Working with different perspectives and a multi-disciplinary group is challenging and 'messy'. The reach of the method also felt small (in terms of the number of people involved) for the time required.

The Conversation data was particularly useful in describing the development context of the SA CM CoP and policy issue:

> I've been struck by the complexity of this 'developing country system' we are trying to influence… there are lots of experiments, wide-ranging failure, and pockets of success. There is a lot of interconnectedness, many moving parts. There is little rationality, things happen and we seldom understand why. This system is very human, very spatial, very messy, highly irrational, and struggling with a serious dearth of capacity and skills (Tyler, 2014b).

The Conversation data also revealed the interconnections between the SA CM CoP and development fields:

> Sometimes it felt like the climate mitigation space we inhabit is situated on another planet, at other times it felt like we were one big 'development' community grappling with exactly the same issues (Tyler, 2014b).

> Significantly, we [SA CM CoP] are not being understood. We heard that we talk a different, acronym-filled language. We were also criticized for being naïve about the complexity of development challenges, and arrogant in our dealings with other experts (Tyler, 2014b).

After the Conversation Series my intensive data collection period came to an end and I had space to start engaging with the literature. Having not had time to do so up until this point was beneficial: I was led for a significant period of time by the social world and my empirical data, and so was able to let themes emerge from the data itself.

### (c) LTMS Interviews

One of the workstreams for which I was responsible under the MAPS Programme in 2014 was to review the South African Long Term Mitigation Scenario Planning process (LTMS), a foundational SA CM policy initiative run between 2006 and 2008. For this review I conducted seventeen semi-structured expert

interviews between August and November 2014 with senior members of the SA CM CoP and development policy researchers and practitioners, with MAPS Director Marta Torres Gunfaus as co-researcher. The audio recordings of this interview series afforded a valuable example of the SA CM CoP in action, offering a perspective outside of the MAPS Programme DevMit workstream and importantly providing access to a number of senior government and business SA CM CoP members. Interviews are well aligned to the case study method (Yin, 1994), although Becher (1987) notes that they are less capable of providing access to tacit knowledges than participant observation methods. This notwithstanding, a secondary analysis of the audio recordings provided useful insights into the SA CM CoP's approach, both from the perspective of senior SA CM CoP members and development practitioners.

The interviewee sample was chosen again on the basis of convenience and purposive criteria including:

- *Inclusion of a range of perspectives including business, labour, government, civil society, process designers, current policy formers (development and mitigation), and academics;*
- *Familiarity with contemporary South African climate mitigation policy and / or its implementation;*
- *Familiarity with South African development policy (in particular perspectives from outside the climate mitigation community of practice);*
- *A level of familiarity with the LTMS itself; and*
- *Availability.*

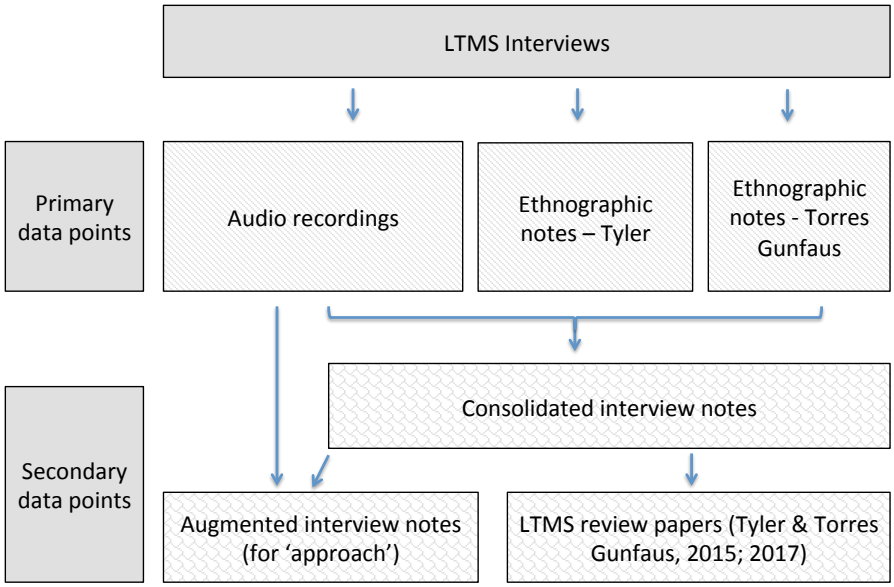
Potential interviewees were typically approached via email, and upon agreement to the interview were sent a letter outlining the interview questions and informed consent aspects (this letter is provided as Document A.5 of the Appendix). Of the eventual interviewee cohort, 53% were government officials at the time of the LTMS (and 41% had remained so until the time of interview). 18% were from business during the LTMS, rising to 24% at the time of interview. The remainder were equally split between academia and civil society. A full list of interviewees is provided in Table A.2. of the Appendix. Whilst agreement was obtained from most interviewees that the majority of the interview could be attributed, in certain instances agreement to attribute specific statements, sections or occasionally whole interviews was denied. In order to honour this within a very small policy community, and also to facilitate the analysis and its reading, all interview data has been kept anonymous, referenced just as 'Interviews, 2014'.

The interviews were mostly conducted in person, although some were done using Skype. The interviews were structured as open-ended conversations, and some 'starter questions' were provided to the interviewee prior to the interview. These questions focus specifically on the LTMS, its objectives, contribution to SA CM policy and core elements, the relationship to South Africa's development agenda, implementation, and progress on SA CM policy more generally. The LTMS Review interview questions dealt explicitly with the relationship between SA CM policy and development policy. Similarly to the

Conversation Series, it is this 'hook' which yielded the most interesting insights into the SA CM CoP approach. A full list of the starter questions used is contained in the letter to interviewees (Document A.5.).

The graphic representation of the data points for the LTMS Interviews appears in Figure 3 below.

*Figure 3: LTMS Interview data points*




Full audio recordings of all except the Skype interviews were taken, together with ethnographic notes made at the time of the interview by both researchers. These were then consolidated into seventeen separate notes for the purposes of the LTMS Review paper. The secondary analysis considered both these notes and a selected listing of the audio recordings for the purposes of revealing the SA CM CoP approach, resulting in augmented 'LTMS Interview' notes. All references to the interviews in the thesis text are to these augmented notes, which were analysed for themes in a similar manner to that of the Conversation Series.

The set of themes from the LTMS data are depicted in Box 5. These were qualitatively different from those generated up until this point in that they are based on a mutual reflection of one policy process, itself an outlier in the context of my research (see 2.7.3.d for a discussion of this). This was a CoP reflecting on its history, and how this history has influenced its present. The themes therefore reflect aspects both of what the CoP values and what was felt to be less helpful (in the LTMS). Through this, both the CoP's approach and the policy issue are glimpsed. Once again, there is contradiction and messiness evident within this final theme set.

*Box 5: Themes emanating from the LTMS Interview analytical process:*

Centrality of data; no connectivity across government departments; lack of context; development addressed through economic modelling; development as context; issues of transition; energy history of South Africa; inflexibility of PPD; value of updating modelling; sound technical basis; optimum level of detail; rigidity; science-policy interface; implementation as end-of-pipe; less focus on the political; positive, opportunity focused (marginal); different perspectives; different origin stories; rational; scientific; realistic; grounded in SA 'indaba' culture; ground-breaking; non-transferable; contestation of targets; openness, looseness; ambition; break in continuity; local-international balance; visionary space; no embedding in policy context; evidence base as feasibility; climate change policy community; insufficient social scientists; non-formulaic, responsive; technical and political brought together; provided principles and aspirations; platform to share views

### (d) Ethnographic research

As a member of the SA CM CoP I had access to CoP events throughout my research journey. The ethnographic fieldnotes included in my data corpus are found in a set of (nine) pocket notebooks dated October 2013 until December 2017. I carried a small notebook with me throughout this time and regularly jotted down both observations and reflections. I also kept a running list of questions and prompts for revealing approach, gleaned from the literature and from personal interactions (this list appears as Document A.6. of the Appendix).

As my doctoral research intensified, I specifically sought out opportunities to observe both the SA CM CoP and its developmental context. For this purpose I remained involved in practice; in the MAPS reflective research team in 2015, and through my participation in a project for the Department of Environmental Affairs and National Treasury (NT) in 2016 considering the alignment of the two primary South African mitigation policy instruments, the carbon tax and carbon budgets. In addition I attended and participated in a number of events of the SA CM and development CoPs. A full list of these is provided in Table A.3. in the Appendix. Throughout, my full historical professional, educational and personal experience was brought to bear on these observations.

During my experience in the field I would identify particularly pertinent issues with an asterisk in my notebooks, and return to these when at my desk. My analytical process was to incorporate these ideas and codes in the writing I was doing at the time, either as evidence or to progress my interpretive thinking.

### (e) Primary policy documentation

Primary SA CM and development policy documentation, including both formal written policy and analysis for policy purposes, provided an additional source of evidence for the SA CM CoP approach and policy issue. This source was not comprehensively themed and analysed: rather it was used in a supportive

capacity, to highlight and exemplify the patterns identified in the empirical data sources. Primary policy documentation is most significantly engaged during the discussion in Chapter Four, where instances of evolution of approach in this data set are also identified.

### (f) Exploration of a complexity approach to SA CM policy with the SA CM and development CoPs

The sixth data source was used specifically to explore the usefulness of the inquiry to the SA CM CoP (part four of the research question). I did this primarily by engaging with the SA CM CoP and its developmental context, through a number of lunchtime seminars, paper presentations and lectures (Table A.4. of the Appendix). The choice of these events was partially emergent (responsive to invitations that arose), but also purposive in that I sought out opportunities to expose my research and thinking in a variety of different settings. In the CM practitioner space these included the MAPS Programme team (international and full complement of country teams), an international climate change conference, civil society groups, and a local government team. In academia I presented to local and international climate change scholars, and local and international complexity (and sustainability) scholars.

There was a limited overlap between the respondents in datasets one to five and those of six, who represented both practitioners and academia, and both SA and international CoPs. I took ethnographic field notes during the discussions following these events, capturing the responses to the ideas I was proposing. I analysed these notes in a similar manner to those of data source 4.

I also took advantage of my participation in a MAPS programme workshop in Bogota in 2015 to discuss my emerging complexity perspective on CM policy with Latin American MAPS Programme participants, as part of my research for my two MAPS working papers on complexity approaches in a development context (Tyler, 2015 a & b). Whilst theses interviewees clearly lie outside of the SA CM CoP, the level of detail accessed and the similarity of the SA and broader CM CoPs render the insights afforded by these interviews applicable to the SA CM policy focus of the thesis.

I used an informal interview method, meeting with individuals and small groups of CM CoP members (and two workshop participants who may be more appropriately consider development CoP members) from Colombia, Peru, Brazil and Chile. I found these interviews very difficult for a number of reasons. I needed to convey complexity principles and concepts in order to discuss their usefulness in approach CM policy, the interviews were only an hour-long each, I did not know the interviewees well in most cases, and many were second language English speakers! Nevertheless, on returning to my notes of the audio recordings towards the end of my research process the interviews provided clear insights into the usefulness and challenges of utilising complexity principles and concepts which I drew upon in response to the fourth part of the research question. The introductory letter sent to the Bogota Interviewees is included as Document A.6. in the appendix.

## 2.9 Summary of the empirical research observations

The main objective of my empirical research was to identify the high-level (and often latent) themes that characterise and describe both the dominant approach of the SA CM CoP and the SA CM policy issue. These were captured in the boxes 1- 5, and taken up, iteratively, in my ongoing analytical process of reading, writing and reflecting described in section 2.8.2. The final themes describing the SA CM CoP's dominant approach are evident in the headings used to structure my argument in Chapter Three. The themes relating to a description of the SA CM policy issue are picked up in Chapter Four. My findings on the usefulness of the inquiry to the SA CM CoP are reflected in Chapter Eight.

However, my observations from the empirical research phase went far beyond the emergent identification and characterisation of these themes. As I attest in a number of places in this thesis, my research journey was a deeply transformative one. During my empirical observation of the SA CM CoP I was impressed by a number of aspects of 'approach', and of complex policy problems and complex policymaking, that have significantly influenced my thinking around policy processes.

In terms of the SA CM CoP's dominant approach, the empirical observations bore out the tacitness and the power of approach. The more sensitised I became to approach, the more I saw of its influence, and therefore relevance. Simultaneously I found the SA CM CoP's approach to be diverse, and not static. It evolved and expanded as I observed and explored it. I was continually challenged to remain open to what the data was revealing, to put my ideological predispositions and preconceptions aside, and to nuance and deepen my articulation of what was being revealed.

I became keenly attuned to my role as researcher, and the history, assumptions and perspectives that informed what I observed, how I described my observations and the agency of these descriptions as I fed them back into the SA CM CoP. We all are involved in creating what we observe. I became aware of my responsibility is to attend to and disclose this.

My observations of the SA CM policy problem, particularly through the perspectives of those from outside the SA CM CoP and through the interactions of the SA CM CoP members with their development counterparts, deeply influenced my understanding of complex policy problems and policymaking. The complexity and systemic nature of SA CM policy is profound, as is its infinite entanglement with other priority policy problems. I was struck too by the dynamism of SA CM policy, and how it is created by the SA CM CoP attending to it, from the scientists to the politicians.

The empirical research underscored how peopled policy processes are. And this is particularly interesting and pertinent for an issue like CM policy, which is delivered as a policy problem by science. As I argue in Chapters Three and Four, the SA CM CoP has underemphasised the importance of this in the main, and has few tools to work with social aspects.

I was struck by just how messy, systemic and complex the empirical data itself was. It took the writing and reading aspects of the total research process to create the themes of Chapters Three and Four, and the theoretical vehicles of complexity and transdisciplinarity to articulate the usefulness of the inquiry investigated through my empirical work. Nevertheless, the empirical research process itself called my attention to the productivity of the research-practice interface, how each informs the other. I was also educated in the importance of engaging reflexivity in all research and practice, and of humility in exploring different knowledges and worldviews.

The findings of my empirical research were therefore as much content-related as they were about process, ontology, epistemology and ways of being. What I observed and experienced during the empirical research phase shaped the method and theory I used, and too the arguments and explorations which comprise this thesis. As is typical in many research processes, especially those in the social sciences and humanities, you don't know at the beginning what you've learnt by the end. Were I to design the empirical research process with hindsight, I would have done it quite differently. The value of remaining fully engaged with practice as the problem emerged, and feeding my thinking back into practice in a more structured and expanded way, would be central.

## 2.10 Research credibility and validity

The nature of my research inquiry demanded thoughtful attention to the issues of research validity and credibility. This section describes my response to these issues throughout the research process.

### 2.10.1 Validity as contextualised by the research purpose

Maxwell argues that research validity has to be assessed 'in relationship to the purpose and circumstances of the research' (1996, p. 86). Through my research journey I have come to understand the primary purpose of my research as being to reveal and highlight approach as a site where SA CM policy effectiveness can be interrogated; to counter its invisibility and to 'activat[e] readers to re-examine assumptions' (Finlay, 2002). Abbott (2004) argues for heuristics as the 'discipline of discovery', and from this perspective I am making the heuristic move of considering 'approach' to SA CM policy as a valid and valuable (from an action orientation perspective) research topic.

Whether the SA CM CoP accepts the version of its dominant approach that I provide is secondary to this primary purpose, as is the value of complexity thinking as offering alternatives. Commensurately, my research effort has been focused on the primary purposes of revealing and highlighting approach as relevant to policy effectiveness, and to this end I have attempted to reveal a broad spectrum across which approach operates. My credibility challenge in this research journey is largely an interpretive one, as opposed to a descriptive one (Maxwell, 1996). I have had to leverage my intuition and insider knowledge, and through the use of evidence and critical, transdisciplinary literature, reveal a sufficiently plausible account of the SA CM CoP's dominant approach as to convince CM CoP practitioners and academics of the

usefulness of considering 'approach' as a site to engage policy effectiveness. (The application of complexity in the second half of the thesis deepens and strengthens this outcome, but is far less dependent on my use of evidence and therefore is less subject to credibility concerns). To do this, I have prioritised breadth above depth. Further, I have allowed myself to stylise and reify aspects of approach to a limited degree in my argument in Chapter Three in order to render them more visible. This complex, transdisciplinary research task required me to value and nurture my intuition, and to proceed with creativity, tenacity, a scrupulous ethical stance, and continuous attention to reflexivity.

### 2.10.2 My position as researcher

Following a critical realist epistemology, reality can only be perceived through particular interpretive frames: 'actors construct their interpretations in a particular social context, influenced by practices, language, ambitions, cultural values, etc' (Buijs et al., 2009, p. 42), and '[situated] complexity starts from the premise that reality is deeply complex and inherently contingent' (Ibid, p. 37). My role as researcher is thus central, and is simultaneously the greatest source of, and greatest threat to, the research's credibility.

Through my position as a SA CM CoP insider I had on-going participant observer status during the course of the research, together with a history of 'retrospective' participant observation as I reflected on my research and practitioner experiences over the previous decade. Miles et al (2014) find that familiarity with the field, a multidisciplinary approach, attention to detail and a heightened sense of objective awareness are all attributes of reliability and validity of a researcher. This is particularly so here as 'tacit knowledge is that particular kind of understanding which is so taken for granted by those who possess it that it is never explicitly taught, but has instead to be acquired by sustained involvement in the relevant cultural milieu' (1987, p. 262). My position in the SA CM CoP meant that I had both contributed to and was a product of the CoP's approaches.

Initially I was largely unable to recognise this tacit knowledge. I blogged: '…it was only in early 2014 that I became aware that the climate mitigation policy community of practice (of which I am a part) is dominated by particular approaches and that these approaches have limitations' (Tyler, 2015). It is this initial blindness that also strengthens the research's credibility; I lacked the words and concepts to articulate my intuitive feel of a dominant approach. This articulation was acquired through an iterative analytical process, going between my data and literature to find a fit. This process of careful, iterative articulation became an important credibility tool.

Given my centrality to the research's credibility, my background and position in the SA CM CoP are relevant. I came to the research with a particular combination of disciplinary education, professional experience and a personal tendency towards deep reflection. My degrees are in finance (Masters), economics (Honours) and an eclectic undergraduate Bachelor of Commerce (I majored in psychology and economics, and included two years of sociology and a year of art history!). My current transdisciplinary

home was latent in this educational profile, which also contributed towards my intuitive sense of my research inquiry years later: whilst I had been exposed to critical thinking and reflexivity of method in the social science courses of my undergraduate degree, these aspects are not emphasised in mainstream economics and finance, nor in the applied fields of energy and climate mitigation. Holding fast to my intuition, borne of my professional and educational background, I had to re-learn social science methods of qualitative data analysis, and discover the academic value of my natural reflexive style.

Throughout the research period and for the five years preceding it I practised as an independent SA CM policy consultant, working for a variety of clients, including government, business, civil society and academic programmes such as MAPS. Prior to this I led a climate change practice in a development economics consultancy, and before this I worked for SSN (www.southsouthnorth.org). I cut my teeth on climate mitigation work in London and Amsterdam at the turn of the century, engaging in early experimentation with climate finance and emissions trading schemes. Throughout, I have promoted rational economic responses in climate policy, and hold strong but not radical environmental and social developmental values. My skills as an economist are best realised in a CoP with the current dominant approach I reveal in this thesis - indeed, I have played my part in strengthening this approach in South Africa – and I'd argue that this counteracts a research bias towards self-validation in my findings. Whilst my affinity for academia and civil society, particularly my strong associations with the ERC and SSN may represent a source of bias, my work for Business (particularly for the synthetic fuel company Sasol and the National Chemical and Allied Industry Association) and National Treasury (NT) counteracts this. Indeed, I would anticipate there to be a number of different perspectives within the SA CM CoP as to my own approach to my work.

A few other aspects determine my particular perspective of the SA CM CoP: I'm white, English-speaking, female, upper middle class, and urban. In that I did not actively seek out perspectives to counter these, they are likely to have prevailed in my findings. It would likely be interesting and productive to explore alternative perspectives in further work. In addition, despite writing of policy, I have only spent eight months (under contract) in government. I understand civil society, academia and consulting better than I understand either government or business, and certainly better than labour.

I am introspective by nature, and have explored a number of paths towards greater self-awareness in my life, explorations which have equipped me with a certain reflexive toolkit that I apply to my research. I am a natural critic, and prefer a position on the periphery of a group. Hence I frequently find myself in the position of 'bridging' different perspectives and knowledge areas, and gravitating towards critique with the objective of improvement. I am aware that in my enthusiasm to uncover something useful with my critical stance, I can go beyond the realms of plausibility, and have remained vigilant for this tendency in my research. It is in this personal tendency, perhaps, that the biggest threat to the credibility of this doctoral research lies: I seek out and push the boundaries of an unconventional, less visible perspective, driven by a critical intellectual curiosity, sometimes too far.

The transdisciplinary, emergent and exploratory nature of the research coupled with my tendency towards an over-enthusiastic critical intellectual curiosity presented the greatest challenges to my interpretive credibility from the start (Maxwell, 1996). I describe in the following two sections how I have used reflexivity and my research design to counter these threats.

### 2.10.3 Engaging reflexivity towards interpretive credibility

Reflexivity in research is at once an obvious and yet confoundingly slippery ideal. In this research, Finlay's (2002) reflexive 'swamp' is specifically navigated with reference to a transdisciplinary complexity methodology.

My personal reflexive practice occurred largely through writing, as described in section 2.8. above. I started a blog, primarily to assist in thinking through some of the issues my analysis was revealing, and wrote blogs for MAPS on the DevMit Forum and Conversation experiences. My iterative process of data analysis, reading and writing meant that I was constantly checking concepts and terminology found in the literature against what my data revealed, grounding my ongoing interpretation in evidence. I kept a presence in the SA CM CoP and at CoP events specifically for the purpose of sanity checking my emerging academic view of its approach with my experience of the CoP in practice.

Both the DevMit Forum experience and the Conversations methods enabled a 'collaborative reflexivity' (Finlay, 2002): SA CM CoP members encountered their approach through the engagement with their development counterparts, and in the Conversations they were specifically invited to reflect on this. This reflexivity served both as a support for the credibility of my research findings, but also to open up possibilities (Finlay, 2002) on a practitioner level. I was aware of prompting reflexivity within the SA CM CoP on a number of occasions (the DevMit Forum, Conversations, and in my presentations back to the SA CM CoP), navigating the tensions between participant and observer (Merriam, 1991), and between research and practice that accompany transdisciplinary research in particular.

### 2.10.4 Research design

A number of aspects of my research design assist in supporting the interpretive credibility of the research.

First, the multiple method design lends itself to this, providing a broad evidence base across which to identify themes and to consider their prevalence. In particular I sought out ways of accessing different perspectives on the SA CM CoP approach and policy issue. These were captured using various techniques, written and verbal. As the respondents were both SA CM CoP members, and development practitioners, valuable multi-disciplinary perspectives were also accessed (Palmer et al., 2018).

Secondly, I was on the look out for competing evidence of SA CM CoP approach throughout the research journey. Across the data sources there were no strong statements countering the understanding I came to of the CoP's approach. There was, interestingly, an insight in the Adaptation Conversation into why we

might have adopted this approach. '…We self-reflected that as a climate mitigation community of practice we have had to make a case for our cause and defend this against an active and 'vicious' campaign against us, which possibly accounts for some of the focus and arrogance' (Tyler, 2014b). There were however, two significant instances where I observed outliers to this dominant approach, and both were close to home. The first was in aspects of the LTMS policy process, a significant outlier given its foundational status in SA CM policy history. This process actively considered process, integration of science and practice, the use of scenarios as a way of working with the future, and a participative stakeholder engagement. Aspects of the LTMS are used as examples of a complexity approach. This notwithstanding, the LTMS was very much top-of-mind in my initial stages of doctoral research (2014) given that I was simultaneously conducting the research for the LTMS Review, and still I found within the LTMS much evidence for the dominant SA CM CoP approach I argue in Chapter Three. The second was the MAPS Programme itself. MAPS was borne of the LTMS experience, and built on its progressive approaches to knowledge and policymaking (Kane & Boulle, 2018; Rennkamp & Boulle, 2015). Nevertheless, I was similarly steeped in the MAPS work during my evidence collection, and found numerous examples of the dominant SA CoP approach, and little competing evidence. In sync with complexity theories, the dominant approach I describe was only valid from my perspective for one point in time (predominantly 2014). Already there were signs that this was changing, and it continued to evolve over the course of the thesis. Understanding its patterning is nonetheless relevant for its future evolution. From a complexity perspective these seeds of alternative approaches are heartening for the prospect of change, topics I will return to later on in the thesis.

Third, I asked regularly for feedback, conducting 'member checks' (Maxwell, 1996) of my findings constantly throughout the research process. I did this via a number of formats: by presenting my work to various formats of the SA CM CoP and development community (data source six); in the review of my MAPS working paper 'Reflecting on climate mitigation policy in a development context: how we do what we do' (Tyler, 2015); via blog commentary and specifically requesting response postings to my MAPS blogs (Kane, 2014c; Winkler, 2015); informal discussion with CoP members; my choice of a CoP member as my supervisor; and requesting review of Chapters Three, Four and Five of this thesis from a CoP member.

### 2.10.5 Addressing internal generalizability

Internal generalizability (Maxwell, 1996) refers to whether samples are credible for my data population: is the SA CM CoP I observed in my data collection the SA CM CoP I define in Chapter Three.

In two of the most significant datasets (The DevMit Forum and Conversations) there was an imperfect fit between the SA CM CoP observed in my empirical work, and that identified and described in Chapter Three in order to analyse its dominant approaches. The misfit occurred across two dimensions. First, there was a bias towards academic and civil society above business, organised labour and government at both the DevMit Forum and Conversations. Second, at the DevMit Forum South Africans were only just in the majority. The act of abstracting a SA CM CoP for the purposes of analysis is both necessary and

problematic (Cilliers, 2001; Haraway, 1998). I therefore accept this credibility issue as being more one of abstract concepts failing to match a messy reality than a challenge of method or data per se. Nevertheless, the additional ethnographic and interview methods employed go some way to counteracting the first dimension of this bias. I also attempted to access government, business and labour views through the LTMS interviews and my ethnographic observations of SA CM CoP events and during my consulting work. The second is mitigated by how well networked the SA CM CoP is internationally, together with the prominent role it has played on advancing conceptual approaches to CM policy in a development context on the international stage, heightening the overlap between the two CoPs. The discussion of the scalar nature of complex systems in section 1 is also relevant here. Where possible a distinction is maintained between observations related to a specific CoP in the analysis. I have carefully articulated and defined the CoP in Chapter Three for my purpose.

## 2.11 Ethics

My intention throughout the research was to maintain a scrupulous ethical stance. On a practical and procedural level, this was achieved by obtaining ethical clearance for my research from the University of Cape Town and following guidelines for the ethical management of evidence. Given that my respondents were all adult professionals, and that my topic was abstract and therefore not particularly controversial in the practitioner realm, ethical risks from the research were deemed low. All respondents of the Conversations and LTMS Interviews were sent letters informing them of the research process, and notifying them of their rights to anonymity and to withdraw at any point should they feel uncomfortable. They were also informed that their data would be stored securely; this remains in my personal notebooks and laptop, including hard drive backups in my possession. There is also a copy on the MAPS drive, held at SSN. This data does include identifiable records of respondents. My time and the logistics relating to the DevMit Forum, LTMS Review interviews; and Conversations were all funded by the MAPS Programme. However, this funding was flexible in nature, and not tied to particular outcomes. All respondents will be sent a link to the final doctoral thesis.

The issue of ethics however runs far deeper than this. Complexity thinking places great weight on an ethical awareness in the light of the inevitable partiality of knowledge, and I understand ethics in the context of my research as being about clearly acknowledging my own perspectives, respecting those of others, and avoiding claims to an objective moral 'truth'. The discussion in 2.9. above is therefore very closely associated with my maintenance of an ethical stance.

## 2.12 Voice and language as navigation and positioning tools

The decision around how to utilise voice and language in this thesis is a non-trivial one. My disciplinary grounding in economics and professional experience in the climate mitigation field results in my coming from a place that values disembodied, all-knowing objectivity (following Haraway (1998)). However, the

journey of my research is one that traverses intellectual worldviews to a place that is inherently and necessarily subjective. The transdisciplinary mode of inquiry, together with the complexity approach I develop towards the end of the thesis and its social issue orientation emphasise the integration of the researcher and observer with the researched or observed, and therefore the appropriateness of an embodied and situated knowledge (Haraway, 1998). Leavy (2011) states that the researcher is central to the transdisciplinary inquiry.

The contribution made by this thesis is born, in a large part, out of this intellectual journey. As an insider in the field of climate mitigation policy I needed to first 'see' that which was tacit, largely unseen and certainly unarticulated by myself and my colleagues, to haul it out into the light of day, to traverse worldviews to consider an alternative, and then finally to communicate this. The communication has two foci. First, I am communicating from whence I've come to my colleagues in the climate mitigation field, with the intention to contribute to this field's influence on climate mitigation action. Secondly, I am communicating to those active in the transdisciplinary and complexity fields, contributing an application of transdisciplinary complexity thinking to a particularly contemporary problem. Because this research traverses such different territories I am aware that the reader is unlikely to be intimately familiar with all of these, thus requiring an emphasis on communication throughout the text. I have also tended therefore to use terminology familiar to the CM field and its attendant disciplines in the early Chapters, and slowly build in and transition to language aligned to transdisciplinarity and complexity as the argument progresses. A glossary accompanies the thesis to assist the reader with this.

My use of voice in the context of navigating different intellectual spaces is experimental. In some places I bring myself fully into the text, and in others I become more distant. By blending the first and third person my intention is to acknowledge and emphasise my perspective and research journey as being integral to the argument, whilst simultaneously enabling the reader to access the content more readily and comfortably. I feel this is particularly important in the case of readers from the natural science, traditional economics and engineering disciplines where writing in the first person is disciplinary taboo!

## 2.13 Integration

The objective of transdisciplinary research is primarily an integrative one. For this inquiry into approaches to SA CM policy, there are five dimensions where integration is of particular importance. The first is integration across research and practice, the second integration across disciplines and social knowledges, the third integration across the policy issues of development and climate mitigation, the fourth integration of the SA CM policy issue and policymaking. The fifth integration dimension has been mentioned earlier in this Chapter as the conceptual development of a complexity approach for SA CM policy which supports and augments the previous four. Each of these is dealt with in turn below.

Firstly, integration across research and practice: Significantly, an initiating event in my research journey - the DevMit Forum – was itself positioned at the interface of research ('academia') and practice (also

'society'). Whilst the Forum included a set of academic papers (Jooste, Tyler, Coetzee, Boyd, & Boulle, 2014) the style of the Forum was very different to a typical academic conference, utilizing roundtable discussions, panels, an informal coffee-shop space, interactive processes (virtual and physical), with a practitioner-oriented output in the form of the Ideas Kit. From these beginnings, the research process sought throughout to balance research and practitioner perspectives, an intention which is maintained in the writing of the thesis. This was advanced through a number of initiatives: I maintained a presence in the MAPS Programme for the initial two years of the research journey, writing working papers, exploring the CM CoPs approach to mitigation and development and engaging with complexity; I presented aspects of the research to both the practitioner and academic community throughout the research process (see Appendix for further details); I continued to work on specific SA CM policy consultancies to ground my research in the realities of practitioner demands, and actively engaged with what Montouri (2010) refers to as the 'intellectual context' of the research: on-going debates, critiques and alternative views in both the local research community and in responses to the fast-moving local and global social system and policy developments of the 2014-2017 period; and I established a blog[12] whose objectives included the maintenance of a social perspective, blogging being recognised as a form of transdisciplinary dissemination (Leavy, 2011).

The integration between researcher and practitioner perspectives is also evident in particular instances in the thesis argument. In Chapters Three and Four it can be seen how the current dominant approach is co-created by research and practice. The complexity approach to SA CM policy is itself presented in two parts, the first (Chapter Six) occupied primarily with concepts and theory, and the second (Chapter Seven) oriented towards a practical expression of policymaking for climate mitigation. The evaluation in Chapter Eight is from both an academic and social perspective.

The second area of integration, across disciplines and knowledges, occurs through the use of literature from multiple disciplines to identify and then critically consider dominant approaches of the SA CM CoP. These different perspectives are then used to move the problem statement forward (Bergmann et al., 2012). Further, practitioner understandings and experiences are considered through the empirical data, both the interviews within the CM CoP and the perspectives of development practitioners, revealing aspects of the CM policy issue which are not revealed through the academic literature.

The third area of integration is that of the policy issue of development with that of climate mitigation. The thesis argues that the current dominant approach of the SA CM CoP to development is as something conceptually separate to climate mitigation, with integration between the two measured at the point of output rather than their being inseparable at the point at which we start to think about them, the point of conception. This integration exercise occurs at a number of levels in the research and thesis. At a process level, the Conversation Series brought together development and climate mitigation practitioners and

[12] www.emilytyler.co.za

researchers, with the only conceptual framing for the discussion being a loosely drawn system including climate mitigation and traditional development issues as equal components (See Figure 4 below).

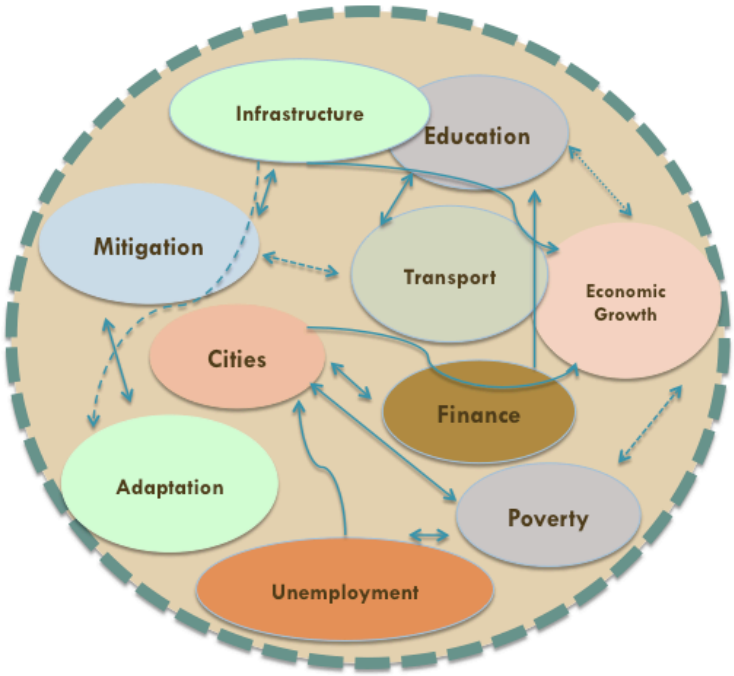



*Figure 4: SA CM and development priorities as complex and intertwined*

As a researcher and practitioner, I moved between development and climate mitigation fora, encountering first-hand the disconnect that currently exists, increasingly cross-pollinating ideas and perspectives between the two, and engaging with the possible opportunities and barriers for integration[13]. Montuori writes of the 'continuing effort to connect the inquiry not only to knowledge bases and theoretical frameworks, but also to lived experience and action' (2010, p. 7).

Empirically, the Development Provocateur exercise and briefing notes and Conversation participant notes represent an empirical dataset which explicitly considers the current relationships and sites of connection between the two areas, a contribution towards integration. On the level of language, terminology which purports to 'bridge' between development and climate mitigation, such as 'sustainable development' and 'green growth', is interrogated. Finally, the exploration of complexity for SA CM policy proposes an approach that is fundamentally integrative of mitigation and development.

The integration of policy issue and policymaking is a position I adopt in the second half of the thesis, underpinned by complexity thinking and in response to the observation of CM policy as an inherently

[13] The role of the REDI 3x3 research programme in triggering my interest in the development perspective was discussed in the introduction. Other examples of engagement with the wider knowledge context include my attendance at discussions on the political and economic future of South Africa organized by the Institute for Security Studies (www.issafrica.org) where I raised questions bringing climate mitigation into the room. At a conference on Restitution in South Africa (www.restitution.org.za/2016-restitution-conference/) I tweeted: '#RestitutionConference: In SA we need to make restitution and transition to a low carbon socio-economy: how to co-conceive these agendas?'

complex policy issue which requires a particular policymaking response. Much of the public policy and administration literature treats the policymaking process as separable from the policy issue being addressed. I specifically explore what stands to be gained from considering both together, as entangled and inseparable.

The development of a complexity approach to SA CM policy (Chapters Five to Seven) represents a multi-dimensional integration exercise: The approach's implications for practice are explicitly articulated together with the theory; complexity's inherently multidisciplinary, multi-knowledge underpinnings integrates across disciplines and knowledges; development and climate mitigation policy priorities are conceptualised systemically and the SA CM policy issue and its policymaking are also understood as an integral part of the same system. The complexity approach is therefore a 'model' that is based upon integration of disciplines and knowledges, research and practice and science, development and mitigation.

## 2.14 Thesis organisation

The thesis proceeds in Chapter Three by identifying the current dominant approach to SA CM policy. Chapter Four considers what this current dominant approach obscures and what it illuminates about the policy issue. By the close of Chapter Four, parts one and two of the research question will have been answered.

Chapter Five comprises an introduction to the field of complexity, oriented towards SA CM policy. Chapter Six describes a complexity view of SA CM policy as concerned with the transformation of the SA STEPE system to a low carbon, high development attractor state. Chapter Seven then considers how complexity principles and concepts reveal SA CM policy more fully, thereby answering the third part of the research question. Chapter Eight considers the usefulness of the inquiry to the SA CM CoP, responding to the final part of the research question. The Conclusion summarises the thesis contribution and identifies some areas for future inquiry.

# 3 Encountering the dominant approach of the SA CM CoP

> *South Africa's approach to mitigation is informed by two contexts: first, its contribution as a responsible global citizen to the international effort to curb global emissions; and second, its successful management of the development and poverty eradication challenges it faces.*

– South African National Climate Change Response White Paper, 2011, p.25.

## 3.1 Introducing South Africa and South African climate mitigation policy

South Africa is a middle-income developing country located on the southern-most tip of Africa. It has significant mineral and coal resources, whose exploitation under the colonial and then apartheid governments of the nineteenth and twentieth centuries left a legacy of an advanced infrastructure, a concentrated economy, and severe political and social challenges. Probably best known internationally for its remarkably peaceful transition out of the repressive apartheid regime to democracy in 1994, the country has subsequently been struggling to adjust its economic, infrastructural, political and policy systems to serve the entire population rather than a privileged minority. All this in an international and African context characterised by rapid, substantial and ongoing change.

South Africa has identified the reduction of poverty, inequality and unemployment as key national policy objectives (National Planning Commission [NPC], 2012). The country has an official unemployment rate of 27.7% (Statistics South Africa, 2017b), and one of the highest inequality levels globally as defined by a Gini-co-efficient of 0.68, with 55.5% of its citizens living below the upper-bound poverty line (SSA, 2017a). Whilst there has been an overall improvement in poverty levels since democracy largely due to the country's significant social grant system, unemployment and inequality remain stubbornly high (SSA, 2017a).

The economy is unusually energy and emissions intensive, with average per capita GHG emissions of 8,84t $CO_2e$ (2012 data, (CAIT, 2017))[14] and absolute net emissions of 546 Gg $CO_2e$ (2012 data (Department of Enviromental Affairs [DEA], 2014a))[15]. The energy sector dominates the emissions profile, contributing 77.9% of emissions in 2012 due to its reliance on coal as a primary fuel (DEA, 2016a). Within this sector, electricity generated from the state-owned utility Eskom contributes 95% of the country's total electricity (DEA, 2016a) and 55% of total emissions (DEA, 2014a). Despite attempts to restructure (Gaunt, 2008), the energy system remains monopolistic and heavily regulated (Baker, 2012; Morris & Martin, 2015).

Climate mitigation surfaced as a national policy issue for South Africa at the time of the democratic transition, just subsequent to the establishment of the UNFCCC in 1992. The country's Long Term Mitigation Scenario (LTMS) planning process of 2006 to 2007 was foundational in translating the issue of climate mitigation into a national context, evaluating possible developmental implications, constituting the climate change policy community and generating data on mitigation options (Tyler & Torres Gunfaus, 2017).

Twenty-five years on, and the CM policy issue is now firmly established and institutionalised in the Department of Environment Affairs' Climate Change and Air Quality branch. A chronology of the key events in SA CM policy is presented in Box 6 below. The current policy position is guided by the 2011 National Climate Change Response White Paper (NCCRWP). In addition to the GHG mitigation aspect, the SA CM policy objectives defined in the NCCRWP are supportive of the development priorities of the country, both of which are addressed through the concept of a transition. These objectives are to:

> ….manage the transition to a climate-resilient, equitable and internationally competitive lower-carbon economy and society in a manner that simultaneously addresses South Africa's over-riding national priorities for sustainable development, job creation, improved public and environmental health, poverty eradication, and social equality. In this regard, South Africa will: …
>
> make a fair contribution to the global effort to stabilise GHG concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner. (Republic of South Africa [RSA], 2011, p. 11).

Inter-Ministerial, Inter-Governmental and National Committees on Climate Change (IMCCC, IGCCC and NCCC respectively) provide the institutional architecture for working on SA CM policy within government and between government and stakeholders. While CM policy can not yet be considered a mainstream policy issue in the country, remaining primarily in the policy domain of the DEA, it does feature in South Africa's first National Development Plan (NDP) (NPC, 2011) and references to climate change mitigation in

[14] All figures given excluding Forestry and Other Land Use change (FOLU), estimated to be a (relatively small) net emissions sink for the country.
[15] Until 2009 the DEA was the Department of Environmental Affairs and Tourism (DEAT).

various guises are now fairly common in public addresses such as the State of the Nation and the Budget Speech (Gordhan, 2017).

*Box 6: A chronology of SA CM policymaking*

| | |
|---|---|
| 1998 | First GHG Inventory based on 1990 data |
| 2004 | Second GHG Inventory based on 1994 data |
| 2004 | First National Communication under the UNFCCC |
| 2005 | National Climate Change Response Conference |
| 2006-7 | Long Term Mitigation Scenario process |
| 2008 | Cabinet releases 'Vision, Strategic Direction and Framework for Climate' |
| 2009 | National Climate Change Response Policy Summit |
| | Copenhagen Pledge announced and submitted under the Copenhagen Accord |
| | Online National Climate Change Response Database established |
| 2010 | National Climate Change Response Green Paper |
| | First Carbon Tax Policy Discussion Document |
| | Second National Communication under the UNFCCC |
| 2011 | National Climate Change Response White Paper finalised |
| | South Africa hosts the Durban Conference of the Parties to the Kyoto Protocol |
| 2013 | Second Carbon Tax Policy Discussion Document |
| 2014 | Mitigation Potential Analysis study published |
| | Fifth GHG Inventory for period 2000-2010 |
| | First Biennial Update Report to the UNFCCC |
| | National Climate Change Conference |
| 2015 | First Draft Carbon Tax Bill released for comment |
| | Intended Nationally Determined Contribution submitted to UNFCCC |
| 2016 | Second Biennial Update Report to the UNFCCC |
| 2017 | GHG legally identified as priority pollutants |
| | Mandatory GHG Reporting Regulations promulgated |
| | Pollution Prevention Plans Regulations promulgated. |
| | Third National Communication |
| | Second draft Carbon Tax Bill released for comment |
| 2018 | Draft Climate Change Bill released for comment |
| | Third Biennial Update Report released for comment |
| | Sixth GHG Inventory for the period 2000-2015 released for comment |

Within the international CM CoP, South Africa has punched above its weight (Atteridge, 2011; Parliamentary Colloquium, 28 October, 2016)[16] in terms of its profile in the UNFCCC negotiations and attendant policy communities, the innovative approach of the LTMS (expanded to other developing countries through the MAPS programme), and the commitments to mitigation in the Copenhagen Accord.

The DEA describes the key elements of a developing SA CM policy in its draft Second Biennial Update Report to the UNFCCC (DEA, 2016b) as likely to include an economy-wide carbon tax, a system of company level carbon budgets embedded within sector level Desired Emission Reduction Outcomes (DEROs), regulated national Pollution Prevention Plans (PPPs) covering specific emitting activities at company level, and a suite of near-term priority Flagship programmes in major emitting sectors. The Flagships are intended to build on existing initiatives within sectors and are described as being cost-effective, having significant co-benefits and well-known mitigation outcomes. A GHG Emissions Benchmark Trajectory Range has been developed against which progress can be measured (DEA, 2011).

Beyond this, work is ongoing to develop a 'mitigation policy system' for the country, comprising a 'learning' Phase One (to 2020) and a more final and mandatory Phase Two thereafter. In the first phase GHG emissions reporting is mandatory under the GHG Reporting Regulations (DEA, 2017a), with certain companies further mandated to submit PPPs outlining mitigation activities (DEA, 2014b). The carbon budgets at company level remain voluntary in this phase, potentially incentivised through a reduction in the carbon tax which is anticipated to come into force during this period. In the second phase carbon budgets are likely to become linked to the mandatory PPPs (to be renamed 'mitigation plans'). The Desired Emission Reduction Outcomes concept is anticipated to evolve into Sectoral Emissions Targets (SETS), which are absolute emissions caps at the sectoral level, to be administered by government line departments. The carbon tax and budgets enforcement and incentivisation system is intended to be formally aligned and operationalized. Both budgets and SETS are likely to be based on historical emissions data. It is anticipated that GHG emissions from the electricity sector will be regulated through a combination of carbon budgets and a SET. At the time of writing, policymaking efforts are focused on promulgating both the Carbon Tax (NT) and Climate Change (DEA) Bills. The latter provides the overarching regulatory framework for climate change.

Despite relatively impressive written CM policy, the gap between these policy aspirations and implementation of them is becoming increasingly apparent. Death observes of South Africa that top politicians' commitment to climate mitigation initiatives is 'sometimes questionable and probably temporary' (2014, p. 16). There are few instances of the SA CM policy envisaged in the NCCRWP having been implemented to date (Boyd & Coetzee, 2013; Interviews, 2014; Worthington, 2014)[17]. Where there have been actions which have mitigated GHG emissions, these have largely been driven by non-climate

[16] References to events of the SA CM CoP in which I participated during the course of the research refer to field notes in all instances.
[17] References to the 2014 Interviews are to the interview notes in all instances. Whilst a full 2014 interviewee list is provided in the Appendix, interviewees requested that the individual opinions expressed were not attributed directly. Therefore the interviews are only referenced generally in the text.

policy drivers, such as the Bus Rapid Transit programmes of large metros which has provision of transport services as its primary objective (Trollip, Torres Gunfaus, & Du Toit, 2015), and the Renewable Energy Independent Power Producer Programme (REIPPPP), a significant and substantial bidding programme for off-take contracts in the electricity sector in response to the 2008 electricity supply crisis (Interviews, 2014; Morris & Martin, 2015). A number of commentators note the disparity between South Africa's projected image of a global leader on 'sustainable development and environmental diplomacy' and the country's internal progress towards these conceptual ideals (Death, 2014; Parliamentary Colloquium, 28 October, 2016; Rafey, 2013; Trollip & Boulle, 2017).

Concurrently, the SA CM policy process itself has become increasingly contested and adversarial within the SA CM CoP (Atteridge, 2011; Interviews, 2014; Trollip & Boulle, 2017; Worthington, 2014), with a significant degree of stakeholder frustration over its pace, depth and process. There is also substantial policy misalignment and lack of integration with other key policy areas (Trollip & Tyler, 2011), as evidenced in the NDP (2011).

Perhaps most noteworthy in terms of SA CM policy progress, and relevant for the consideration of the dual objectives of climate change mitigation and development more generally, is the argument that South Africa's economy is dominated by a Minerals and Energy Complex (MEC) which continues to entrench a high carbon growth and development path for the country (Baker, 2012; Burton & Winkler, 2014; Chandrashekeran, Morgan, Coetzee, & Baker, 2015; Fine & Rustomjee, 1996; Forti, 2013; Morris & Martin, 2015; Rafey, 2013). South Africa's elite remain heavily invested in coal and mining (Burton & Winkler, 2014). Whilst the Department of Trade and Industry has included 'green economy sectors' into its Industrial Policy Action Plans, support is retained for the core energy and emissions intensive mining and minerals sectors. The two coal-fired power stations, Medupi and Kusile, which are being built in response to the 2008 electricity crisis, are amongst the largest in the world (Eskom, 2017), and two new coal-fired electricity generation plant approved under the coal Independent Power Producers programme[18] are included in the latest draft IRP (Department of Energy [DoE], 2018).

The extent to which the SA CM CoP has impacted either South Africa's economic structure or its policy counterpart is therefore questionable. Whilst research considering planned and existing energy infrastructure finds that the country looks set to exceed its GHG emissions targets under the GHG Emissions Benchmark Trajectory Range (Burton and Winkler, 2014), DEA's presentation to the Portfolio Committee on Environmental Affairs (DEA, 2017b) reported the opposite, based on low projections of economic growth. However, the carbon emissions intensity of the energy system was reported in the presentation to be unchanged, and that energy efficiency measures (likely resulting from the 2008 electricity crisis) contributed significantly to compliance with the GHG Emissions Benchmark Trajectory Range to date. Therefore where there has been mitigation policy influence, it appears to have been

[18] www.ipp-coal.co.za

marginal rather than central. Despite South Africa's early efforts on addressing mitigation in the form of the LTMS, there has been little progress 'on the ground' (Chandrashekeran, Morgan, Coetzee, & Christoff, 2017; Trollip & Boulle, 2017; Worthington, 2014).

## 3.2 Defining the SA CM CoP

For the purposes of this thesis the SA CM CoP is defined as being those people and institutions who focus the majority of their professional time and effort on SA CM policy (which is national, regional or city level as opposed to international, and is specific in its focus on climate mitigation as opposed to either of the other climate change themes or broader themes of sustainability). Members include civil servants, donor organisations, corporate employees, representatives of industry organisations and trade unions, civil society organisations, consultancies and academia. Institutions include the NCCC, IGCCC, IMCCC, Industry Task Team on Climate Change[19] and Air Quality unit at the DEA, Eskom, Sasol and the World Wide Fund for Nature (WWF). The SA CM CoP is found to be relatively small and contained (Rafey, 2013, p. 21)[20]. Similar to its international counterparts, the CoP is mostly comprised of economists, engineers, environmental scientists, sustainability practitioners and environmental activists, most of whom are white[21] (Rafey, 2013, p. 21) and upper middle class (Consumption Conversation, 16 October, 2014). The CoP is dominated by government, business, civil society, academia and consultants, with organised labour still finding its voice (Interviews, 2014; Rafey, 2013). The SA CM CoP is not formally organised, but comes together in various configurations around particular issues and events, particularly the frequent stakeholder consultations organised and funded by national government which are required by the South African Constitution for the development of environmental policy (Rafey, 2013).

The SA CM CoP is a community highly integrated across research and practice, with many of those working as policy practitioners also active in the research field and vice versa. Many members, both academic and practitioner, have active roles in both the international and broad CM CoPs, particularly focusing on the issue of climate mitigation in developing countries.

The SA CM policy CoP focuses its attention in a number of core areas. The systematic quantification, recording, monitoring and evaluation of the country's GHG emissions in a sectoral framework provides the foundations for SA CM policy. This reporting was initially conducted as part of the UNFCCC-required National Communications, based on the IPCC GHG categorisations and method. It has subsequently expanded, become more sophisticated and SA CM policy-relevant through a mapping to domestic

[19] www.ittcc.org.za

[20] Rafey, for an Honours thesis on energy, development and climate mitigation in South Africa, conducted 51 interviews: 22% from academia; 18% from civil society; 26% from government; 34% from business (2013)(author's calculations). Rafey interviews those involved in energy and climate. It is therefore possible that some interviewees would not adhere to the strict definition of 'primary climate policy', but in the author's opinion the difference is unlikely to be material to the results and that this is an acceptable approximation.

[21] 41 out of the 51 interviewees in Rafey's study were white. This proportion is significantly out of kilter with the demographics of the total South African population, a legacy of the country's colonial and apartheid history.

economic sectors in the Mitigation Potential Analysis (MPA), which identified and analysed mitigation options in key economic sectors (DEA, 2014c). An online system to align the national GHG emissions inventory with mitigation measures and actions as part of a broader climate change monitoring and evaluation system is envisioned (Letete, 2016). GHG reporting is now mandatory for emitting activities above a threshold (DEA, 2017a). Energy and economic modelling to drive scenario planning and emissions projections is a core component of SA CM policy work, and underpins most of the main policy analysis initiatives (including the LTMS, MPA, GHG Emissions Benchmark Trajectory Range, carbon tax and carbon budgets). Policy instrument design is progressed through analytical work, stakeholder consultation, lobbying and the development and promulgation of regulations. Some attention is paid to establishing mechanisms to co-ordinate use of international climate mitigation donor funding, although these are not yet coherent. A significant portion of overall attention is given to responding to UNFCCC information and reporting requirements, and input into the international CM policy process. Less attention is paid to developing Flagship Programmes, policy mainstreaming, governance and integration more generally.

The SA CM policy CoP definition and description given above is high level and generalised, based on empirical observation and corroborating literature. However, given that the purpose of the concept is as a vehicle to reveal tacit knowledge, rather than an end in and of itself, this is justified. Having introduced SA CM policy and provided a working definition of the SA CM CoP, the main task of this Chapter - to articulate and describe the dominant approach of the SA CM CoP - can commence.

Aspects of the dominant approach are profoundly intertwined in their origin, evolution and implications for the SA CM CoP's work, presenting a formidable challenge to structuring the argument in this Chapter. For the sake of clarity therefore, these aspects are introduced separately and in association with the following themes: the influence of the international CM policy CoP (section 3.3.1); the influence of the hegemonic scientific and cultural worldview (section 3.3.2.); normativity within the SA CM CoP approach (section 3.3.3); and discounting the social realm (section 3.3.4). The Chapter then considers how this dominant approach is manifested in two key issues associated with the SA CM policy objectives, transformative change and development (section 3.4).

## 3.3 Aspects of the dominant approach

### 3.3.1 An international CM policy frame

Climate mitigation emerged on the international policy agenda with the creation of the UNFCCC as an international environmental agreement at the 1992 Rio Earth Summit. Internationally climate mitigation is conceptualised as an environmental policy issue (Huq, Reid, & Murray, 2006), and institutionalised as such within the UNFCCC. The South African negotiating team to this international policy process was drawn primarily from DEA and the Department of International Relations and Co-operation together with business, civil society and academic representatives. This team and their experiences in the UNFCCC

processes during the late 1990's and early 2000's created a group of South Africans with climate mitigation expertise and experience gained from an international CM policy perspective.

South Africa is designated a developing country under the UNFCCC. From a developing country perspective, the international CM policy process is dominated by narratives concerning fair and equitable contributions to the global mitigation effort given the 'Common but Differentiated Responsibilities' (CBDR) (United Nations, 1992) of countries falling into various classifications of development, together with issues of technical and financial support for the developing country categories. In the early days of international CM policy, developing countries had responsibilities limited to the submission of National Communications to the UNFCCC concerning national climate change impacts, adaptation and mitigation. However, by 2005 the South African team saw that these obligations were bound to increase, and that therefore, as a government official put it, 'our international efforts needed to be nationalised' (Interviews, 2014), prompting the initiation of the LTMS process. The final report of the LTMS reflected the SA CM policy CoP perspective of the time: '…there is increasing pressure on the larger developing country emitters to demonstrate their plans for achieving emissions reductions. It is accordingly incumbent on South Africa not only to urgently develop such a plan, but also to prepare the path for its implementation…' (Scenario Building Team [SBT], 2007, p.2).

SA CM policy therefore entered the domestic policy agenda as a direct response to an international policy issue, situated in the realms of environmental and foreign policy, and dominated by narratives of international equity and financial and technological assistance. Tanner and Allouche (2011) note how climate change generally has mainly been problematized as a global rather than national issue. Rafey writes of how much of the terminology that has been incorporated in national policy documents mirrored that of the international policy process (2013, p. 56). He further argues that in South Africa, as in many developing countries, the initial driver of developing national climate mitigation policy was to support the international climate mitigation position, and described international climate change policy as 'shadowing' the domestic conversation. He identifies a discourse within the SA CM policy CoP maintaining that international action must come before SA CM policy solidifies. Whilst this influence has weakened since Rafey's research it is still evident at SA CM CoP events. For example, the 2014 national Climate Change Dialogue was co-ordinated with the IPCC Regional Outreach Event on its Fifth Assessment Report and facilitated by IPCC scientists (DEA, 2014d). The Environment Minister (the late Edna Molewa)'s statement at the 2016 Parliamentary Colloquium on SA CM policy emphasised South Africa's leadership position in the international negotiations, and the moral argument of the country needing to do its fair share (Parliamentary Colloquium, 28 October, 2016).

The international perspective extends to SA CM policy details. Rafey argues that three main areas of technical modelling attended by sub-groupings within the SA CM CoP (the DEA's LTMS scenarios, NT's carbon tax modelling and the DoE's Integrated Resource Planning (IRP) process) drive the policy process forward, with all three technical models having international origins. In policy process too, the

international CM policy process is highly influential in the evolution of SA CM policy. The Copenhagen Conference of the Parties in 2009 saw President Zuma announcing South Africa's Peak, Plateau and Decline GHG emissions trajectory based on the LTMS numbers, an opaque action that undermined hard won trust within the SA CM CoP due to the DEA having assured the LTMS participants that the process would only inform policy, not prescribe it (Tyler & Torres Gunfaus, 2017). South Africa hosted the Conference of the Parties to the Kyoto Protocol in Durban in 2011, resulting in a flurry of domestic policy activity including the release of an initial carbon tax briefing paper (National Treasury [NT], 2010) and the NCCRWP itself with hugely ambitious timeframes which have since proved unattainable (Chandrashekeran et al., 2017; Worthington, 2014).

### 3.3.2 Situated within the hegemonic scientific and cultural worldview

Beyond the level of theories and assumptions, the SA CM CoP, similar to other human social phenomena, is influenced by the set of beliefs, paradigms or worldviews[22] from which it operates. Much has been written about these issues: what they are and their role in determining both what constitutes a valid approach to knowledge and the form and evolution of the social realm. These discussions therefore have both epistemological and ontological reach. The literature attending to them arises from a wide range of perspectives, utilising diverse terminologies. The portion of this literature encountered in this research includes perspectives from biology (Sheldrake, 2012), feminism (Haraway, 1998), philosophy (Bhaskar, 2010; Kuhn, 1962/2012), social sciences (Leyshon, 2014), education (Becher, 1987; Montuori, 2010), science and technology studies (Jasanoff, 2007; Law, 2004; Wynne, 1986), systems thinking (Meadows, 2008), environmental science (Hulme, 2009) complexity thinking (Cilliers, 1998; Morin, 2006; Wells, 2013), as well as in popular literature and social media (Capra, 1974/1983; Gladwell, 2000; King, 2015).

This thesis is not concerned with the details of the debates within this literature. Rather, adopting Capra's approach, it extracts from this the definition of a paradigm as being comprised of 'thoughts, perceptions, and values that form a particular vision of reality' (Capra, 1974/1983, p. 11), and the heuristic of there being one worldview currently hegemonic within the western world, which then influences the SA CM CoP's dominant approach. Because this move to assume a single, definitive hegemonic worldview is a heuristic one, it involves a not-insignificant degree of generalisation and simplification. However, it provides a useful entry point for exploring some of the implications of 'thoughts, perceptions and values' held at the cultural level for the SA CM CoP's dominant approach, and then later on in the thesis as a point of contrast with alternative paradigmatic possibilities.

This section continues by describing this hegemonic worldview in (a) below, generally (and not definitively) associating contributions from a multidisciplinary literature dealing largely with philosophies of science with Capra's conceptualisation. The operation of this worldview within CM policy CoPs broadly

[22] For the purposes of this thesis the terms paradigm and worldview are equated.

is then discussed in (b), with (c) dedicated to excavating the influence of the hegemonic worldview on the SA CM CoP specifically.

## (a) An overview of the hegemonic worldview

Capra describes western science and culture as being dominated by the current hegemonic worldview since the Middle Ages, defined by: values, such as efficiency, rationality, discrimination, competition and materialism; the reductive scientific method of Newton and Descartes; and by social systems of patriarchy and environmental extraction. The dominant metaphor for this worldview is that of machine: a compilation of separate parts which when assembled into a whole constitutes the sum of these parts, nothing more and nothing less (Ashby, 1962). This metaphor is applied to all aspects of the world: humans, human bodies, knowledge, technology, nature and the universe.

Within this worldview, nature is inherently ordered (Morin, 2006), and people are assumed to be homogenous, rational and logical beings. This finds particular expression in the assumption of the 'rational man' in orthodox economics. Social life is viewed as a competitive struggle for existence (Capra, 1974/1983), with an emphasis on the individual above the community, separateness and independence above connection and interdependency. These views and beliefs saturate the western cultural environment, determining the cultural normative, and shaping identity (King, 2015).

The reductive scientific method (inherent in the terms classical, Newtonian or traditional science) is deterministic, aiming for prediction and control. Knowledge obtained through the observation of natural phenomena through sensory experience (positivism) is considered epistemologically superior to other forms of knowledge, contributing to a deep materialism (Heylighen, Cilliers, & Gershenson, 2007). The reductive scientific method separates and abstracts ever-smaller units for isolated and in-depth analysis. As such, the scientific endeavour has achieved an incredibly detailed understanding of parts, and respect for experts and expertise, reflecting this detail. From determinism flows the assumption that the future is knowable and unfolds in a linear fashion through singular, linear causal drivers (Fazey et al., 2017) with certainty as the general condition (Jasanoff, 2007). Time is viewed as 'invariant, infinitely divisible [into] space-like units… expressible as a number and reversible' (Urry, 2005, p. 4). The scientific method prizes objectivity, a separation between the observer and the observed, where the observer is neutral and is neither influenced by nor influences the observed. This assumption of objectivity supports the aim of generating universalisms, and generic 'truth'. Ultimately this method assumes that with enough research and knowledge the world is understandable, and this knowledge can then be directed towards the modernist project of progress as delivered through technology and industrialisation, where the principles of efficiency and optimisation hold sway. Values are assumed to lie outside of this process, and to have no bearing on it (Ravetz & Funtowicz, 1999). Quantification is prized as a way of knowing, and topics less available to quantification, particularly social and human dimensions are less studied, and correspondingly less visible as areas of relevance.

Within academia, the hegemony of this worldview has led to an 'epistemic exceptionalism' (Leyshon, 2014) of the scientific method which is concentrated in the natural (Poli, 2013) and applied natural sciences but also maintained throughout the academy in varying degrees (Heylighen et al., 2007). In society, the classical scientific method and modernist focus on progress has led to significant achievements in medicine, science and engineering (Dombkins, 2014). This progress has been attained within a basic model of top-down organisation of society and perceived control (King, 2015). Managerialism in public policy and technocratic views predominate.

Despite the scientific and societal achievements gained, the hegemonic worldview also enabled slavery, colonialism, Nazism, the destruction caused by the two World Wars, the atomic bomb, and the current global environmental crises (Wells, 2013). Many commentators argue that this worldview has outlived its usefulness to humanity, with critiques emerging from fields including post-modernism (Cilliers, 1998), transdisciplinarity (Hadorn, Bradley, Pohl, Rist, & Wiesmann, 2006) and post-normal science (Funtowicz & Ravetz, 1993). There is also a more specific argument that a paradigm shift of vast proportions is currently underway (Ison, 2010). Capra (1974/1983) argues that this shift was initiated by quantum and relativity theories in physics early in the twentieth century, and that the implications of this modern physics are filtering slowly through the academy, unseating hegemonic disciplinary orthodoxies. Accordingly, the emergence of a new paradigm is inevitable. This process can be associated with more or less human suffering, depending on the extent to which humanity consciously appreciates what is happening and engages with its values, discarding those that are no longer useful and recovering those that have been lost; in so doing, supporting rather than resisting the paradigm shift.

### (b) The operation of the CM policy CoPs within this hegemonic worldview

The provenance of climate mitigation lies within the natural sciences which Leyshon argues 'condition[s] the terms of entry' for other disciplines attending to the issue (2014, p. 363). CM policy has therefore come to be dominated by engineering and economics, disciplines strongly aligned with classical science and the scientific method (Byrne, Smith, Watson, & Ockwell, 2011; Corbera, Calvet-Mir, Hughes, & Paterson, 2015; Leyshon, 2014; Rommetveit, Funtowicz, & Strand, 2010; Shove, 2010b)[23]. Of the social sciences, economics is most strongly associated with the hegemonic worldview (Montuori, 2013b; Morin, 2006), and Grubb et al. acknowledge the dominance of the neoclassical and welfare economics orthodoxy in CM policy, the 'workhorse framework for most economic analysis' (2014, p. 54).

Where other disciplines are engaged in CM policy, it is predominantly the orthodoxies within these disciplines that are similarly aligned to classical science, such as psychology, geography and environmental studies (Shove, 2010a, 2010b). Corbera et al. find that within the working group attending to mitigation

[23] Corbera et al. (2015) find that 49% of the authors of the IPCC's AR5 WG III for whom the researchers were able to get data on highest academic training were economists and engineers, a percentage rising to 58% of the influential Coordinating Lead Authors responsible for drafting the Summary for Policymakers.

(Working Group Three (WGIII)) of the IPCC, which is described as the pre-eminent scientific community attending to climate change, 'disciplinary biases...constrain how climate change is known and acted on, with only certain forms of knowledge and expertise authorized to construct a problem with global implications' (2015, p. 1). Leyshon (2014) and Hulme (2009) problematize how climate change has come to be known, as a problem of excessive GHG emissions to be solved by reduction or avoidance. Science is seen as providing the truth upon which CM policy can act, and the primary CM CoP challenge becomes enabling and facilitating this science-policy interface.

Determinism underpins assumptions on how CM policy is made (Heal & Kriström, 2002) and mental models such as Lasswell's (1951) policy cycle dominate CM CoP thinking, largely rendering the process of climate change policymaking a black box (Wellstead, Howlett, & Rayner, 2015). It is a policy design and planning approach that is completed up-front by experts and then sequentially implemented and delivered by others. Corbera et al. (2015) comment on the 'technical and managerial framings' of the IPCC WGII. As such, the CM CoP has focused on content over process, which Giddens terms the 'what' rather than the 'how' of policymaking (Giddens, 2009; Jasanoff, 2010; Leyshon, 2014; Shove, 2010b).

Levin et al. note that CM policy utilises 'the conventional theoretical toolkit of political science, international relations, public policy analysis and evaluation, and the theories of global and domestic environmental politics and policy adapted from them' (2010, p. 8). Policymaking within the CM CoP is strongly influenced by an orthodox economics view based on rational choice theory (Grubb et al., 2014). Preferences are taken as fixed, 'consumers' have rational foresight (Grubb et al., 2014) and short term 'self-interest' predominates (Levin, Cashore, Bernstein, & Auld, 2012). The types of policy tools considered appropriate and legitimate include cost-benefit analysis, statistical decision theory, multi-attribute utility theory, and contingent valuation. These tools rely on assumptions such as exogenous and known values, single actors, economic efficiency as the goal of optimisation, and isolation from other policy issues (Levin et al., 2012; Morgan, Kandlikar, Risbey, & Hadi, 1999). Only knowledge generated through the classical scientific method is considered valid for CM policy, together with the assumption that simply injecting knowledge into the policy process will produce 'a direct and proportionate response' (Leyshon, 2014). This results in an approach to policy design that is involved with balancing costs and benefits (Grubb et al., 2014), is static, ordered, rational, linear and objective, assuming that the world can be known. The CM CoP relies on retrospective analysis of what policies worked historically, or on assessing interventions by modelling their effects going forward in a linear and deterministic fashion (Levin et al., 2012). Biesbroek et al. in (Rommetveit et al., 2010, p. 155) note that the quantitative approaches employed by the CM CoP produce highly specialised and complex knowledge.

CM policy practice is itself steeped in the hegemonic worldview prioritising technology, finance, managerialist approaches and market-oriented solutions (Boyd, Grist, Juhola, & Nelson, 2009; Byrne et al., 2011; Shove, 2010a; Woiwode, 2013). Discrete mitigation actions, physical technologies, market mechanisms, financing, additionality in donor funding, quantification and inventorying of GHG and

targets, and policy instruments to reduce these feature highly in practice of the CM policy CoPs. This is evident in the international climate negotiations, national policy, mitigation projects and programmes and conference topics (see for example the conference proceedings from Our Common Future Under Climate Change (2015)). Key conceptual contributions to the CM CoP have included Pacala and Socolow's technology wedges (2008), the United Nation's Environment Programme's Technology Needs Assessments, Stern's Economics of Climate Change (Stern, 2007), McKinsey's Marginal Abatement Cost Curves, and the World Bank's Market Readiness Programme for market-based policy instruments[24]. Underpinned by reductionism, mitigation strategies are typically embedded in separate sectoral policy domains (Rommetveit et al., 2010).

A central policy approach of the CM CoPs has been that of developing long-term, coherent, CM policy scenarios at a global and country level (Rommetveit et al., 2010). Examples include the Special Report on Emissions Scenarios (Nakicenovic et al., 2000), and the subsequent Representative Concentration Pathways (Van Vuuren et al., 2011), the Pathways to Deep Decarbonisation Programme (Sustainable Development Solutions Network and Institute for Sustainable Development and Internation Relations, 2014), and the MAPS Programme processes in Latin America. Quantitative energy, economic or 'integrated assessment' modelling regularly underpins this type of analysis, projecting future GHG emissions trajectories against a particular emissions target, and identifying alternative trajectories for the economy. Corbera et al. (2015) describe modelling chapters as being at the 'heart' of the IPCC's Fifth Assessment Report (AR5), WGIII.

Morgan et al. identify six assumptions of conventional policy analysis, which will be discussed as being evident in the SA CM policy CoP's dominant approach:

> (1) the assumption that there is a single public-sector decision maker who faces a single problem in the context of a single polity; (2) the assumption that the impacts involved are of manageable size and can be valued at the margin; (3) the assumption that values that are known, static, and exogenously determined, and that the decision maker should select a policy by maximizing expected utility; (4) the assumption that time preference is accurately described by conventional exponential discounting of future costs and benefits; (5) the assumption that uncertainty is modest and manageable; and, (6) the assumption that for most questions of interest, the system under study can reasonably be treated as linear (1999, p. 271).

These assumptions are underpinned by a positivist philosophy of science, are deterministic and significantly simplify social aspects such as governance and what motivates people (Geels, Berkhout, & Vuuren, 2016). A 'global planner' is assumed, with 'perfect foresight' between now and the end of the century, allowing for the identification of lowest cost pathways (Grubb et al., 2014, p. 411). Mitigation

[24] www.thepmr.org

actions happen sequentially and at the margin (Fankhauser & Stern, 2016), focusing on a particular scale (Geels et al., 2016). A high degree of certainty about economic structure, growth rates and available technologies is assumed.

CM policy models form the basis of CM policymaking and little attention is paid to the model assumptions or the theory from which the models are developed (Geels et al., 2016); rather their outputs are accepted as useful and accurate indicators of the impact of policy action against policy objectives. Factors such as political economy, power and institutions, whilst cited as being very important to CM policy, are seldom afforded focused attention by the CM policy CoP (Geels, 2014; Giddens, 2009; IPCC, 2014b). Commentators have observed that social scientists have been forced into an 'end-of-the-pipe' and auxillary role in climate change, one that prioritises supporting and interpreting natural scientific and technological developments for decision makers (see the discussion in Leyshon (2014)). From within this constrained engagement with knowledge, the field of CM policy is rendered incapable of critically reflecting on itself, and therefore structurally unable to consider its own 'approach', or to see the hegemonic worldview from within which it operates. The planners Rittel and Webber argued as early as 1973 that the reductionist scientific paradigm and method is ill-suited to open societal problems (such as climate change): 'We shall want to suggest that the social professions were misled somewhere along the line into assuming they could be applied scientists - that they could solve problems in the ways scientists can solve their sorts of problems. The error has been a serious one' (1973, p. 160).

Whilst the reasons for the operation of the CM CoP within the hegemonic worldview are beyond the scope of this thesis, it is worth suggesting three possibilities here. First, Becher (1987) reflects that the tacit knowledge of disciplines - 'approach' in the working terminology of this thesis - reflects aspects of the fields which they attend. The natural science provenance of CM policy is one of these aspects, and its formal emergence onto the international policy agenda in 1992 under the UNFCCC, at the height of modernist and neo-classical intellectual and cultural hegemony is another.

Second, CM policy presents a systemic and fatal challenge to the dominance of the fossil fuel political economy (one of three transitions which Capra argues are driving an evolution of the hegemonic worldview). CM policy advocates have had to defend themselves against a powerful, long-standing, well-resourced and active opposition, a 'vicious campaign' (Adaptation Conversation, 15 October, 2014). This opposition operates from within the reductive worldview, only admitting evidence and knowledge developed through classical scientific method. To defend against this sustained attack, the CM policy CoPs have, to date, largely focused on refuting it within the same reductive worldview (Transport Conversation, 24 November, 2014) given its cultural hegemony. The IPCC was described by a climate mitigation policy veteran Metz as doing its work by 'bringing together the best scientists, engineers, and economists of the world to critically look at all available publications' (Metz, 2010, preface).

Third, Corbera et al. (2015) suggest that the exclusion of disciplines and knowledges in AR5 WGIII may be necessary to attain consensus on policy advice. They note a far stronger harmonisation of views within

this Working Group than when research on climate change within the broader social science community is considered.

## (c) The influence of the hegemonic worldview on the SA CM CoP's approach

Seven themes are teased out of the more general discussions of this section up until this point, and used to structure a specific analysis of the influence of the hegemonic worldview on the SA CM CoPs approach.

### (i) Rationality and objectivity

The SA CM CoP appeals routinely to rationality and objectivity, devoid of the notion of values and the possibility of multiple perspectives. As the Development Provocateur Kane observed at the DevMit Forum, there is a reliance within the SA CM CoP on the ability of 'good objective science' to inform rational planning and decision-making (Kane, 2014a). The Development Provocateur Kumar reflects that 'climate change is about statistics and science' (Kumar, 2014, p. 49).

Kane observed that, in the DevMit Forum, a deeply emotionally evocative keynote presentation was awkwardly received by the group, and later described in plenary as 'cheeky'. The first discussions about human lifestyle and diversity only came in the second day with Essop's presentation on South Africa's experience of National Development Planning (2014a, p. 5). The Adaptation Conversation (15 October, 2014) reflected that whilst 'adaptation is hard to measure; mitigation is hard to feel'. Conversely, the CM Reflective Conversation (27 November, 2014) suggested a collective CoP understanding that 'we need objectivity'. As Development Provocateur Kumar notes of the SA CM discourse, '… that there is little sense of the people…climate change… needs to develop a heart' (Kumar, 2014, p. 49). The SA CM policy CoP seldom asks what is valued in our society, and how these values relate to the issue to which SA CM policy attends. The orthodox economic assumption of rational individuals as best portraying humanity is itself value based, supporting externally imposed policy instruments that force compliance. Ostrom's (1990) work has revealed how an alternative assumption of social connection and collaboration as dominant values results in quite different policy implications for issues involving scarce communal resources.

Kane comments of the SA CM CoP, 'the knower in this world is disembodied, and does not believe that human emotion is part of knowing' (2014a, p. 5). The LTMS lead facilitator wrote that climate change in 2005 required 'a national conversation… in which emotion is stripped out of the equation and trusted and reliable data inserted in its place' (Raubenheimer, 2011, p. 3). The first CM policy conference (in 2005) was held adjacent to the room holding the annual African climate science research conference, to reinforce the position that South Africa's response should be based on science (Interviews, 2014), with the LTMS formalizing the connection between the country's scientific research capacity and its climate policy (Rafey, 2013). An interviewee reflected that government learnt a lot of what it does on climate mitigation policy through the science-policy interface of the LTMS (Interviews, 2014). The NCCRWP extends this objective rationality, anticipating the development of 'desired emission reduction outcomes for each significant

sector and sub-sector of the economy based on an in-depth assessment of the mitigation potential, best available mitigation options, science, evidence and a full assessment of the costs and benefits' (RSA, 2011, p. 5).

The SA CM CoP does not venture regularly into the spaces made available through either the Development Provocateur reflections or the Conversations, and particularly in the more intimate setting of the latter a level of discomfort was evident, with CM policy CoP participants reporting experiencing an awkwardness and defensiveness (SA CM CoP Reflections Conversation, 27 November, 2014). This awkwardness may have stemmed from the SA CM CoP being poorly equipped to discuss the differences in approach between social scientists, engineers, natural scientists and modellers, and an uncomfortable sense that 'we have preconceived ideas and live in lala land' (SA CM CoP Reflections Conversation, 27 November, 2014).

The Conversations started to open up both awareness of and discussions on the SA CM CoPs approach. The SA CM CoP participants became aware of their lack of tools to work with different perspectives, 'how do we work with this?' they asked (SA CM CoP Reflections Conversation, 27 November, 2014). It was also reflected that the Conversations helped one researcher get out of his box and get other perspectives, and that this happens more readily in practice than in research (SA CM CoP Reflections Conversation, 27 November, 2014). The CoP ignores the validity of co-existing multiple perspectives, appealing strongly to a perceived neutrality.

This appeal to objectivity and rationality excludes an explicit consideration of the role of values both within the SA CM CoP and in SA CM policy. Values are not a legitimate topic for discussion or investigation. Where they have been incorporated, they are done in the form of 'policy principles' (NPC, 2011; RSA, 2011), and as such disguised as being consensual and fixed, and external to the 'objective scientific analysis' that forms the basis of SA CM CoP activity.

**(ii) Portraying the world as deterministic and linear**

SA CM policy relies on a stable and certain view of the issue to which CM policy attends, with linear and sequential conceptualisations of the future strongly underpinning its mental models. This worldview then emphasises the accumulation of knowledge as a basis for action, assuming that certainty is the general condition and causality is linear: the better the world is known the more mitigation action will result. Kane describes the SA CM CoP as viewing 'the future as an island waiting to be discovered' through accurate data and improved models (2014a, p. 5). Rafey (2013) finds the NCCRWP to rest heavily on a bureaucratic style management approach, underpinned by the assumptions that more knowledge and information, better and more skilled expert analysis are desirable; the NCCRWP has an 'enthusiasm for dynamic and evidence-based policy'. Indeed he reports a desire for more information and analysis across all stakeholder groups within the SA CM CoP. The Development Provocateur Mistry (2014) intimated that the mitigation sector considered a lack of knowledge as being a deficiency.

As in the broader CM CoP, the SA CM CoP emphasises quantitative modelling as a key policy analytical tool (Rafey, 2013), orientated towards neoclassical economics, optimisation and equilibrium (Lane-Visser, 2015). Notable instances of the use of these models include the LTMS, the MPA, the pathways to Deep Decarbonisation Programme and the carbon tax modelling (Altieri et al., 2015; Altieri et al., 2016; Caetano & Thurlow, 2014; Devarajan, Go, Robinson, & Thierfelder, 2009; Hughes, Haw, Winkler, Marquard, & Merven, 2007; RSA, 2015) and are often embedded within scenario planning processes. Computable General Equilibrium (CGE) models of the economy, and energy models such as SATIM[25] are typically used, underpinned by baseline trajectories[26]. Currently modelling work within the SA CM policy CoP and CM policy CoP is focused on considering ways of linking these economic and energy models (Altieri et al., 2016; Lane-Visser, 2015), expanding from the 'knowability' premise of positivism which holds that the more complex the model, the better it is able to reflect reality.

In a deterministic and 'knowable' world, uncertainty is considered to be abnormal, something to be managed through assessment, quantification and ultimately control (Jasanoff, 2007). For example, the NCCRWP policy tool used to evaluate policy progress, the 'GHG Emissions Benchmark Trajectory Range' (DEA, 2011) (see Figure 5 below), captures uncertainty over emissions to the single tonne up to 2050, prioritising quantitative accuracy but leaving no possibility for engaging with emissions levels outside of this specific range. This approach is sustained despite the recognition that economic (and likely energy) modelling is better suited to explaining timeframes three to five years hence (Economic Growth Conversation, 20 November, 2014).

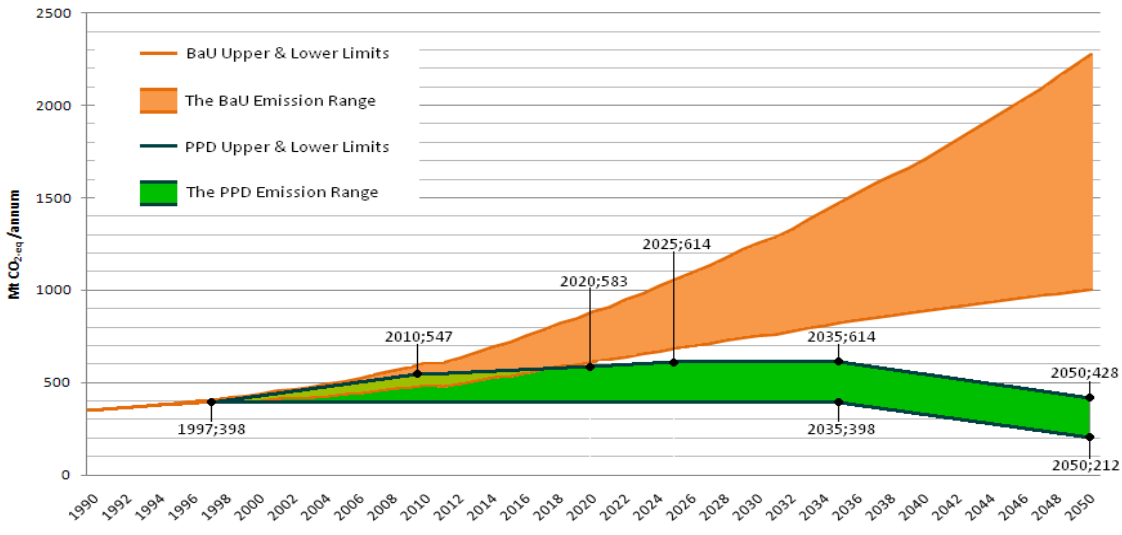



*Figure 5: The GHG Emissions Benchmark Trajectory Range (*Source: *DEA, 2011)*

[25] SATIM is the South African application of the TIMES (The Integrated MARKAL-EFOM System) energy modeling platform, developed by the Energy Research Centre at the University of Cape Town.
[26] For example 'BAU' in the LTMS, 'WOM' and 'WEM' in the MPA

### (iii) Providing a disjunctive and reductive underpinning

The SA CM CoP has a detailed understanding of individual GHG emissions and mitigation technologies embedded in separate sectors (DEA, 2014a, 2014c; Energy Research Centre [ERC], 2007). However, it only pays attention to the interconnections between areas through the lens of quantitative energy and economic modelling where linkages are represented by formalised equations. Energy models also shed light on aspects of cross-sectoral and systemic issues from the particular perspective of energy demand and supply. Less work has been done on cross-sectoral mitigation drivers and mechanisms (although forthcoming analytical modelling work for the mitigation policy system is reported to be taking a far more integrated and systemic approach (Cohen, personal communication, December 2017)).

Whilst at a rhetorical level climate mitigation has been mentioned in certain key cross-cutting policy statements, including policy statements of the ANC, bespoke Executive statements (Van Schalkwyk, 2008), State of the Nation Addresses and Budget speeches, the DEA is seen as solely responsible for SA CM policy, with little dedicated CM policy capacity in other national departments. The DEA has little voice in initiatives central to SA CM policy but outside their immediate control (Chandrashekeran et al., 2017; Worthington, 2014), such as the REIPPPP, despite these being where most of the material emission reductions are occurring. The two economy-wide mitigation instruments of the carbon tax and carbon budgets were developed in isolation, by different departments (NT and the DEA) with no regular or embedded process for discussion. The draft Climate Change Bill, a DEA initiative, doesn't even mention the carbon tax. Whilst expert consulting projects were undertaken to consider their interaction at various points (Tyler & Cloete, 2014; Vivid Economics, DNA Economics, & Tyler, 2016) only latterly has an integrated mitigation policy suite been envisaged.

Integration of SA CM policy with other policy areas has proved challenging (Trollip & Tyler, 2011), pursued largely via a 'mainstreaming approach', to various effect (Cloete, Bole-Rentel, Cohen, Constantinou, & Mhlaba, 2014; Department of Environmental Affairs and Tourism, 2004; Giordano, Hall, Gilder, & Parramon, 2011). Institutional platforms to facilitate integration are compromised; the IGCCC lacks executive power, budget and secretariat, with poor to no attendance by key government departments such as NT, no executive representation and insufficient mechanisms to ensure that climate mitigation discussions go beyond the Parliamentary Environmental Portfolio Committee, or retain the engagement of key Ministries (Giordano et al., 2011). Currently, alignment and co-operation between both ministries and departments in the SA CM policymaking system is weak (Chandrashekeran et al., 2017). In 2010/11 a process was run to support the development of the low carbon theme in the NDP, including a substantial and high-level stakeholder consultation, and this is currently being revisited (NPC, 2018). Ultimately however, given the organisation of the NDP report, climate mitigation was included in the 'environment' chapter, with little depth of coherence with recommendations of the economic chapters, which include energy.

SA CM policy work is also isolated from the other tiers of government policy (metro and provincial) with the connection to the national level discussion thinly developed. It was noted by a parliamentarian at the Parliamentary Colloquium (28 October, 2016) that SA CM policy is not getting assistance from the grassroots, provincial or metro level leadership. Provincial and city spheres are scarcely mentioned in the NCCCRWP apart from the requirement for them to give effect to the national level policy document (RSA, 2011, p. 37). The draft Climate Change Bill attempts to address this.

A reductive and disjunctive approach is also evident in another dimension of SA CM policymaking, that of separating climate mitigation both from the other themes of climate change (such as adaptation and 'loss and damage') (Poverty Conversation, 6 November, 2014), and from other environmental crises, including ocean acidification, biodiversity loss, and phosphorous and nitrogen cycle disruption (SA CM CoP Reflections Conversation, 27 November, 2014). Development Provocateur Sulle (2014) commented that there is little serious attempt to integrate across these areas.

**(iv) Abstract and decontextualised**

Encouraged by its international framing and the South African negotiating team's success on the international policy stage, SA CM policy tends to abstract its work from its context (Chandrashekeran et al., 2017; Parliamentary Colloquium, 28 October, 2016). Whilst the international CM policy CoP acknowledges in principle the importance of context through its 'nationally appropriate' mitigation concepts, the SA CM CoP has interpreted 'nationally appropriate', similarly to most other developing countries, as being supportive of traditional development indicators rather than an invitation to engage deeply with context (see the discussion in section 3.4.2. (b)). This approach is both encouraged and exacerbated by the UNFCCC mechanisms for financial and technological assistance to developing countries (the Clean Development Mechanism (CDM), Nationally Appropriate Mitigation Actions (NAMAs), and most recently the Green Climate Fund[27]) as internationally standardised funding protocols and requirements are applied.

Dimensions of context with which the SA CM CoP insufficiently engages can be found across the dimensions of history, the physical environment, scale, culture, institutions, people, space and time. An interviewee emphasised the influence of South Africa's MEC history commenting that an economy oriented towards fossil fuels took one hundred years to develop, and that it can't change overnight (Interviews, 2014). The physicality (in infrastructure) and social expression of the MEC in skills and education orientation, contracting relationships, culture and institutions is deeply embedded in South African economy and society.

The Development Provocateurs found that there was little reference to scales of policymaking beyond the national: Kumar comments how 'the city and neighbourhood scale discussion was largely missing' (2014,

[27] www.greenclimate.fund

p. 49), with van Ryneveld noticing a lack of attention to the meso and local policymaking levels by the SA CM CoP, a scale where 'much of the urban development discourse is focused' (2014, p. 37). This was corroborated by an Interviewee noting that South African national government tends to be rather suspicious of cities (Interviews, 2014). In the Adaptation Conversation (15 October, 2014), a CM CoP member remarked how 'we don't really think so much in terms of projects, but rather in policies, regulation'. The reliance on quantitative modelling exacerbates this process of abstraction from the unquantifiable aspects of the SA CM context. Ramkolowan (2014) reflected that the SA CM policy CoP's view also focused on a linear, long-term (to 2050) concept of time, encapsulated in 'often abstract' scenarios.

The spatial dimension is also not routinely considered, with Development Provocateurs Kane (2014b) and Black (2014) both identifying apartheid's legacy of segregation at a rural / urban and then intra-urban level as spatial features contributing to South Africa's high carbon and low employment growth path, and one which was not raised at the DevMit Forum. The Transport Conversation (24 November, 2014) discussed how, with regard to the transport sector, the SA CM CoP focused on quantifying emissions from various transport technologies but focused less on aspects such as travel time and distance.

**(v) Pursuing a technocratic and finance orientated approach**

The SA CM CoP believes that demonstrating a technologically and financially feasible path of mitigation action is useful (Chandrashekeran et al., 2017), and has generated a substantial quantitative information base on technologies that mitigate emissions, primarily through the LTMS (which used Pacala and Solow's technology wedge approach and assessed for cost efficiency) and the MPA. The economic modelling used with the energy models and to assess the carbon tax prioritises financial indicators. Rafey's (2013) argument that SA CM policy is driven forward by sub-groups coalescing around three central technical models is relevant here too.

The Development Provocateurs Kane, Mistry and Verwey reflected on the quantitative and technical nature of SA CM policy CoP tools and outputs: 'Many of the research outputs presented over the DevMit Forum were framed [like this -] as tables, models, graphs, charts' (Kane, 2014a, p. 5). The 'discourse focused on technical tools and models that could measure co-benefits… and multi-criteria decision making dominate' (Mistry, 2014, p. 33). Verwey was struck by 'how strongly technocratic much of the discussion [in the DevMit Forum sessions on Nationally Appropriate Mitigation Actions and sustainable development] was' (2014, p. 19). Interviewees emphasised how technology is the basis for allocating carbon budgets and the lens through which climate mitigation action implementation is being approached (Interviews, 2014). Kumar noted that most of the small-scale innovations considered by the [DevMit Forum] proceedings were 'technology improvements rather than community/citywide civil society processes' (2014, p. 50).

The DEA explicitly identifies mitigation policies as including regulatory instruments, economic instruments, government procurement programmes and direct and indirect investment by government (DEA, 2017c), demonstrating the broader CM policy bias towards price instruments (Geels et al., 2016). The possibility of social, cultural, and value-oriented policy interventions is largely ignored. Innovation is also considered by the SA CM policy CoP as largely pertaining to technology (neither process nor policy innovation are mentioned in the NCCRWP), and this innovation is encouraged through the creation of institutional niches, financial incentive schemes and the 'stick' of the carbon tax (RSA, 2011).

The SA CM CoP's financial and technology focus is itself dominated by aspects of the hegemonic worldview. Kumar found the discussion on climate financing

> very disturbing and straightjacketed. It didn't look at innovative ways of resourcing mitigation measures and relied predominantly on funding from the global north. The whole sector of microfinance, community savings, local resources etc. were completely overlooked as creative finance mechanisms (2014, p. 50).

**(vi) Driving a predict and control approach to policymaking**

The dominant SA CM policymaking model remains a top-down, mechanistic and technocratic one - policymaking as a black box out of which a series of instruments to regulate South Africa's GHG emissions will emerge. Development Provocateur Kumar (2014) observed an underlying assumption at the DevMit Forum of governments being in control of their nation and cities. The NCCRWP conceives of a top-down cascade of mitigation targets: 'Defining desired emission reduction outcomes for each significant sector and sub-sector of the economy…'; 'Adopting a carbon budget approach… in relevant sectors and/or sub-sectors and, where appropriate, translating carbon budgets into company level desired emission reduction outcomes'; mitigation plans to achieve DEROS at company, sector or subsector level (RSA, 2011, p. 5). From the assumption of control flows another; that top-down policy targets are effective at achieving that control, evidenced in the strong emphasis on defending the GHG Emissions Benchmark Trajectory Range by a 2014 Interviewee who was 'very worried' that a review of the Range (being called for by Business at the time) would 'fundamentally undermine all the work that is happening in SA' (Interviews, 2014).

This focus on content work and analysis as opposed to process considerations prompted an Interviewee to note that the targets developed by the LTMS and formalised in the GHG Emissions Benchmark Trajectory Range do not constitute a plan (Interviews, 2014). The concept of time is used only as identifying external commitment points, or points of evaluation. Another Interviewee observed that targets were justified by technical scenarios but the work to translate them into a negotiated plan was never done (Interviews, 2014).

Further, the SA CM CoP was considered by Development Provocateur Verwey (2014) to be poor on implementation, a perspective backed up by literature (Boyd & Coetzee, 2013; Chandrashekeran et al., 2015; IPCC, 2014a; Trollip, Torres Gunfaus, & Du Toit, 2015). Further Development Provocateur reflections on this theme included that of Kumar who noted:

> an assumption that the move from plan to implementation is somehow automatic, with no discussion of the role of intermediary organisations... who play a significant role in lobbying and advocating civil society and the State around development and mitigation issues… Implementation is about 'deal making and negotiations'. This is not something that the SA CM CoP understands at all (2014, p. 49).

Van Ryneveld observed that 'there was relatively little attention paid to implementation and building the institutions required' (2014, p. 37). This emphasis on knowledge, abstract policy scenarios and technical and financial feasibility is sustained (Altieri et al., 2016; Organisation for Economic Cooperation and Development [OECD], 2017), possibly at the expense of deep engagement with how implementation happens.

Policy documents reveal aspects of a different understanding of policy at a rhetorical level: the transition to a low carbon economy is described in the NCCRWP as a journey (RSA, 2011), an understanding sustained in the NDP (NPC, 2011). There have also been regular stakeholder consultations during the development of SA CM policy, including the 5 yearly conferences or dialogues and specific consultations on various issues such as the INDCs, in line with a more general environmental policymaking tradition in post-democracy South Africa (Chandrashekeran et al., 2017). However a 2014 Interviewee from outside the SA CM policy CoP warned against the dangers of 'fetishising' participation, without understanding power relations (Interviews, 2014). This caution has been borne out over the years. The NCCC, established for the process of collaboration between government and stakeholders, has become a platform for reporting rather than interaction (Worthington, 2014), whilst in the Economic Growth Conversation (20 November, 2014) an economist noted that the climate change argument is not being inserted into the deliberative space around key infrastructure decisions, and described this space as political and stakeholder oriented, slow and incremental. Little attention is paid to policy integration and devolving ownership for policy objectives to those directly engaged with policy implementation.

It is interesting to note that right at the beginning of the SA CM policy process the LTMS contained aspects of an alternative approach to policymaking, pioneering an innovative process-evidence design that enabled participatory co-production of knowledge and established the SA CM CoP. This generated a high degree of trust and consensus which, through lack of attention to policy process, has subsequently been eroded (Interviews, 2014; Tyler & Torres Gunfaus, 2017). The LTMS has therefore been described as the high point of stakeholder participation in SA CM policy (Raubenheimer, 2011). There have not been further processes of knowledge co-production (as opposed to consultation).

**(vii) Supporting an introspective domain of experts**

The SA CM CoP both values and generates complex knowledge and expertise (Worthington, 2014). Development Provocateur Kane spoke to the example of the SA CM CoP's presentation of Multi-Criteria Framework analysis to consider the sustainability contribution of a mitigation project, noting that this technique assumes 'that an expert can know a complex situation, assign weightings to contested matters of value and valuing, and come to an independent decision which will be right (according to this worldview) and adopted.' (2014a, p. 5). Similarly, the South African 2050 Pathways Calculator tool, intended by the DEA to engage stakeholders outside of the SA CM CoP, remains strongly aligned to and underpinned by the SA CM CoP's expert modelling and scenario tools and technocratic approach (DEA, 2013). The user of the Calculator requires access to an internet connection, and education in a particular form of knowledge.

During the Conversations, members of the SA CM CoP revealed their valuing of experts: In the Employment Conversation (20 October, 2014) surprise was expressed that labour experts were not able to say much about solutions; in the SA CM CoP Reflective Conversation (27 November, 2014) one of the participants stated that 'we must go to the expert if we need to know about a development aspect'. Along with expertise and specialised knowledge comes a high level of jargon, something Development Provocateurs (Kumar, 2014; Mistry, 2014) commented on specifically. In the Conversations there were calls to 'demystify the conversation, make it less scientific and more tangible' (Adaptation Conversation, 15 October, 2014). 'There is so much jargon! I don't understand what you are saying, the language doesn't translate well, I felt lost' (Poverty Conversation, 6 November, 2014). A clear distinction is assumed by the SA CM CoP between knowledge and communication of that knowledge (SA CM CoP Reflections Conversation, 27 November, 2014). From here, the SA CM CoP identifies one of its main challenges as being maintaining a balance of effort between the production of this knowledge and communicating it (SA CM CoP Reflections Conversation, 27 November, 2014).

This aspect of the SA CM CoP's dominant approach betrays an intellectual arrogance, both in dealing with experts from other fields, and with other forms of knowledges. The development practitioners and researchers in the Cities Conversation (19 September, 2014) reflected that 'Cities are complex: the climate mitigation community keeps trying to simplify cities – this does not work; and it reflects an arrogant attitude.' 'Climate people are disrespectful when addressing cities by ignoring the expertise around them'. Stakeholder consultation on SA CM policy issues has largely been within the SA CM CoP itself, and rarely have these consultations been accessible to non-experts, either grassroots communities or those involved in other policy areas.

The Development Provocateurs further reflected on SA CM policy as an isolated field and practice, one which loves talking to itself [as academics, policymakers and practitioners] and forgetting there is a 'real' world out there consisting of other change agents e.g. opinion formers and marketers (Mistry, 2014, p.

32). Trollip (2014) commented on the SA CM policy field's academic insularity in that it fails to engage the social sciences. In the Conversations, a SA CM policy researcher reflected that '... a lot of the research done [by the SA CM CoP] might be new to the researcher, but not necessarily new to the world. It is important to keep in touch with the literature beyond climate policy' (Poverty Conversation, 6 November, 2014). The SA CM CoP reflective Conversation acknowledged that research in the SA CM CoP is just 'chatting to the same people and reading the same literature', and in the Cities Conversation that the SA CM CoP is 'ambitious, and isolated in a certain unhelpful way'.

### 3.3.3 Shaped by a normative undercurrent

The SA CM CoP has a strong normative undercurrent to both its objectives and approach, although there is no consensus within the CoP about exactly what these norms are, they remain tacit and largely unacknowledged. Strong values are associated with key aspects of SA CM policy, such as development priorities, capitalism, energy intensive business, international influence, donor organisations, materialism, local initiatives, civil society and organised labour. Stakeholder groupings within the CoP tend towards particular value perspectives, and these serve to strengthen sub-group cohesion and identity. Evidence of these normative aspects surfaced empirically in the SA CM CoP Reflective Conversation (27 November, 2014) where SA CM policy research was described as 'covert activism', and less reflexively that 'its all about policymakers, shifting our perspectives, shifting other's perspectives'. The Conversation identified 'a tension between activists and researchers in our community' and participants questioned to what extent the SA CM CoP is evangelising as opposed to doing 'objective' research. There is an assumption that the SA CM CoP, particularly its government, civil society and academic members, is comprised of 'good people' working for 'change to the status quo' (Poverty Conversation, 6 November, 2014). A number of the more senior members of the SA CM CoP were active in South Africa's apartheid liberation struggle, and have a strong activism bent, channelled into environmental issues once democracy was achieved in 1994.

The NCCRWP policy objectives appeal to normativity in their use of the words 'fair' to describe the country's contribution to the international CM policy effort (RSA, 2011, p. 11), and the set of principles which guide the NCCRWP further elaborate on the moral basis of the policy area, as do the first two principles guiding the environmental chapter of the NDP (a 'just, ethical and sustainable transition' and 'global solidarity' (NPC, 2011, p. 200)). This normative undercurrent is at odds with the SA CM CoP's assumptions of rationality and objectivity, and the implications of this are neither actively and systematically engaged nor resolved.

### 3.3.4 Discounting the social realm

Similarly to the broad CM CoP, the SA CM CoP is dominated by engineers and economists, with many environmental management graduates inhabiting the practitioner realm. Here too, social scientists largely contribute in Lowe's 'end-of-pipe' role. Institutions, behaviour, how change happens, values, culture,

belief are poorly understood. The version of the person the SA CM CoP models is an abstract one of someone who is price-taking, rational, and possesses perfect foresight and full information (Geels et al., 2016). Development Provocateur Trollip noted of the SA CM policy CoP that the 'technocratic, science-based problems and solutions presented were relatively settled but that more focus was required on analysis of the social and political challenges' (2014, p. 30). Aspects of this have been discussed in the previous section; the SA CM CoP has a particular approach to how policymaking occurs, the role of values is discounted, and contestation around concepts central to SA CM policy is ignored. Humans are treated 'as somewhat homogenous and atom-like… [and the SA CM CoP's worldview] is quite removed from thinking about a social, political, cultural, historical, gendered world, which finds (and celebrates) diversity and difference' (Kane, 2014a, p. 5).

Of particular importance to the issue to which SA CM policy attends is power. Beginning with the LTMS the SA CM CoP has ignored power. In the environmental activist organisation Earthlife Africa's critique of the LTMS, Hallowes argues that 'the LTMS doggedly abstracts its analysis from social power relations' (2008, p. 30). One interviewee stated that whilst the LTMS identified a target range of emissions levels that are technically and financially feasible, these had not yet been subjected to the negotiation process that is the development of a plan to achieve them (Interviews, 2014). The implications of the SA CM policy objectives are a sizeable re-organisation of the current political economic incumbents and institutions (Burton & Winkler, 2014). The significance of this was underlined by an Interviewee: 'In South Africa, a small number of people control the whole economy, which impacts development (labour) issues, it impacts environmental issues' (Interviews, 2014). Another considered that right from its inception in the LTMS, SA CM policy fails to 'confront the very politically charged broader policy focus within the Departments of Trade and Industry (DTI), Mineral Resources (DMR) and Energy (DoE) on beneficiation, and energy intensive industry' (Interviews, 2014).

This neglect of engaging with power and politics was also highlighted by a number of the Development Provocateurs at the DevMit Forum: Black (2014) noted that presentation of modelling work on the impact of a carbon tax in SA showing a fall in the rate of employment did not emphasise the political unacceptability of this finding. Ramkolowan (2014) reflects that it is not clear if there is sufficient focus by the SA CM CoP on identifying the winners and losers, and identifying the opportunity costs, for any [mitigation] interventions. Black further commented that the very particular political institutional context (the MEC) is not addressed in the NCCRWP, or by the discourse of the SA CM CoP. Trollip noted that the SA CM CoP largely ignores domains that address material, political and institutional interests and highlight conflicting interests and how these need to be addressed (2014, p. 30). Kane argues that the SA CM CoPs approach is one 'perplexed by power' (2014a, p. 5). Certainly we have not prioritised engaging directly with the powerful: Few, if any, of the controlling beneficiaries of the current SA socio-political system are part of the SA CM CoP and as Trollip noted in his Provocateur briefing, they are 'a necessary part of the solution' (2014, p. 30).

## 3.4 Manifestations of the dominant approach in the SA CM CoP's engagement with transformative change and development

Development and transition were identified in section 3.1. as key concepts associated with the SA CM policy objectives. These are, however, high-level concepts, lacking in any one agreed definition (Fazey et al., 2017; Feola, 2015; Martinussen, 1997; Munck, 1999; Rist, 2007; Rostow, 1990; IPCC, 2007; Thomas & Mohan, 2007). Whilst it may be neither possible nor desirable to find such a definition at the high-level (Fazey et al., 2017) the implications of this 'fuzziness' include: a lack of substantive clarity, a difficulty n operationalizing the concept in the real world and subjecting it to scrutiny through research, the possibility of the concepts being co-opted by actors to defend the status quo, and inhibiting an understanding of social processes and mechanisms involved in transformational change (Feola, 2015). Such concepts can also obscure agency and causality, potentially 'detracting attention from more important problems and agendas' (Markusen, 2003, p. 871). Fazey et al. argue that there is therefore an onus on those using such concepts to provide an explicit interpretation in the context of their use.

The current section develops an argument that the SA CM CoP has not done this interpretative work. In the absence of this, the concepts of transition and development, (together with a plethora of associated concepts referred to in SA CM policy such as transformation, sustainable development, sustainable growth, sustainability, green growth, low carbon development and climate compatible development) become vehicles for augmenting the SA CM CoP's dominant approach, particularly aspects of the hegemonic worldview and international and environmental perspectives. Because the dominant approach is not a reflexive one, there is little awareness of the possibility of a more critical interpretation of these key high-level concepts.

A final observation before proceeding: whilst on a first reading the terms transition and development may appear distinct, this distinction is eroded as both concepts are engaged with more critically, thus justifying the brief treatment of transition before moving on to a more in-depth treatment of development. In many cases, observations that hold for one hold equally for the other.

### 3.4.1 A linear, technocratic view of transformative change

At the high-level, SA CM policy is replete with references to the need for transformative change: The NCCRWP uses the terms transformation, transition, and just transition (RSA, 2011); the language of a 'just transition' is used in the NDP (NPC, 2011), and was particularly emphasised in the low carbon stakeholder workshops supporting the policy document's development; the terminology was prominent in the Parliamentary Colloquium (28 October, 2016). This transformative change is aligned with a similar transformative change associated with the country's developmental vision; the NCCRWP speaks of aligning with 'developmental' agendas such as the 'broader social and economic transformation as envisaged by the New Growth Path' (RSA, 2011, p. 12).

At the point of entry onto the South African policy agenda, the LTMS provided the opportunity for a more specific interpretation of 'transformative change' in SA CM policy. The LTMS analysis demonstrates the gap between its lowest carbon trajectory, 'Use the Market' and the 'Required by Science' scenario (see Figure 6 below), describing the systemic change required to overcome this gap as involving 'people oriented measures' and 'to consider the energy–intensity of our economy, structurally' (SBT, 2007, p. 23), However this opportunity was not taken up, and there is little additional elaboration of these components of transformative change in the SA CM policy context.

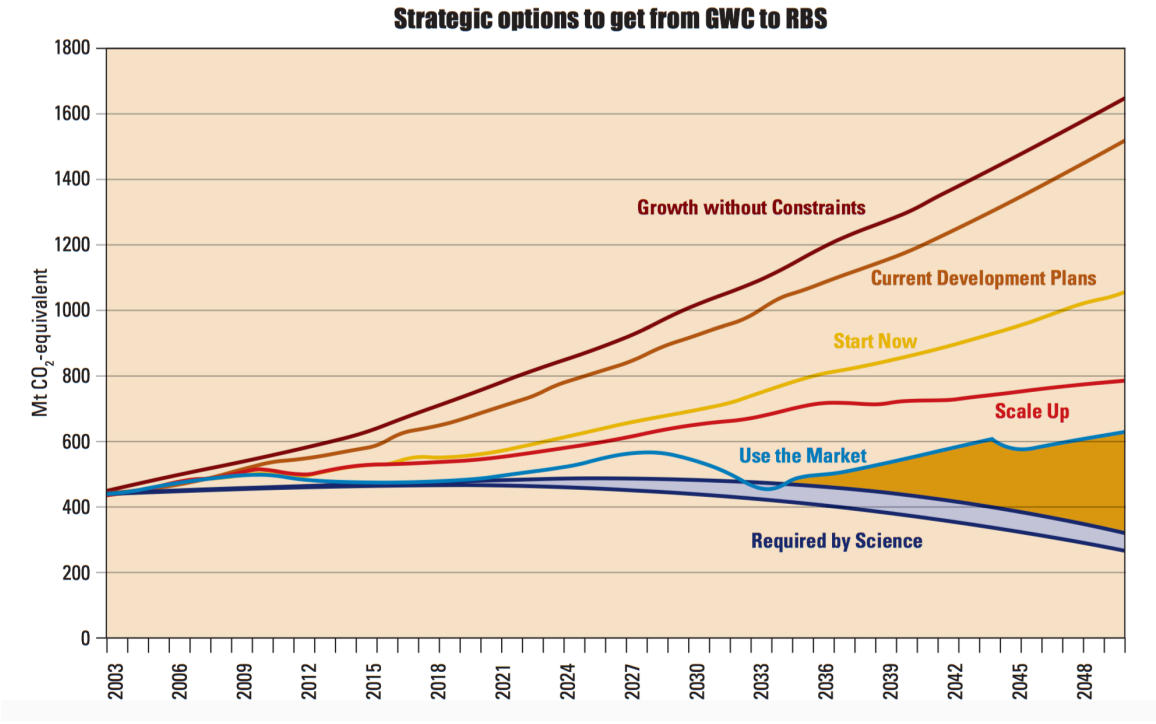



*Figure 6: Transformative change as reflected in the LTMS scenarios and trajectories (Source: SBT, 2007).*

In the absence of more detailed contextual interpretation, the transformative change envisaged by the SA CM CoP is defined by the hegemonic worldview; change largely occurs at the margin, in the realm of macro-economics, technology and energy systems, is linear, and is defined by GHG emissions indicators (the SA CM policy objective expressed in South Africa's INDC is of 'near zero emissions of carbon dioxide ($CO_2$) in the second half of the century' (RSA, 2015, p. 1). The social dimensions of transformation have not been prioritised by the SA CM CoP, and the heartland of CM modelling cannot address transformation of aspects such as values, norms, behaviours, societal organisation, politics or system goals (Geels et al., 2016). Stirling (2014) provides a general heuristic distinction between first, a more technically oriented and linear view of transformative change towards an assumed shared understanding of the goal - using the term 'transition', and second, the type of transformative change assuming a primary role for societal

re-organisation and political re-alignments with a plurality of goals, as 'transformation'[28]. This distinction is a useful one for elucidating the arguments of the thesis and as such is adopted going forward, with the SA CM CoP's dominant approach therefore identified as one of transition rather than transformation. Fazey et al (2017) infer that thinking in environmental discourse is dominated by the transition approach, which Hoyer (2010) describes as not substantially engaging with a broader societal interpretation of systemic transformation, more akin to Stirling's 'transformation'.

Despite the SA CM CoP's approach to transformative change being one of transition, the CoP does not look far beyond orthodox economics to understand how this change might happen. There is little research utilising the rapidly expanding literature on socio-techno transitions nor a focus on how structural economic change occurs.

### 3.4.2 A particular view of development

South Africa occupies a prominent position with regard to mitigation and development policy. Its negotiating team in the international CM policy process has risen to a position of prominence over the years, and plays a key role in championing developing country views. Members of the SA CM CoP have contributed in both articulating the development argument within the CM CoP (Klinsky & Winkler, 2014; Winkler, Boyd, Torres Gunfaus, & Raubenheimer, 2015; Winkler & Dubash, 2015), and in advancing the global ambition of the international policy CM CoP's work (Interviews, 2014). The LTMS was the first time of any significance that a national mitigation approach assessed development impacts (Interviews, 2014) and has been described as 'landmark' (Rafey, 2013), influential to international CM policy evolution (Dubash, 2009), and is internationally acclaimed (Wang, La Rovere, Yang, & Fedorsky, 2008). From the LTMS experience, the MAPS Programme has continued to experiment with mitigation scenario planning and the mitigation-development interactions in the developing countries of Latin America. The academic members of the SA CM CoP have also been particularly active in contributing to the issue of mitigation and development, for example: (Altieri et al., 2016; Chandrashekeran et al., 2017; Klinsky & Winkler, 2014; Rahlao, Mantlana, Winkler, & Knowles, 2012; Rennkamp, Haunss, Wongsa, Ortega, & Casamadrid, 2017; Winkler, 2017; Winkler et al., 2015; Winkler, Spalding-Fecher, Mwakasonda, & Davidson, 2002; Winkler & Dubash, 2015).

#### (a) An uncritical, unexamined approach

Despite the central positioning of - and orientation towards - development in its mitigation work, and internal agreement on both 'the need to consider mitigation in conjunction with socioeconomic priorities', and that this 'affects the standard by which progress is measured' (Rafey, 2013, p. 32), the SA CM CoP struggles to articulate a clear view of what development is and how it relates to mitigation (Cities

[28] This distinction is not one generally held across the literature, with Feola (2015) commenting on how differently the term transition is understood in relation to transformation by various authors.

Conversation, 19 September, 2014; Kane, 2014a). When asked how well the LTMS dealt with development, some Interviewees considered development to have been taken into account through the inclusion of welfare and employment indicators in the scenario modelling exercise. Some felt that as long as climate mitigation can be shown not to influence growth then development is accounted for, whilst others viewed electricity generation planning as development policy. Yet another group viewed stakeholder participation as sufficient expression of a 'development appropriate' response (Tyler & Torres Gunfaus, 2015). Similarly, when asked to identify characteristics of developing countries, and what distinguished policymaking in a developing as opposed to developed context, the SA CM CoP provided a very wide-ranging set of inputs (MAPS Programme DevMit stream presentation, 9 February, 2015). The position of inequality – one of the NDP's top policy priorities, reflected explicitly in the NCCRWP objectives - in relationship to the concept of development is also seldom interrogated. In a rare example of reflexivity, a 2014 SA CM policy CoP interviewee opined that the 'development context of mitigation was not understood at the time of the LTMS and is still not understood. We don't understand the impact of climate change nor how to approach it. We also don't understand all of our options' (Interviews, 2014). This situation aligns with the argument proposed at the beginning of this section (3.4.), that the high-level concept of development has not been critically interpreted within its particular SA CM policy context.

In his research on the SA CM CoP Rafey (2013) identifies five competing discourses of energy and climate mitigation policy, originating from different stakeholder groupings and with competing visions for SA CM policy. He finds that 'what constitutes a successful balance between socioeconomic and climate goals remains, in the words of philosopher W.B. Gallie, 'essentially contested' in the South African context (2013, p. 29). Gallie elaborates on essential contestation as being systemic, with conflict 'not… at one point only…but at a number of intimately related points: conflict along a whole front' (1949, p. 333). Forti (2013), through semi-structured interviews with thirty members of the SA CM CoP[29], demonstrates that many differences in understanding of how mitigation and development interact persists, both at a stakeholder category and individual level.

The SA CM policy CoP also does not engage substantially or critically with the multidisciplinary literature and practice attending to development issues. Here there is a different and ever expanding perspective of what development constitutes, how it differs from 'developed', how it is measured, what the implications are for policy, and contestation around its meaning (Thomas & Mohan, 2007). Rather, it will be argued in the following section that the CoP takes an orthodox economics view of development. More recently the general development literature has been augmented with a view from systemic global environmental crises (Raworth, 2012; Swilling & Annecke, 2012; Swilling, Musango, & Wakeford, 2015) which adds a further critical view of both the development / developing distinction, and the term 'developed' itself. Inequality is a key contemporary issue spanning the developing / developed divide, and is particularly

[29] 50% from civil society and academia; 23% from government and 8% from business (Forti, 2013) (author's own calculations).

prominent in South Africa. In CM policy the interaction of mitigation and development has always been 'climate-centric' (Hourcade, Shukla, & Cassen, 2015; Winkler et al., 2015), in other words, considered from a climate change rather than development point of view. The development policy community of practice is further assumed to be similar in its composition, approach and conceptualisation of its policy focus as the CM CoP; a community of experts focused on the quantitative, rational, linear, uncontested project of development in an objective manner. Development Provocateur Kumar (2014) found the SA CM CoP's understanding of what it terms development to be superficial, simplistic, out-dated, and unexamined, and in the Conversation Series the SA CM policy CoP was criticized for being naïve about the complexity of development challenges (Cities Conversation, 19 September, 2014; Consumption Conversation, 16 October, 2014).

That the high-level concept of development has no definitive interpretation in SA CM policy, and further that it is essentially contested is neither acknowledged nor routinely considered (Hallowes, 2008) with theorising on how mitigation and development interact remaining in its infancy (Altieri et al., 2016; Winkler et al., 2015). This is despite evidence of a similar contestation on what development is in South African development policy circles, with the NDP itself found to be internally inconsistent regarding what development means (Forti, 2013), bracketing contestation around the role of economic growth and how to achieve it with opaque references in the NDP to 'management,' 'implementation' and 'policy alignment' (Rafey, 2013). This inconsistency reflects the spectrum of views on development across South African society: Development participants (economists) in both the Employment (20 October, 2014) and Economic Growth (20 November, 2014) Conversations mentioned that the South African economic community is not internally aligned on the priority of economic growth, and stakeholders across the political, civil society and labour spectrums strongly contest either the priority status economic growth is afforded, and / or the neoclassical orientation of economic policy in general (Cock, 2014; Hallowes, 2008).

### (b) Development following the economic orthodoxy

In the absence of a critical perspective from which to engage development, the SA CM CoP has implicitly adopted the economic orthodoxy dominant in the international CM CoP's approach to development. Rafey finds that South Africa generally has a 'dominant, institutionalized vision of economic growth' (2013, p. 88), evident in the NDP and underpinned by the assumption that economic growth is necessary to address the three development policy priorities of employment, poverty and inequality (Death, 2014). This orthodox economic view of development also predominates in the international and broad CM CoPs, where development and progress are largely assumed to be driven by economic growth, as defined by the indicator Gross Domestic Product (GDP). Rafey (2013) finds the NCCRWP, like the NDP, adheres to the 'dominant institutionalised vision of economic growth'. This argument is supported by the Earthlife critique of the LTMS as following economic growth as the 'organising principle' of development in South Africa and climate mitigation going forward (Hallowes, 2008). Development Provocateur Mistry observed that 'much mitigation discourse focuses on emissions linked to GDP growth, with assumptions that growth

means development' (2014, p. 33). Box 7 below considers the interrelated concepts of GDP and economic growth from the perspective of CM policy.

*Box 7: Relating GDP and economic growth for CM policy*

An important distinction is often overlooked in both the academy and practice between the measurement indicator GDP and the concept of economic growth. Economic growth as measured by the GDP (Capra (1974/1983) refers to this as 'undifferentiated economic growth'), has been positioned at the centre of the economic and political agenda internationally, despite economists acknowledging its flaws as an indicator for human well-being (Bergh, 2011; Grubb et al., 2014; Munasinghe, 2011). Whether the measurement of GDP has a sufficiently strong link to development to warrant the focus it receives is the subject of a sizeable literature (Bergh, 2011). Within the international CM policy discussion the value of undifferentiated economic growth is implicitly assumed to be a foregone conclusion (Lane-Visser, 2015); most powerful framings of CM policy assume or argue uncritically for the continuation of economic growth (New Climate Economy, 2014; Stern, 2007). Technological innovation is a key aspect of this position. The alternative view (which also often conflates economic growth with GDP) is that continued economic growth and remaining within the UNFCCC limit of two degrees temperature rise is not possible, emphasising economic growth as the key driver of emissions (Hallowes, 2008; Klein, 2014; Smith, 2010, 2011). The discussion at the South African 2014 National Climate Change Policy Dialogue evidenced a very polarised version of these discourses, where either growth-as-usual or no-growth appeared as the only possibilities (Economic Growth Conversation, 20 November, 2014; National climate change response policy dialogue, 2014), with no critique or differentiation of the concept of growth itself. How the NDP and NCCRWP objective of inequality reduction fits into the development / economic growth / GDP discussion is also seldom engaged with.

The orthodox economic view of development dominating the SA CM CoP is unitary, singular, abstract and disembodied. The SA CM policy CoP seldom differentiates between aspects of development, such as poverty, education, health and unemployment, and the implications for SA CM policy of this differentiation. In the international CM CoP there is an assumption that CM policy in a designated developing country is categorically different to that of CM policy in developed countries, yet the implications of this assumption are thinly developed in the literature. The IPCCC AR5 WGIII (2014) acknowledges that not much time has been spent focusing on the specificities of the developing context. The dualism of either a developed or developing situation dominates conceptually and difference, context and detail are underplayed.

This lack of differentiation was heavily criticized at the DevMit Forum. Development Provocateur Black commented that 'there was relatively little mention of unemployment at the Forum and even less discussion of what a green and employment intensive growth path might mean. (Yet Black describes unemployment and underemployment in SA as ' a social, economic and political disaster which is not on the distant horizon, but of pressing and immediate concern' (2014, p. 20)). The lack of differentiation and context was also sharply contrasted with the development discussed in the Conversations. The Employment Conversation (20 October, 2014) found that the only way to address poverty and inequality

in SA is through the labour market, 'which is inherently spatial: Rural versus urban, formal versus informal are key aspects'. A CM policy CoP modeller in the Employment Conversation noted that engaging with employment researchers took her from 'an aggregate view (of employment) to an awareness of the extent of details which are important'. The Finance Conversation (21 October, 2014) revealed the complexity of the metro and development finance worlds in South Africa, with development participants commenting that 'mitigation people can do much more to understand (finance), especially how to access it'.

At the macro level, the orthodox economic approach of the SA CM CoP frames the relationship between mitigation and development through CGE modelling and input-output tables (Lane-Visser, 2015) to evaluate the economy wide impacts of mitigation policies on a set of development indicators (see for example (Caetano & Thurlow, 2014; DEA, 2014c; DEAT, 2007; Devarajan et al., 2009). These models approach mitigation and development interactions as deterministic, linear pathways into a knowable future. Either mitigation (LTMS) or development (Nakicenovic et al, 2000; Winkler et al., 2015) trajectories can then be assessed for their development (mitigation) impacts, and retrospectively re-engineered in an abstract modelling exercise to bring the two closer together (Altieri et al., 2016; Winkler et al., 2015; 2002).

The economic development orthodoxy is based upon a particular model of national development within an international context, underlain by the assumption that developing countries lack sufficient endogenous entrepreneurial capacity and hence rely on external sources of technological innovation to develop, a model which inherently justifies and perpetuates extraction and colonisation (Juma, 2014). This model remains dominant in the conceptualisation of development within the international CM policy CoP, where achieving development in 'developing countries' requires both access to global GHG emissions space and international financial and technical assistance to enable alternatives to 'business as usual' development paths[30]. Climate science is invoked to support this model, based on the principles of CBDR as discussed in section 3.3.1. above. The CDM and NAMA mechanisms of the UNFCCC have tied up much of the CM policy capacities of developing countries over the past two decades in perpetuation of this model, despite being framed by the international CM policy as issues of national appropriateness and national sovereignty (Tyler, Boyd, Coetzee, Torres Gunfaus, & Winkler, 2014; Winkler & Dubash, 2015). The South African Copenhagen Accord pledge also lies within this narrative, with the country pledging to implement mitigation and development to the extent that it is granted international technical, capacity and financial assistance (Wills, 2010). Grubb et al. (2014), in their substantial contribution to the evolution of CM policy from the perspective of the economics discipline, point to another assumption on how economic development occurs that they argue has hampered mitigation-development progress: that

[30] Corbera et al. (2015) have observed the domination of Northern voices within the IPCC, which may influence this particular framing. Similarly, the literature on NAMAs is written almost exclusively by developed country researchers (Tyler, Coetzee, Torres Gunfaus, Boyd, & Winkler, 2012).

transformations in the energy sector have no implication for economic progress. The economic and energy systems are treated separately in orthodox economics, and separately optimised in economic modelling.

The influence of the economic orthodoxy of the international frame is intensified by the requirement under the UNFCCC that developed countries contribute financially to the climate change response of developing countries. As such, DEA has access to off-budget donor funding to support SA CM policy development, unusual in South African government, and that has allowed the climate mitigation agenda to develop far quicker than many others, particularly those of line departments closely associated with the implementation of the policy (Interviews, 2014). Donor funding further lends the donors a level of involvement and influence in determining the policy activities (for example, the German donor agency GIZ has funded many of national DEA climate mitigation policy consultancies).

### (c) A disjunct between mitigation and development

The hegemonic worldview's influence is also evident in the reductive and separate treatment of development and mitigation in CM policy. Development policy is understood as pertaining to social and economic policy areas, whilst CM policy is by origin, conception and institutionalisation, environmental. These two distinct areas are then seen as needing to be aligned and co-ordinated. Both the UNFCCC and Kyoto Protocol texts exemplify this in the language used. For example the UNFCCC affirms that 'responses to climate change should be coordinated with social and economic development in an integrated manner with a view to avoiding adverse impacts on the latter, taking into full account the legitimate priority needs of developing countries for the achievement of sustained economic growth and the eradication of poverty' (UN, 1992, p. 6). The United Nations Conference on Sustainable Development attempts to bridge these two areas[31], with a general trend towards integration as evidenced by the evolution from the separatism of the Millennium Development Goals in 2000 compared to the more integral framing of the 2015 Sustainable Development Goals (Swilling et al., 2015). The early mechanisms and concepts designed to support mitigation in developing countries are borne of this conceptual disjunction: the CDM at the individual project level and NAMAs at the sectoral and policy programme level. Projects are identified first for their mitigation impact, and then consideration is given to how they can be designed to meet development objectives (a co-benefits approach). South Africa, somewhat uniquely amongst developing countries, has largely resisted or ignored these international CM policy mechanisms; it has not engaged substantially with the CDM (Fay, Kapfudzaruwa, Na, & Matheson, 2012), and both the term 'NAMA' and LCDS are absent from the NCCRWP (Tyler et al., 2014)[32]. This disjunction is evidenced in the CM policy modelling heartland, where mitigation pathways are modelled as being distinct from the baseline, which

[31] Sustainable development is discussed as a bridging concept between mitigation and development, discussed in section 3.4.4.
[32] The country's draft Third National Communication identifies that the Flagship Programmes have NAMAs embedded within them, but only identifies two, both of which are in early stages of development.

extrapolates current economic structures and policy pathways into the future assuming climate change does not exist. The South African Copenhagen Accord pledge is based upon such a narrative; South Africa pledged to reduce its emissions 34% in 2020 and 42% in 2025 below a 'business as usual' trajectory (Wills, 2010).

Both the institutional and conceptual separation between CM policy and development is reflected and augmented in the academic community: Swart et al cited in Huq et al. (2006, p. 6) note that 'until recently, climate change and development communities operated largely independently of one another, in both research and policy'. Formally, the development CoP, largely due to resource constraints, made a decision to engage with climate change largely through the (climate negotiation determined) issue of adaptation, and have concentrated their efforts on this subsequently (Parnell, 2014). That there is a rise in the proportion of the global poor situated in middle-income industrialising countries increasingly challenges this decision (Parnell, 2014; Wlokas, Rennkamp, Torres, Winkler, Boyd, Tyler, Fedorsky, 2012), and authors are calling for the development CoP to re-consider their stance towards climate change mitigation (Boyd et al., 2009; Forti, 2013). The climate change articulation of issues (adaptation, mitigation, technology and finance) is very foreign to how the development CoP frames issues of development; as poverty, unemployment, hunger, and education (Huq et al., 2006). From a disciplinary standpoint, the two fields are dominated by separate disciplines: climate change by the natural sciences and development by the social sciences (Huq et al., 2006).

At the sectoral, programme and individual (offset) project level, co-benefit methodology is employed to connect mitigation and development (see Box 8 for a discussion), most often quantitative in orientation. There is little consideration in either research or practice of the connections between the multiple scalar dimensions where the mitigation-development relationship plays out (as exemplified in Wlokas et al. (2012)). This disconnect runs counter to a South African development expert's view of the relationship between mitigation and development policy being progressed in a site-specific, policy-specific, iterative manner (Du Toit, 2013).

*Box 8: Co-benefits as a reductive and disjunctive methodology*

The disjunction between mitigation and development is entrenched in the CM CoP literature that has developed around the concept of co-benefits (Cohen, Tyler, & Torres Gunfaus, 2016; IPCC, 2014b; Ürge-Vorsatz et al., 2016; Ürge-Vorsatz, Herrero, Dubash, & Lecocq, 2014; von Stechow et al., 2015). Co-benefits analysis is used primarily as a tool to evaluate and identify the contribution of individual mitigation actions to development, such as local air quality and energy provision, which may then lend political support to mitigation policy initiatives in developing countries (IPCC, 2014b, p. 1154). An alternative understanding, largely articulated by Indian experts, is that climate mitigation can be conceptualised as a co-benefit of development actions. Co-benefits are identified either by the nature of the mitigation action or by the design of the mitigation programme or policy. Co-benefits analysis is underpinned by a disjunctive approach, and is most often focused on co-benefits that can be reduced to categories and quantified (Cohen et al., 2016).

One of the main outputs of co-benefits analysis is that of increasing political support for a mitigation initiative. This reflects a fundamental challenge to climate mitigation policy in a development context; that development issues are prioritised above environmental issues in South Africa (Forti, 2013; Giordano et al., 2011), an experience of most developing countries (Davidson et al., 2003; Interviews, 2014; Winkler et al., 2002). As an LTMS Interviewee put it: 'key measures of the NCCRWP will not be implemented if we don't get the jobs thing right' (Interviews, 2014).

#### (d) SA CM policy as environmental

In South Africa the DEA was both identified as country Focal Point to the UNFCCC and allocated the CM policy portfolio, mirroring the international CM policy institutional pattern of climate mitigation as an environmental issue. This institutionalisation has entrenched CM policy's climate science provenance, and exacerbated the disjunction between mitigation and development. Climate mitigation is situated firmly within the sustainability discourse surrounding environmental issues in the country, nurtured by the DEA (RSA, 2011; RSA, 2018) and accepted across government (as evidenced by climate mitigation occupying the environmental chapter of the NDP).

Forti finds that the SA CM CoP still perceives climate mitigation to be 'in a different box, detached from socio-economic issues' (2013, p. 72). Development Provocateur Mistry reflected that the underlying assumption at the DevMit Forum was that 'cutting emissions is the ultimate target' (2014, p. 32), and that the DevMit Forum discourse moved quickly to terminology and actions relative to UNFCCC and especially NAMAs (2014, p. 32). A 2014 Interviewee reflected that the government stakeholders to the SA CM CoP routinely consider development as an afterthought (Interviews, 2014; Parliamentary Colloquium, 28 October, 2016) to the technical climate mitigation aspects of emissions trajectories, mitigation technologies, policy instruments, international processes and positioning that dominate the discussion. In reflecting on the Adaptation focus group a SA CM CoP member commented that 'the adaptation perspective is inherently developmental' (SA CM CoP Reflections Conversation, 27 November, 2014), implying that that of the SA CM CoP is not. Both at international and national level, economic institutions tend to have more power and influence than the environmental ones, and this is also the case in South Africa (Forti, 2013; Rafey, 2013), with DEA's source of power confined to environmental legislation (Interviews, 2014).

### 3.4.3 Poor communication between CM and development policy CoPs

The SA CM CoP very seldom engages in development or non-climate mitigation forums (SA CM CoP Reflections Conversation, 27 November, 2014; REDI 3x3 workshop, 2013) and does not understand well the languages and disciplinary norms of the development community of practice. SA CM CoP stakeholder consultations seldom extend beyond the boundaries of the CoP itself. At a practice level one of the

development participants in the Economic Growth Conversation (20 November, 2014) asked who was the 'development planner' within MAPS?, expecting there to be development capacity within such a large CM policy programme. Rafey relays the dominance of purely technical aspects in energy-related professional qualifications, and how this 'has thus tended to create an elite professional class somewhat out of touch with the country's development needs' (2013, p. 103). Development Provocateur Mistry (2014) asked rhetorically to what extent the SA CM CoP had engaged with the Sustainable Development Goal consultation process. Development Provocateur Black (2014) observed too that the development community is not well informed about the mitigation agenda, corroborated by a development participant of the Finance Conversation (21 October, 2014) who commented: 'I thought mitigation was passé, nothing we could do, no need'.

This poor communication of the CM policy issue outside of CM policy CoPs extends beyond the realm of 'experts'. Development Provocateur Mistry conceded that 'mitigation gets bad press and is not understood by the public in general. Generalisations include that mitigation means rolling back development, and that rich countries are expecting poor countries to remain poor whilst they continue their consumption-rich lifestyles' (2014, p. 35). Development Provocateur Verwey agreed, feeling that mitigation is 'poorly understood and associated with the concerns of the North' (2014, p. 16), and that 'awareness and buy-in of the mitigation agenda is largely absent'. This was again corroborated by the Finance Conversation (21 October, 2014): 'there is a perception [outside of the SA CM policy CoP] that climate change is a 'wealthy' issue', and from the SA CM CoP reflective Conversation (27 November, 2014) that 'there is a perception that mitigation is an approach to wealth and adaptation is an approach to poverty'. Development Provocateur Mistry commented that the mitigation discourse is hugely reliant on jargon, especially 'scientific measurements…that are not meaningful to the development sector' (2014, p. 33). When directly asked what mitigation looks like from a development practitioner perspective, those participating in the Conversations often reported ignorance, lack of awareness and bewilderment at the array of technicalities. Development Provocateur Kumar (2014) commented that the SA CM CoP has not focused on demonstrating action that brings about measurable, visible change to people's lives. The Finance Conversation participants found it an imperative to communicate the climate mitigation issue in newspapers and TV, rather than the academic realm. This isolated approach of the SA CM CoP breeds an abstraction, almost aloofness, the SA CM policy CoP as 'quite detached' from the broader development research community (Poverty Conversation, 6 November, 2014). Little effort is made by the CM CoP to understand this separate issue of 'development'.

There is another facet to this remove, linking back to the abstract nature of an orthodox economic view of development. The development participants in the Adaptation Conversation (15 October, 2014) noted that there is a perspective that the SA CM policy CoP works with the rich (compared to the adaptation people who work with the poor), tends to be 'removed' from communities… with no 'street cred'. Parliamentarians also commented on this lack of connection to people at the Parliamentary Colloquium (28 October, 2016). An interviewee suggested the CoP's view of development was unpeopled:

'Environmental people are not good at seeing the reality at the bottom of the pyramid' (Interviews, 2014). As a result the Consumption Conversation (16 October, 2014) similarly found that the SA CM CoP understands the drivers of consumption in South Africa very poorly: 'In economic/energy modelling, the representative consumer behaves as they have in the past, except for when prices change. This is the only way changing consumption patterns are represented'.

Institutional capacity is a significant hindrance to communication. An Interviewee commented that the DEA has no economic capacity, and correspondingly the economic departments have no environmental capacity (Interviews, 2014), thereby limiting their ability to speak to each other. This takes time to build and if it is not prioritised it is just easier to 'say the DEA is doing it [environmental work]' (Interviews, 2014). As a result, the economic departments are 'absolutely not on board with this…[they are] systemically not engaging' (Interviews, 2014). Further, that DEA has not engaged with the lack of cross-cutting institutional capacity (for instance by going to NT to request a director level environment person in each of the economic departments), but rather 'just feel oppressed by other departments not playing with them' (Interviews, 2014). This has been slowly changing. NT's carbon tax work represents a substantial area of SA CM policy capacity (although sceptically NT's interest was described by an Interviewee as the 'department's corporate social initiative, an interesting diversion from its central focus on poverty' (Interviews, 2014). The DTI and the Economic Development Department (EDD) have engaged through a 'green growth' discourse (Cock, 2014), although this is largely disassociated from the DEA's CM policy work. The disparity in capacity for climate mitigation between DEA and its economic counterparts (DTI, EDD, DoE and DMR) remains significant (Interviews, 2014).

### 3.4.4 High-level concepts adopted to frame the mitigation-development relationship

From the separate conceptualisation of development and mitigation follows an imperative to theorise or frame the relationship between these two issues. To this end, various high-level bridging concepts have been both developed and/or adopted by the CM policy CoPs, including 'sustainable development' (Forti, 2013; IPCC, 2014a; United Nations Framework Convention on Climate Change, 1998), 'low carbon development' (LCD)(Mulugetta & Urban, 2010; Yuan, Zhou, & Zhou, 2011) and the 'LCD Strategies' of the UNFCCC[33], 'green growth' (Jacobs, 2012), 'green economy' (Death, 2014) and 'climate compatible development' (CCD)(Mitchell & Maxwell, 2010). In SA CM policy, sustainable development and green economy / growth are the most common of these high-level bridging concepts used. The DEA has adopted a sustainable development frame to approach the relationship between environment and development

[33] The intention of LCDS was broadly intended to encourage developing countries to identify NAMAs through a coherent process and to situate them in a coherent framework, as a 'soft alternative' to voluntary or mandatory mitigation obligations under the UNFCCC process (Tilburg, Würtenberger, Coninck, & Bakker, 2011, p. iii), as a 'useful conceptual middle ground between quantitative commitments and bottom-up NAMAs' (Dubash, 2009, p. 2). A LCDS is understood varyingly by developing country practitioners; with different countries emphasising it as a strategy, a framework, or just a 'wish list' of mitigation actions (Tyler et al., 2014). Dubash (2009) wonders whether the LCDS concept may perversely exacerbate the schism between national mitigation and development policy as it tries to navigate the political objectives of international CM policy and the implementation objectives of the national level.

generally (DEA, 2008), and climate mitigation specifically (RSA, 2011). The concept of green growth is primarily pursued by the EDD and the DTI (Cock, 2014), but also the DEA (RSA, 2011). In the application of neither of these bridging concepts is the aspect of inequality clearly articulated.

Similar to transformative change and development, these bridging concepts are high-level, and therefore ambiguous outside of a particular interpretation (Drexhage & Murphy, 2010; Dubash, 2009; Ficklin et al., 2017; Mulugetta & Urban, 2010), which has not yet been done for SA CM policy (Cock, 2014; Death, 2014; Forti, 2013; Rafey, 2013). Forti argues that a particular interpretation of sustainable development is neither elaborated nor sustained across policy documents and discussions. Death (2014) finds evidence of four 'green economy' discourses within the SA CM CoP[34] (green revolution, transformation, growth and resilience), each based on different competing priorities, with no consensus view even amongst the government members of the CoP.

The lack of a contextual interpretation of these high-level bridging concepts entrenches the dominance of the orthodox economic approach to development discussed in 3.4.2 in SA CM policy, together with a disjunctive view of mitigation (environment) and development as two simultaneous yet separate techno-economic and socio-economic 'transitions' respectively.

## 3.5 Concluding thoughts

The dominant approach of the SA CM policy CoP is borne out of - and lends support to - a worldview that presents the issue to which SA CM policy attends (climate mitigation in South Africa) in a particular way. As such, the SA CM CoP understands well the issue thus presented, and illuminates many important aspects of it. However, also due to this particular presentation, other aspects remain underexplored and even invisible. It may be that these obscured aspects have particular relevance for climate mitigation in a development context more generally. Chapter Four both summarises what the current dominant SA CM CoP approach illuminates and identifies and articulates those aspects which are obscured, paying particular attention to implications for the implementation of SA CM policy.

[34] Death relies on documentary evidence to make his argument, however given the content and Death's examples there is assumed to be sufficient alignment with the SA CM CoP defined in this Chapter for his observations to broadly apply.

# 4

# What does the SA CM CoP's dominant approach illuminate and what does it obscure?

> *Indeed, the enormity of the task is only matched by the belief in the ability of western-knowledge-making to deliver on it: to make the complexity of the world visible and knowable.*

– Catherine Leyshon, Critical issues in social science climate change research, 2014, p 365

## 4.1 Introduction

At this point in the argument I am particularly aware of a challenge related both to conducting a transdisciplinary inquiry, and to the linearity and chronology of an academic thesis. Whilst I am committed to identifying what is illuminated and what is obscured by the dominant approach of the SA CM CoP, I have not committed to any particular perspective from which to know what the issue with which SA CM policy deals actually 'is'. The SA CM CoP, influenced by the hegemonic worldview, assumes its epistemological and ontological understanding of the SA CM policy issue as being the only possible one in a world encountered through the rationality and knowability of classical science. However in investigating metacognition and 'approach' it becomes apparent that this worldview is just that: one of many possible paradigms from which to encounter knowledge and the world.

To recount, my method in this Chapter utilises a multi-disciplinary literature, together with my empirical observations to analyse what the SA CM CoP's dominant approach illuminates and what it obscures of the SA CM policy issue. Whilst this method provides me with a wide range of perspectives, I do not assume here that together these amount to a whole, i.e. that the SA CM policy issue is a sum of what is illuminated and what is obscured. Rather, I am developing an argument that the dominant approach identified in Chapter Three is insufficient in and of itself in both articulating and responding to the SA CM policy issue. I make no claim to be either comprehensive or weight equally my attention in this Chapter. I have focused, ruthlessly it could be said, on describing what the dominant approach of the SA CM CoP obscures over that which it illuminates. The picture thus presented is unfair to the CoP including my own efforts within it. It is impossible to know, even with the benefit of hindsight, whether a different approach

would have resulted in greater progress on climate mitigation action, and each observation point is time-specific. My intention therefore is not to undermine what has been achieved, through great effort and at great personal cost in many instances. Rather it is my critical disposition, interest in improvement and the urgency of the CM policy issue that drives the analysis. In addition, the performance of my method and heuristic is of greater significance than the details of the content.

Because the SA CM CoP's approach is dominated by the hegemonic scientific and cultural worldview, what is illuminated by this approach is correspondingly framed by the perspective of this worldview. Hence there is a restriction placed upon that which is illuminated which is lifted when considering what is obscured, as one then has access to alternative perspectives and paradigms for the analysis. This does not make that which is illuminated less valid or useful, but instead more particular and contained.

## 4.2 What does the SA CM CoP's dominant approach illuminate?

### 4.2.1 The techno-economic implications of international CM policy objectives

The international CM policy CoP has generated substantial information to illuminate the extent of global GHG emission reduction, sequestration and avoidance required to achieve the goal of keeping temperature rise below two degrees enshrined in the UNFCCC's Paris Agreement. Characteristics of such a future are described by the IPCC (2014) as being rapid energy efficiency improvements and a quadrupling of zero and low carbon power generation by 2050. Quantitative modelling has played a key role in this process and has 'formidable' analytical strength, particularly in the analytical ability of models to combine economic, natural science and engineering information, their future orientation and their broad scope (Geels et al., 2016). The SA CM CoP has interpreted a version of what this might look like for South Africa through the Required by Science trajectory of the LTMS, illustrating that perpetuation of South Africa's 2008 economic structure and GDP growth rate looked to exceed the country's GHG budget for the period 2010-2050 with an emissions total exceeding by four times a fair contribution to the international mitigation effort by 2050 (DEAT, 2007). The GHG Emissions Benchmark Trajectory Range indicates a timeframe for peak emissions, point of decline and rate of decline over a timespan of three decades for South Africa. Further techno-economic implications of this Range and variations of it are explored in Altieri et al. (2016) and Caetano and Thurlow (2014) amongst others[35].

At an international level, the international CM CoP has demonstrated that remaining within two degrees temperature rise is theoretically possible with technologies available (although not necessarily proven) today, and that sufficient funds can be made available to meet the investment required (IPCC, 2014a; OECD, 2017; United Nations Environment Programme, 2016). The SA CM CoP has demonstrated that such a future is at least technologically and financially attainable for the South African energy sector (Altieri et

[35] Throughout section 4.2. reference is made to SA CM policy work supporting the argument. This is done by way of example, and is not intended to be a comprehensive account.

al., 2016), with the techno-economic implications having also been explored at the economic sector level (DEA, 2014e; World Wide Fund for Nature, 2014), with particular attention having been paid to the energy sector, including implications for lock-in (Burton et al., 2016; Burton & Winkler, 2014; Cloete & Venter, 2012) and technology choice (DEA, 2014e; ERC, 2007).

### 4.2.2 A detailed technical understanding of South Africa's GHG emissions profile and mitigation options

The SA CM policy CoP has described in a high level of detail South Africa's emissions profile by gas and by sector, production activities that give rise to GHG emissions, which sectors these are concentrated in, the timeframes of these activities and the technologies they use (i.e. what is 'locked-in'), and the GHG implications of sectoral expansion (DEA, 2014a, 2014c, 2016a). The smaller role played by land use change in GHG emissions, unusual for a developing country, has been identified (DEA, 2014a). Analysis has further distinguished and elaborated the role of emissions intensity of GDP, energy intensity of GDP and emissions intensity of energy in the GHG profile (Cloete et al., 2011; DEA, 2016a).

The SA CM policy CoP has similarly developed a detailed technical understanding of mitigation potential on a sectoral basis (DEA, 2014c; 2016a; ERC, 2007). Optimisation modelling has revealed lowest financial cost mitigation options and pathways (DEA, 2014c; SBT, 2007). The financing implications of most significant identified mitigation options (according predominantly to the criteria of cost efficiency and environmental effectiveness) has been studied and explored at the project level, with upfront investment requirements known (Carbon Disclosure Project, 2017; DEA, 2014c; ERC, 2007; Tyler, Boyd, Coetzee, & Winkler, 2013). There has been experimentation with the implications of different financial structures at the project and programme level including combinations of donor, public and private capital with various forms of debt and guarantee finance in the South African context (Development Bank of Southern Africa, 2011). The role of contractual structures in both allocating responsibility for GHG emissions and enabling low carbon investment has been revealed through SA CM policy work on reporting, mitigation projects and policies.

The evolution of reporting protocols and initiatives by both DEA and the private sector has revealed the intricacies of GHG data reporting challenges (CDP, 2017; DEA, 2016a). Along with greater data availability, increasingly sophisticated financial metrics have been adopted to analyse the impact of GHG emissions on company value, risk assessment and shareholder reporting (CDP, 2017).

### 4.2.3 A technical understanding of a possible suite of mitigation policy instruments

The CM policy CoP has developed a detailed technical understanding of policy instruments and mechanisms, both economic and regulatory in nature, to reduce the South African GHG emissions profile from a technical and orthodox economic perspective (DEA, 2015; Devarajan et al., 2009; NT, 2013; Promethium Carbon, 2015; Tyler & Cloete, 2014). This understanding demonstrates a level of cognisance

of South Africa's economic structure, particularly the challenges of domestic emissions trading within a concentrated economy and carbon taxes within a regulated and monopolistic energy market. The ability of different instruments to tackle various aspects of the emissions profile, such as energy efficiency, energy infrastructure decisions, transport emissions and emissions from industrial processes has been explored within the strictures of the SA CM policy CoP's dominant approach.

Policy instruments are assessed predominantly against the criteria of environmental performance (emission reductions) and cost effectiveness (NT, 2010, 2013; Vivid Economics et al., 2016).

### 4.2.4 The importance of timely, measurable, verifiable data, and evidence of contestation

The SA CM policy CoP's activities have demonstrated the importance of access to detailed, specific, timely, verifiable data, both on GHG emissions and on mitigation options (Cloete et al., 2011; Trollip & Tyler, 2011). This is particularly important given the role of the natural sciences in the CM policy issue, and the DEA has worked systematically to secure mandatory reporting of GHG emissions. The issue of data, 'the numbers', has been at the heart of SA CM policy contestation itself (Interviews, 2014), the site where the underlying systemic contestation has most often spilled over into public view. This contestation is largely presented as a data issue, addressed through the commissioning of more research and analysis.

### 4.2.5 Implications of climate mitigation for conventional macro-level development indicators

While acknowledging the narrowness of the interpretation of development from the view of orthodox economics, the SA CM CoP's macro-level modelling work indicates that mitigation trajectories aligned with the GHG Emissions Benchmark Trajectory Range have either positive or slightly negative implications for traditional macro-economic development indicators over the timeframe to 2050 (Altieri et al., 2016; Caetano & Thurlow, 2014; DEA, 2014c; DEAT, 2007; Devarajan et al., 2009). Research has illuminated possibilities for mitigation-development linked policy design (Winkler, 2017) and clarified linkages between mitigation actions and developmental indicators in particular sectors (Tait & Winkler, 2012).

There is less clarity on the implications of mitigation for development outside of modelling results. Using the co-benefits methodologies described in the previous Chapter, the SA CM CoP suggests that mitigation activities at a project and programme level can have positive development impacts when considered as isolated interventions.

### 4.2.6 Challenges associated with implementing SA CM policy

The SA CM CoP has (inadvertently) illuminated the challenges of implementing the NCCRWP, with the DEA being unable to adhere to their stated timeframes in the NCCRWP (Worthington, 2014), and having limited influence on line departments (Chandrashekeran et al., 2017; Worthington, 2014).

## 4.3 What does the SA CM policy CoP's approach obscure?

The influence of the hegemonic worldview in the SA CM CoP's approach means that it is unable to see or engage with the implications of this worldview, to see it as partial, or to consider perspectives alternative to it. In addition, the SA CM CoP's inability to acknowledge its normativity, to engage with the social realm or to work interrogatively with its metaphors of transformation, development and mitigation-development bridging concepts all work together to result in the SA CM CoP both actively and passively obscuring perspectives on the SA CM policy issue. These perspectives, together with how they are obscured by the SA CM CoP, are introduced here.

### 4.3.1 The policymaking implications of climate mitigation as a complex policy issue

Despite describing the SA CM policy issue as systemic and complex in the NCCRWP, the SA CM policy CoP does not bring a rigorous understanding of either complexity or systems to bear on the SA CM policy issue. In fact, there is a surprising lack of literature probing characteristics of CM policy generally (see Hovi, Sprinz, & Underdal, (2009) and Levin et al., (2012) for exceptions), nor are distinguishing features of CM policymaking in developing countries identified (MAPS Programme DevMit stream, 9 February, 2015). This seems strange, for as a number of policy authors note, it is important to understand what type of system and policy problem is being dealt with (Astill & Cairney, 2015; Australian Public Service Commission [APSC], 2007; Emison, 1996). From the brief review of literature defining complex policy problems in Box 9 below, climate mitigation can easily be identified as a quintessentially complex policy problem, the poster-child of complexity (Camillus, 2008, cited in Mertens, 2014; APSC, 2007; Bhaskar & Parker, 2010; Dombkins, 2014; Ison, 2010; Levin et al., 2012). Development, the focus of South African policy generally, is itself also quintessentially complex (Mertens, 2014), resulting in SA CM policy lying at the intersection of (at least) two particularly complex policy problems: climate mitigation and development.

*Box 9: Literature on complex policy problems*

In 1973, the planners Rittel and Webber coined the term 'wicked problems' (in the sense of 'tricky' rather than 'deplorable') to describe the open, societal policy issues which they felt were so poorly represented by standard planning approaches. These wicked problems, they claimed, are problems different to the ones that scientists and engineers routinely deal with, and for which an approach grounded in a reductive, managerial, positivist worldview is no longer appropriate. Rather, they described wicked problems as being individually unique but lacking in definitive formulation or explanation as these are subject to the various perspectives of those attending to the problem. In addition, there are as many purported 'solutions' or ways of approaching wicked problems as there are perspectives of the problems themselves, and each wicked problem is also a symptom of another problem. Wicked problems have no stopping rule, no immediate nor ultimate test of a solution, and the choice of explanation for the problem will determine the 'solution', or options for progressing or improving the problem. Since Rittel and Webber introduced the concept, the characteristics of wicked problems have been engaged with across the academy (Head & Alford, 2008). Ackoff (1974) further contributed to this characterisation of open societal problems writing of 'messes' out of which policymakers extracted 'difficulties', which are simple problems which can be solved, but which do not attend to the underlying 'mess'. Schön, writing later in the 1980s, writes similarly of a 'swampy lowland, [where] messy, confusing problems defy technical solution' and yet this swamp is also where the problems of the 'greatest human concern' lie (1987, p. 28). Morgan et al. (1999) write of complex global change problems as having multiple decision makers and constituencies; impacts at the margin which can't be valued or managed; with unknown, endogenous, and dynamic values; time preferences which can't be accurately described by discounting; large and unmanageable uncertainties; and being systemically subject to complex and non-linear interactions.

Traditional policy approaches aligned with the hegemonic worldview are argued to be inadequate for complex policy problems such as climate change (Dombkins, 2014; Fankhauser & Stern, 2016; Grubb et al., 2014; Leach, Scoones, & Stirling, 2007), and are only likely to result in disillusioned and frustrated policymakers (Dombkins, 2014; Emison, 1996; Geyer & Cairney, 2015a; Koppenjan & Klijn, 2004), an experience attested to by 2014 interviews with SA CM CoP members. The institutionalisation of the hegemonic worldview in both academia and policy practice globally has meant that thinking on complex policy problems has received relatively little practical traction or research interest (Ison, 2010; Zellner & Campbell, 2015), despite significant implications for the relevance of traditional policy approaches. Complex problems are inexplicable from within the hegemonic worldview, and they cannot be deeply engaged from within it. Whilst theorists within the post-positivist stream of public policy have elaborated on many complex aspects of policymaking they do so focusing on aspects of the policymaking process as opposed to engaging with the category of complex policy issues itself[36]. Two aspects of complex policy problems of particular relevance to SA CM policy are explored briefly here by way of exemplifying some of the implications of a complex policy issue for policymaking. First, that complex problems are riddled with uncertainty, and second that they lack the possibility of centralised control.

[36] The situation of this inquiry in relation to public policy literature is addressed more fully in Chapter Seven

Complex problems are characterised by deep uncertainty (Sprinz, 2009)[37]. Koppenjan and Klijn (2004) find that traditional approaches to uncertainty are both sub-optimal and, perversely, can actually increase the uncertainty they seek to reduce. This observation is supported in the SA CM policy CoP's experience in the years after the LTMS: A rigid approach to the LTMS data created a focal point for challenge and invited push back from industry in particular around the SA CM policy objectives (Interviews, 2014). The SA CM CoP's 'knowable' view of the future constrains adequate identification of and preparation for deep uncertainty, which Heal and Kristom (2002) have long argued should be central to any economic discussion on climate change policy. By implicitly approaching uncertainty as something negative to be quantified and thereby contained, largely in the assumptions driving modelling exercises, the SA CM CoP is prevented from seeing the possibility of a more expansive range of potential futures, and the opportunities for mitigation and development they may contain. For example, the current SA CM policy approach does not routinely assess for outliers, 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 had significant mitigation impacts but which the SA CM policy CoP was unable to engage. Morgan et al., commenting on the use of Integrated Assessment Models at the international CM policy level warn that 'when the basic structures of the models are uncertain, and when uncertainties change significantly over the time horizon of the analysis, conventional tools for analysis and display of uncertainty are inadequate' (1999, p. 279). Such an approach to uncertainty prevents the CoP understanding and identifying different types of uncertainty, learning how to approach each type, and even how to use uncertainty as opportunity (Leach et al., 2007; Morgan et al., 1999; Stirling, 2010).

Complex problems lack a central public authority with all the measures to respond at its disposal (APSC, 2007; Head & Alford, 2008; Levin et al., 2012). This is obscured by the SA CM policy CoP's approach which assumes a state-in-control, that policymaking happens in a top-down, linear fashion, and therefore relies on centralised targets and budgets. Rather, complex problems require the prioritisation of a coordination approach across departments, policy scales and policy subsystems that are engaged with the problem (Dombkins, 2014).

This discussion of the policy implications of complex policy issues is taken up again in the context of a complexity approach for SA CM policy in Chapters Six and Seven.

### 4.3.2 The implications of climate mitigation as systemic

SA CM policy is a systemic issue, and yet the influence of reductive science and its tools in the SA CM CoP ignores, obscures and de-emphasises connectivity, multiple causality and systemic considerations in favour of illuminating particular and isolated aspects of mitigation (DEA, 2014c; Winkler, 2017). Whilst the

[37] Uncertainty and risk in relation to complex problems are variously described in the literature (Leach et al., 2007; Snowden & Boone, 2007; Sprinz, 2009). Different knowledge-making and policy responses are required for each of these uncertainty types.

SA CM CoP's modelling exercises are ostensibly systemic in nature, they are bound by reductive and constraining assumptions and deterministic views of a knowable future, emphasising whole-system outputs rather than illuminating systemic interconnections. Morgan et al. (1999) find that Integrated Assessment Models used at the international CM policy CoP level are better at engaging with the complex and systemic nature of the problem, but remain limited by the particular worldview they inhabit. This notwithstanding, these types of analyses can be very illuminating and useful if they are appropriately considered in their complex systemic context. The current analytical modelling underway on the mitigation policy system appears to be paying greater attention to the systemic view (Cloete et al., 2017).

The SA CM CoP has noted its own lack of attention to the systemic aspect of mitigation: 'as the conversation has gone on we've lost the bigger picture. We haven't drawn the links across government departments, or even within the mitigation agenda' (Interviews, 2014). Traditional economic analysis tools such as cost benefit analysis, CGE at the macro-economic level and identification of winners and losers and street surveys at the micro level, make it very difficult to consider a portfolio of options, especially when work happens in silos (Economic Growth Conversation, 20 November, 2014). Inter-sectoral and network levers for mitigation such as consumption are obscured (Consumption Conversation, 16 October, 2014), as are those of information and communications technologies, or urban form. Cross-cutting drivers arising from economic structure or systemic organization, such as the role of the electricity transmission and distribution network, are less able to be considered. In addition, the systemic consequences of introducing mitigation measures in one sector are only considered to the extent that they can be captured in CGE models, the limitations of which as describing and capturing the dimensions of a STEPE issue have been discussed.

Scale in systems is also relevant here: The SA CM policy CoP's focus on the national or project / programme level does not invite consideration of the linkages between these two (Cohen, Tyler, & Torres Gunfaus, 2016; Wlokas et al., 2012) or other scales. In the Cities Conversation (19 September, 2014) it was noted that both at the city level and for urban households and collectives there is no discussion about lock-in at all (although this is part of the national CM policy discussion). Mitigation-development interconnections occur along a scalar continuum, with Leyshon (2014) finding that scale - temporal and spatial - is of utmost importance to the climate change issue. An example of this was provided by the Economic Growth Conversation (20 November, 2014), that of provincial scale space in South Africa being one step removed (from metro) and so the provincial perspective can see and articulate issues to the national scale, and assist in strategising around this.

As well as obscuring individual interconnections, the dominant SA CM policy CoP approach obscures a whole-system view of the policy issue. An approach that prioritises its efforts according to the technological feasibility and cost-effectiveness of mitigation options means that the driving force of the MEC heart of the economy is insufficiently addressed (Chandrashekeran et al., 2017), rendering SA CM policy subject to a marginality which undermines its transformational objectives. A marginal approach is

entrenched in the economic analytical tools employed (Fankhauser & Stern, 2016; Winkler et al., 2015). This marginality is demonstrated in the ineffectiveness of the institutions designed to promote SA CM policy integration, and the ongoing misalignment of CM policy with other policy areas (Interviews, 2014; Trollip & Tyler, 2011). The silo nature of government and the low level of climate mitigation capacities in the various line departments are issues that are not directly tackled by the SA CM policy CoP.

In terms of the development component of the SA CM CoP's policy objectives, the systemic and intertwined nature of mitigation and development relationships is obscured by the disjunctive aspects of the CoP's dominant approach. As Dubash (2009) describes, few areas of development policy are free of climate linkages. From a systemic view, mitigation and development issues are caught up in multiple systemic interactions occurring along a spectrum of scale, time, place, people, politics, values, culture, finance, technologies, materials and institutions. How climate mitigation considerations might be co-conceived with development decisions along the spectrum described above is obscured by the current SA CM policy approach. For example, the SA CM policy CoP participants in the Employment Conversation (20 October, 2014) were taken by surprise when they heard that the Employment participants viewed low carbon initiatives as the only potential they could see for opening up employment opportunities in the rural areas as they themselves were out of options. The SA CM policy CoP's dominant approach obscures the opportunities to be found in working together with development practitioners to build mitigation into the 'foundations of development policy' (Black, 2014). This need for co-development and co-creation of mitigation and development policies was also identified from the perspective of the land-use sector (Sulle, 2014). Research has found that where climate mitigation actions have been implemented in developing countries this has often been a result of developmental drivers such as energy efficiency, provision of public transport or waste reduction, and the existence of these drivers certainly facilitates implementation (Boyd & Coetzee, 2013; Garibaldi et al., 2014; Tyler, Boyd, Coetzee and Winkler, 2013). The link between implementation and the existence of GHG mitigation targets or strategies is found to be related in some instances, but is not definitive (Garibaldi et al., 2014).

Emerging integral conceptualisations such as the 'doughnut economics' of Raworth (2012) which models the global challenges of humanity remaining within environmental limits whilst uplifting the marginalised, assist in opening up ways of thinking about and working from an alternative (to that of the SA CM CoP) perspective of connection, context and interrelation. Models such as these provide ways of navigating the continuum and texture between polarities of growth or no-growth, wealthy or poor, low carbon or carbon intensive, which are all part of the current SA CM CoP discourse.

### 4.3.3 Different perspectives and knowledges

The hegemonic worldview obscures perspectives and ways of knowing the SA CM policy issue other than that available through the SA CM CoP's approach. Despite operating from a normative basis, the SA CM CoP does not see clearly that its models are 'temporary substitute object[s] created by a knowledge-

seeking subject for a specific cognitive purpose' (Knobloch 2011 cited in Bergmann et al., 2012, p. 96), both obscuring the dynamism of the situation and providing just one perspective on it. That there are other perspectives, accessed perhaps by different languages and knowledges is unable to be seen. As Montuori (2010) puts it, a partial view is taken to be the whole. Geels et al. (2016) argue for the use of Integrated Assessment Models with alternative approaches to knowledge-making, based on different philosophies of science, and in opposition to the project of one model to reflect the world. Certainly in order to address the social aspects of transformation, such multi-philosophical, multi-method approaches to knowledge making are required.

Rommetveit et al. suggest that 'at the centre of the discourse [on climate change] there are still few openings for conceiving of the great variety of knowledge forms that will be needed' (2010, p. 156). These include a role for the knowledge of practice and embodied knowledge, and finding better and more explicit ways to incorporate knowledge with ethics and aesthetics which will require new approaches to both how knowledge is produced and how it is used (Fazey et al., 2017, p. 7). From here, multi-, inter- and transdisciplinary approaches have particular advantages. The edited Routledge volume on 'Interdisciplinarity and climate change' (Bhaskar & Parker, 2010) argues for bringing in different disciplinary perspectives under an interdisciplinary frame underpinned by the philosophy of critical realism (Cornell, 2010; Costanza, 2010; Naess, 2010). As such, authors explore topics such as $CO_2$ reductionism (Hoyer, 2010), consumption, social imaginaries and the role of the media (Frank, 2010), the role of knowledge, democracy and action (Rommetveit et al., 2010), technological idealism (Hoyer, 2010), and ethics of knowledge and care (Parker, 2010).

### 4.3.4 How structural economic change occurs

In Chapter Three it was observed that the CoP's dominant approach has not paid substantial attention to how structural economic change occurs. This had its beginnings in the LTMS, which was criticised as 'not dealing with the transition story' in its setting of long-term targets, with one interviewee commenting that the LTMS had actually 'contained [the climate mitigation problem] for industry to continue with business as usual growth regardless of the mitigation issue for the next decade' (Interviews, 2014). The technical focus of the SA CM CoP obscures the political and process aspects of dealing with structural change. CGE and energy models cannot easily accommodate structural economic change, with Grubb et al. noting that traditional economic tools 'focus on trade-offs rather than transformation' (2014, p. 1). SA CM policy instruments are politically constrained from being effective for timely structural economic change, a problem which the SA CM CoP seldom appears to address directly as a political one. The CoP also doesn't routinely engage in other areas influential to the form of economic structure (for a discussion in the context of climate mitigation more generally see Blyth (2010)). Burton and Winkler (2014) find that lock-in decisions in the South African energy sector are currently being made in response to energy security concerns and the continued reliance on coal. The Economic Growth Conversation (20 November, 2014)

noted that these decisions occur in deliberative spaces which are 'political, stakeholder focused, incremental and slow', and where the SA CM CoP is absent.

From the hegemonic worldview the role of infrastructure in transformative change is obscured (Frantzeskaki & Loorbach, 2010; Geels, 2014; Grubb et al., 2014). For example, transport technologies such as electric vehicles are prioritised above the transport implications of urban form. This neglect is also a feature of mainstream and development economics per se. The writings of Schumpeter in the early 1900s emphasised the role of infrastructure in endogenous innovation and transformation (Juma, 2014), and both Geels (2014) and Pueyo (2014) return to these, Geels within the Multiple Level Perspective of transformations and Pueyo from an econophysics complexity theorising, highlighting the importance both of generating new structure and of destroying the old in transformative change. Geels specifically finds that the CM policy CoP's is a solutions-oriented approach, one which pays more attention to that which must be added rather than that which requires destruction in order to release human, physical and financial capital within a transformation.

The CM CoP's dominant approach to structural change as linear, marginal and informed by orthodox economics underplays a potential advantage that developing countries may have over the developed world with regards to building future low carbon systems. Developing countries are not yet committed to the type and form that this 'hard infrastructure' takes. In a developed country, by comparison, physical infrastructure and built environment largely exists and its form is known; future needs are focused on the upgrading and replacement of capital stock and are therefore easier to plan for. Developing countries can thus be said to have a far higher level of optionality than developed countries in this regard. From the perspective of complex problems, having options has an intrinsic value, one which increases the greater the level of uncertainty (Heal & Kristrom, 2002).

### 4.3.5 Opportunities from a critical engagement with 'transformative change' and 'development'

Chapter Three argued that the SA CM policy CoP uses a number of high-level concepts, including transformative change and development to describe its objectives, which remain un-interpreted in the SA policy context and as such are difficult to operationalize (Markusen, 2003). This practice and the resultant amplification of the SA CM CoP's dominant approach in turn obscures options for pursuing these very objectives. This section discusses how the dominant approach works to close down options under three headings. The first deals with the concept of development itself, the second with visions of the future available to us, and the third comments on how narrowly we conceive of possible pathways to achieve this future.

## (a) A critical view of development

The SA CM CoP's development concept is situated in a narrative of linear progression towards a state that has already been achieved by the 'developed' world, and therefore that mitigation within a developing country is only achievable with international technological and financial assistance. This geopolitical and historical narrative implicitly describes South Africa as lacking in entrepreneurial capacity and internal resources to create a low carbon and 'developed' future, as opposed to developing countries having the potential to emerge progressive responses to the climate mitigation issue which the developed world cannot (See Henderson, 2008 cited in Capra (1974/1983)). Juma (2014) notes this as a colonial and particular view of economic development. Perversely, it was this hegemonic narrative (of development) that the South African business community appealed to as a premise for disengaging from the mitigation discussion until more certainty about international assistance was forthcoming (Tyler & Torres Gunfaus, 2015).

The implicit acceptance within the SA CM CoP on the role of undifferentiated economic growth in development (Box 7 in Chapter Three) obscures the need for a discussion on values, and precludes detailed, contextualised interrogation of the links between economic growth and 'development'. It also obscures the policy objective of reducing inequality – which is of particular importance in the South African context. SA CM models do not allow for an alternative to GDP as driver of growth, and given the assumption of the economy operating at the production possibility frontier also imply that mitigation-development trade-offs are inevitable (Winkler et al., 2015). Whilst undifferentiated economic growth is understood within the hegemonic worldview as the most powerful development driver, it is simultaneously an equally powerful driver of GHG emissions. This tension is never tackled head on by the SA CM CoP, rather existing as the SA CM CoP's own 'inconvenient truth'.

Prising development from this international orthodox economic development narrative, an argument could be made that development is that which refers to the socio-economic aspects of any society's progress (such as that captured in the United Nations Development Programme (UNDP)'s Human Development Index[38]). Further disentangling the concept, this time from its economic and historical strictures, writings by Raworth (2012), Sen (1999), Costanza (2010) and many others including in the South African context (Fioramonti (2017) and Lane-Visser (2015)) expand the attributes of 'development' to those furthering a desired state of human wellbeing, including the roles of culture, community, work, values and even spirituality (Woiwode, 2013). Others bring in equality and environmental aspects explicitly (Stirling, 2014). Fazey et al. write that 'many contemporary challenges are deeply rooted in and reinforced by massive global inequalities which are particularly emphasized in the context of climate and development' (2017, p. 9). It is these expansive and historically disrupted conceptualisations of

[38] http://hdr.undp.org/en/content/human-development-index-hdi

development which could speak specifically to the South African issue of inequality, which are obscured by the SA CM CoP's dominant approach.

From a slightly different angle, the Development Provocateurs cautioned that SA CM CoP may miss some key lessons that development practitioners have learnt the hard way, related to the orthodox economic development model the SA CM CoP implicitly adopts: Kumar (2014) warns that the climate mitigation agenda might be failing to respond to the needs of the urban poor in the same way the development sector has failed, and Verwey (2014) cautions against mistakes made by the development finance community in responding to the development context.

### (b) Envisioning an inclusive transformative change

Fazey et al. (2017) reporting on a workshop convened to consider transformational change from the perspective of the social sciences and humanities, argue that for change to be termed transformational it must include the three aspects of depth, breadth and urgency. This definition is used here to explore transformative change as it relates to the SA CM policy objectives of transformational change, mitigation and development.

Whilst the SA CM CoP's dominant approach does illuminate the depth of mitigation required (section 4.2.1.), it is constrained in its range of responses to the urgency of transformation, and the need to transform the structure of the South African economy (section 4.3.4.). The breadth aspect of Fazey et al.'s definition, identified in their article as climate justice in the context of climate change transformations, demands inclusion of the social realm. As such, transformational change is more akin to Stirling's transformation than the techno-economic transition approach of the SA CM CoP. Therefore values, power and politics must be included with economics and technology as central to mitigation-development transformations (Geels, 2014). Leach et al. describe situations relating to environment, technology and development as being where there are a 'multiplicity of possible goals, and multiple pathways to meet them' (2007, p. 4), requiring that the goals of development or sustainability are necessarily normative and politically defined. As Winkler et al. capture it, 'who defines transformation matters deeply when pursuing 'transformational change'' (2015, para. 10). These social issues are elaborated on in section 4.3.8 of this Chapter, but in relation to transformational change, it can be argued here that the SA CM CoP's disjunctive approach of two separate mitigation and development transitions obscures both the social and intertwined aspects of transformative change for mitigation and development. The political prioritisation of development issues over environmental issues is then sustained, rendering a critical view of what a mitigation and development transformation might be out of reach of the SA CM CoP. As Forti (2013) and Winkler et al. (2015) observe, addressing climate mitigation in South Africa requires changing how 'development' is conceived.

Fazey et al. argue that 'invoking the concept of transformation [therefore] requires users to be explicit about from what and to what something is being transformed' (2017, p. 2). Whilst the SA CM CoP has

done this in detail in terms of GHG emissions, the societal and developmental implications of a mitigation-development transformation are less well elaborated, if at all. Not providing a contextual interpretation of the bridging concepts used to frame the SA CM mitigation-development policy objectives implies a specificity of the goals of transformation that has not yet been achieved. The SA CM CoP can conceptualise of a GHG emissions transformation aligned to a separately driven 'development' transformation, but can less easily conceptually access GHG mitigation as a driver of a mitigation-development transformation itself. Grubb et al., (2014) argue along similar lines that the energy sector as a driver of economic progress itself is obscured by orthodox economics.

#### (c) Considering how transformative change occurs

From the expanded view of development explored in 4.3.5. (a), together with a view of mitigation and development transformation as one and the same, the question of 'what processes are transformational in what manner and to what extent' (Feola, 2015, p. 384), and from here how such transformative change can be supported (O Brien & Sygna, 2013) come centre-stage. Stirling argues how history shows the 'greatest ongoing forms of transformative progress (like release from colonialism, racism or patriarchy) owe more to plural knowledges and values and unruly hope-inspired agonistic contention, than to single orderly technical 'transitions' based on formally-integrated science or fear-driven structured control' (2014, p. iii). Such an 'unruly', uncertain, messy, human and contested context of transformative change (Stirling, 2014), including the contention and ambiguities in climate change (Fazey et al., 2017) and of how the future can be actively desired and co-created, is obscured by the SA CM CoP's dominant approach.

Fazey et al. argue that:

> through such critique [of how change happens] and by being more explicit about what is meant by transformation, greater opportunities will be provided for opening up a dialogue about change, possible futures and about what it means to re-shape the way in which people live. (2017, p. 1).

### 4.3.6 How to design policy for the temporal dimensions of climate mitigation

The essential aspect of time in the CM policy problem is recognised by practitioners and researchers alike: The development participants in the Economic Growth Conversation (20 November, 2014) recognised climate mitigation as a long-term policy problem, and that there is no sense of immediacy. Researchers identify climate mitigation as a 'quintessential' long-term policy problem (Hovi et al., 2009; Lempert, Scheffran, & Sprinz, 2009), with the challenge of how to 'bring it forward' as distinguishing (Hovi et al., 2009; Levin et al., 2012).

This temporal aspect is acknowledged within the SA CM policy objectives, but with no guidance to resolve what is experienced as an inherent tension from the classical scientific view of time as linear; mitigation must both occur within a timeframe that provides an equitable contribution to the global mitigation issue (identified as 2050), and within a timeframe that allows for development.

However uniform time units are not equal in their implication for climate impact. Delayed mitigation action means that it becomes more costly to attain a future low carbon economy as fossil fuel based infrastructure forecloses on investment in its low carbon counterparts, with implications for the evolution of socio-economic systems (Erickson, Kartha, Lazarus, & Tempest, 2015; NCE, 2014). Delayed action at a global level also increases the risk of not remaining within the two degree level of global warming agreed by the UNFCCC as an upper limit (IPCC, 2014a). As Levin et al. (2012) note, this leaves no room for compromise as nature cannot be mediated by the political system as in the case of social problems. Therefore there is an urgency to the CM policy issue, one of 'time running out' (Lazarus, 2009; Stern, 2007).

The inaugural New Climate Economy report (2014) suggested that the next 10 to 15 years are critical, and this is particularly so for developing countries (Bhattacharya et al., 2015). In the South African context significant hard infrastructure build programmes are underway in response to economic and social infrastructure trends (Presidential Infrastructure Coordinating Commission, 2012). For example, the country needs to accommodate an additional 7.8 million people in its urban centres by 2030 and make substantial investments in rail and power generation infrastructure (NPC, 2011). As has been discussed in the previous section, the SA CM policy CoP does not engage with how these infrastructural decisions are made.

There are additional aspects to climate mitigation's temporal dimensions lying in the realms of human behaviour and politics that SA CM policy systematically sidesteps. This is not atypical, Sprinz (2009) and Steinberg (2009) find that the political aspects of coping with long-term environmental problems have received relatively little attention in the literature. The temporal scale of the CM policy problem is vast - the impacts of climate mitigation or its absence will only be felt beyond one human generation, the current generation is already locked in to a level of temperature rise over which we have no control (Lazarus, 2009), reducing the current generation's imperative to act. This is unfortunately exacerbated by the way human cognition works. Morcol warns that 'our simplifying minds cannot easily grasp the complexities of global warming and this mismatch is an impediment to taking actions to reverse the warming trend' (2015, p. 82). Lazarus describes the psychological heuristics humans use that curtail mitigation actions. He quotes Rachlinski, (2009, p. 1174) as describing humans as having 'cognitive tendencies and limitations which produce a 'massive social trap''. The first is myopia; we tend to discount things in the future in favour of short-term reward. Levin et al. (2010) draw on behavioural economics literature describing this tendency as 'hyperbolic discounting', beyond that which the economic discounting tool suggests is rational. Secondly, we use an 'availability heuristic' whereby we respond to things that are imaginatively available to us. Because of climate change's long timeframes, we are largely unable to imagine it. Thirdly, we use a 'representative heuristic'. Were the cause and effect of our actions clear, it would be more compelling to address them. The complexities of climate science render this possibility remote. These heuristics are amplified when considered in the South African context of

poverty, unemployment and intra-generational inequality: Myopia is likely to be exaggerated in the face of overwhelming daily challenges, the imaginative availability of climate impacts are even further reduced, and the historic responsibility of the developed world for GHG emissions complicates the representative heuristic.

These human cognitive heuristics are also evident in the realm of politics and policymaking. Hovi et al. describe a 'commitment' problem inherent in translating a long-term strategy on climate mitigation into a set of effective policies[39] which he refers to as time-inconsistency (following Kyland and Prescott's 1977 work), where the optimal policy response at one point in time is inconsistent with the optimal policy response at a later date. Kyland and Prescott quoted by Hovi et al. explain that 'sub-optimality arises because there is no mechanism to induce future policy- makers to take into consideration the effect of their policy, via the expectations mechanisms, upon current decisions of agents' (2009, p. 22). Lazarus concurs: the institutional mechanisms to address climate mitigation's temporal scope on the domestic or international level do not yet exist. The use of discount rates in traditional policy analysis tools he describes in the temporal context of climate mitigation as 'heroic, foolish, or a mixture of both' (2009, p. 1168). Auld et al. (2012) agree that the ability of current institutions and policy processes to respond to the urgency of climate mitigation is overwhelmed. As much as humanity's cognition fails, so does its collective political processes as these are unable to account for future generations.

There is yet another temporal dimension, relevant to the international CM policy issue, but intensified in the inequality and development challenges of South Africa. King (2015) writes of the current evolution of the world's systems as creating vulnerabilities in the context of significant inequalities as 'the convergence of global political and cultural systems is removing crucial checks and balances, raising the prospects of global cascades (such as the financial crisis) to dangerous levels'. The development aspects of SA CM policy are not impervious to time, particularly when considered from a systemic perspective and as intertwined with environmental crises.

In the light of this conundrum, Levin et al. identify the challenge of CM policymaking as being:

> to counteract the tendency of our political institutions, as reinforced by our individual tendencies as consumers and voters, to make decisions that give greater weight to immediate interests and to delay required behavioural changes, even when doing so is clearly contrary to our long-term interests (2012, p. 125).

They argue the alternative as being to identify collectively rational responses to 'constrain our future selves' (2012, p. 129) in addition to adjudicating currently competing interests. Even if we were able to

[39] They identify a third commitment problem of 'anarchy' at the international policy level, which bedevils the ability to achieve a multilateral, binding commitment to mitigation globally. This problem is not time related, and is of greatest relevance to the international CM policy issue. It is therefore not a key focus here.

access a collective rationality, the unequal distribution of power in society serves to further work against action for the long term, as it usually comes at a cost to the present incumbents.

Finally, the deterministic approach of the SA CM CoP renders any conceptualisation of the future inherently constrained by the present, and as such 'conceptually closed' (Hermanus, Resilient urban development seminar, November 2016). The scenarios methods and models used extensively in SA CM policy work create 'current future scenarios' out of the same order of logic defining the current problem. This obscures possible futures conceived within different, higher order logics (following futures thinker Dorstal (2010)). Stirling (2014) emphasises that transformative futures can be democratically co-created, an activity of 'culturing plural, radical progress'.

### 4.3.7 Context: spatial, demographic, physical, institutional, and historical

The abstraction of the SA CM approach obscures the role of context in CM policy design and implementation, rendering policy analysis and design less applicable and implementation less likely. Modelling is a significant driver of this, as 'local heterogeneity' is difficult to capture in models with simplifying assumptions (Geels et al., 2016). In addition, opportunities for the SA CM policy issue arising from unique contextual aspects might be missed. Co-benefits analysis, whilst closer to real situations, projects and programmes than modelling remains abstract in approach, and does not invite a systemic consideration of mitigation-development links. Whilst co-benefits analysis has provided insights into the areas of synergy and misalignment between mitigation and development at the project and programme level, it also suggests a more complex and less obvious picture once interrogated, where context is highly relevant to the balance of outcomes (Cohen et al., 2016).

South Africa apartheid's spatial and economic (MEC) legacy has resulted in:

> features [that] contribute to both high emissions intensity and low employment intensity... both [of which are] structural outcomes of particular policy choices over many decades… such as the subsidisation of heavy industry before and after 1994 leading to a subsidy of R1m per employee per annum in BHP Billiton (Black, 2014, p. 21).

The physicality of the country is relevant: large distances between rapidly growing urban areas, whose design bears legacies of apartheid planning, impact GHG emissions and mitigation options in transport and energy. These features will continue to influence the implementation of CM and development policy into the future. From a broader perspective, Grubb et al. note that the lack of interest in climate change itself by the mainstream economic community 'reflects the abstraction of finance and GDP from physical realities.' They also argue that 'climate change offers an overarching context that could also help the field of economics itself reconnect with the physical basis of economic systems'(2014, p. 424).

South Africa's social history has bearing on the CM policy issue. The Conversation on Consumption (16 October, 2014) reflected that white privileged people telling poor black people not to consume doesn't work, and Development Provocateur Kumar (2014) points out that who is giving the message is important. An interviewee in Rafey's study reflected that a rights discourse was required to rescue the environmental policy discourse as a 'predominantly white, middle class affair' in South Africa (2013, p. 47). Rafey reflects that the racial make-up of the non-governmental members of the SA CM CoP (business, civil society and academia) exacerbates a 'breakdown in communication between researchers and policy analysts and advisors and government' (2013, p. 47).

South Africa is characterised by limitations in various capacities, a situation typical of developing countries (Davidson et al., 2003; Dubash, 2009; Parnell, 2014). The Development Provocateurs and participants in the Conversation Series spoke explicitly or implicitly of the policy relevance of the irrationality, chaos, interconnectedness and complexity of development policy issues, corruption, lack of governance, weak institutions, lack of long-term planning capacity or prioritisation, and the lack of resources and skills that predominate in a developing country context. As an Interviewee (2014) observed in the light of the LTMS' Required by Science trajectory, the SA government's typical response to targets is to 'delay, delay, delay and then say it can't achieve the targets'. The IPCC WGIII on Mitigation found that a lack of resources and skills generally means reduced capacity for CM policymaking (IPCC, 2014b), particularly as it is a policy issue requiring cross-silo interaction and a long-term focus. This is significant - Held et al. are cited as claiming that 'limited institutional capacity in developing countries presents the most significant barrier to mainstreaming of mitigation policies' (2014, p. 1180) - and yet this is not made visible by the SA CM CoP's approach.

At the time of writing South Africa is unstable politically, reeling from mounting evidence of systemic corruption and in technical economic recession. This political instability also has particular implications for how the SA CM policy objectives are interpreted. Parnell comments on this at the level of local government: 'the fragmentation of urban governance means that mitigation based ideas like green growth are being used to marginalise issues of justice and promote the interests of the elite' (2014, p. 6). This contemporary context exacerbates the disconnect between the approach of the SA CM CoP to how policymaking happens and how policymaking and implementation is happening in the country.

More generally, there has also been a growing literature engaging with the urban scale of CM policy, with urbanisation and cities becoming a core focus for CM policy research, projects and programmes in the past few years. The New Climate Economy has made cities a focus (Floater, Rode, Friedel, & Robert, 2014), and the international C40 Cities Climate Leadership Group[40] has been playing an increasingly prominent role in practice. However, there remains a lack of articulation between the local and national policy scales (Centre for Policy Research, MAPS Programme, & ERC, 2013).

[40] www.c40.org

### 4.3.8 The social aspects of mitigation

Both in international and domestic CM policy, the role of social structures and aspects such as institutions, policies, politics, political economy, individual and collective decision making, behaviours, values, culture and spirituality are placed at the periphery of the CM policy issue (Grubb et al., 2014). For example, Corbera et al. (2015) finds that the IPCC WGIII struggles to effectively incorporate many important social aspects into its discourse, notably questions of justice or governance. As a result of this, Shove argues that CM policy is proceeding 'on the basis of an extraordinarily limited understanding of the social world…' (2010b, p. 278). Leyshon (2014) and Shove (2010a, 2010b) amongst others (Driessen et al., 2013; Fazey et al., 2017) argue that the social sciences, including policy studies, are critically missing from CM policy literature, and need to be repositioned as 'an indispensable part of reframing and understanding climate change as a social phenomena (sic)' (Leyshon, 2014, p. 359). In addition, narratives in the social sciences that 'focus on questions of ontology and epistemology, or which interrogate methodological assumptions and interpretative frameworks' need prioritisation (Leyshon, 2014, p. 371). Cornell argues that 'physical science has reached its explanatory limits in the climate context and now needs to be integrated with the human sciences' (Bhaskar & Parker, 2010, p. xi), and Fazey et al. (2017) concur that 'instead [of current approaches], structural, social and cultural changes will be needed across societies including reconsideration of deeply held beliefs, assumptions and paradigms, and those about what it means to be human' (2017, p. 2). Geels et al. (2016), in a paper focused on quantitative modelling, argue that engaging with the social means a plural approach to knowledge making and method in CM policy.

Some of the implications of the SA CM CoP's underemphasising the social aspects of mitigation have been considered in section 4.3.5. in the context of the particular view of development and transformation. This section picks up on that discussion.

#### (a) Engaging people, society, culture, values

One of the strongest critiques of the Development Provocateurs at the DevMit Forum was how the SA CM CoP's dominant approach ignored people, obscuring the embodied, emotional part of knowing and removed thinking about a social, political, cultural, historical, gendered world (Kane, 2014a). Individuals are abstracted from communities in both CM policy and research as 'consumers' or 'citizens', negating social relations. Leyshon recounts how Shove describes carbon-intensive practices such as travel by car as 'not simply an individual act but [acts which] have been constituted and enabled by constant repetition and are the product of historical conditions and contemporary meanings, competencies and materials' (Leyshon, 2014, p. 370), arguing that this perspective explains why they are so difficult to influence purely with information. People and social processes also interact with technologies and science, with the potential to both support or undermine mitigation, and organisational, social and business model innovations have a significant role to play in transformations (Geels et al., 2016).

Development Provocateur Mistry (2014) noted that the SA CM CoP seemed to treat behaviour and aspirations as set, rarely including these aspects in policy analysis (Leyshon, 2014; MAPS Programme, 2014), with the development participants in the Consumption Conversation (16 October, 2014) commenting that behavioural factors such as the role of consumption as a driver of GHG emissions are underexplored. Because the SA CM policy CoP assumes that knowledge sequentially and commensurably results in action, it is less able to understand why people act. However, research undertaken in the field of human cognition suggests that a better understanding of human behaviour may be critical for designing mitigation policies (Lazarus, 2009; Levin et al., 2012). Guattari, 2000, cited in Fazey et al. reflect on this:

> The challenge confronting humans is [therefore] to understand how self-knowledge of our essential natures can enable people to overcome the evolutionary tendencies that are reflected in contemporary cultural practices (2017, p. 11).

A number of authors argue that dialogue and engagement are central to both developing an understanding of how societal transformation happens, and also to supporting its emergence (Dombkins, 2014; Fazey et al., 2017; Shine, 2015). However, the dominant approach of the SA CM CoP obscures the need for engaging with people to effect change. Rommetveit et al. find the problem of lack of effective action, indeed a lack of agency, on climate change is one of Verfremdung – 'alienation' and - 'there seems to be no solution to the issue without the radical involvement of citizens…science is not enough' (2010, p. 159). Rafey alludes to aspects which make this particularly difficult for the SA CM CoP, reflecting that experts must work for acceptance by those from different knowledge backgrounds 'by exhibiting sensitivity to the political and historical contexts that their scientific training advises them to bracket during the modeling process' (2013, p. 146). Mistry warns that 'The mitigation sector should not make assumptions of prior knowledge and, importantly, needs to be careful not to consider any lack of knowledge as a deficiency' (2014, p. 34). The CoP needs to get out of its silo to train urban practitioners, and learning from the development sector, to unpack the jargon which prevents communication and keep it simple (Kumar, 2014; Mistry, 2014; Poverty Conversation, 6 November, 2014).

The mitigation (and development) discourse needs to extend into broader social and economic discourse, but also beyond academics, policy makers and practitioners. There are change agents amongst the private sector, social and economic opinion formers and marketers who should be engaged for the mitigation agenda to be more widely understood and adopted (Mistry, 2014, p. 35).

The SA CM CoP has not understood 'how to unpack climate change with civil society and community groups to jointly come up with solutions' (Kumar, 2014, p. 50; Mistry, 2014), or to hear the voices of the grassroots communities (Mistry, 2014). Mistry further comments that this is also something that the development community has not necessarily done well in the past, and the SA CM CoP may make similar mistakes. Kumar gives an example of this, where very abstract dialogue at the national level has not assisted the issue of urban housing, rather it has 'further divided the urban fabric' (2014, p. 49).

Meadowcroft (2011) reflects that because climate mitigation is an inherently normative issue, it requires working with different perspectives and values to progress it. For example, Leyshon (2014) argues that climate change is 'a category of knowing' resulting from the careful meteorological observations of the recent and more distant past. Interrogating the set of values implicit in the hegemonic worldview for their relevance in the twenty-first century context of global environmental constraints and rising inequality provides a starting point, which is out of reach of the SA CM CoP. Morgan et al. reflect that for problems of global change: 'an essential part of the challenge then is to incorporate uncertainty about future values into our analyses and to choose strategies that preserve future flexibility' (1999, p. 275). Working with values has been described as being particularly relevant to perspectives on development, and the interaction of these issues with mitigation. Ultimately it is not clear that achieving the SA CM CoP's mitigation-development goals is possible without an interrogation of the role of values.

### (b) A consideration of how policymaking and policy implementation happen

The SA CM CoP's dominant approach to policymaking obscures a consideration of how policymaking and implementation happens. The mental model of injecting knowledge into a black box that churns out policy instruments that are smoothly implemented assumes a rationality in policymaking and implementation that is not evidenced in practice. The public policy and administration literature suggests that the policy instruments which form such a significant focus of the SA CM CoP's activities are not neutral, they produce effects independently of their intended objectives and are also only one aspect of policymaking (Hill, 2013). The predominance of quantitative modelling as an analytical tool in the CM CoPs introduces biases in the favour of carbon pricing against other mitigation policy instruments which have been shown by International Energy Agency research as being more effective to date, such as tax breaks, capital grants, production subsidies and performance standards (Geels et al., 2016). 'Unfortunately [these approaches] may stop deep engagement with planning and decision- making as it is; rather than planning and decision-making as it is desired to be by the mitigation community' (Kane, 2014a, p. 5).

Rafey observed that the South African policymaking process is not necessarily systematic or structured. 'Some of it is; a lot of it isn't' (2013, p. 22). A 2014 Interviewee observed that 'policymaking in South Africa is a very complex process... things happen in quite unpredictable ways'. This notwithstanding, the approach of SA CM CoP constrains it from knowing how to work with this, and it reverts to relying on the production of evidence (Rafey, 2013). Leyshon reflects that 'the problem of climate change seems stubbornly resistant to this [knowledge led] approach' (2014, p. 364), whilst Wellstead et al. (2015) find that considering the policy-making process a black box is probably the biggest thing missed by climate policy analysts. Geyer and Cairney (2015b) observe that the 'black box' approach - inject knowledge, expect commensurate outcomes - just doesn't hold in a social world and particularly for complex policy problems such as climate mitigation (Dombkins, 2014; Geyer & Cairney, 2015a; Levin et al., 2012).

The SA CM CoP's focus on content above process is a theme of sustainability policy more generally (Dombkins, 2014), perhaps related to the dominance of environmental considerations (above the social) in sustainability, and therefore the natural as opposed to the social sciences. Thomas and Mohan (2007) argue that considering policy as prescriptive and top-down in a development context is particularly inappropriate. Insights from the postmodern policy theorists who emphasise social aspects and policymaking as a process emanate from a different worldview, and are mostly ignored by the SA CM policy CoP. This uni-dimensional view of policymaking is exacerbated by the dominance of quantitative modelling in policy analysis, which cannot account for the role of policymakers as being able to balance different interests and policy priorities (Geels et al., 2016).

To give effect to a broad, deep and urgent transformation, policy areas such as transport, energy, and industry require re-orientation, not just the retroactive alignment that the SA CM policy concept of mainstreaming and the Flagships programme suggests (Giordano et al., 2011). The development participants of the Economic Growth Focus Group observed that the SA CM CoP has not paid attention to communicating clear mitigation goals (the GHG Emissions Benchmark Trajectory Range is highly complex and technical as a policy performance measure), an issue that is exacerbated by the environmental institutionalisation of SA CM policy. The natural science and environmental influence in the terminology used to describe mitigation-development relationships does not find traction with those attending to the social policy issues of development, and was absent in the language of the development participants of the Conversations. Issues of co-ownership, capacity, motivation and co-operation are not central to SA CM policy, despite the limited ability of DEA to influence other policy areas directly. An Interviewee (2014) highlighted that the lack of capacity within the economic departments on climate issues corresponded to an inability to respond to and own the issue. The SA CM CoP has been ineffective in the 'selling' of a low carbon vision across government and society, and particularly to the governing party executive in a compelling manner. Attention to the implication of assumptions and perspectives, to cultivating policy ownership, to working with essentially contested concepts, to communication, are all aspects underemphasised by the SA CM CoP.

The dominant approach of the SA CM CoP also obscures the deep contestation both within the CoP and between the CoP, South African policymakers and society around how the high level objectives of the NCCRWP are to be translated into an implementable plan. At the heart of this contestation is the issue of addressing the mitigation and development relationship, with sections of the CoP operating from very different implicit understandings of what the objective is in this regard (Forti, 2013; Rafey, 2013). Unable to either see or engage with this 'essential contestation', the SA CM CoP has only achieved a 'vision of consensus' (Rafey, 2013), expressed through high level concepts such as sustainable development, low carbon development and green growth. Whilst useful for achieving consensus visions, the lack of contextual interpretation of these concepts constrains policy implementation. Rafey finds that the five different discourses on climate and energy development in the country identified through his research have different implications for implementation, focusing separately on: protecting coal exports or energy

intensive development, or boosting local job creating renewable energy, or invoking moral reasons for mitigation, or avoiding the competitiveness impacts of international carbon pricing, or advancing international climate mitigation negotiations. The use of high-level concepts cannot resolve contestation at a lower order of policy process (Forti, 2013; Rafey, 2013), such as that playing out in the design of the primary SA CM policy instruments of the carbon tax and carbon budgets. This inherent contestation has been identified by some commentators as the reason why progress on CM policy implementation has been delayed (Forti, 2013; Parliamentary Colloquium, 28 October, 2016; Rafey, 2013; Trollip & Boulle, 2017).

### (c) The role of power and political economy

The dominant approach to SA CM policy largely ignores politics, political economy and power. And yet the political economic pattern of the country is that of the MEC, steeped in the hegemonic worldview valuing top-down control, extraction, and large sophisticated technology. By ignoring power, current patterns of power are likely to endure. Power is self-reinforcing. Using political discourse analysis of interviews with the SA CM CoP, Forti (2013) finds that South Africa has implicitly taken a 'status quo' interpretation of sustainable development, reflecting the interests of the political-economic incumbents.

The implications of this are twofold: first that the incumbents will resist SA CM policy, and second that particular narratives of low carbon pathways for South Africa – those born of the hegemonic worldview - have greater power and influence than others (Leach et al., 2007). Hallowes notes how 'the LTMS analysis binds each wedge to the dominant interests in the relevant sector' (2008, p. 20) and Leyshon (2014) and Stirling (2014) reflect how power and political economy sustain material infrastructures. Both of these implications have particular relevance for the ability of the SA CM CoP to respond to its twin policy objectives of mitigation and development.

Power is therefore highly relevant to challenges of transformative change (Fazey et al., 2017) particularly climate mitigation, and should be centre stage in deliberate systemic transitions (Geels, 2014). Political and institutional processes shape how particular perspectives and narratives come to dominate (Stirling, 2014), and therefore are particularly important to consider. The SA CM CoP's use of high-level concepts such as sustainable development masks agency and causality and abstracts from actors and institutions (Markusen, 2003). The relative immaturity of South Africa's institutional and democratic structure is relevant in this context (Tyler & Torres Gunfaus, 2015) - climate mitigation is not a voting issue in the country. Yet the manifestations of poverty, unemployment and inequality are more so, and development experts have commented that being able to articulate why climate action could have developmental advantages is key (Parnell et al., 2008; Simon and Lech, 2013).

There are aspects of the CM policy issue which render it especially vulnerable to having particular powerful narratives (of CM policy response) imposed upon it. Typically, mitigation actions entail focused costs (on one actor, or sector, and typically on those wielding substantial power currently), and disbursed

benefits, particularly for the powerless. Policy analysis however maintains it is far easier to adopt and implement a policy when the inverse is true (Hovi et al., 2009). Levin et al. (2012) and Lazarus (2009) expand on this in the context of international CM policy by noting that the current incumbents with greatest historical contribution to the problem have the least incentive to act. In addition, the 'dynamics of vertical disintegration' appear to apply strongly to the climate mitigation issue: As the policy moves from a high-level goal and principle through to policy as action, it is subjected to increasing pressure to dilute it.

### (d) Engaging contestation

By obscuring the possibility of different perspectives, conceiving of mitigation and development as separate and ignoring power, the SA CM CoP situates contestation at the periphery of the SA CM policy issue. Right at the start of SA CM policymaking, the LTMS implied significant losers in the shift from its 'Growth Without Constraints' baseline scenario to any of the described mitigation trajectories, but didn't explicitly engage with these (2014 interviews); there was a sense at the 2014 National Climate Change Response Conference that the issue of trade-offs was being skirted, that these discussions are yet to happen (Parliamentary Colloquium, 28 October, 2016). Rather, the SA CM CoP focuses on the concept of 'win-wins' for mitigation and development (SBT, 2007). Whilst the concept of trade-offs entered the discussion prominently in the low carbon stakeholder workshops supporting the drafting of the climate mitigation text of the NDP (NPC, 2011), the SA CM CoP still shied away from engaging with contestation. As Development Provocateur Trollip notes 'We don't seem to accept that there are some 'fundamental win-lose situations', nor that some mitigation actions may present losers in the form of the poor' (2014, p. 30). Provocateur Black notes for example that electric cars in South Africa, promoted by the SA CM CoP, is a win-lose policy from a mitigation - development perspective as it privileges car owners above public transport. Equally there are mitigation situations where the wealthy incumbents stand to lose. Engaging with losers is a political issue, and the SA CM policy CoP has few tools with which to address this, or to work with different perspectives. A participant in the SA CM CoP Reflective Conversation (27 November, 2014) was at a genuine loss: 'we are polarising even more. How do we work with this?'

Rafey reflects that the 'vision of consensus' achieved through the use of high-level concepts was useful for supporting the SA international CM policy negotiating position. Domestically however, the lack of engagement with the contestation serves the purpose of sustaining the status quo, and masks the distribution and utilisation of power within the SA CM CoP and broader policy system.

The absence of the social sciences and the humanities in the SA CM CoP's discourse particularly prevents it from seeing contestation. Corbera et al. suggest (of the IPCC) that considering a broader perspective of views might 'help unearth key conflicts and choices to be made in CM policy, between values and interests.... emphasizing the important political choice societies confront as they respond to climate mitigation' (2015, p. 6). Accessing different perspectives may also give weight to mitigation-development

drivers other than those of international moral equity and the moral prioritisation of development at a national level.

## 4.4 Reflections on what is illuminated and what is obscured

The SA CM CoP's dominant approach has illuminated essential aspects of the SA CM policy issue, which in turn has led to important policy achievements. First, and perhaps most significantly, the depiction of the policy issue in the quantitative, scientific and moral language of the hegemonic worldview has gone a long way to getting climate mitigation onto the South African policy agenda (Tyler & Torres Gunfaus, 2017). This has translated both the outputs of climate science and the international policy process into a national policy issue of deliberate transformation (O Brien & Sygna, 2013), represented by the GHG Emissions Benchmark Trajectory Range. This is significant, both because of the long-term and guided nature of the problem, but also because it occurred during a time when there was a dearth of new policymaking by a policy system exhausted from its efforts after the 1994 democratic transition.

Secondly, much progress has been made with regard to data: mandatory reporting, collection, and systems development. This evidence base is critical in the case of a guided policy issue and deliberate transformation. Third, the SA CM policy provides a long-term policy signal, albeit only at a high-level. Whilst the effectiveness of this signal is constrained by the extent to which it is believed, (many would argue that the SA CM policy signal is currently weak), it nevertheless exists and can be said to have provoked a response in terms of investment. This is most significant in the REIPPPP, a result of carbon constraint incorporated into the IRP as a result of the LTMS. Finally, the articulation of the SA CM policy objectives and vision has supported South Africa's position in the international CM policy negotiations (Rafey, 2013).

However, Farley et al. (2007) observe that how a policy issue emerges onto the policy agenda is significant, as it potentially results in particular problem definitions and policies dominating the political agenda going forward. The analysis in this Chapter reveals that the current SA CM policy approach obscures, both actively and passively, aspects of the SA CM policy issue that are becoming increasingly more significant as the policy issue matures. This places the SA CM CoP's progress on a tenuous footing: SA CM policy implementation, where it has happened, has been largely accidental and strongly influenced by non-CM policy drivers (Tyler et al., 2013). Rafey observes that 'South African [domestic] climate policy starts – and could possibly collapse – in the international arena' (2013, p. 69).

## 4.5 Evolution of approach within the CM CoP

Notwithstanding the dominance of a particular approach within both the CM and SA CM policy CoPs, there are growing instances of CM policy academics and practitioners engaging with those aspects which the dominant approach obscures, and the CM policy CoP itself expanding, incorporating different and new

perspectives. Geels et al. (2016) characterise this change as the climate change debate shifting from discussing problems to discussing solutions. During the four years that it took to research and write this thesis, this trend grew exponentially. Whilst instances of this growing body of work have been cited in the preceding analysis to assist in developing the argument of what the SA CM CoP illuminates and what it obscures, it is summarised here by way of evidencing and describing this trend.

Research into mitigation and development as one systemic issue was alluded to by the emerging conversation of the DevMit Forum as a 'multiple benefits' approach (MAPS Programme, 2014), and there has been other work on this theme (Khosla, Dukkipati, Dubash, Sreenivas, & Cohen, 2015). Further work engaging systemic approaches to mitigation and development includes Tanner and Allouche (2011), Burch, Shaw et al. (2014), Stern and Fankhauser (2016), Ingwerson et al. (2013), Lane-Visser (2015) and Winkler et al. (2015). Winkler et al.'s 2015 article covers much of the groundwork for the mitigation-development theme of this thesis, arguing explicitly for a systemic approach to mitigation-development, and implicitly for an evolution of worldview. On a practice-level systemic approaches are being explored in the SA CM CoP through systems dynamics modelling of the transport sector (Van der Merwe, Lewis, Cohen, & Naude, 2015), and the systems approach currently being undertaken in the SA CM policy system design (Cloete et al., 2017). The framing of the most recent IPCC report, the special report on 1.5 degrees of global warming (2018) demonstrates a step–change towards a systemic view of climate change and sustainable development.

The concepts of transformation and transitions are increasingly being explored within CM policy (IPCC, 2018), particularly emphasising social aspects such as power (Geels, 2014; Geels et al., 2016; O Brien & Sygna, 2013; Upham, Kivimaa, & Mickwitz, 2014), and the role of infrastructure (Bhattacharya et al., 2015; Erickson, Kartha, Lazarus, & Tempest, 2015; Lecocq & Shalizi, 2014; Rozenberg, Vogt-schilb, & Hallegatte, 2014). Carbon lock-in has received a recent surge of interest (Aghion & Hepburn, 2014; Erickson et al., 2015), particularly in the coal sector in the South African context (Burton et al., 2016; Burton & Winkler, 2014).

Within the dominant CM policy discipline of economics there is a growing realisation of the need to move away from traditional economic approaches (Balint et al., 2016; Fankhauser & Stern, 2016; Mercure et al., 2015). Veteran climate economists Grubb et al. argue in their book 'Planetary Economics' (2014) for an expansion of the current orthodox economics approach to climate mitigation to include the two additional decision-making 'domains' of behaviour and systems, thereby drawing on the more recent and experimental realms of behavioural and organisational economics, and institutional and evolutionary economics respectively. Planetary Economics is unusually reflexive in nature, arguing that the CM policy CoP is 'stuck in the wrong conversation' and acknowledges many of the implications of the complex, systemic, and temporal aspects of the policy issue. Together with Stern and Fankhausen (2016) and Balint et al. (2016) they suggest that orthodox economics is not able to reveal the benefits of climate mitigation for development and societal progress. Mercure et al. (2015) argue that the role of innovation has been

misunderstood by orthodox economics, with alternative approaches suggesting climate mitigation policy as a driver of economic growth. In the SA CM CoP, recent modelling treats GDP as endogenous rather than exogenous, reducing the weight of undifferentiated economic growth in the analysis (Altieri et al., 2016).

The Paris Agreement itself represented a significant shift in approach to understanding policy approaches for complex systemic problems. After attempting for decades to achieve a deal based on 'targets and timeframes' under the UNFCCC, the Paris agreement is based on a 'pledge and review' system. Setting targets and timeframes for climate change mitigation is a top-down exercise in command and control type policymaking, with a global emissions limit agreed and apportioned to individual countries, together with timeframes for achieving this. A pledge and review system is primarily bottom-up and collaborative in nature. Countries identify what they think they can achieve in the form of a pledge, and these pledges are periodically reviewed against what is possible and fair at the country level, and globally against environmental adequacy. The former is based on a centralised control view of the problem. The latter has given up the illusion of centralised control, emphasising collective responsibility. It is up to cities, communities and citizens to ensure adequacy.

The CM CoP is increasingly recognising the importance of the social, with the IPCCC (2014) including a chapter on the 'Social, Economic, and Ethical Concepts' in its most recent ($5^{th}$) Assessment report. Whilst this chapter remains within an orthodox economics frame, the 2014 report acknowledges the limitations of this for taking account of the issues of justice and human rights. The IPCCC Special Report on 1.5 degrees (2018) goes further to directly consider behavioural change, governance and institutions. Politics and power are also starting to be investigated (Geels, 2014; Hovi et al., 2009), as well as political economy, particularly in the climate-development interface (Tanner and Allouche, 2009). Sanwal and Zheng (2016) consider the relevance of global social trends for China's climate mitigation response in an inherently systemic framing. There is an increasing call for multiple knowledges to be brought to bear on the CM policy issue (Bhaskar, 2010; Geels et al., 2016; Grubb, et al., 2014). Within the SA CM policy CoP there has also been a rise in research into social aspects of CM policy, including institutions (Chandrashekeran et al.,2015), policy networks and coalitions (Rennkamp et al., Casamadrid, 2017) and political economy (Baker, Burton, Godinho, & Trollip, 2015; Baker, 2012). The SA CM CoP has also started to consider the challenge of CM policy implementation (Boyd & Coetzee, 2013; Trollip & Boulle, 2017; Trollip, Nontshokweni, & Godinho, 2015; Worthington, 2014).

Together with these new research areas, some significant CM policy institutions are experimenting with perspective: The New Climate Economy project has experimented with a different articulation of its core question as 'how can economic decision-makers achieve their principal goals while also reducing their impact on the climate?' an inherently systemic approach (The Global Commission on the Economy and Climate, 2014, p. 12). The project is to a degree exploratory in its methodology too, seeking answers through engagement with decision-makers as a central feature. Its inaugural report positions the CM issue as a systemic one (NCE, 2014), and there is no mention of 'science' by way of validating its findings and

recommendations. The MAPS Chilean team incorporated a number of complexity aspects in its Phase Three work, such as taking a networked view of co-benefits, considering triggers of networked causality, looking at unintended consequences, and incorporating social aspects explicitly (Calfucoy, 2015).

A number of authors are beginning to consider the temporal nature of the CM policy problem (Hovi et al., 2009; Lazarus, 2009; Levin et al., 2012). Work is emerging on the spatial dimension as a 'switchboard' for an integrated approach to mitigation, adaptation and sustainable development (Aghion & Hepburn, 2014; Biesbroek, Swart, & Knaap, 2009).

Significantly, a main finding of much of this newer research is that there is much more to be done to illuminate these primarily social, systemic and complexity aspects (Driessen et al., 2013; Leyshon, 2014), and to consider their implications for mitigation action. This finding suggests that there is great potential for both academic and practice-based work in these areas.

## 4.6 Implications for considering an explicit alternative approach to SA CM policy

It is clear from the section above that both SA and CM policy CoPs more broadly are starting to work with many of the aspects which the dominant SA CM CoP approach obscures. And yet, the dominant approach remains active in the powerful areas of agenda setting, determining the type of work deemed valuable, and too that which is funded. This was evident at the inaugural international conference on the state of climate change science (Our Common Future under Climate Change, Paris, July 2015), which I attended. The research presented, the focus of the side-events and the general discourse - despite significant forays into transdisciplinary, systems and complexity approaches - remained strongly influenced by an overriding approach similar to that of the SA CM CoP (Our Common Future Under Climate Change, 2015). In an example from international practice, the OECD's recent publication, 'Investing in Climate, Investing in Growth' (2017) is similarly constrained. In South Africa, the Climate Change Bill retains key hallmarks of the SA CM CoP's dominant approach and the majority of the SA CM CoP is noticeably absent in one of the main areas undergoing rapid systemic transformation with long-term mitigation and development implications, the power sector.

There appears therefore to be a mismatch between work required to progress climate mitigation action and the SA CM CoP's dominant approach. More strongly put, the dominant approach could be said to be actively constraining this emergent work.

The work of this and the previous Chapter – to make explicit the SA CM policy CoP dominant approach and its implications - allows this approach to be seen, to be contested or accepted, and by so doing start to neutralise the power it wields. By considering Wenger's 'cradle', the extent to which it has become a 'cage' can be assessed. Such work requires the skill of reflexivity, the ability of a CoP such as the SA CM CoP to 'know itself', and 'how it does what it does' (Ison, 2010).

But there is another benefit to making 'approach' explicit; that of creating spaces for alternative approaches to gain traction (Dunn, et al., 2017). This benefit is particularly pertinent to this thesis given both the situation of this research within a transdisciplinary inquiry predicated on a usefulness to society, and the urgency of the SA CM policy issue. Creating spaces for alternative approaches can only be considered useful, however, if these approaches enable rapid progress on mitigation in South Africa. To assess this, requires a careful and explicit consideration of what types of approach will support progress on climate mitigation action in a development context. It is to this issue that the thesis now turns.

Before concluding this Chapter however, I'd like to make two comments in response to this question of what types of approach will support progress at this point. First, because the hegemonic worldview underpinning the current dominant approach of the SA CM CoP is itself central to obscuring aspects of the policy issue, considering different approaches cannot therefore be an exercise of 'adding on' to the current dominant approach, but rather a fundamental repositioning outside of the hegemonic worldview whilst still retaining the illumination this worldview has provided. Many argue that such a repositioning is required more generally in the context of global environmental crises and poverty (Cornell et al., 2013; Morgan et al., 1999; Stirling, 2014). This does not mean that the current approach is wrong. Rather that it is in and of itself inadequate (Stirling, 2014), or no longer useful. Echoing the quotation famously attributed to Einstein, Fazey et al. reflect that 'many current global challenges cannot be resolved solely by the same kinds of approaches that created them'(2017, p. 2). Second, the discussion in this Chapter has demonstrated that such an approach will also need to access insights across all disciplines given the reach of the CM policy issue (Cornell et al., 2013).

In Chapter Two (2.4.) I described my journey towards complexity as a field which appeared to hold promise for informing a more explicit and useful approach to SA CM policy than the current dominant approach. In the next three Chapters (Five to Seven) I move to explore this promise. At this point though, the thesis has dealt with the first two parts of the four-part research question: 'w*hat is the current dominant approach to SA CM policy?'* and *'what does it illuminate and what does it obscure about the policy issue?*' It can now proceed to the third: '*how does a complexity approach contribute towards revealing SA CM policy more fully?*'

# 5

# Complexity and complex systems thinking: a literature review

> *Complexity science takes us far from the classical focus on equilibrium and stability. It presents us instead with a world where open systems re-shape their environment and its dynamic development.*
>
> – Graham Room, Complexity, Power and Policy (Room, 2015, p. 20)

## 5.1 Introducing complexity thinking

Attention is now turned to introducing the field of complexity which I have chosen to consider as offering potential alternatives to the SA CM CoP's dominant approach. This Chapter starts by introducing complexity thinking, which is quickly situated in the context of the inquiry into approaching SA CM policy. By the end of the Chapter, I will have populated a box of complexity thinking tools and identified a method that will accompany me into Chapters Six and Seven, the heart of the case study.

**Complexity** is observed to be a key characteristic of the living, social and physical realms, such that all of reality, 'the world', can be described in terms of **complex systems**; the human brain is a complex system, as is the leaf of a plant, a community association and a country's economy. Complexity studies is emerging as a loosely defined but increasingly distinct field of enquiry, 'a lively arena of competing and contested discourses' (Ison, 2010, p. 33). Complexity thinking is ambitious: many complexity scholars argue for complexity as an alternative to the hegemonic scientific and cultural worldview; one where relationship and connections are more powerful in determining outcomes than are the characteristics of individual units, where change is constant, and predictability and control are impossible. This is a worldview that is essentially transdisciplinary (Wells, 2013), and where the only way to engage authentically is to 'learn to dance' with the complexity (Meadows, 2008).

Complexity studies is thus emerging from interactions within and between diverse intellectual lineages, notably those of chemistry, biology, physics, mathematics, systems thinking, cybernetics, ecology, earth sciences, philosophy, economics, and management. Yet it remains an immature field, and as such most

work on applying complexity remains explorative. There is a wide-ranging interpretation of key terminology within the field (Dunn, Brown, Bos, & Bakker, 2017), with scholars working from differing ontological and epistemological positions (Ison, 2010), the implications of which are seldom fully discussed. There is thus a high level of internal confusion and intellectual churn as theories are extended and critiqued, and practical applications reveal insights and challenges. The chronology of complexity thinking is relevant, with an evolution of the field from pre-science to classical science to modern science to postmodern thinking discernible. Each of these scientific traditions have added perspectives and insights, but the field has not yet sufficiently matured as to render these differences accessible to any but the experienced complexity scholar. As Webb notes '... the varied contexts of those employing a complexity analysis will lead to multiple interpretations of what complexity is, and the contribution it can make' (2015, p. 59). As such, the rendition of complexity thinking offered in this Chapter (and beyond into Chapters Six and Seven) is my sense-making of the field as I have encountered it for the purposes of my research.

Complexity thinking has also permeated the popular literature (for example Gladwell (2000), Lewin (1992) and Waldrop (1993)), and concepts have been picked up and contemplated within other academic fields and disciplines, again without a clear reference to complexity terminology or origins. Wells (2013) refers to an ‘explicit’ complexity literature (that which uses established complexity terms and references complexity studies, science or theories as a discrete field), as opposed to ‘implicit’ complexity thinking, where complexity concepts are not identified as such and merge with other analytical frameworks.

Accounts of the roots of complexity studies and its key influences and contributors are strongly determined by an individual author’s disciplinary situation and perspective (see for example Ashby (1962); Chu, Strand, & Fjelland (2003); Dunn et al. (2017); Ison (2010); Richardson & Cilliers (2001); Walby (2007); Wells (2013)). Whilst some argue that complexity thinking was inherent in many early philosophical traditions (Boulton et al., 2015; Capra, 1974/1983), complexity most seriously entered the scientific realm with quantum and relativity theories at the turn of the twentieth century. Towards the middle of the century complexity was observed and identified as abounding in natural systems and their evolution, particularly by the scientists Prigogine and Kauffman, and inherited mathematical expression where key properties and behaviours of these systems were captured and described (Von Bertalanffy, 1968). Advances in computing technology enabled the modelling of complex systems and extended complexity thinking in the fields of cybernetics and systems analysis. Computing power and the use of sophisticated modelling continues to reveal properties of complex systems to this day. The 1970s and 1980s were an important period for complexity studies as a distinct field, with a major French Cerisy conference on the topic being held (Wells, 2013), and the first journals founded (including Emergence: Complexity +

Organisation (E:CO)[41]. It was however only in the 1990's that complexity thinking began to be taken up in earnest by the social sciences (Holland, 2014).

Particularly as contemporary philosophers engaged with complexity, the argument emerged for complexity as paradigmatic, a worldview, or a way of seeing (King, 2015; Morin, 2006; Wells, 2013). This **complexity paradigm** stands in opposition to the reductionist, determinist and disjunctive assumptions of classical science (Woermann et al., 2018), but is not so defined. Two philosophers have made particular contributions here. The French philosopher Edgar Morin (2006) emphasises principles of relation, between part and whole, system and context, order and disorder, as being essential to complexity. Whilst binary logic, disjunction and reduction enable us to understand the parts well, they do not assist in understanding connectedness, the 'weave' (Montuori, 2013b). Morin advances a '**generalised complexity**' view, positing that a complexity paradigm is inherently transdisciplinary (Wells, 2013).

South African philosopher Paul Cilliers advanced complexity as paradigmatic through his advocating for a '**critical complexity**' (Cilliers, 2016). In dialogue with post-modernist thinking, critical complexity emphasises that objective knowledge of complex systems is an impossibility and there is no final reference point from which to engage (Woermann et al., 2018). This does not mean that anything goes (Cilliers, 1998). Instead, the loss of a final reference point demands a critical engagement with any complex system, social or natural or both, with 'critical' referring to the 'attitude' of the person(s) doing the engaging (Woermann et al., 2018). The role of the observer of complexity then becomes definitive, as every observation is unique to that observer, in that place, at that particular time.

As elucidated by Morin and Cilliers, a complexity paradigm takes as a point of departure the limited and provisional nature of understanding, the increasing complexification and unknowability of reality, and the context specificity of all knowledge (Richardson & Cilliers, 2001). From here, many within complexity studies argue that the study of complexity itself inherently defies generalisations as well as claims to representivity and universality (Chu et al., 2003; Peter & Swilling, 2014; Walby, 2007), and hence any attempt at overview or grand narrative (Heylighen, Cilliers, & Gershenson, 2007). Cilliers argues: '[a] general theory of complexity should…remain a critical one. It should be constantly vigilant about the limits of our understanding' (2008, p. 53), and therefore correspondingly modest about its claims (Webb, 2015).

The lack of a consistent philosophical base in complexity remains an issue to be navigated and grappled with, particularly through specialisations and applied forms of complexity thinking (Geyer & Cairney, 2015a). Indeed, a number of 'types' of complexity thinking are identified in the literature, such as the critical and generalised complexity I have made reference to above. These are a product both of different philosophical positions and of different types of complexity models (I will return to complexity types in the following section). Some writers suggest complexity thinking can help to articulate an intermediary

[41] https://journal.emergentpublications.com/

position on epistemological issues (Astill & Cairney, 2015; Wells, 2013), reiterating that engaging this demands a high level of reflexivity and criticality in utilising complexity concepts and tools.

## 5.2 Engaging complexity thinking to approach SA CM policy

Complexity thinking requires an engagement with specific complex systems (Cilliers, 1998), an interpretation within each discipline/ field (Geyer & Cairney, 2015a), involving '**work of contextualisation**' (Chettiparamb, 2014). From a complexity paradigm, complex situations such as SA CM policy are essentially unknowable. Exactly what the reality of SA CM policy as a 'complex situation' is - how it 'works' - we can ultimately only speculate (Ison 2010). This is particularly so in the case of social complexity.

The advance of complexity studies has provided us with concepts, principles and models which, taken individually and collectively, give us perspectives on possible and probable characteristics of complex situations. These, in turn, might or might not provide us with insights into how we can act to influence these situations in particular directions. Whilst complexity tools cannot therefore reveal any universal 'truth' about a complex situation such as SA CM policy, they can be used to develop insights into the situation. However, this must be done with a reflexive awareness of the origins of the particular tool, and therefore the constraints to its application. There are a number of issues to look out for in this regard:

1. Complexity is written about from both classical and modern scientific perspectives (Prigogine, 1987) as well as from postmodern philosophies (Cilliers, 1998) and most recently from critical realist philosophical positions (Bhaskar & Parker, 2010; Byrne, 2011). **Different ontologies and epistemologies** have implications for what we assume about the complex situation itself, how complexity concepts arise and are used, and are closely associated with emerging complexity principles.
2. As complexity thinking has been taken up within **disciplinary traditions and perspectives**, these disciplines add their own layer of assumptions and emphases. For example the social sciences emphasise complexity concepts that engage with key themes of that discipline such as structure and agency (Byrne & Callaghan, 2014) whilst ecology engages particularly with systemic adaptation and evolution (Walker, Holling, Carpenter & Kinzig, 2004).
3. **The central role of modelling** in the development and articulation of complexity theories is widely acknowledged (Boulton et al., 2015; Cilliers 1998; Woermann et al., 2018). Indeed, the only way to engage with complexity is argued as being through modelling (in the broad sense of the term – both quantitative and qualitative) (Woermann et al., 2018) – because complexity is too complex to access otherwise. However, different models are used to advance our understanding of complex systems in very particular ways, imbued with deeply held assumptions originating from the philosophies of science, disciplinary traditions and contextual applications from whence each model comes.

Such a reflexive approach to engaging with complexity thinking should not – from a complexity paradigm perspective – be unique to the complexity field. Indeed, such an approach applies to the use of any theory, law or tool developed by science or indeed by society. Our knowledge of our world is necessarily partial, a view from a certain perspective at a certain point in time, and therefore reflexivity and humility in approach is essential.

Complexity thinking has developed along a number of primary trajectories which align with particular perspectives and assumptions. Some of these were were referenced in 5.1. above, and here I add a few more which I've found particularly relevant in parsing a complexity approach to SA CM policy. Generalised and critical complexity were discussed as being associated with a transdisciplinary and postmodern philosophy of science respectively. '**Restricted complexity**' is a term introduced by Morin (2008) to describe complexity thinking which remains in a largely reductionist and classical science paradigm. Other types used in this thesis include '**evolutionary complexity**' which emerged from biology and which emphasises the role of micro-variation in systemic change. '**Perspectual complexity**' is a term coined by Islam et al. (2006) in the context of a discussion on emergence in the management literature. '**Functional complexity'** is used by Dunn et al. to refer to the mechanistic complexity of certain human engineered systems. These complexity categories are broad, and differently defined and understood across the literature. I use them here as short-hand, to appeal to the particular emphases of each in the course of my exploration of complexity thinking for SA CM policy. To assist the non-specialist reader in navigating these concepts in the text, a table outlining each type used in the thesis and its (highly simplified) emphasis is provided below.

*Table 4: Different types of complexity views and a suggestion of their emphases*

| | |
|---|---|
| Restricted complexity | Uncertainty, non-linearity |
| Evolutionary complexity | Variation, open-systems |
| Critical complexity | A critical position, observer involvement |
| Generalised complexity | Transdisciplinarity insights, interconnection |
| Perspectual complexity | Human perspective, conceptual view of wholes |
| Functional complexity | Mechanistic complexity of engineering systems |

One view of complexity omitted from my list above but which is often referred to in the complexity literature is **chaos theory**. This theory is situated within a classical science paradigm, and relevant only to a very particular sub-set of systems and problems (Johnson, 2015; Woermann et al., 2018). Although concepts arising from chaos theory (such as fractals and strange attractors) are often considered together with other complexity concepts in the broader literature, I find this only serves to confuse in the context SA CM policy which is predominately social. That said, the contributions of complexity from a classical science paradigm (restricted complexity) more generally are nevertheless still very relevant to SA CM

policy given the prevalence of functionally complex systems, such as technical energy and industrial systems.

The structure and content of the remainder of this Chapter reflects the discussion in this section. From this point on I am moving to the specific context of SA CM policy, and elaborating a complexity thinking approach for it. The following section, 5.3., deals with complexity concepts and principles emerging from the main complexity views. Where there are particular issues to look out for in terms of applying these concepts and principles these are flagged. The main themes in social complexity – a central aspect of SA CM policy – are dealt with in section 5.4. Also important to SA CM policy, the theorising of change in complex systems is discussed in 5.5., with a review of relevant complexity literatures the focus of section 5.6. Finally, section 5.7. concludes this Chapter's initial encounter with complexity thinking for SA CM policy by establishing a clear method for my use of complexity tools in exploring the case of SA CM policy.

## 5.3 Complexity concepts and principles

This section introduces a set of complexity concepts and principles identified both for their ability to convey a sense of complexity thinking to the non-specialist reader, and too to begin populating a SA CM policy complexity 'toolbox' (Shine, 2015). A loose distinction is made between a complexity 'concept' as emerging from particular models of complex systems, and complexity 'principles' which are more aligned to philosophical considerations.

### 5.3.1 The complex dynamic system

The concept of a complex dynamic system has been described as central to the complexity field (Heylighen et al., 2007). The universe as we know it is viewed as a complex system and is comprised of complex systems. Richardson et al. write of 'everything' as a system (Richardson, Cilliers, & Lissack, 2001). Complex systems are nested within complex systems, described as autonomous systems or **sub-systems**, and complex systems overlap each other. They can comprise any combination of human, animate and inanimate components, or **agents**, and these agents can have roles in more than one system simultaneously. Complex systems do not necessarily saturate their territory (Walby, 2007), and can be said to operate within **environments, or contexts**, which are themselves systemic (Von Bertalanffy, 1968).

Prigogine in particular emphasised the role of a system's **openness** to its environment in complexity (Boulton et al., 2015). Whilst a 'mechanical' or 'complicated' system is closed to its environment, a complex system is interconnected and open. Changes in the environment influence the complex system, and vice versa. (A **radically open** complex system (Chu et al., 2003) is one where the system's external context is relevant to the system all the way up to the global level. A movement in one system can cause unpredictable changes in related systems, driving unpredictability and instability in all systems). A complex system adapts to changes in its environment in a process of dynamic **co-evolution**, and as such it can be said to be uniquely contextually determined.

Complex systems are characterised as being comprised of **multiple autonomous agents** (Heylighen, Cilliers & Gershenson, 2007). These agents are interconnected and networked but are necessarily ignorant of the whole system (Cilliers, 1998). Such autonomy enables agents to continuously engage in emergent, self-organising processes, thereby enabling complex systems to learn, innovate and to create (Wells, 2013). Both their open and multi-agent qualities mean that complex systems are not deterministic. Rather, the quality of the system is an aggregation of individual responses occurring simultaneously and dynamically. In contrast, complicated systems are rare cases found particularly in specialised and technical industries, where system components have pre-determined functions and are closed to their environment.

Significantly, complex systems are not chaotic, but have an inherent productivity (Ostrom, 2010) through order and structure developed over time. Equally, they are **dynamic** and find stability outside of equilibrium (i.e. they are **non-equilibric**) through the operation of feedback loops (Byrne & Callaghan, 2014). A complex system can change radically should the feedback loops be disrupted. Complex systems can therefore be said to operate **between rigidity and chaos**, with **episodes of stability and instability** (Boulton et al., 2015) driven by both internal and external change. Whilst complex systems are inherently uncertain and unpredictable, they can be recognised by their **emergent patterning** (elaborated in section 5.3.3. below).

As networked phenomena, connections and inter-linkages are more useful in understanding complex systems than the individual system agents (Cairney, 2013). This **relational and interconnected** quality is fundamental to most complexity thinking, positioning complexity in opposition to reductionism. **Causality** in complex systems is multiple (Byrne, 2011), originating in the interaction and self-organisation of system components, and augmented or dampened by networks. There are no singular explanations as to how a complex system has come to be in its particular state, nor singular pathways to potential future states for the system. Causality is **probabilistic** and impossible to predict, recursive (Stirling, 2014) and essentially **contingent**.

Advances in modern science contributed the observation of time as **irreversible**, an 'arrow' (Prigogine & Stengers, 1997), in contrast to classical scientific assumptions of time as consisting of interchangeable units. Therefore, as a complex system continues through time, its history becomes part of the system's structures. Memory, as the outputs of what happened before, becomes inputs to the current system (Cilliers, 2000c; Emison 1996). Meadows (2008) describes system **structure** as the memory of system flows and the codification of rules. Structure provides stability within a system, a buffer against volatility.

Complex social systems are theorised as being relatively more complex than their natural counterparts because human agents are more interpretive, purposeful, wilful and **conscious system actors**, with sophisticated abilities to strategise and learn (Edmonds & Gershenson, 2015; Morcol, 2015; Shine, 2015; Wells, 2013) (this assertion is interrogated in 6.3.).

### 5.3.2 Self-organisation

Self-organisation is a distinguishing feature of complex systems. It is the process whereby complex system agents constantly **respond and adapt** at a micro level to change; both internal change, a focus of restricted complexity, and external change whose importance in complexity was highlighted by evolutionary complexity and the open systems approach of Prigogine.

In complex social systems, self-organisation is theorised as being guided by agents following socially and politically constructed regulations, societal mores, and norms (Room, 2015), and beliefs and values (Cilliers, 2008; Peter & Swilling, 2014). For Heylighen et al. (2007) writing of natural systems, self-organisation occurs in a 'short-sighted and selfish' manner, considering only the agent's immediate environment. In social systems, human consciousness and intelligence is considered to relax this assumption of immediacy, providing additional dimensions to the self-organisation process through which humans are argued to have the opportunity to influence the direction of the complex systems of which they are a part (Shine, 2015; Wells, 2013). This reflexive attribute of humans is emphasised in critical and perspectual complexity.

Self-organisation is what renders complex systems inherently dynamic; a balancing and satisficing task, and one which delivers an ever-new stream of conditions within the complex system (Emison, 1996). Through self-organisation, complex systems demonstrate a **complex ordering** as opposed to being hierarchically or centrally organised, with self-organisation enabling stabilities and structure (emphasised by certain social complexity theorists including Byrne) to emerge from within the system.

Evolutionary complexity highlights the value of **variety and diversity** at the micro level in a complex system. Boulton (2010) describes this variety as the 'raw material' for systemic self-organisation. All local variants are available for self-organisation in response to changing external circumstances, rendering diversity crucial for enhancing the ability of the system to endure (Pueyo, 2014). **Redundancies** are also desirable for systemic **resilience**, both to account for the failure of innovation, and to build in duplicates in case individual agents or agent communities fail. Both diversity and redundancy promote system stability.

### 5.3.3 Emergence

Emergence is a second distinguishing feature of complex systems and one which, together with the associated concepts of emergent patterns, properties and 'emergents' is subject to different interpretations and usages across the literature.

The concept of emergence in complexity literature encompasses two attributes. The first is **unpredictability**. Emergence stands in contrast to the determinism of complicated systems (Cilliers, 2000a). It is the 'surprise' element (Peters & Swilling, 2014) that renders complex systems inherently unpredictable, and interventions in them likely to have unintended consequences. An evolutionary view of complexity emphasises the role of external events in contributing towards emergence as unpredictability.

Changes in any system's broader (complex systemic) environment act as a source of unpredictability for the system itself.

The second attribute is the **generative capacity** of a complex network. This is a more mechanistic interpretation of emergence, that which arises from a networked series of interactions in the context of a specific complex system. Restricted complexity views describe emergence as that which occurs as a result of the micro-level interaction of system agents. These **emergents** then 'travel through' the remainder of the system, influencing its self-organisation as they go (Cilliers, 1998), and also eventually the macro level system output.

As complexity thinking moved beyond restricted complexity, complexity thinkers proposed that the characteristics of the 'whole' that is the macro level complex system can also 're-enter' the system at any level, influencing its self-organisation and emergents. Such complexity thinking fundamentally challenges all notions of hierarchy or linearity. It is in this sense that emergence is described as that which makes complex systems more (or less) than the sum of their parts (Morin, 2008), as certain characteristics of the system agents are emphasised or constrained by the macro level systemic emergence. Islam et al. (2006) introduce the term **'perceptual-emergence'** to describe the reflexive ability of humans to create wholes within their minds. This is a view that resonates with Cilliers' critical complexity. These human reflections themselves then re-enter the system at all levels, contributing towards emergence.

*Box 10: Emergent patterning*

Reference is often made within the complexity literature to emergent patterns as being recognisable, recurring patterns at a system level (Holland cited by Wells, 2013). Because these patterns are independent of particular system agents, they remain similar despite agents changing. Wells (2013) gives the example of an eddy in a stream, where a pattern persists despite the actual water molecules being constantly replaced. There is a degree of 'knowability' of these patterns, although at any point they can be overturned. That complex systems are patterned is a function of self-organisation interacting with structure, of systems developing history which contributes to their present state, and of the influence of macro level emergence. When used in relation to systemic patterning, the term emergent is used more in its generative sense, than that of unpredictability.

### 5.3.4 Non-linearity

Complex systems are non-linear; there is disproportionality between cause and effect. This means that a collection of small micro-level disturbances can cause major changes at the system level. Similarly, complex systems can be insensitive to large disturbances, including those at the macro system level.

The non-linearity of complex systems underlies a number of other complex system features. **Tipping points** can develop in a system or sub-system, which if breached can result in system collapse or fundamental re-ordering. **Feedback loops** causally connect the output of a complex system to a series of

interactions which then feed back at the original output point in a circular manner (Walby, 2007). These feedback loops can be either '**reinforcing**', promoting instability and change in the system, or '**balancing**', dampening change and promoting system stability and maintenance. Reinforcing feedback loops can then produce **path dependency** in a particular direction, rendering system evolution path dependent rather than generic (Walby, 2007).

The non-linear features of complex systems, combined with changes in a system's environment, counter self-organising stabilities, resulting in equilibrium or stasis never being achieved - complex systems are typically non-equilibric (Dunn et al., 2017).

### 5.3.5 Unknowability

From philosophy comes the concept of complex systems being essentially **incompressible** (Richardson & Cilliers, 2001) or **unknowable**; they are too complex to know. Cilliers (2002) argues that any accurate description or model of the system would end up as complex as the system itself. In complexity thinking therefore, there is always the danger of loss through simplification, be that through modelling or through the use of simplifying language and concepts. Evolutionary complexity suggests that the degree of complexity of a system itself plays a role in systemic evolution. Micro variation is observed in ecological systems to play an important role in adaptability, resilience and transformability (Walker et al., 2004). It may be that simplification similarly renders a social system less resilient and flexible. Writing of social complexity, Mitleton-Kelly (2015) argues that when under stress a system will self-organise and explore the **'space of possibilities**', different options for systemic evolution (this concept is discussed further in section 5.5. below). The more complex the system, the more options there are within this space (up to a point – a system can become too complex and chaotic which can lead to collapse (Pueyo, 2014)). Significantly, dualisms and polarities can exist within resilient complex systems, with Byrne & Callaghan (2014) emphasising the importance of being able to synthesise across these in complex social systems.

There is a temporal aspect to unknowability too. Because complex systems constantly change, they can only ever be (partially) observed at a particular point in time, a complexity principle that was famously illustrated by Heraclitus, who said that no man steps into the same river twice (Wells, 2013). This principle emphasises context specificity in complexity, problematizing generalisation and universalism.

### 5.3.6 Perspective

Because complexity is 'incompressible' to simple concepts or models, this 'essentially negates the possibility of the existence of a globally and permanently valid perspective, or paradigm' (Richardson et al., 2001, p. 9). This complexity insight, contributed by authors writing from a postmodern philosophical position, then invites consideration of the frame of reference of the system in addition to its mechanics (Peter & Swilling, 2014). Islam et al. (2006) refer to this as perspectual complexity.

Perspective is also not passive in this view. Byrne and Callaghan (2014) discuss '**reflexive agency**', where different perspectives themselves have agency (act as system agents) within a complex social system. Similarly, simple rules, norms or concepts reflexively created by social agents themselves re-enter a social complex system to influence its self-organisation and emergence.

### 5.3.7 Uncertainty

Uncertainty is a general feature of complexity, to be embraced, in contrast to the determinism of classical science where uncertainty is to be managed or contained. The source of uncertainty is differently introduced and emphasised in various complexity literatures. From a restricted complexity view, non-linearity is the driver of uncertainty. From a modern science complexity view, uncertainty is understood as a fundamental property of nature (following Heisenberg, 1927). Postmodern philosophies and complexity applications in the social sciences introduce the role that different perspectives, values and beliefs play in creating uncertainty in complex social systems. A different view again is that it is complexity itself which causes uncertainty; the rich, multiple and dynamic interaction between agents in complex systems. Complex causality is systemic, multiple, multi-dimensional, path dependent and historical.

Due to uncertainty, the underlying data distribution in complex systems is more often Pareto than Gaussian in nature (Astill & Cairney, 2015; Benyamin Lichtenstein, 2016), resulting in fundamental interpretation errors if statistical analysis based on Gaussian distributions is used to understand complex systems (Astill & Cairney, 2015).

### 5.3.8 Boundaries

The concept of a boundary in complex systems is, similar to emergence, understood differently depending on the philosophical lens from which this concept is viewed. In realist traditions, boundaries have an ontological basis in the real world, whilst in postmodern views the distinction between any complex system and its context only exists in the eyes of the observer (Cilliers, 2001; Ison, 2010). For a complexity application in the postmodern view, the decision about where to draw a boundary for analysis is both an ethical and technical one. Cilliers (2001) notes how a boundary does not imply that what then becomes central in the system is more important than that which is at the periphery and suggests rather that the concept of intersecting processes may be a more useful one than that of well-bounded systems.

### 5.3.9 Constraints

A constraint to a complex system can be considered as a change in its environment or internal rules which changes the spaces of possibility available to the system. Constraints can be physical, such as environmental or resource constraints, or in the case of social systems, created through codes such as regulations or norms (Wells, 2013). Constraints may be associated with particular timeframes, akin to

Walker et al.'s (20014) description of thresholds 'passing through a system'. Whilst the term 'constraint' may have negative connotations in common use, a constraint in a complex system is not necessarily negative in terms of its impact on the evolution of the system. Cilliers observes in relation to constraints that 'by eliminating certain possibilities, others are introduced' (2001, p.139). Constraints influence the very fabric of the system's self-organisation. Complex systems constantly adapt to both internal and external change, and the outcome of the constraint on the system's evolution depends on how the system responds to it, which cannot be known a priori.

## 5.4 The treatment of key social science themes in complexity

Whilst the study of complexity using the tools of science originated in the natural sciences, there is a small but growing body of literature considering the application of complexity thinking to social complexity - or complex social systems - a sub-field of particular relevance to SA CM policy. Social complexity can be considered as 'adding' to the complexity (Shine, 2015), in the form of quintessentially complex humans who are strategic and conscious beings, potentially with the ability to understand more of the system of which they are a part than are non-human agents. Social complexity literature (itself discussed further in 5.6.) engages with existing themes in the social sciences, including human agency, values, power, and institutions (Byrne & Callaghan, 2014). These are discussed below, in so doing further populating a complexity toolbox for approaching SA CM policy.

### 5.4.1 Human agency

The extent to which humans are differentiated from natural and inanimate system agents in a system is a moot point, although most social complexity literature suggests that humans are more conscious, strategic, intelligent and therefore powerful than our non-human counterparts (Walker et al., 2004; Wells, 2013). It is this superiority that affords us a greater understanding of the systems of which we are a part, and from here, greater agency and ability to influence these systems in a particular direction (Byrne & Callaghan, 2014). (The complexity theorising behind systemic change is considered in greater detail in 5.5. and humanity's role in this is picked up on again in 6.3.).

### 5.4.2 Values, norms and beliefs

Norms, values and beliefs are inherent in complex social systems, contributing to the 'rules' whereby self-organisation occurs. Boulton et al. (2015) describes values as 'regulating' self-organisation. As such, they form part of a system's patterning, and influence its emergent properties. Drawing from evolutionary complexity, diversity in values, norms and beliefs could constitute the raw material of self-organisation in complex social systems similarly to the way genetic diversity does in natural systems. As such, Stirling (2014) argues for the maintenance of a pluralistic diversity of values within a society, as a source of creativity and generativity.

From a critical complexity view, the loss of a final reference means there is no external standard for determining the 'goodness' of particular values, norms and beliefs. There is therefore no immediate 'right' or 'good' systemic evolution or systemic state (Ashby, 1962). The purpose of complex systems is to endure (Meadows, 2008). Because both rigidity and chaos can lead to system collapse, neither a rigid adherence to an imposed value set - no matter what those values are - nor complete self-interest (chaos) contribute towards systemic endurance.

Any attempt to influence a complex system is therefore necessarily a normative exercise. As such, all human action involves a moral frame and ideally requires the tools and methods of a **complex ethics** (Bhaskar & Parker, 2010; Capra, 1974/1983; Delgado Diaz, 2004; Price et al., 2015; Richardson & Cilliers, 2001; Shine, 2015; Wells, 2013). Cilliers (1998) describes such an ethics as emphasising responsible and conscious consideration of values in each application.

### 5.4.3 Power

Power in complex social systems is also neither an inherently good nor bad thing; rather it is inevitable, contributing to how humans self-organise. Human agents in systems aim to maintain or maximise their position, and look both to their immediate micro system and to the macro system to do this (Room, 2015). Changes in power at a small, micro level can result in significant changes in the system as a whole (Wood & GIvel, 2014). Wood and Givel conceptualise patterns of power as complex systems themselves, which influence systemic patterning and play a role in systemic change. Power operates through feedback loops. Reinforcing feedback loops pull against system structure creating instability in a system and providing momentum for change (Givel, 2015). Balancing feedback loops are used by the powerful to maintain the status quo.

Room (2015) contextualises a complexity discussion of power in social systems within the literature on power in sociological and political science. He identifies two ways in which power is exercised. The first is **top-down** where powerful agents seek either to maintain the status quo or to re-organise the system and its emergent patterning to their benefit. The second is a **bottom-up** exercise of power, where by making particular choices large numbers of individual system agents can exert influence on systemic structure, norms and rules and path-dependencies. Wood and Givel (2014) describe a **third form of power** as operating in a complex system, akin to Lukes' (2005) third face of power. This form of power is non-linear and non-visible, operating through ideological preferences, values and position.

Through a systemic theorisation of power, complexity thinking in the social sciences provides an inclusive view of the different types of power operating within a system, providing insights into the relationships between power and institutions with other system characteristics. A systemic theorisation of power also allows for a collective responsibility for a system's emergent patterning (Room, 2015).

### 5.4.4 Institutions

The pattern of social institutions existing in a complex social system is theorised as being informed by the system's history and memory which interacts over time with internal and external change in a non-linear manner. Institutions contribute to the structure of complex social systems, providing stability but also inertia.

Room associates the institutional structure of a complex social system with Lukes' (2005) argument for a third face of power - the power in a system that gets people to act willingly against their own interests. Institutions are highly relevant to power patterning in a system. The exercise of power by individuals is entrenched and augmented by institutions (Givel, 2015; Room, 2015). Powerful institutions command the 'playing field' upon which power struggles are played out (Room, 2015), and as such can steer innovation, infrastructure, values and thereby path dependent evolution. Institutions can be subverted from below, a reflection of collective power and responsibility arising from many micro-actions, or reformed from above.

## 5.5 Change in complex systems

SA CM policy was described in Chapter Four as involving transformative systemic change, and thus the cause, nature and degree of this change is of great relevance to the SA CM policy case. Complexity thinking on change in social systems is less studied than that in the natural sciences, hence this section draws predominantly from the latter to elaborate a suite of complexity concepts to assist in gaining insight into transformation in complex social systems. As such, this section constitutes the final exercise in populating a toolbox for approaching SA CM policy.

Complex systems are definitively dynamic. Restrictive complexity emphasises the internal, self-organising and emergent drivers of systemic change, whilst an evolutionary complexity view contributes the significance of changes in a system's environment in driving change. Complex systems are therefore in a constant state of flux as they self-organise and respond to changes in their internal and external environment. Complex systems are described as occupying a **phase space**, defining all possible configurations of the system's fundamental properties (Prigogine and Stengers 1984 as cited in Byrne & Callaghan, 2014). Walker et al. (2004) describe these properties as 'function, structure, identity and feedbacks', whilst Boulton et al. (2015) refer to them more generally as the system's characteristics –both descriptions remain at the high-level, an issue to which I return in the next Chapter. Within a phase space there are a number of different **attractors,** which represent particular emergent patterning or expressions of the system. Which attractor the system lands up in depends on the evolution of the system within its environment over time, including the particular paths taken at bifurcation points. Attractors therefore can be viewed as representing possible systemic futures for a system which retains a particular fundamental property set.

Because complex systems are mostly non-equilibric, many possible configurations of a system's fundamental properties are possible within one attractor, representing 'spaces of possibilities' available to the system to maintain this attractor. The more complex a system is, the greater the 'spaces of possibilities'. **System adaptation** can be considered as movement between attractors, in response to internal or external change, but where the same system properties are maintained (Walker et al., 2004). **Thresholds,** or constraints, play a role in provoking a system to move between attractors; either by a system crossing an internal threshold, or by an external threshold 'moving across the system' (Walker et al., 2004).

However, complexity theories allow for a more substantial change, that of a change in the fundamental properties of the complex system, either by adding new properties (Walker et al., 2004) or removing properties (Pueyo, 2014). From the view of evolutionary complexity, this implies the system shifts into a new phase space (with correspondingly new attractor configurations). Byrne (2011), with Harvey describe this 'phase shift' as 'the qualitative transformations of the evolutionary phase space itself… the evolution of evolution itself' (2009, p. 27). **Phase space change** may come about as a result of systemic collapse and loss of significant systemic structure and function, although not necessarily. Whether the system can be said to retain its essential identity in the shift depends on the context and importantly, the needs of the observer.

Resilience theory and Holling's '**adaptive cycle'**, emanating from evolutionary complexity, suggest that complex systems cycle through four stages of maturity, providing insight into the nature of connections and stability associated with various stages: A growth and exploitation stage is characterised by expansion; a conservation stage represents a more stable period of consolidation, increasingly locking in structure and patterns of connectivity; a phase of instability, chaotic collapse and release typically follows; and finally there is a phase of re-organisation and experimentation as connections are tried out. Boulton et al. (2015) emphasise the role of **variety and diversity** at a micro level in providing the material from which new systemic stages (and phase spaces) can emerge. Overly tight, or rigid connections between system agents reduce systemic flexibility and therefore stability; the system becomes **'locked-in'**. Instability can also be associated with loose connectivity. Overly rigid or chaotic system states can both lead to systemic collapse. Whilst the adaptive cycle is rooted in descriptions of natural systems, it has also been used and advanced in the context of socio-ecological systems (Walker et al., 2004).

I have not yet encountered any definitive complexity theorising linking these complex change concepts in the natural sciences to thinking on transformative change in the social sciences. Does transformative change in a social system require a system to shift phase space, i.e. to add or lose fundamental properties? Or may a shift to a different attractor suffice, with the same set of properties remaining in a different configuration? These questions are taken up again in Chapter Six. However for the sake of clarity in the interim, the concept of shifting attractors can be used as shorthand for both degrees of transformative change (because a new phase space implies a new set of attractors).

A number of other complexity concepts drawn from across the complexity literatures are useful for understanding change in complex systems. Chu et al. (2003) argue that either internal or external stressors can cause the system to become less stable and **'tip'** into a form from which the system may or may not be able to revert - i**rreversibility** is a feature of complexity thinking of particular relevance to the sustainability field (Wells, 2013). Non-linearities can result in rapid movement towards tipping points, with these coming suddenly and from surprising angles (Gladwell, 2000). **Instability** is a sign of potential tipping and even transformation (Webb, 2015), and complexity mathematics can provide insight into when systems are stable or not and which variables are sensitive (Astill & Cairney, 2015). Social systems are observed as typically demonstrating long periods of stability and rapid periods of heightened instability (Byrne, 2011), resulting in their being characterised by **episodic change**. This characteristic may be a result of a slow build-up of tensions across the system which then reach a tipping point resulting in rapid tension release.

**Systemic structure** is another important aspect in systemic change, playing a significant role in the pace and direction of change. Structure is slow to build and therefore acts as a brake on change. Structure can also be destroyed in periods of rapid system change (Peuyo, 2014). The extent of this destruction informs whether a system transforms or re-organises.

A complex system is not a homogenous entity – the different **sub-systems** within the larger system will move at different speeds, according to their own temporal rhythms. Therefore, each sub-system could be in a different phase of the adaptive cycle at any one time. This is described from a futures literature perspective as pockets of the future already present in the system, with others which are still to emerge (Curry & Hodgson, 2008). Such differentiation at the sub-system level may contribute to the episodic nature of change, as the different paces of various sub-systems dominate at different moments (Meadows, 2008).

Complex systemic change does not occur according to any type of optimising function. Rather, this change is about **endurance** (Meadows, 2008); an intention at the micro system levels to continue (Capra, 2007). Even in social systems where individual agents can identify desirable system states and try to support these states emerging, this is an inherently normative activity. There is also never any certainty that a desired direction of change will be realised, the system itself only intends to continue.

Whilst at any point the observed conditions of a system, a snapshot in time, are not a good indication of where the system may land up (Shine, 2015), its future is not entirely unknowable. Boulton et al. (2015) propose that a system evolves according to the interplay of external or internal events with systemic structure and patterning. She explains:

> The future builds on the past, but not with clear one-to-one correspondences and cause-effect relationships, but collectively; the future is created from a complex mix of influences including history, context, chance and choice… There is more than one possible future. (2010, p. 33).

As such, the future may be conceived as a set of possibilities (Fazey et al., 2017), influenced by actions in the present.

## 5.6 Complexity literatures for SA CM policy

Chapter Four, in discussing what the current dominant approach of the SA CM CoP illuminates and obscures about the SA CM policy issue, revealed a particular view of SA CM policy. This view was of an entanglement of the policy issue – the 'what' (climate mitigation in a development context), and policymaking for this policy issue – the 'how'. I argued there that the SA CM CoP has traditionally largely overlooked the 'how'. From a generalised complexity approach - refuting disjunction - these two aspects are exactly that: entangled. However, complexity literature on this particular entanglement handles the two issues separately: I found literature on complex policymaking, and literature highlighting the SA CM policy issue as a complex one[42], but very few instances of literature tackling the entanglement (Levin, Cashore, Bernstein & Auld (2012) and Dombkins (2014) are the exceptions). Wellstead et al. (2015) challenges this problem head on, arguing that the dominant approach of treating policymaking as a black box is sustained in the complexity literature on climate change.

There is a significant literature applying complexity thinking to issues of sustainability (for example Peter & Swilling, 2014; Swilling & Annecke, 2012; Wells, 2013), climate science and climate adaptation (for example Wellstead, Howlett, & Rayner, 2015), but I find this literature to be less useful in approach SA CM policy for a number of inter-related reasons. First, the literature also suffers from the disjunction between policy issue and policy approach discussed in the previous paragraph. Second, whilst the literature testifies to the relevance of complexity to climate change policy, seldom are the fundamental distinctions between climate adaptation and climate mitigation thought through when making these claims, and these distinctions matter. Third, much of the sustainability, sustainable transitions and climate adaptation literature has its root in the natural and earth sciences where an evolutionary complexity is well established, but critical complexity and the concerns of social complexity less so. Complexity-aligned fields such as resilience and socio-ecological systems theories contain an inherent bias towards the environmental sciences, displaying a superficial engagement with the social, particularly dynamics of power and political economy (Presentation: Resilient Urban Development, 2016; Wellstead et al., 2015). In Chapter Two, SA CM policy was described as a socio-techno-economic-political-environmental (STEPE) issue: multi-disciplinary, with a dominant role for the social sciences, and engineering and energy. The role of the natural sciences was argued as being smaller. Power and political economy were argued in Chapter Four as being particularly relevant to the issue of climate mitigation, especially in developing countries. Overall, the superficial treatment of the social in the sustainability, climate change, resilience

[42] Winkler et al. (2015), members of the SA CM CoP, point explicitly to the need for a complex systemic approach to mitigation in a development context, although they stop short of substantially engaging complexity thinking to this end.

and socio-ecological complexity literatures mirrors the dominance of environmental perspectives in the current dominant approach to SA CM policy, and is similarly problematic.

The social sciences have been slow to engage with complexity thinking[43], but there is now an increasing number of concepts and tools being generated in both the explicit (Byrne, 1998/2001, 2009, 2011; Holland, 2014; Shine, 2015; Urry, 2005; Walby, 2007) and implicit (Levin et al., 2012; Ostrom, 2010) social science complexity literatures. Complexity in economics is clearly relevant to SA CM policy for its insights into both economic systems and aspects of development. The specialist economics fields of evolutionary, institutional and ecological economics all reject the equilibric underpinnings of economic orthodoxy and are argued as being complexity-aligned (Byrne & Callaghan, 2014). Whilst complexity has been identified as holding significant potential for understanding development issues, not least due to the foregrounding of practice and context (Kane, Torres Gunfaus, & Boulle, 2015) and its insights into global inequalities and their underlying power balances codified in institutions and rules (Geyer & Cairney, 2015b), there has been very little work done specifically on complexity and development policy issues, with complexity thinking to date largely advanced by northern, developed world institutions and researchers (Geyer & Cairney, 2015b). A gap also persists in the social science literature for a more detailed complexity view of social change.

The current dominant approach to SA CM policy was argued in Chapter Four to be particularly adept at revealing the technical change required in hard-engineered systems, especially in the areas of energy, industry, transport and the built environment. Whilst an extensive literature search has not been conducted in the academic fields attending to these systems, complexity theories appear less well represented here (Dunn et al., 2017) in contrast to the information and systems technology literatures. I suggest two possible reasons for this, based on the journey I've undertaken for this thesis. The first is that these fields remain relatively closed and unreflexive (as argued in Chapter Three). The second is that these fields have been historically well served by classical scientific assumptions (many aspects of these technical fields involve complicated systems (Dunn et al., 2017)). This looks likely to change as the complexity of the twenty first century accelerates. The presence of a significant number of complicated systems of relevance to SA CM policy requires that any overall SA CM policy application should include consideration of how these are treated.

Finally, policymaking has recently started to receive attention from a complexity view. 2015 saw the first Complexity and Public Policy Handbook and a Journal dedicated to complexity and public policy[44]. This literature, whilst in its infancy and critiqued as suffering from a lack of practical guidance for practitioners (Dunn et al., 2017), is sufficiently populated so as to draw some meaningful inferences for complex policymaking, particularly if augmented by insights from the literature applying complexity to management studies and other related fields. Similarly, whilst complexity thinking for public policy

[43] See Heylighen et al. (2007), Richardson & Cilliers (2001) and Walby (2007) for some arguments as to why.
[44] http://www.ipsonet.org/publications/open-access/policy-and-complex-systems

acknowledges the significance of power, governance and politics in social systems, it is widely held that the literature needs to address the issue of power; how it is distributed, and its institutions, better than it currently does (Geyer & Cairney, 2015b; Room, 2015; Webb, 2015). The nascent complexity literatures on public policy and power are introduced in more detail in Chapters Six and Seven.

## 5.7 A brief return to method

I can now clarify my methodological approach for how I use complexity thinking to explore approaches to the SA CM policy issue.[45] This method rests on three pillars: the logic of abduction, the 'usefulness' orientation of complex transdisciplinary research, and reflexivity. Each of these are discussed in turn below.

**Abduction** is a logical process appropriate for exploring new areas, for creative inquiry and within transdisciplinary research. Based on the thinking of philosopher Pierce writing at the turn of the twentieth century, different definitions of abduction have been offered (Bateson in Ravetz & Funtowicz, 1999; Byrne, 2009; Miller and Fredericks 1999 in Thomas & James, 2006). Of relevance here, abduction is argued as a third method of reasoning to deduction and induction, and a fundamental process in human thought (Bateson in Ravetz & Funtowicz, 1999 p.645). Unlike deduction and induction, abduction does not rely on general laws or truths. Its role is less about assessing explanations as it is about generating new discoveries; 'a creative process by means of re-description and re-contextualisation' (Naess and Jensen, 2002, in Isakson, 2012, p.12). Abduction appears to fit well with both the state of the complexity field, and the SA CM policy situation. My discussion of complexity in this Chapter has emphasised the multi-disciplinary, messy, and immature nature of the field – and 'complexity' itself. Similarly, my inadvertent description of the SA CM policy issue in Chapter Four (inadvertent in that this wasn't the objective of the Chapter) revealed SA CM policy as being multi-disciplinary, messy and immature.

Also underlying my choice of abduction in method is my strong affinity for critical and generalised complexity views. Abduction aligns well with a generalised complexity view: 'rather than accreting further truths, we must develop further inquiries' (Wells, 2013 p.135), and with one of the aims of a critical complexity which is to encourage different explanations and lenses of the world (Cilliers, 1998). Critical complexity emphasises a critical engagement with partial knowledge rather than seeking any general theory or grand narrative, and has been argued as the more productive complexity perspective for the social sciences (Byrne, 2011; Cilliers, 2008); and also the preferred perspective for sustainability issues (Cilliers, 2008; Wells, 2013). Ison (2010) states explicitly that a critical lens is essential to dealing with the wickedness of the mitigation-development issue, and also for managing issues of incommensurability associated with different philosophical underpinnings when working with different knowledges (Geels et

[45] Until I had encountered complexity thinking, I was unable to see the need for a method to support my using it. This section could therefore also be considered a final piece of Chapter Two.

al., 2016). Generalised complexity has as one of its main tenets 'integration' in opposition to classical science's assumption of disjunction, which includes synthesis of disciplinary views, of philosophical positions, of perspectives, of dualisms and polarities.

My partiality for critical and generalised complexity views also influences my response to the debate raging in the social science complexity literature as to whether there is a use for complexity in the social sciences beyond the metaphorical (Shine, 2015). The use of metaphor in complexity research is controversial – some argue this to be problematic (Boulton et al., 2015) whilst others argue that everything is a metaphor and that the use of metaphor is therefore inevitable (Byrne & Callaghan, 2014). My position tends towards the 'everything-being-a-metaphor' side of the debate given the unknowability principle of complexity, but this position does not negate a very careful, reflexive and contextualised approach to using the tools of complexity science.

Using an abductive reasoning therefore, I apply the complexity thinking concepts, principles and literatures discussed in this Chapter (together with the literature on complexity for public policy introduced in Chapter Seven) to re-describe SA CM policy, thereby accessing new insights into how the complex situation of SA CM policy might be influenced. My intention in doing so is not to arrive at the end of my journey with any definitive understanding of what SA CM policy is from a complexity view. The 'reality' glimpsed through the use of the tools of complexity thinking is inevitably partial and temporary. My intention instead is to reveal new and potentially more effective spaces for SA CM policymaking. I find two further methodological pillars are necessary to guide this endeavour.

My second methodological pillar is the transdisciplinary research principle of action orientation, or '**usefulness**'. Hence I am constantly guided by the question: Is the way in which I use complexity thinking at the level of 'approach' useful to the SA CM CoP? The validity of my method and of the complexity tools themselves should be assessed in both academia and practice, and I address this specifically in Chapter Eight.

The third pillar is the discipline of **reflexivity**, which has been discussed at length in Chapter Two. In the context of the complexity field described in this Chapter, the role of reflexivity is to maintain my discipline of constantly attending to the particular origins and assumptions of the various complexity tools I am using.

From here, I use the complexity toolbox populated during the course of this Chapter in my exploration of a complexity approach to SA CM policy in Chapters Six and Seven. This is undertaken from a curious, critical and integrative position, guided by reflexivity and 'usefulness'. In the main, both critical and generalised complexities are foregrounded, but structure and systemic properties are maintained as theoretical constructs (following Walby, 2007). Whilst the approach is integrative, the practicalities of linear thesis-writing require a separation of the focus on the SA CM policy issue (Chapter Six) from SA CM policymaking (Chapter Seven).

# A complexity view of the SA CM policy issue

6

> *Different strategic representations of the situation may allow entirely different problem definitions and policies to dominate the political agenda.*
>
> – Farley et al., Opening the policy window for ecological economics, Katrina as focusing event (Farley et al., 2007, p. 344)

In this Chapter, I return to the empirical and literature based discussion of Chapter Four to re-engage with the SA CM policy issue described there using complexity thinking. My aim here is to focus particularly on the aspects which complement and support Chapter Seven's exploration into complexity thinking for approaching SA CM policymaking.

## 6.1 SA CM policy through the lens of complex dynamic systems

From a complexity view, everything is a complex system. Therefore concepts used to describe SA CM policy in the first half of the thesis - and their relationships to each other - require re-casting in the language of complex systems.

The case of 'SA CM policy', introduced in Chapter Two as the subject of the thesis, can be conceptualised as comprising the entanglement of two complex systems. The first is the 'SA CM policy system'. This system is conceptualised as a sub-system of the second, the 'SA STEPE system' (this term following from my description of SA CM policy as a STEPE issue in Chapter Two, together with the further elaboration of its social, cultural, ethical, political, economic, structural, technical, environmental, financial, leadership, spiritual and data dimensions in Chapter Four). The SA STEPE system is the multi-dimensional system which the SA CM policy system aims to influence. Following Byrne and Callaghan's (2014) complexity application of attractor states to the field of health, the SA STEPE system's current patterning of high carbon and low development can be interpreted as the situation of the system within an attractor state of high carbon and low development. If complex systems find stability far from equilibrium, the current

configuration of the SA STEPE system can be viewed as one of many which would result in it remaining within this attractor. The 'SA CM policy issue' then involves the transforming of the SA STEPE system away from its current high carbon and low development attractor, towards a desired future low carbon high development attractor. The SA CM policy system is thus depicted as an integral part of the issue it is attending to. This conceptual configuration is depicted in Figure 7 below.

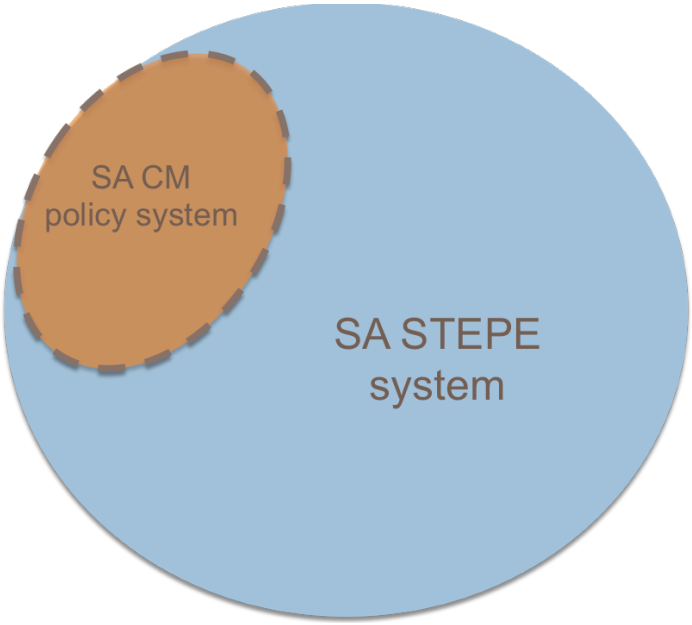



*Figure 7: The SA CM policy system as a sub-system of the SA STEPE system*

In a different entanglement, the twin objectives of SA CM policy - mitigation and development - are also inherently systemically interconnected. I describe this entanglement as the 'mitigation-development complex'; defined for the purposes of my argument as a systemically and integrally conceived set of issues associated with mitigation and development concerns. Splitting mitigation from development at any scale, time or place and attending to each separately is a form of simplification, inevitably losing details of their complex interactions, and with this, the system's 'spaces of possibilities' to move towards an attractor enabling both.

Engaging the organising concept of a complex system presents a view of SA CM policy that embraces rather than attempts to ignore or contain the interconnection and complexity so remarked upon in the Conversation Series, and visible in Chapter Four. A complex systemic lens assists in navigating the complexity, revealing entry points for organising our thinking about it without reverting to attempts to contain or simplify the complexity away. The remainder of this section elaborates on the complex situation that is SA CM policy as viewed through the lens of a complex system, whilst simultaneously utilising other complexity tools to access additional perspectives. The focus is on the SA STEPE system, the

SA CM policy system is elaborated on in the context of complex policymaking as opposed to the complexity of the policy issue, in Chapter Seven.

### 6.1.1 The SA STEPE system as comprised of intersecting sub-systems

In addition to conceptualising the SA CM policy system as a sub-system of the SA STEPE system, the concept of sub-systems can be more extensively applied to gain insight to SA CM policy. The SA STEPE system is multi-dimensional; it comprises many types of dimensions and agents. For this discussion I focus on three types of particular significance to SA CM policy, all anthropocentric: technical, infrastructure and social. From a critical realist complexity view, I am aware that I am creating these sub-system level boundaries based both on natural characteristics and my analytical needs. There are many possible configurations of sub-systems which could be used to explore different aspects of the SA STEPE system, for example grouping agents and dimensions according to physical location rather than according to type.

The first two types have significant functionally complex components. 'Technical' sub-systems are defined as systems that are human-created and technology or process focused. These sub-systems include the distribution of electricity, the treatment of solid waste and financial infrastructure. 'Infrastructure' sub-systems are also created by humans but are focused on physical infrastructure, such as the built environment and transport networks. 'Social' sub-systems are organised around particular cultural, ethical, spiritual, social, and political interests, but also operate (using Walby's (2007) complexity applied to sociology) as social relations (such as race and gender) and institutions (the economy, polity and particularly in the context of SA CM policy, consumerism). From critical and perspectual complexity views, I can further argue that different perspectives of the SA STEPE system also act as their own social sub-systems, entering and influencing the SA STEPE system. These SA STEPE sub-systems co-evolve according to their own temporal and spatial reach. Each sub-system operates according to its own rhythm, and has its own build-up of pressure and release, path dependencies and tipping points. Again following Walby (2007), sub-systems do not necessarily fully saturate their environment (the SA STEPE system), and are not necessarily hierarchically nested. Rather they are radically open to similar sub-systems operating at regional and global scales.

The concept of different sub-systems enables me to address an important attribute of complexity thinking in relation to approaching SA CM policy, the presence of significant functionally complex sub-systems. The transformation of these sub-systems is usefully explored with the current tools of the SA CM CoP, especially those of energy and economic modelling. However, because these functionally complex sub-systems are open to their (complex) systemic environment (the SA STEPE system), their 'complication' is rendered complex (Dunn et al., 2017). This view of complicated aspects within a complex environment is compatible with generalised and critical complexity views, as well as applied complexity thinking in the management literature (Ison, 2010; Kurtz & Snowdon, 2013). Such a conceptualisation implies that different knowledge tools are appropriate for exploring different aspects of a complex situation such as SA

CM policy. Critically, however, the broader complexity remains and, from a generalised complexity view, should be addressed with particular strategies for communicating and integrating knowledge areas. A complexity thinking approach can therefore accommodate the SA CM policy aspects that the current dominant SA CM CoP approach illuminates, despite these emerging from a more classical science oriented paradigm. The openness and interconnection of functionally complex systems with their social environment has been understudied (Dunn et al., 2017), and is certainly an issue that warrants further attention from a complexity approach to SA CM policy.

Before leaving the concept of sub-systems, I return to Walby's (2007) application of complexity thinking to multiple intersecting inequalities which, I propose, provides particular insight into the SA STEPE system's mitigation-development complex. Walby hybridised complex systems and social theory to argue that social sub-systems impacting on inequality each have their own ontological depth, and that different aspects of these sub-systems change each other at an intersection point, rather than just adding to each other. This renders it impossible to generally predict the particular expression of inequality as a result of the interaction of two social institutions or relations at any one point. Applied to the mitigation-development complex of the SA STEPE system, this results in the development-relevant sub-systems (including poverty, unemployment and inequality) not having pre-specified relationships to either each other or to mitigation-relevant sub-systems (such as electricity distribution, infrastructure, and consumerism). Rather the interaction of these sub-systems at any one point results in a context specific mitigation-development outcome. The SA STEPE system GHG emissions and development patterning is therefore the result of a myriad of sub-systemic interactions: site and context specific, networked and multi-dimensional. As Walby puts it, the mitigation-development complex is an emergent outcome of complex, path-dependent co-evolution of sub-systems, as opposed to the generic development of the hegemonic worldview.

### 6.1.2 Using a critical realist view to interrogate the SA STEPE system boundary

In the introduction to section 6.1., I offered the concept of a SA STEPE system as the primary 'system-of-interest' (Ison, 2010) for SA CM policy. In doing so, I simultaneously defined the SA STEPE system by assuming a (vague) boundary around it. This boundary can be viewed from a critical realist philosophical position; it has some basis in physical reality – the South African borders - but in large part I am appealing to a shared social understanding that it pertains to all things 'South African'. For SA CM policy, this boundary and the SA STEPE system it creates serves an important function, that of emphasising a primary domestic orientation for SA CM policy that cannot be assumed in the current dominant SA CM CoP

approach. From such a view, the international CM policy system is conceptualised as a related and interconnected system[46], to which the SA STEPE system is radically open.

The critical realist view was also active in my discussion in section 6.1.1. above of the technical, infrastructure and natural sub-systems operational within the SA STEPE system. The electricity grid, road and rail networks, and air quality systems have a strong physical and measurable presence. This critical realist view is useful to highlight how the act of boundary-setting in SA CM policy can both frame it in a particular way, and obscure particular aspects of the complex situation. It may be that something just outside a particular version of a SA STEPE system or sub-system boundary contains important optionality for a low carbon and high development system transformation, and the boundary could be usefully changed (Ison, 2010).

### 6.1.3 The SA STEPE system's emergent patterning

The SA STEPE system has a patterning determined by its history (which has contributed towards system structure), values, and mechanisms of path dependency and feedback loops. Understanding this patterning, in particular those aspects most relevant to the mitigation-development complex, is important from a SA CM policy perspective because any internal or external change to the SA STEPE system interacts with its patterning, and how the system moves forward through time is a result of this interaction. Differences between macro level patterns and systemic manifestations on the micro level are important as instances of variation, offering 'spaces of possibilities' which the system can explore. Examples of the SA STEPE system's current patterns are discussed in this section.

The SA STEPE system's self-organisation over time has been codified in physical form. The segregation of South Africa's cities from the Apartheid era coupled with low-density development continues to demand long, expensive and carbon intensive commutes to places of employment from the urban poor, entrenching poverty, inequality and carbon intensity. So too, the physical coal mining and power generation infrastructure developed over the past century both provides employment for significant numbers of unskilled labour (Chamber of Mines, 2018) and generates significant GHG emissions (DEA, 2014b), entrenching a high carbon path dependency which is augmented by the balancing top-down power feedback loop of MEC elites.

The history of the education sub-system has significant implications for both carbon intensity and development as the world moves in the direction of the fourth industrial revolution (Seedlab South Africa, 2018). The inferior education provided to black people under apartheid left the majority of South Africa's

[46] Whilst some may prefer to invoke the complexity concept of fractal patterning from a restricted complexity to describe SA CM policy as a particular scale of a more general CM policy, I intentionally set this aside in order to foreground the South African mitigation-development and other local contexts as distinguishing for the CM policy issue. This also serves to distinguish such a complexity approach to SA CM policy from the current dominant approach.

citizens with only a basic education in 1994, a pattern which continues to impact the 'born frees' (those born after the fall of Apartheid). Poor policy decisions and the lack of schools with adequate facilities and teachers in historically black areas serve to entrench this path dependent inequality (Equal Education, 2018). A child takes twelve years to educate in the South African schooling system, assuming that early childhood development needs are met which is more often not the case (Atmore, Van Niekerk, & Ashley-Cooper, 2012). This situation has implications for the level of skills entering the economy over the next twenty years, and for debates on whether renewable energy (skills intensive) or coal fired power (highly labour absorbing) are the best policy paths for electricity supply in the country.

The SA STEPE system predominantly values conspicuous consumption, typically luxury vehicles and designer clothing. This value runs across income levels, cultures and physical locations (Consumption Conversation, 16 October 2014). It informs how the system self-organises around events such as an increase in the money supply, new investment opportunities, or the development of a new shopping mall. It also suggests how the SA STEPE system might respond to a policy initiative such as a tax on high-emitting luxury vehicles.

At least two balancing feedback loops can be identified in the SA STEPE system which work to maintain the system in its carbon intensive attractor. First, the monopolistic economic structure of the electricity sector maintains a path dependency around large coal fired power generation and the dominance of the national grid, with reach to areas of governance, culture, technical capacity, regulatory capacity, and elite networks (Marquard, 2006). The second is related to the first: the era of low cost electricity in the late twentieth century created an energy intensive economic structure, which now requires high levels of electricity supply to maintain. Rresilience theory draws attention to the tight connections of this historically stable electricity sub-system which are increasingly de-stabilising in the face of changes in the coal sector (Gosling, 2018), Eskom's challenges (Eberhard & Godhino, 2017; Steyn et al., 2017), and the rise of renewable energy technologies (Jain & Jain, 2017).

### 6.1.4 Power and institutions in the SA STEPE system

Power and institutions are viewed from social science complexity theorising as inevitable and important aspects of the SA STEPE system, with their own historical, structural and patterned characteristics. Two forms of power patterns can be said to currently dominate the SA CM policy issue. The first form of power is the top-down power of incumbent elites invested in GHG emission-intensive assets who leverage an institutional legacy to exercise their power. Eskom's institutional experience and expertise in building large power generating plants and a centralised grid is used to crowd out any other form of power generation, including off-grid or renewables.

The second form is Wood and Givel's (2014) power which operates through ideological preferences, values and position. In the SA STEPE and CM policy systems the workings of this power are evident in the SA CM CoP's orthodox economic approach to the developmental objectives of the NCCRWP, supported by

institutional and political processes (Leach et al., 2007). From an orthodox economics view the role of material consumption in supporting the carbon intensive attractor of the SA STEPE is difficult to see. Room (2015) describes too how individual choices can add up to significant collective expressions of power.

Both of these forms of power operate through balancing feedback loops, maintaining the high carbon, low development attractor state. Wellstead et al. (2015) emphasise the importance of understanding how a government is positioned in relation to the balance of power in a system, and in South Africa the government and its policies are relatively weak compared to the power of the political and business elites. Room (2015) supports Wellstead et al. in this emphasis, arguing the importance of combining complexity insights around power with those around political economy and institutions.

A third form of power is increasingly evident in the SA STEPE system (and globally): the destabilising exercise of bottom-up power by citizens. This form of power can be exercised in various ways. One of these is the voting mechanism. Whilst South Africa is a democracy, it remains an immature one, and thus the potential for using bottom up power through elections is significantly constrained as citizens tend to vote along historical loyalties rather than current performance. For the SA CM policy issue this lack of potential is exacerbated in the face of immediate development priorities which would translate into voting priorities far more quickly than environmental ones.

Another way of exercising bottom-up power is through civil resistance, and it could be argued on the basis of the growing service delivery protests and the recent #feesmustfall and #UniteBehind movements in South Africa that there is latent and growing potential for the operation of this type of bottom-up power, particularly as confidence in the ANC government declines (Booysen, 2015). Both Wood and Givel (2014) and Meadows (2008) find that access to information is closely linked to the pattern of power in a system, and the expansion of information technology globally supports the rise of bottom up power in social systems. The issues driving these expressions of bottom-up power in South Africa are not currently environmental; however, because of the essentially interconnected nature of the mitigation-development complex, they could nevertheless destabilise high carbon incumbents. There is also always the potential for destabilisation to tip the SA STEPE system into collapse, with extremely negative short-term development implications.

## 6.2 A complexity view of the SA CM policy objectives

Re-cast from a complex systems view, policy objectives are an expression of what the collection of agents comprising the complex system desire at a particular point in time. These objectives are often contested, with different agents within the system having very different perspectives on what the objectives are or should be, with these perspectives being subject to the system's power patterning. Because South Africa

is a democracy, the SA CM policy objectives are brokered by politics (Room, 2015), influenced by power, and informed by science, economics, and worldviews.

Discovering what is desirable for the SA STEPE system with regards to a policy issue revealed in Chapter Three as containing significant normative elements, is itself a complex systemic task and one which is never complete. We cannot predict or fully imagine how the SA STEPE and SA CM policy systems may evolve, and the tension between nature as non-negotiable and humanity as eminently negotiable is an important axis upon which CM policy turns.

The SA CM policy objectives stated in the NCCRWP reflect an intention to mitigate GHG emissions and support development through a transition. Using the organising concept of a complex dynamic system together with resilience theory, these objectives are interpreted as being to shift the SA STEPE system from its current high carbon, low development attractor to one of low carbon and high development. This shift may or may not involve the addition or removal of fundamental system properties. This articulation is appropriately (for a complex policy issue) multi-dimensional and broadly stated. Similarly to the SA STEPE system's current attractor state, there are many systemic configurations that could realise a future of low carbon and high development. This implies, encouragingly for the SA CM CoP, that there are multiple ways in which the SA STEPE system could respond to and realise the NCCRWP objectives.

## 6.3 Deliberate transformative change in the SA STEPE system

In considering transformative change in a complex social system, it is important to reiterate upfront the discussion in 5.4.2. that complex systems have no inherent objective or evolutionary direction. From here, can humans then steer the complex systems of which we are a part towards a desired future – a 'deliberate transformation'? Can the SA CM policy sub-system avoid the 'classic systems trap' (Meadows, 2008) caused by delays in information feedback loops that climate change presents? In part, the response to this depends on one's view of whether humans are different to natural and inanimate system agents (5.4.1.). For the purposes of this thesis, and consciously adopting a philosophical position of hope, I concur with the dominant position of complexity authors and assume that yes, humans have superior consciousness and abilities to learn and strategise. This notwithstanding, complex systems are inherently unpredictable and cannot be controlled, therefore any effective wielding of human influence in a complex system is necessarily of a very different type to that suggested under classical scientific assumptions.

Whilst the issue of deliberate system transformation is not well explored in the complexity field (Pueyo, 2014), complexity thinking can contribute towards an understanding of deliberate transformation on a number of levels. The main ones are introduced here, and taken up again in greater detail in the context of complex policymaking in Chapter Seven. First, viewed particularly from critical complexity and the application of complexity in the social sciences, the nature of the desired future state of the system is likely to be differently understood and also fundamentally contested within a complex social system. Second, the self-organisation of complex systems implies that a lack of centralised control requires any

deliberate systemic transformation to be a collaborative effort, requiring a wide array of approaches, entry points, disciplines, and scales of actors (Wells, 2013) (although often when tipping points are breached, the resulting change can be superficially attributed to a smaller sub-set). Third, the uncertainty of complexity suggests that both a desired future and how to get there are inherently uncertain and emergent, unpredictable and uncontrollable. Fourth, the effectiveness of various types of human activity is usefully considered within the organising concept of a complex system, a concept defined by non-linearity, feedback, micro level self-organisation, radical openness, and the ever-present tension between rigidity and chaos. Fifth, from a critical complexity view particular systems are 'brought into being' for a temporary purpose by a human agent. Therefore complex systems don't 'exist', they are constantly being performed (Ison, 2010). This in turn suggests that new ways of being and seeing can influence a complex situation. Leach et al. (2007) observe that a change in the perspective of one agent can act as a shock to that system – with the impact of Mandela's personal journey on South Africa's democratic transition an anecdotal example of this. Finally, again from a critical complexity view, both a moral frame and an appeal to a complex ethics are necessary given that any attempt to influence a complex system is a normative exercise.

With the discussion of deliberate transformation above as backdrop, complexity thinking drawn predominantly from the natural sciences can assist in exploring what a deliberate shift of the SA STEPE system to a low carbon, high development attractor might involve.

Chapter Five introduced the question, using resilience theory, of whether systemic transformation required a change in attractor only, or a full phase space shift. Given the immature state of theorising of transformative change in complex social systems, the specifics of the resilience theory terminology are not important here. Rather, what is useful to the SA CM CoP is how the question places a focus on fundamental systemic properties. Two questions in particular are raised: Do we need to lose some of the fundamental SA STEPE properties and gain new ones, or can a deliberate transformation of the SA STEPE system happen whilst retaining the current set of properties? And second, what constitutes a fundamental property? From my reading it is not apparent that complexity theory can yet assist us in answering these questions - as noted in 5.5., descriptions of fundamental properties remain at a high level in the literature. If the first question were presented to the SA CM CoP, I would suspect the CoP would be divided – indeed the differentiation mirrors that of major political and ideological positions. My view is that a change in fundamental system properties is necessary. This position is echoed in Chapter Seven as I contemplate how both the loss and introduction of these properties might be supported by the SA CM policy system. However, I leave space for both views as the thesis proceeds, and continue to write of deliberate transformation merely as being a shift in attractors.

Whilst systems collapse and re-generation is a theoretical possibility to achieve a shift to a different attractor, its short-term developmental implications render this a morally hazardous form of deliberate transformation. To detect possible system collapse, resilience theory suggests paying attention to the

tightness of connections, to the tension between rigidity and chaos in a complex system. Simplification (of rules, concepts, interactions) increases rigidity, over-complexification may lead to chaos (Pueyo, 2014). For example, a simple response to a complex social situation produces rules which are repeated (at both an individual and an institutional level) and which close down options for change (Geyer & Cairney, 2015b; Shine, 2015), and reduce the general capacity of the system. Large technology responses to climate mitigation within a development context, such as nuclear power, therefore run a high risk of this. However a response acknowledging complexity and enabling expression of this complexity does the opposite. Suppression or control in a complex system reduces self-organising properties and emergent interaction, an argument against dictator-style responses to the CM policy issue (Stirling, 2014). Rather, self-organisation can be supported by supporting diversity, acknowledging context, pushing information down through the system to enable agents to deal with the complexity at lower orders of the system (Meadows, 2008), and by supporting interconnectivity and networking, and enabling information flow.

The organising concept of a complex system pays attention to the whole SA STEPE system, in contrast to the marginal approach of the current SA CM policy dominant approach. This suggests that a degree of change throughout the system is required; an engagement with the nature of the rules, power patterns and institutions (De Coninck & Byrne, 2013; Shine, 2015). Change at the level of values, beliefs and social mores raises the possibility of 'taming' (Pueyo, 2014) or 'regulating' of the system's self-organisation (Boulton et al., 2015). A whole system view also considers system dismantling as well as expansion. The MEC is one such structure that is easy to identify in the SA STEPE system, with early coal fired power station decommissioning a more tangible example (Steyn, Burton, & Steenkamp, 2017). Smart grid functionality in the electricity sector is an example of a structure that needs to be built.

Resilience theory suggests the concept of breaching thresholds is important in a systemic shift to a different attractor. Human agents can deliberately cultivate instabilities and disequilibria in various sub-systems to facilitate this, utilising our knowledge of path dependent mechanisms. One way of doing this is through supporting rapid innovation in a particular area. Around these points of instability attending to the nature of structural change is then critical, together with how various path dependencies might begin. Pueyo (2014) suggests that there is greater momentum and energy for change in a developing country, and fewer structures of the 'old' system that require dismantling. This aspect of a complexity theorising around change resonates with a Southern Theory view of developing countries as lacking in certain capacities, and therefore requiring different theories from those of orthodoxy (Kane et al., 2015). Whilst it may be true that many sub-systems of the SA STEPE system have looser connections than their developed counterparts, an important exception is the electricity sub-system, which has been historically locked-in to coal power.

Ongoing decisions and events can also lock-in new or existing path dependencies for a long time, particularly in sub-systems with medium to long-term temporal rhythms. For example, a number of pending decisions around coal (a rail-line to the Waterberg or the two proposed coal Independent Power

Producer plants, Khanyisa and Thabametsi (DOE, 2018)) will exert a disproportionate influence on the ease or ability of the SA STEPE system to shift attractors to one of low carbon and high development, whilst the REIPPPP may drive change rapidly in the desired direction.

The (hierarchical) location of an internal or external event in a system is not definitive in determining system or sub-system change (Walby, 2007). Evolutionary complexity suggests that an innovation at a community level has equal potential to influence the SA STEPE system's attractor state as a national policy instrument such as a carbon tax. Experimentation and innovation to expand the 'spaces of possibilities' available to the system can support adaptation and transformation and assist in avoiding system collapse.

Because complex systems are non-equilibric, the states of the SA STEPE system that could comply with a low carbon, high development attractor are, theoretically, many. Some may rely on substantial change in technical or information sub-systems from the present SA STEPE system state, or to SA STEPE system infrastructure, or others on change in the underlying values and beliefs that influence self-organisation, yet others on behaviours, or on perspective changes to the concept of development, or shifts in power patterns that re-organise financial flows. As such there are trade-offs to be had, possibilities to explore; the system is possibly less constrained than suggested by a more linear view. In the context of a deliberate transformation, supporting and enhancing the ongoing systemic activity of opening up these 'spaces of possibilities' which arise from the system's inherent complexity, can contribute powerfully towards systemic transformation.

In concluding this section I'd like to contextualise the discussion of deliberate transformative change by commenting on both the constancy and the inherent non-linearity of change from a complexity view. A shift of the SA STEPE system to a low carbon and high development attractor is not an 'arrival' of the SA STEPE system at its NCCRWP 'destination'. There are no 'solutions' in complexity. The SA STEPE and CM policy systems will both continue changing after this, with new policy goals and issues emerging. These may be expressed as low carbon and high development, or more likely not. Transformative change is an ongoing process as the SA STEPE system progresses through time. Such a view stands in stark contrast to the dominant SA CM CoP approach which, similarly to much of the sustainability literature, retains the assumption of linearity and the modernist view of an 'end state', that sustainability can be 'achieved'. This perpetual, 'unsolvable' aspect of complex situations has significant implications for policymaking which will be unpacked in Chapter Seven.

# Complexity thinking for SA CM policymaking

7

> *To approach policy with due regard to the complexity and multi-faceted nature of the decision and actions of individuals and to the complexity and inter-related impacts of policies as they are implemented, requires a rethinking of the policy-making process. Such a rethinking would cut across existing governance structures and have huge implications for existing well-established power relations. But not to do so limits the effectiveness of all policies.*

– Jean Boulton, Complexity Theory and Implications for Policy Development (2010, p. 36)

## 7.1 Chapter orientation

Having engaged the SA CM policy issue using complexity thinking in Chapter Six, I now turn to exploring how complexity thinking assists us in opening up policy spaces that are unavailable or under-prioritised in the current dominant SA CM CoP approach. To do this, I draw on the complexity view of the SA CM policy objective as being to shift the complex SA STEPE system to a low carbon high development attractor. I also utilise additional complexity insights on complex policymaking from both Chapter Five and the complex policymaking literature. In this process, I present an integrated view of both the SA CM policy issue and its complex policymaking.

I am also now in a position to answer part three of the research question in this Chapter: *how can a complexity approach contribute towards revealing the SA CM policy issue more fully*?, and can begin to answer the final part of the research question: *What is the usefulness of this inquiry to the SA CM CoP?* Before commencing, three framing comments are necessary, followed by a brief deviation into public policy literature to situate the Chapter's discussion.

The first comment pertains to the long-standing public policy debate about whether policy analysis can or should be policy descriptive or policy prescriptive (Hill, 2013). Historically, both the humanities and social sciences have reluctantly engaged with the social world beyond description and explanation. Yet an action-orientation in researching SA CM policy is justified given the urgency of the climate mitigation

issue. The transdisciplinary method described in Chapter Two is oriented towards producing knowledge that is useful for society. This orientation resonates with Geyer and Cairney's (2015a) observation that utilising a complexity lens for public policy must be useful, it must do more than just state complexity or add a 'complexity gloss'. 'Usefulness' is therefore a central intention of my consideration of a complexity approach for SA CM policy, applicable to and integrated across research and practice. This usefulness is situated primarily in the realm of knowledge: contributing to a reflexive knowledge of 'approach', in order to open up qualitatively different policymaking spaces for the SA CM policy system, and offering policymakers some guidance for accessing these spaces and practising within them. Encouragingly for my intent, Zellner and Campbell (2015) argue that complexity thinking has the potential to finally provide a practical basis for engaging with wicked policy problems – something that they believe the academy has not yet achieved since the term was coined in the 1970s.

Second, I am aware of a rapidly growing academic literature together with practical resources, both implicit and explicit, on complex systemic change at the personal, community, local, national and global levels. This represents a rich resource for elaborating and expanding a complexity approach for SA CM policy. My intention in this Chapter is therefore not to be comprehensive. Rather, I sketch out what I see to be some of the main contributions of complexity tools in revealing important but currently obscured spaces in SA CM policy.

Third, my chosen focus of 'policy' in this thesis is but one avenue for human agency in response to the issue of climate mitigation in South Africa. From a complexity view, every human agent of the SA STEPE system will, consciously or unconsciously, influence the systems evolution and thus its attractor state in relation to the SA CM policy objectives.

Complexity for public policy was described in Chapter Five as a small but growing area of applied complexity thinking. At a high-level, complex policymaking is described in the literature as a journey (Dombkins, 2014; Shine, 2015), with policymakers as 'compass-bearers for desired future(s), driving from the policy-swamp of the present an emergent and complex process of social change' (Shine, 2015, p. 171). Complex policymaking reflects a shift in focus away from content, plans and evidence towards principles, process and emergent properties; a re-ordering of policy priorities and leverage points. The literature on complex policymaking is positioned in relationship to two philosophical positions that have dominated the field of public policy since its inception in the 1950s. The first is positivism which accepts as valid knowledge only that which can be observed and measured, exemplified by Lasswell's (1951) policy stages model. The second is post-positivism which rejects the central tenants of positivism, primarily that the world can be known outside of the perspective of the knower[47].

[47]Post-positive public policy theories include policy streams theory (Kingdon, 1984), path dependence (Pierson, 2000), punctuated equilibrium (Baumgartner & Jones, 1993; Jones & Baumgartner, 2005), advocacy coalition theory (Sabatier & Jenkins-Smith, 1993), and policy implementation theorists (Lipsky, 1980) amongst others.

In their appreciation of the complexity, non-linearity, irrationality and unpredictability of the policymaking process, post-positive public policy theories provide significant insights into the policy process from a complexity view. Complexity authors describe these theories as 'complexity-inspired' (Geyer, 2012), 'pre-complexity' (Geyer & Cairney, 2015a), and 'implicit' complexity-type thinking (Shine, 2015). However within the public policy literature these insights are offered in silos, each offering 'self-contained worlds' from which policymaking is understood and from which to view the policy process (John, 2013). Post-positivist theories are united only in their rejection of positivism and reductionism. Complexity thinking, in contrast, is cohered by a particular set of concepts and principles, despite these having different interpretations and emphases in different complexity lineages. Cairney (2013) proposes complexity thinking in application to public policy as synthetic, capable of integrating post-positive theoretical insights although requiring particular regard for differences in epistemological and ontological underpinnings in so doing. In relation to positivist public policy theories, complexity thinking deepens the reasons why a positivist position is inappropriate for a complex problem situation (Dombkins, 2014; Emison, 1996; Givel, 2015; Levin et al., 2010). Whilst complexity policy authors do not reject the use of positivist and reductive methods as they do the positivist philosophy itself (Shine, 2015; Wellstead et al., 2015), they advocate that these methods need to be selectively and consciously applied, as representative of one perspective on knowledge and the world.

There is much within a complex view of policymaking that presents as 'common sense', introduced into the policy field previously by other views and perspectives. As such, much of complexity for public policy is not new, and complexity writers are aware of the danger of 'old wine in new bottles' (Geyer & Cairney, 2015a). Rather it is the integrative and critical aspects of complexity, together with observations of complex policymaking from the complexity literature itself that are the foci of this Chapter, as opposed to a rehearsing of the complexity-aligned and foundational public policy arguments of the post-positivist school. In this, I rely heavily on the critical and generalised complexity positions to emphasise the practice of complex policymaking.

Finally, a clarification of terms: 'Complex policymaking' will be used in this Chapter to refer to a complex policymaking response to a complex policy issue, where the policy issue is viewed as complex and systemic and the policy system entangled in it. The current dominant approach to SA CM policy of Chapter Three could be described by way of contrast as a simple policymaking response to a complex policy challenge[48].

[48] Some complexity scholars argue that, if the policy issue is simple, a simple policymaking response would be appropriate. Authors such as Dombkins (2014), Emison (1996) and Snowdon (Kurtz & Snowden, 2003) distinguish different categories of policy issues as a precursor to determining the appropriate type of policy response. Others such as Ison (2010) and Cilliers (2000), may challenge such an approach based on the complex properties of unknowability, perspective and interconnectedness.

The Chapter is organised into themes describing how complexity thinking opens up important but currently obscured spaces for SA CM policymaking, picking up on some of the arguments of Chapter Four. Throughout, I include practical suggestions as to how the SA CM policy system could take these insights forward. These suggestions are then presented together in 7.12.

## 7.2 An invitation to reflexivity: how do we do what we do?

Grounded in the assumption of neutrality, the current dominant approach to SA CM policymaking ignores reflexivity as a relevant aspect of SA CM policymaking. Instead, a critical complexity view emphasises the agency of different perspectives in a system. To situate Cilliers' (2008) words in the SA CM policy context: How we approach SA CM policymaking then becomes part of the SA STEPE system we are seeking to transform. The perspectives that the SA CM policy system brings to the SA CM policy issue influence and even constitute the policy issue. It is important to understand the role of well-established lenses and ways of thinking as system components, as these approaches can influence how systems behave, especially in instances of rapid and unpredictable change. Leach et al. (2007) reflect that changing an actor's frame of a system can in and of itself act as a stressor to the system. Complexity thinking itself therefore justifies reflecting on 'approach' as a site of policy research and action.

Taking action in complexity turns on a different (from the hegemonic) worldview, and as such is as much about 'being' as 'taking action', or 'doing'. As agents in complex systems we have the potential to influence the emergent properties of the system even when we choose to do nothing. As such, 'who we are' in the system, the values and beliefs we hold, and how strongly we live these becomes part of the systemic fabric. This perspective on action invites reflexivity, calling attention to how we act, how we 'are', and the implications of this for the system of which we are a part. Approaching SA CM policymaking from complexity therefore invites the SA CM policy system to develop a complex policymaking practice, which is both about 'being' and 'doing'.

Practising complexity turns on a tension within humans: On one side the cognitive and emotional desire for simplicity and control, entrenched and augmented by the hegemonic worldview (Heylighen et al., 2007), and on the other, our intuitive understanding of complexity (Meadows, 2008). The ubiquity of uncertainty, the potential for unintended consequences, the interconnectedness of everything appears obvious, common sense even (Richardson et al., 2001). A complexity practice must navigate between these opposite poles of attraction, leveraging the resultant tension to enable appropriate engagement with a complex systemic world. As products of a westernised education system in the past century, most people in western societies are schooled to think reductively, in specialities. A focus on science and technology prioritises a causal rather than relational thinking (Ison, 2010). A complexity practice requires the opposite, developing a systemic, relational, connected and multi-knowledge way of thinking about the world.

Practising complexity involves engaging another complexity tension: between unknowability and the need to act to move forward. Where then can we look for guidance to complex action? Complexity literature suggests a number of lines of response to this question. First, that taking action in complexity is a continual balancing act between enhancing observation and understanding of both complex system properties and the specificities of the complex system being attended to on the one side, and then taking conscious action on the other. It is a balancing act which requires our full humanity, and a perpetual critical and reflective attitude (Wells, 2013). A complexity view does not negate positive, intentional action as viewed from the hegemonic paradigm, nor the use of reductionist tools and approaches within a complexity practice. There is place and method within complexity for acting with intent, but this action comes from a place that acknowledges unknowability, and that is ready to adapt as the system responds. Richardson et al. (2001) describe this as necessarily moving to a positivist position momentarily, but then immediately reverting back to a post-positivist stance as circumstances inevitably evolve. A SA CM complex policymaking practice will demand an agility of approach, an ability to adapt to changing circumstances.

A complexity practice further advocates an awareness of paradigms; what they are (Meadows, 1997), what they do and what types of action are effective within a particular paradigm. An awareness of paradigms suggests that any particular approach, including that of complex systems, is but one way of 'doing'. Ison challenges students of complex systems to ask 'what might I learn if I were to engage with this situation as if it were a complex adaptive system?' (2010, p. 132). A complex policymaking practice advocates an awareness of the framings from within which policy action occurs, and 'a balanced and pragmatic approach to the strengths and weaknesses of all types of policy' (Geyer & Cairney, 2015b, p. 459).

The complexity principle of unknowability, together with the generalised complexity approach of considering all knowledges, demands a humble practice where ways of hearing, respecting and cooperating with other perspectives are made routine. For the SA CM policy system this means finding ways to collaborate with policy practitioners in different institutions and policy areas, with other system agents, with different disciplines in a research setting, and between research and practice. A complexity practice would thus prioritise taking time to learn from others, to understand their particular 'traditions of knowledge' (Cairney, 2013; Ison, 2010), focusing on learning within relationship and context, rather than identifying absolutes. The Conversation Series demonstrated the value and productivity of these activities despite their being counter to the mainstream silo professional culture (Tyler, 2014). Development Provocateur Mistry (2014) noted that for the SA CM policy system institutions already exist which straddle environment and development issues and which could be used to build stronger connections with the SA STEPE system. And yet, as Kane (2014c) reflected after the Conversation Series, the value of disciplinary work remains. Here again there is a tension between connecting and deepening, which the SA CM policy system would need to navigate throughout the policy cycle. Wells (2013) promotes bringing those who

specialise in transdisciplinarity into teams specifically, advocating a ratio of 1:10 transdisciplinary to disciplinary specialists (although this ratio may need to initially be higher to establish a transdisciplinary competence and orientation within the SA CM policy system).

A complexity practice also requires a wariness of simplification, abstractions and binary positions. Rather, in a complexity practice there needs to be an intention towards complexification of descriptions and narratives, scrutinising language for simplification and resisting reductionism as far as possible.

Ison (2010) offers the analogy of a juggler as a way of understanding what constitutes a (complex) systems practice. A systems practitioner always operates with four balls in the air when in any situation: 1) a knowledge of *being* a practitioner with a particular tradition of understanding, (2) the characteristics of the system the practitioner is *engaging* with, (3) the act of *contextualising* an approach to the situation, (4) and then *managing* his or her involvement in the situation. In Ison's analogy there is a strong emphasis on awareness of oneself, of the complex systems operating, and of what other people bring to the situation. A complexity practice demands an increasing consciousness and sophisticated level of interpersonal skills.

Astil and Cairney argue that complexity thinking requires one to change one's view of the world in order to better operate in it (2015, p. 136). I would argue from my experience of writing this thesis that this needs to be extended further still, that an encounter with complexity thinking challenges one to change oneself. Ison (2010) reflects that adopting a complex systems view can be deeply transformational for the adopter, that this is ultimately a challenge of identity, both personal and collective.

Complexity's invitation to reflexivity is thus clearly a very personal issue, and not something that the SA CM policy system can control or could adopt wholesale. However, complexity theories propose that systemic change can start with small changes at micro-system levels, suggesting that the individual practice of complexity and reflexivity is not irrelevant to inspiring change at a broader system level. SA CM policy education is clearly a place where reflexive thinking could be encouraged, as well as in the types of training opportunities, SA CM policy seminars, and literature made accessible to those in the SA CM policy system. Indeed, my hope is that this thesis itself might contribute towards a greater reflexivity of approach.

## 7.3 Shining a spotlight on policymaking ethics

The view from complexity of human intervention in a complex system as necessarily normative (5.4.1.) implies that a complex policymaking requires the tools of ethics to rise to equal prominence with traditional content-focused tools (Jasanoff, 2007). Complex ethics requires an explicit and constant consideration of values to guide explorations of different perspectives, navigate middle grounds of undecidability, and bound possible options and interventions (Mitleton-Kelly, 2015; Shine, 2015). Recent developments in ethics, looking at ethics of care (Parker, 2010) and pragmatist ethics (Wells, 2013),

contribute towards such a complex ethics. In a developing country such as South Africa, ethics and value-based tools are particularly important given the limitations in resources for ensuring data and information availability and access through the system.

The current dominant approach of the SA CM policy system was argued in Chapter Four as having a strong normative undercurrent. A complex ethical stance requires that these values are routinely made explicit in the SA CM policy system's activities. Apart from its ethical necessity, exploring different value positions may itself open up systemic spaces of the possible for moving towards a low carbon high development attractor.

## 7.4 Prioritising responsive policymaking

A complexity approach to public policy explicitly addresses how policymaking and implementation happen, the 'how', in addition to the 'what' of policy instruments, targets and regulation. Meadows' (2008) metaphor of a dancer is particularly helpful in the context of the 'how'. Policymakers dance with the complex systems of which they are a part, and which they are trying to influence, and their touch is light. Complex policymaking is therefore an ongoing journey of guiding, supporting and amplifying desired properties and patterns as they emerge (Snowden & Boone, 2007) from both the policymaking and societal systems, and dampening down (Price et al., 2015) or disrupting (Shine, 2015) those less successful or desirable.

Complex policymaking operates from a place of certain uncertainty (Ison, 2010), and therefore prizes flexibility, agility and responsiveness (Boulton, 2010; Dombkins, 2014; Emison, 1996; Geyer & Cairney, 2015a; Shine, 2015; Ranger & Garbett-Shiels, 2012). This involves knowing when to let go and let the systems respond, and when to be vigilant, such as around times or areas of heightened instability or tipping points (Shine, 2015). As such the SA CM policy system would have a 'finger on the pulse' of systemic change (MacMaster, 2016), responsive to internal and external stressors, with energy and momentum maintained and directed to the policy objectives (Shine, 2015). An example of when the SA CM policy CoP acted in this way was the initiating of the LTMS: pressures were mounting in the international arena for developing countries to engage with the global mitigation effort formally (Interviews, 2014). The LTMS was conceived of and commissioned to respond to this, addressing the sense locally that there was not much that South Africa could do in terms of mitigation. It did so very effectively as government 'let go of control' (Interviews, 2014). Conversely, from a complexity perspective, the 2008 electricity supply crisis could be argued as a missed 'responsive' opportunity. Rather than observing the crisis as an energy sector issue, the SA CM policy system could have prioritised enabling and supporting the electricity policy sub-system rise to leadership to incorporate concepts of energy efficiency (as opposed to energy conservation) and energy and carbon decoupling innovations (beyond the REIPPPP) into their response and management of the crisis.

A complex policymaker needs to be able to let go of policies that are not working (Geyer & Cairney, 2015a) and accept that success might come from unpredictable avenues. This applies to policy instruments and process, policy leadership, and even to how the problem situation (including its boundaries) is conceived. Policy outcomes should also be viewed collaboratively and dynamically from a number of perspectives (Boulton, 2010). Complex policymaking has been described as a craft, an exercise in non-perfection (Price et al., 2015), doing more of what works and less of what doesn't.

Complex policies and policy instruments will constantly require adjusting to a changing policymaking and systemic environment and should be explicitly designed to anticipate learning, with 'adaptability and agility as two of their undergirding principles' (Emison, 1996, p. 192). Policymakers need to find a balance between policy flexibility and certainty – to enable policy evolution without a significant break in continuity. This can be done within the policy, for example by supporting modular implementation (Steyn, 2014). Strategies for flexibility include the sequencing of actions over time, mechanisms to reduce the lifetime of decisions, and initiatives that anticipate the ability of stakeholders to learn over the lifetime of the policy.

Monitoring and revising the parameters of SA CM or other policy areas can counteract asymmetric behaviours used to circumvent the intent of the policy (Dombkins, 2014). 'Parameters' are used here to refer to the details of a policy, including both quantitative aspects such as tax or subsidy rates or thresholds, and qualitative aspects such as the types of activities covered. For example, including energy efficient specifications in the National Housing Code is likely to contribute to a reduction in both current and future peak time electricity demand from the residential sector, diminishing Eskom's argument that additional coal base load power supply is required to service this peak. New policies can also be added to specifically deal with unintended consequences and undesirable feedback. For example, urban grid defection by high-income households due to unreliability of electricity supply is argued by some municipalities to reduce an important source of their municipal revenue, decreasing their ability to provide services to the poor. Introducing taxes on high-income consumption, especially that which has multiple social and environmental externalities (for example sport utility vehicles) may offer an alternative revenue source. A complex policymaker will also not hesitate to discard policies that, at the point of their implementation, generate undesirable emergent properties. Policy errors should be treated as sources of learning systemically, as a way of responding to uncertainty (Geyer & Cairney, 2015a). Dombkins (2014) cautions that planning in detail beyond the short-term in a complex world is a wasted and even counterproductive effort. This suggests that, in the SA CM policy system that is currently being designed (Cloete et al., 2017), efforts to specify policy parameters should be concentrated on the very short-term, with the medium to longer-term efforts expressed more in terms of principles and links to the policy objectives. This does not detract from the need to respond decisively to urgent decisions with long-term implications, especially those that lock-in undesirable or desirable path dependencies.

Responsive policymaking relies on accurate and timely information about its 'systems-of-interest' (Ison, 2010). In order to access this, the SA CM policy system could usefully establish a 'foresight function': a network of diverse individuals or organisations who are on the lookout for SA STEPE system disruptors and trends both within and, importantly, outside of the typical energy and economic remit of the SA CM policy system. Such events or trends across the STEPE dimensions could represent opportunities to entrench or augment low carbon high development path dependencies, or those which may require active undermining if they run counter to the SA CM policy objectives. Process mechanisms of regular interaction between the foresight function and the day-to-day of policymaking will need to be developed, potentially feeding information into a stakeholder platform in the interests of co-ownership of information and policymaking, or to the DEA or Ministerial Committee on Climate Change (MCCC) directly.

## 7.5 A collaborative and connecting approach

Conceptualising the SA CM policy system as a complex sub-system of the SA STEPE system - and thus as part of the SA CM issue or 'situation' (Ison, 2010) - recognises that the policy process itself is complex, systemic, and 'integral to the policy's design, implementation, and ongoing management' (Dombkins, 2014, p. 26).

This integral and systemic conceptualisation of the policymaking process offers a critically important insight; because complex systems are self-organising, attempts at centralised or external control are not guaranteed to influence a system in a particular direction. Complex systems are inherently unpredictable. In the current dominant approach to SA CM policymaking, influencing the SA STEPE system relies heavily on the Air Quality Act (of the National Environmental Management Act), where GHG emissions are identified as priority pollutants (DEA, 2017a) and can be regulated. In Meadows' (2008) list of leverage points to change a system, regulation comes in as least effective.

Complex policymaking has been described as a counter-narrative to that presupposing a state in control (Geyer & Cairney, 2015b), and offers a different view of influence, one based on co-ordination across multiple policy areas. Levin et al. (2012) write of policy baskets being a more useful concept than individual policies, and that attending to the interactions of different policies and policy areas is critical. Room (2015) describes the policy environment as a complex system itself, an 'ecosystem' of policies; the policy owner launches policies into it, sees if they 'stick' and then seeks out synergies to lead to desirable emergence.

Dombkins (2014) develops a 'mega-system-of-systems' model of complex policymaking which assists in thinking through how indirect policymaking involving multiple sub-systems might be organised, and offers a useful model for organising SA CM policy along collaborative lines. Dombkins' model applied to SA CM policy is based on the idea of relevant, autonomous and loose-coupled 'component' SA STEPE policymaking sub-systems, each with their own policy objectives, being brought together under a separate

organising 'mega' policy system to deliver unique, higher order complex policy objectives; those of the NCCRWP. The component sub-systems remain operationally independent, potentially under different authorities, and continue to deliver on their own objectives such as running a city, developing transport infrastructure, expanding a corporate, championing the environment, or ensuring the economy is stable, whilst being part of a mega-system-of-systems governance structure. Each sub-system evolves in different timeframes and may also change in response to its being part of the mega system-of-systems (each sub-system is thus radically open to the complex policy).

The model is based on the complexity concepts of self-organisation and emergence as generative at the micro level. Dombkins proposes that the component sub-systems are best placed to handle the complexity of the complex policy issue, hence, the sub-systems 'need to have authority devolved to provide them with the capacity and opportunity to adapt it to local or changing circumstances' (2014, p. 32). The model identifies a 'policy owner' of the mega-system-of-systems, which in the current configuration of SA CM policy is the DEA. Dombkins argues that the owner should then focus on setting system-level goals and delivery options that are continuously adapted to an emergent policy environment.

In many instances of complex policymaking, the policy owner is interacting with sub-systems that are far longer standing and institutionalised, necessitating a collaborative, negotiated approach. This is particularly relevant for pursing mitigation policy in a development context. According to Dombkins, 'a successful complex policy requires that the [component sub-system] agents are able to make sense of the [complex] policy individually, in the context of their respective roles, as well as collectively' (2014, p. 46). This requires ongoing assessment and information, and awareness of the broader implications of the complex policy. At all policy stages the existing plans of the component sub-systems need to be acknowledged and leveraged in the interests of the complex policy objectives. The expanded policy community is a feature of Dombkins' model, and he writes of the critical task of developing stewardship between the policy owner, component policy owners and agents. Dombkins describes these types of processes as developing a 'web of shared interests' rather than a 'chain of command'. For SA CM policy, this web would encompass the multiple points of interaction between mitigation and development.

Dombkins' model of a complex policy system is further detailed as comprising two types of 'mega-system-of-systems', managed by the policy owner. The first is a political mega-system-of-systems, where the complex policy owner's goal is to gain and maintain the objectives and strategy of political support for the complex policy. Political support for the complex policy is managed primarily through negotiating trade-offs. In the SA CM policy case, a significant component sub-system of the SA CM political mega-system-of-systems is South Africa's engagement with the international CM policy system. From the view of Dombkins' model the policy owner's role with regard to the international CM policy system is to identify which changes within this system are supportive of low carbon emergence in the national system, and which are not, and to support or contain these accordingly. This is a very different conceptual positioning to that of the current SA CM policy approach.

The second mega-system-of-systems is centred on implementation, with implementation understood here as being an emergent property (Dombkins, 2014), here of the SA STEPE system. In complex situations policies continue to evolve as they are implemented, and Emison (1996) cautions that implementation is at least as critical as policy design, with implications for the allocation of resources and policymaker attention. The complex policy owner's task here is to create processes to support the complex policy's implementation by the component sub-systems, responding to the component sub-system's emerging experience.

I find that Dombkins system-of-systems approach has particular value in responding to the SA CM policy issue from a number of aspects. First, it engages directly with the reality that climate mitigation is not a priority for any department or sector other than DEA at the national level, and it provides a conceptual model for working within this reality. Second, it is an approach that emphasises policy process and politics whilst retaining a technocratic thread (Friedmann, 1987) particularly necessary in the case of CM policy. Third, it is based on the premise of there being no centralised control in a complex social system.

The complexity thinking emphasis on collaboration and connection, the integral, entangled conceptualization of mitigation and development, together with the description of the SA CM policy issue as primarily a social one, also raises a more fundamental question: Is the DEA the appropriate policy owner in Dombkins' model? It may be that CM policy is more effectively situated in an institution that itself is more systemically integrated across all the STEPE dimensions than DEA, such as the Presidency.

The ineffectiveness of DEA's current model for working with other policy sub-systems, including the IGCCC, has been noted in Chapters Three and Four. The 2018 Climate Change Bill proposes changes in the institutional governance of SA CM policy from the IMCCC to the MCCC. Dombkins' model offers a complexity inspired alternative against which to consider these changes. There are some encouraging developments: The MCCC is proposed as being co-chaired by the Minister of Monitoring and Evaluation in the Presidency and the Minister of Environmental Affairs, acknowledging the implications of SA CM policy beyond its environmental dimension, although the DEA is retained as the functional 'policy owner'; the MCCC is also integrated both horizontally (to other national ministers, in as yet un-defined 'functional areas') and vertically (to the provincial leadership executive, again a cross cutting and politically relevant forum).

Some further opportunities are suggested by Dombkins' model - with varying profiles of political and organisational practicality. Re-organising functional SA CM policy initiatives within DEA along collaborative lines as per the implementation-mega-system-of-systems aspect of the model is one, for

which the Flagship Programme offers an existing entry point[49]. This re-organisation could include embedding SA CM policy officials in line departments to both learn from these policy sub-systems' implementation experiences, and to continuously align their work with the SA CM policy objective. The Lets Respond initiative (DEA et al., 2012) has advanced similar initiatives vertically (from National to Provincial) providing experiences to inform horizontal replication in national policy sub-systems. Creating dedicated capacity within DEA for SA CM policy political engagement and management is another opportunity which Dombkins' model suggests. Finally, whilst the proposed co-chairing of the MCCC by the Minister for monitoring and evaluation goes some way to emphasise the systemic nature of the SA CM policy issue, this could be entrenched and expanded by a full institutional re-organisation, taking CM policy out of DEA and either creating a separate department or positioning it functionally within the Presidency.

## 7.6 Policymakers as custodians of policy objectives

The self-organisation and non-linear properties of complex systems undermine the traditional view that policymakers 'enforce' policy objectives, and that the objectives linearly determine policy formulation, which in turn determines policy implementation (as per Lasswell's policy stages model). Dombkins (2014) argues instead that system actors should be anticipated to subvert policy objectives to their own individual ends, adapting them to their perspective and context. This sense-making and redefinition in response to a policy objective happens 'individually, in the context of their respective roles, as well as collectively' (Dombkins, 2014, p. 47). For example, civil servants may be motivated (or constrained) by the goal of achieving their performance targets, which will influence how they interpret SA CM policy objectives. Civil society activists will self-organise according to their particular organisation's focus and their personal agenda. Company employees are likely to have an objective function that incorporates technology and economic aspects more strongly. Such adaptation of high-level policy objectives contributes to the generation of unpredictable emergence and systemic self-organisation to which policymakers need to respond.

The complex policy literature offers two main roles of policy objectives in complexity which are dealt with in the following sub-sections. The first is a visioning role, unifying and orientating (Lichtenstein, 2000) and articulating the 'desired future' for the policymaking journey (Dombkins, 2014; Shine, 2015). The second is that of compass (Shine, 2015), keeping the relevant systems on course towards this desired future. The relationship of the SA CM policy system to its objectives is therefore one of custodian or steward; supporting the SA STEPE and policy systems to self-organise towards the objectives, defining the system from within as both systems move forward through time.

[49] The Flagship Programme has been largely ineffectual to date (Worthington, 2014), mirroring rather than critically engaging with that which is occurring in the line departments anyway. Little attention has been paid to the process of leveraging component sub-system goals for a mitigation objective. As such, the Flagships would require a significant overhaul with the objective of developing a deep understanding of each sub-system's objectives and contexts, and paying attention to their perspectives in order to seek out opportunities to align policy objectives.

### 7.6.1 The visioning role of complex policy objectives

Acting as custodian of a contested and dynamic vision (policy objectives being temporary expressions of what the SA STEPE system finds desirable at any one time), has particular implications from a complexity view. Rather than being obstacles to progress, different and opposing perspectives are sources of potential in a complex social system, engaging and experimenting with these supports the system-led process of creating spaces of the possible. Exploring what a low carbon high development SA STEPE system future might look like would therefore be useful to nurture and complexify the visioning role of the NCCRWP policy objectives. As Development Provocateur Verwey (2014) reflected on the DevMit Forum: both climate mitigation and development perspectives will need to engage with the SA STEPE system and be part of reinventing it.

An ongoing and active engagement with policy objectives also serves the important function of promoting ownership over the objectives within the SA CM policy system. Critical complexity's emphasis on different perspectives invites members of the SA CM policy CoP to consider that 'their' view of the world is just that, it is not necessarily 'right' nor 'shared' either within the SA CM policy system or the SA STEPE system. Shine (2015) emphasises co-creation of objectives as being an important way to support self-organisation towards these objectives throughout the system. This was done very well in the LTMS process (see Box 11 below). Engaging different perspectives is theorised by Dunn et al. (2017) as 'stretching system boundaries', implying that it may be beneficial for the SA CM policy system itself to expand to incorporate different (disciplinary) perspectives (Ison, 2010) in order to more adequately fulfil its role. Tools for hosting and facilitating discussions aimed at engaging perspective and contestation are plentiful especially in the management literature.

The complexity value of engaging stakeholders in the ongoing evolution of a policy vision suggests that the SA CM policy system would benefit from establishing an institutional platform to this end. There was a clear opportunity to do this after the LTMS, which was lost as trust was eroded through President Zuma's Copenhagen announcement, and stakeholders became increasingly polarised. Whilst consultation is a regular feature of the CM policy process in South Africa, consultation is not co-production, and disguises what is predominantly a top-down, centrally controlled process (LTMS Interviews). The NCCC provides an existing institutional structure for ongoing stakeholder engagement, although its function and scope would need to be re-thought. For example, should government so clearly 'own' the platform and determine its processes? How could diversity (of scale, sub-systems and perspectives) of the SA STEPE system be achieved? What would its mandate include?

*Box 11: Co-creation of a vision in the LTMS*

One of the LTMS innovations was the use of a facilitated stakeholder process to understand what could be done in terms of climate mitigation in the country. At the time (2005), there was a sense domestically that South Africa had few mitigation options given its coal based economy. The LTMS brought together key stakeholder groups including business, labour, government, civil society and academia, who explored what mitigation might mean for country's future, by modelling emissions and development impacts for South Africa from 2010 to 2050. During the process, the stakeholders (interviewed in 2014) described coming to the realisation that the baseline 'Growth Without [emissions] Constraints' scenario was not a viable option for the country, with the 'Required by Science' scenario (comprising an emissions path whereby South African takes an equitable share of the global mitigation effort required to remain below two degrees of global warming[50]) presenting a more viable, although not consensus, position (Interviews, 2014). The LTMS process took over a year, and during this period stakeholders reported learning about what climate mitigation entailed, and what South Africa could and couldn't do (Interviews, 2014). A significant degree of social capital was developed, together with an initial sense of a policy community being formed (Interviews, 2014). There was therefore a degree of buy-in to the Peak, Plateau and Decline (PPD) trajectory for the country that Cabinet endorsed soon after the LTMS process concluded (Van Schalkwyk, 2008). As such, the policy vision developed through the LTMS and captured in the Cabinet statement was co-created, and this was reflected in the ownership the nascent SA CM CoP felt over the LTMS outcomes at the time. Subsequently within the SA CM policy system, the focus has swung away from the co-created vision and objectives of the LTMS towards the numbers of the GHG Emissions Benchmark Trajectory Range. Policy objectives and vision were translated into a more rigid and uncompromising focus on centrally determined regulatory targets (in the form of a cascading carbon budget). This has isolated and antagonised stakeholders, many of whom hold considerable political power. A number of business interviewees (Interviews, 2014) held the view that 'freezing' the LTMS numbers into the PPD trajectory introduced rigidity into the policy development process at the cost of what will 'actually be implementable'. There is currently little underlying consensus on the detailed objectives and substantial trust has been lost (Tyler & Torres Gunfaus, 2017).

### 7.6.2 Complex policy objectives as a compass

The compass-bearing role of the SA CM policy system is particularly relevant for a policy issue that is long-term, involving delays in information feedback loops, and complex climate change science. In SA CM policy currently these issues are engaged through the GHG Emissions Benchmark Trajectory Range. Using the organising concept of a complex system, the Trajectory Range can be considered as a constraint on the SA STEPE system (following Wells (2013)), enabling access to complexity insights as to what this constraint is and how it operates.

The Trajectory Range identifies the desired range of measurable natural components of the SA STEPE system, i.e. GHG emissions, as determined by a combination of climate science, domestic and international politics in an international CM policy system process. The constraint currently has a

[50] What comprises South Africa's 'equitable share' is a subject of much debate and analysis (see for example Klinsky & Winkler (2014)). The LTMS Required By Science scenario reflects one interpretation of what this could be.

temporal dimension (to 2050). Because this constraint enters the SA STEPE system through the social and technical sub-systems of international relations, diplomacy, economics, technology and culture, it is itself a contested entity, influenced by perspectives and power. From a critical complexity, the findings of climate science are themselves not an incontestable truth but rather a particular perspective of the system at a particular point in time: evidence to inform complex, multi-dimensional policy. As a result, the constraint may co-evolve with the SA STEPE system and the international CM policy system of which it is a part.

The impact of introducing a constraint to a system was discussed in 5.3.9. and 5.5., notably how it influences the self-organisation of all the system's sub-systems and agents, that a constraint is neither 'good' nor 'bad', and that the outcome of a constraint depends on how the system responds to it. This complexity view disarms the dominant mitigation versus development narratives in the SA CM policy system of much of their power and emphasises the patient complex policymaking task of orientating the emergent evolution of the SA STEPE system. The complexity principle of uncertainty, and the view of emergence as unpredictable emphasise that the outcome of introducing a policy constraint to support the compass-bearing role of the policy objectives cannot be known upfront, and depends on how this constraint interacts with existing systemic patterning and decisions and events going forward. The constraint may contribute to systemic collapse, a re-ordering to a low carbon low development attractor state, or a shift to a low carbon high development attractor (in this instance the policy constraint may have the effect of passing a threshold through the entire system to initiate a shift in attractor, as per Walker et al., 2004). The way the constraint becomes part of the SA STEPE system and effects its self-organisation is influenced by the SA STEPE system's non-linearity, the different temporal rhythms of its sub-systems and the diversity and complexity of the SA STEPE system itself. The emergent outcome of the introduction of the constraint is multi-causal.

Whilst the introduction of a constraint is necessary for a policy issue involving deliberate transformation because of delays in information flows, its expression in the GHG Emissions Benchmark Trajectory Range is limited in at least two areas. First, the linear, bi-dimensional (time and GHG emissions) and deterministic expression of the constraint using modelling constrains its ability to assist SA CM policymakers in its compass-bearing role. Complex systemic properties such as non-linearity, and the different temporal rhythm and structural aspects of the SA STEPE's sub-systems also need to be considered. Secondly, the 'end-point' of 2050 is at odds with the persistence of complex systems, never reaching a 'destination'.

Policy evaluation is another tool for compass bearing. The SA CM policy system developing the ability to identify possible futures before they become a reality (Emison, 1996) would illustrate this. Macmaster (2016) notes the importance of evaluating against whether a policy is working to support desirable emergent properties, not whether it is sticking to its original timelines.

The complexity insight of policymakers as compass-bearers and custodians rather than top-down enforcers suggests that the SA CM policy system could usefully revisit the interpretation of the carbon budget concept currently at the heart of the mitigation policy suite under development. This system is dominated by a cascade of top-down GHG emissions controls: from the GHG Emissions Benchmark Trajectory Range, to Sector Emissions Targets (SETS) to company level carbon budgets. (Interestingly, the expression of these policy elements in the NCCRWP itself is closer to the complexity view of custodianship, where the 'benchmark' and 'evaluative' aspect of the Trajectory Range is emphasised, and SETS were 'Desired Emission Reduction Objectives' (DEROs))[51]. At all levels the quantification of these budgets is based on the historical patterning of the SA STEPE system, rather than on an appreciation of where the system may need to evolve, which structures (companies, activities, infrastructure) it wishes to support with carbon space and which it needs to dismantle. Meadows (2008) emphasises that intervention in a system needs to focus on changing the system structure as opposed to the system outputs at any particular moment.

Of the two main mitigation policy instruments being considered in South Africa – carbon tax and carbon budget – a complexity view would favour the use of the carbon tax as more aligned with the self-organising property of the SA STEPE system. However, the tax is also limited from a complexity view: it can less easily respond to the non-linear properties of complexity, and similarly to the budgets, to the need to destroy and build particular systemic structure. Changing system structure requires a more strategic and whole-SA STEPE system-view than the current dominant SA CM policy approach currently affords.

## 7.7 Complexifying 'development'

Chapter Four discussed how the concept of development has been simplified and subjected to particular interpretations in SA CM policymaking. From a complexity view of developing spaces of possibilities into which the SA STEPE system can move, complexifying development may prove very valuable for the SA CM policy system.

Binary positions in the CM policy lexicon such as conservationalism versus environmental justice, economy versus society, developed versus developing, capitalism versus socialism, clean energy versus dirty energy all work to simplify and to close down options for the SA STEPE system to move to in response to a GHG constraint. As Wells notes, these dichotomies are 'distinct in our thinking but not so distinct in the messy world of network causalities and interdependence' (2013, p. 106). Such a simplification of development in particular loses the contextual and social aspects of development explored in Chapter Four, instances where there is experimentation and progress towards low carbon and high development objectives. Simple concepts also encourage the abstraction, ideologies, myths and simplification which complexity

[51] The DERO concept has subsequently been abandoned.

thinking alerts us to (Hoyer, 2010), and quickly become vehicles for the powerful to justify actions in any direction.

Because complex systems are non-deterministic, it is impossible to know in advance whether any one perspective of development can be realised together with the GHG emissions constraint, and extensive policy efforts to do so are misdirected from a complexity view. Instead, a complexity approach would seek out different perspectives of the term development, a complexification as opposite to simplification, paying particular attention to regaining the local and less power-filled variations that the simplified concepts now hide. Such work encourages multiple interpretations of 'development' and 'sustainable development' as they appear in the NCCRWP, and an appreciation for what development means and how it is constantly created across the SA STEPE's multiple intersecting sub-systems.

The discussion thus far notwithstanding, the action of simplification can be useful in particular instances. For example, simplification of 'development' may have been necessary to secure the buy-in of many different perspectives to the stated SA CM policy objectives at one point. However, from a critical complexity position, when simplifications are utilised, this should be done with acute awareness of the reason for the simplification, and its possible consequences.

Finally, it is worth noting here that the fields of evolutionary, institutional and ecological economics amongst others are increasingly offering alternative and complexity-based views of development, which may assist in complexifying the current dominant SA STEPE system development views going forward.

## 7.8 Actively engaging power

Complexity thinking highlights the role of power in complex systemic transformation and provides some insights into how policymakers could respond to this issue, suggesting a more active and dedicated political and strategic role for the SA CM policy system than that currently in place. Levin et al. (2012) argue that attention to politics and power can allow for creative solutions to address complex policy challenges, with the challenge to policymakers being to understand how to meet the objectives of the powerful whilst simultaneously guiding the system towards the SA CM policy objectives.

Dombkins' political mega-system-of-systems described in section 7.5. provides an institutional placeholder for the SA CM policy system to engage explicitly with the top-down aspect of power. Managing power patterning involves both constraining SA STEPE system power being exercised against the NCCRWP policy objectives, and utilising power towards achieving the objectives. Givel (2015) focuses on the role of policymakers as being to block powerful elites, thereby constraining undesirable negative feedback loops in a system. Creating instabilities within a sub-system can intentionally disrupt existing power patterns.

The second form of power, the implicit power residing in concepts, narratives, collective choices and ideologies, works at a very fundamental systems level to influence the SA STEPE system's self-organising

properties. Some of these implicit power patterns are desirable for the shift towards a low carbon high development attractor, most work against this shift. By making these negative power patterns and their role in achieving the SA CM policy objectives explicit, the SA CM policy system can disarm them of some of their power. Geyer and Cairney (2015b) advocate investigating marginalised perspectives to assist in exposing power patterns, particularly when changing power structures is required for change.

As the exercise of bottom-up power becomes an increasingly important mechanism for social change both in South Africa and globally, this form of power requires more attention from the SA CM policy system. The civil society resistance to the proposed nuclear fleet[52] (largely on the development grounds of unaffordability and corruption rather than environmental concerns) provides strong evidence of how the exercise of bottom-up power influences the SA STEPE system's evolution. Regardless of the issue around which the bottom up power is focused, its destabilising impact provides opportunities for the SA CM policy system to influence the direction of system change towards a low carbon high development attractor. This observation underpins the relevance of thinking systemically and widely to identify opportunities for responsive SA CM policymaking.

The creation of dedicated capacity within the SA CM policy system to manage the political aspect of SA CM policy was suggested in section 7.5. The focus on power in this section strengthens this suggestion, elaborating on its strategic role. Attention to potential shifts in all three forms of power could be included in the brief of the 'foresight network' suggested in 7.4.

## 7.9 Responding to the temporal aspects of the CM policy issue

The temporal challenges of the SA CM policy issue – as long-term and urgent – were argued as being obscured by the current dominant approach to SA CM policy in Chapter Four. The organising concept of a complex social system, its non-linear properties and the varying temporal rhythms of its sub-systems open up different areas where the SA CM CoP can tackle these temporal challenges. Four of these areas are considered below.

### 7.9.1 Avoiding undesirable lock-in

As complex systems, the SA STEPE system and its sub-systems have the potential to get locked-in to undesirable path dependent trajectories. As such, SA CM policymaking should pay attention to the temporal rhythms and lock-in potential of the various SA STEPE system sub-systems to identify and attempt to avoid undesirable lock-in events. For example, a complexity view would focus SA CM policymaking effort in the short term on influencing the pending decision regarding the two additional coal fired independent power stations (Thabametsi and Khanyisa) in the electricity sub-system. This view highlights a strategic approach to SA CM policymaking; the creation of a strategic function within the DEA

[52] http://nuclearcostssa.org/

which could assess where the urgent lock-in decisions are being made across the SA STEPE system, and how these could be influenced appropriately towards a low carbon high development attractor. This function would prioritise knowledge of the temporal rhythms of the SA STEPE sub-systems together with their potential for negative lock-in.

### 7.9.2 Creating positive path dependencies

Conversely to avoiding undesirable lock-in, Levin et al. (2012) propose utilising the non-linearity of complex systems to create desirable lock-in in the context of CM policy. The aim of their approach is to identify how policy interventions might lock in desirable low carbon policy pathways over time. Drawing on path dependency literatures, such pathways are envisioned as path dependent processes that are durable and which themselves will impact behaviour and politics, gaining momentum over time. To create these pathways, Levin et al. propose a new class of policy analysis and design techniques – termed 'progressive incrementalism' - that focuses foremost on creating 'sticky' policies that expand their support base over time, binding society to preferred paths.

A key aspect of progressive incrementalism is the observation that climate mitigation policies intent on ushering in once-off paradigmatic change are subject to significant push back from the present incumbents who stand to lose their advantageous situation. Progressive incrementalism pays attention to the point of intervention in a complex system (policy calibration rather than system goal), avoiding the more difficult (and effective) lever of system goal and focusing on policy calibrations which are less effective but easier to change. By paying attention to entrenching and expanding the sub-systems supporting a policy intervention – designing policy for 'stickiness' – small incremental changes can gather pace and power without encountering opposition from powerful incumbents at the point of policy promulgation.

Levin et al. therefore caution that locking-in a particular approach or technology at one point in time is a useful but insufficient aspect of policy design for low carbon path dependencies, as many lock-ins are vulnerable to reversal, for example under a new government. As such they advocate including additional 'policy logics' in progressive incremental policies: first ensuring ongoing support for the policy over time, either through rising costs of reversal or through increasing benefits to the initial stakeholder population, and second, creating positive feedback loops to expand the policy to additional populations over time without losing the support of the initial population. Levin et al. give the example of the carbon tax in British Colombia, which was designed as revenue neutral in order to entrench support for the tax by business. The government also shared tax revenues with municipalities and schools committing to carbon neutrality, creating additional supportive populations who would resist the tax being reversed.

In their work Levin et al. emphasise interactions between policies across the spectrum, and the value of looking for low order entry points in other policy spheres in order to nurture low carbon path dependencies. For example property taxes supporting people living close to schools and places of work

reduce transport miles and hence GHG emissions in a city. They argue that normative change must be focused on triggering swift progressive incremental trajectories, especially for ingrained norms; there must be plausible logic that the change can occur within the timeframes required.

A progressive incrementalism approach incorporates very different CM policy design priorities to those of current SA CM policy, particularly the core policy instruments of the carbon tax and budgets, which are considered primarily for their performance against the principles of environmental and cost effectiveness (Vivid Economics et al., 2016) and not against logics such as those of progressive incrementalism. An aspect of the design which makes little sense from the perspective of efficiency and effectiveness - the carbon offset scheme whereby entities with tax liabilities can purchase project offsets from activities not covered by the tax - may actually have powerful path dependent logics, entrenching the support of business for the tax and expanding the populations supportive of it for revenue going forward. The REIPPPP design also provides a good example of paying attention to path dependency, as it actively expands the supportive populations beyond those of the renewable energy industry through its socio-economic requirements in procurement design, although the interactive effects between expansion and entrenching may need careful consideration going forward.

A progressive incrementalism approach also has the specific advantage in the South African context of avoiding an engagement at the level of policy goals, where climate mitigation is vulnerable to being trumped by a development-first argument.

### 7.9.3 Focusing on institutions as agents of long-term systemic transformation

Institutions, as contributing to the structure of a social system, have a particularly important role to play in terms of the temporal aspects of CM policy. Steinberg (2009), writing about biodiversity conservation, focuses on institutional design in the context of long-term policy problems. He asks how socially agreed-upon rules governing long-term environmental resource use can be maintained in the face of ongoing societal change. Whilst he finds that Ostrom's (2010) (implicit complexity) work on polycentric governance provides valuable insights into the rules governing durable institutions, Steinberg's focus is rather on how these institutions can remain true to the normative orientation of their founders – in this case a shift of the SA STEPE system to a low carbon high development attractor. He argues that maintaining the original objective of long-lived institutions can be done through building and maintaining a system of diverse social constituents. Whilst one set of supportive constituents is under threat (for example an economic recession undermines long-term cost arguments in support of renewable energy) then the other constituents will work to maintain the policy intention. Steinberg's argument is supported in the context of SA CM policy by Rennkamp et al.'s (2017) research into political support coalitions for renewable energy.

Steinberg suggests that government might actively foster these resilient social constituencies through system design and inclusivity of diverse constituencies. This resonates strongly with Dombkins' idea of

managing a political mega-system-of-systems, which Steinberg extends beyond government stakeholders. Steinberg identifies the availability and transparency of knowledge as a priority in order for the system to self-organise effectively (addressed further in section 7.11. below). For SA CM policy, Steinberg's constituent advocacy system approach then motivates for the SA CM policy system to both prioritise the political, and too to look far beyond environmental and energy institutions for support as these present only a few of the multiple possible advocacy constituents of a low carbon, high development attractor shift.

### 7.9.4 Attending to tipping events

A view of complex systemic change as episodic and non-linear also suggests that change can happen very quickly. Areas of instability in the SA STEPE system may cause sub-systems or the whole system to tip. Tipping is a form of rapid transformation – which may or may not be desirable to the SA CM policymaking system depending on what happens in the aftermath of the tipping event. This view has a number of implications for SA CM policymaking: to identify instabilities, to assess whether these could give rise to desirable change and to intervene appropriately, and then to influence the direction of the change (mostly by attending to the SA STEPE's self-organisation on an ongoing basis).

The electricity sub-system again provides an example here, that of the REIPPPP. Given the current context of electricity sector transformation globally, this programme has the potential to disrupt the local sub-system, and potentially the SA STEPE system itself given how extensively electricity is interconnected across the STEPE system. Therefore, from a complexity view the REIPPPP should be closely monitored by the SA CM policymaking system, both for opportunities to support the REIPPPP's potential to tip the electricity sub-system, and to influence the aftermath of a tipping event – enhancing the self-organising capacity of the system to re-organise along low carbon high development lines.

## 7.10 A policymaking that prioritises innovation

Given the importance of experimentation and innovation in opening up spaces of the possible in complex systemic change, there is a role for the SA CM policy system to support this in both policymaking and the various dimensions of the SA STEPE system.

Viewing complex policymaking as an experimental exercise, policies and policy instruments are best considered as experiments themselves. Dunn, considering complex policymaking in the urban water sector, suggests a move from 'ultimate solutions' to 'reflexive 'learning-by-doing' approaches with a portfolio of options' (2017, p. 764). An example of the value of learning by doing is in the South African renewable energy space, where the REIPPPP emerged after a period of policy experimentation (a feed-in tariff was initially partially developed but eventually politically blocked (Baker, 2012)). Policy innovations in one system can also be taken up in other related systems. This occurred in relation to the LTMS, where

the process innovation of stakeholder co-creation was argued by a 2014 interviewee to have been taken up by a sub-system in the SA STEPE system, the electricity planning process in developing the IRP 2010.

The role of the SA CM policy system should be precisely to tolerate and promote such experimentation, to evaluate what emerges, and to support or contain the innovation accordingly. Geyer and Cairney (2015a) advocate enabling freedom to experiment at a micro-system level in particular, such as at the point of local policy implementation, with Dombkins (2014) emphasising the concept of 'emergent implementation' where local actors adjust policy to their local contexts and priorities. Emison (1996) argues that innovation is easier at sub-system level. From here, the SA CM policy system can then look for opportunities to support the replication of appropriate elements of the process, model or learning elsewhere in the SA CM policy system (Pueyo, 2014). The experience of the community benefit programme of the REIPPPP is instructive in this regard. Successful REIPPPP bidders are required to allocate a proportion of profits to the communities in the vicinity of the power generator, but the implications of this as a highly context specific initiative and determined by the particular stakeholders involved has been underestimated (Wlokas, Westoby, & Soal, 2017). The process has been very difficult, criticised and messy. From a complexity view the ongoing experimentation is valuable. Emergent implementation gets fed back into the system, with the possibility of replication at other scales, and of consequences unintended by the initial policy design. The SA CM policy system should remain engaged as this process unfolds.

From a view emphasising innovation, diversity of policy teams is as or even more important than their high-level skills components in order to encourage experimentation (Page, 2007), and there is a particular role for transdisciplinary researchers bridging the worlds of academia and practice to cultivate conceptual innovation (Fazey et al., 2017; Ison, 2010). In the SA CM policy system the founders of the carbon offsetting platform 'Credible Carbon'[53] exemplify this, as they have pioneered alternative ways of conducting offsetting relevant to a development context, feeding lessons into the formal policymaking process through the carbon tax commenting process.

Enhancing the ability of the SA STEPE system to innovate both generally and specifically around low carbon and development at a technical, process, social and cultural level becomes a SA CM complex policymaking priority. Goldstein et al. in Price et al. (2015) advocate the idea of supporting an 'ecology of innovation', evolving a portfolio of experiments, aimed at identifying small, system-changing 'perturbations' (Byrne, 1998/2001). If the experimentation is not yielding results in the right direction then undesirable feedback loops can be constrained. If the experiments do go well then they can be supported (Snowden & Boone, 2007).

From the perspective of futures literatures, Curry and Hodgson's (2008) three horizons model offers the concept of 'seeds' of the future as already being present now. Supporting a general environment of

[53] www.crediblecarbon.com

experimentation and innovation, and considering what emerges for alignment with a desired attractor, are ways of contributing towards realising this desired future. There are a number of initiatives in South Africa and elsewhere starting to identify these small 'seeds', both specifically in the climate mitigation space, and closely aligned to it[54].

Experimentation is also relevant in the dimensions of values and social mores (Shine, 2015). The SA CM policy system has engaged with values to a degree in the development of a set of principles for CM policy in both the NCCRWP and the NDP[55]. From a complexity view, these principles can be more actively engaged with by the SA CM policy system and used to engage different perspectives.

Innovation in the NCCRWP is predominantly focused on technology, and there is no mention of innovation of policy, processes, systems (apart from financial) or the social aspects of behaviours and values. From a complexity perspective the SA CM policy system could benefit from prioritising dedicated capacity to support an expanded view of innovation, both within the SA CM policy system and within the SA STEPE system. Attention to innovation at the micro-level of both these systems is particularly important.

## 7.11 Re-orientating SA CM policy research and data management

The unknowability principle of complexity emphasises the partiality of all knowledge. A complexity approach to knowledge for policymaking aims to accrete knowledge rather than 'truth', enhancing understanding of complex social systems and the various perspectives active within them. This is done acknowledging that the world can never be fully known, and too that the knowledges we bring to a complex situation themselves are perspectives which can acquire agency and power within a complex system. Knowledge on its own however is unlikely to be sufficient to drive change.

Shine (2015) elaborates on the role of knowledge in complex policymaking through the distinction she makes between traditional evidence-*based* policymaking – relying on information which provides a snapshot at a point in time focusing on 'what was' and 'what is', an approach strongly supported by the current SA CM CoP approach (RSA, 2011) - and an evidence-*informed* policymaking, which asks questions such as 'what might be' and 'what should not be'. An appropriate research goal from a complexity perspective would be to 'identify possible policy interventions and reason forward to how the problem and interventions might unfold over time' (Levin et al., 2012, p. 130). This is a forward-looking policy analysis, which is interested in the role of current actions in making possible futures come about (Patomaki 2006).

[54] See for example www.flowafrica.org and www.goodanthropocenes.net

[55] A stakeholder process was conducted over a number of months under the auspices of the National Planning Commission (NPC), including workshops, research and forums for discussion which gathered perspectives from across the SA STEPE system resulting in the co-creation of the set of SA CM policymaking principles contained in chapter five of the NDP.

Three further aspects of knowledge and data for a complex SA CM policymaking are elaborated in the sub-sections below: the organisation of knowledge according to a complex system view, a complexity approach to data analysis and communication, and finally the role of data in enhancing the SA STEPE system's self organisation.

### 7.11.1 Knowledge organised by the concept of a complex system

The type of knowledge prioritised for SA CM complex policymaking is that which assists in understanding the properties and patterns of the SA CM policymaking and SA STEPE systems (Geyer & Cairney, 2015a). Most of these have been discussed in Chapters Six and Seven to date and include: path dependencies, structures, institutions, rules, interconnections and interdependences (Peter and Swilling, 2014), stabilities and instabilities, sub-systems, phases in an adaptive cycle (Walker et al., 20014), temporal rhythms, multiple causalities and potential points of influence (Emison, 1996; MacMaster, 2016; Shine, 2015), systemic memory and history, thresholds and tipping points (Wells, 2013), and values (Stirling, 2014).

In complex policymaking, the conceptualisation of the policy situation is always systemic rather than marginal or reductionist. As such, complex policymaking involves an appreciation of all systemic agents (in the case of SA CM policy this includes physical, spatial, environmental, cultural, relational, political, technological and economic) and their potential contributions towards emergent patterning (Emison, 1996). The SA CM policy system has accumulated valuable GHG emissions data and quantitative information on technical opportunities for reducing these emissions in relation to the constraint. Situated within a complexity view, this knowledge should be networked throughout the system: Horizontally by identifying the connections with social and economic databases (such as the links between jobs and low / high emissions activities or structural economic re-organisation) and vertically by enhancing site-specific understandings of the GHG constraint across the SA STEPE system. Because complex systems are dynamic, knowledge for complex policymaking is dynamic, implying ongoing observation of the relevant systems, and specifically their emergent patterning (Shine, 2015). Real-time data becomes important to support responsive policymaking.

### 7.11.2 A complexity approach to data analysis and communication

The objective of research within a complexity paradigm has been described as describing and understanding complexity (Peter & Swilling, 2014; Richardson & Cilliers, 2001; Wells, 2013). The complexity principles of unknowability and ubiquitous uncertainty - the partiality and limitation of knowledge – require that the implications of uncertainty for the use of data and analytical tools are constantly acknowledged and made transparent (Geyer & Cairney, 2015b), including that there are limits to fine-tuning deterministic models. Jasanoff (2007) calls for the development of 'technologies of humility' as 'disciplined methods' in response to unknowability and certain uncertainty.

Complexity thinking also advocates reflection on the 'sources of ambiguity, indeterminacy and complexity' as being productive (Stirling, 2010), avoiding the constant temptation to break the problem down into manageable parts (Geyer & Cairney, 2015b). Astil and Cairney (2015) write of curiosity and discovery, and of pattern-based and puzzle-solving methods of inquiry being appropriate for exploring complex situations: playing with models to see what happens when a rule is changed, or an agent introduced, which may provide insight into causality and emergent patterns. There is a particular role for complexity research to critique and problematise (Wells, 2013), particularly as a way of excavating perspectives (Richardson et al., 2001). Clearly the extent of relevant data in complexity is infinite: Lichtenstein (2016), suggests an 80/20 heuristic as providing for a practical way forward for appreciating and approaching complex causality, and towards a similar end Mitleton-Kelly (2015) suggests identifying 'critical co-evolving clusters of issues' within multiple dimensions. For the SA CM policy system this criticality should be assessed against the objective of shifting to a low carbon high development attractor.

From a generalised complexity view, researching complexity demands a transdisciplinary, pluralistic approach to tools and methods (Wells, 2013). Augmenting SA CM policy research teams with philosophers, artists, psychologists, sociologists, political scientists and public policy academics and both expert and non-expert social stakeholders will expand the perspectives the SA policy system can access, particularly around the SA STEPE system's social dimensions. The existing SA CM policy tools (of quantitative modelling, cost benefit analyses, technology studies, economic analysis and scenario planning) can be augmented both with those of other disciplines and with emerging tools designed specifically with complexity in mind. (There is an emerging literature and methodology attending to the challenges of transdisciplinary research generally which then becomes applicable (Lawrence, 2015)).

Different methods provide different perspectives of the SA STEPE and policy systems. For example, time series data such as that extracted from the South African GHG Inventory illustrate the GHG emissions of the SA STEPE system over time (DEA, 2016a), useful for understanding historical patterns. Meadows (2008) makes an important point in this though, cautioning that what she terms flow data (that which the system produces at a particular time, such as GDP) is less relevant to anticipating future emergent patterns than is gaining an understanding of the system's structure and interconnections. Quantitative modelling is useful for experimenting with the dynamic quality of a system, exploring sensitivities, investigating multiple causality and exploring how, why and what type of patterns emerge through simulation, networks, taxonomy and structuring (Astill & Cairney, 2015). Deterministic quantitative models are particularly useful for gaining detailed insights into functionally complex sub-systems within the SA STEPE system. Qualitative methods such as social network analyses, agent-based simulations and comparative case studies provide rich reflections of complexity (Morcol, 2015), revealing how and why a system produces what it does. Narrative approaches and interviews assist in understanding systemic rules and norms.

Different types of research tools can support each other. For example Allen cited in Wells (2013) finds that models improve the quality of qualitative narratives by providing structure, quantified precision, constraint and boundary conditions. Qualitative methods can be used to both assist in designing quantitative models and in adjusting them. Models can then challenge the narratives on which they are based, and vice versa. Morcol (2015) suggests that within complexity research quantitative methods are more appropriately used generatively, not deductively, to suggest questions and areas of further exploration rather than to offer 'solutions'.

As important as using different methods to reveal different aspects of complex systems is, so too is how their findings are interpreted. When using any model the complexity researcher should ask what the simplified model reveals about the complex reality, paying attention to what has been simplified, and how the outputs can be situated back in the complex context. Boulton (2010) cautions that normative assumptions about morals and values are inseparable from (economic) models, requiring practitioners to make explicit what moral and ethical principles are being utilised in any modelling, or description of a system. Mertens (2014) particularly finds that researchers interested in the intersection of economic development, environmental justice and human rights need to select methods that identify the different constituencies, their social and cultural positions, and ways to counteract negative or distrustful relationships. The assumptions upon which models are based therefore become of equal importance to the model outputs (Geyer & Cairney, 2015b). Multidisciplinary and multi-stakeholder perspectives assist in identifying incorrect assumptions and implausible research and modelling results, and Cairney (2013) suggests putting competing interpretations or empirical narratives within a particular research project to achieve this.

Contextualisation and communication of results cannot be underplayed in policy-oriented analysis, for example Rommetveit et al. (2010) highlight that scientific analysis is less able to communicate the extent of ignorance around a policy question, potentially leading to poor decisions. Awareness of context will show when it may even be beneficial not to 'run the numbers' if this were to provoke an undesirable political response, a lock-in or push back. 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. Visualisation of data is useful, and all data and analysis must be contextualised. Simplicity in policy advice is still something to aim for (Geyer & Cairney, 2015b).

### 7.11.3 Knowledge and data to enhance self-organisation

The final aspect of data and knowledge in complex policymaking considered here is that of supporting the system's ability to self-organise (Lichtenstein, 2000; Meadows, 2008). Meadows refers to the importance of making data available throughout the system, not only at the macro level. Increased availability of timely information will enhance the self-organising ability of the SA STEPE system, enabling the system itself to adapt and respond to the GHG emissions constraint. This was emphasised in the Cities Conversation (19 September, 2014), where a development practitioner observed how practitioner access

to the data was far more powerful than the results of any data manipulation technique. Conversely, the lack of access to reliable data constrains effective self-organisation around a system constraint. In March 2017, coal delivery truck drivers carried placards in central Pretoria comparing the cost of REIPPPP (high) versus coal (low) generated electricity[56]. They were protesting that their jobs were under threat from the 'expensive' REIPPPP. However the figures on their placards were not accurate, the inverse being true (Walwyn & Brent, 2015). Whilst the cause of their protest was multi-dimensional and politically driven, availability of accurate information may have assisted in containing what had the potential to become a potent reinforcing feedback loop, undesirable from the perspective of the SA CM policy objectives.

Shine (2015) emphasises the importance of co-creation and co-ownership of data for supporting diverse, open knowledges. Accessibility supports the availability of data throughout the system, whilst co-production of knowledge empowers agents within a system to act upon that information. Co-creation and co-ownership pose both a process and data challenge: to develop ways of enabling SA CM policy system and societal system agents to contribute to knowledge generation, and ensuring that that information is widely accessible.

## 7.12 Summarising opportunities for the SA CM policy system going forward

In this Chapter I have used complexity thinking to open up spaces for the SA CM policy system that are unavailable or under-prioritised in the current dominant approach. Throughout the Chapter's analysis I have suggested how these complexity insights could be taken up by the SA CM policy system. I summarise these here, not as a whole 'plan-of-action' (this is an important issue to which I return in Chapter Eight), but rather to highlight them individually, especially because there was a degree of overlap as they emerged from the thematic structure of the Chapter. They are intended as discrete initiatives which the SA CM policy system could take up and integrate in a piecemeal manner. It is noteworthy that many of these are process interventions.

1) Create a permanent, diverse, independent, independently facilitated and adequately resourced **SA CM policymaking stakeholder platform** (possibly a re-work of the existing NCCC) that is representative of the many dimensions of the SA STEPE system. The platform's activities would include: visioning desired futures, sharing perspectives, exploring contestation, co-evolving policy, finding out about emergent implementation experiences, sharing experiences of engaging with the GHG constraint, and complexifying 'development'.
2) Establish a **SA CM policy foresight network** to flag new or as yet unconnected aspects across the STEPE dimensions relevant to the SA CM objectives, particularly emergent path dependencies,

[56] Photo posted by Twitter account @Naewizzle on https://www.news24.com/SouthAfrica/News/live-tshwane-traffic-chaos-20170301. Retrieved December 13, 2017.

lock-ins, instabilities and tipping points. Attend specifically to how the knowledge generated by this network is integrated across the SA CM policy system.

3) Establish a **strategic SA CM policymaking function** within government. Activities would include: undertaking an assessment of existing SA STEPE system structures across all STEPE dimensions from the perspective of a low carbon high development attractor to assess which are likely to be maintained / dismantled / built, maintaining a watching brief of power patterning across the SA STEPE and policy systems, and assessing for lock-ins, instabilities and tipping points.
4) Re-consider **how SA CM policymaking is organised within government**, where responsibility for SA CM policymaking is most appropriately situated, and how government's SA CM policy efforts could be organised along collaborative lines. Establish dedicated capacity within the policy-owner responsible for political management of SA CM policy, network the SA CM policymaking stakeholder platform, the foresight network and the strategic policymaking function appropriately into the SA CM policy system.
5) **Complexify the SA MC policy research efforts** and align these with the priorities revealed from a complexity view. This includes building on existing initiatives (for example the online emissions database) to push data down through the system, identifying and understanding SA STEPE system patterning and properties, diversifying research teams to include the social sciences, humanities, systems thinkers and transdisciplinary expertise, and expanding existing methodologies and policy analytical toolsets.
6) **Complexify the SA CM policy system design** to utilise the complexity insights around: building resilient social constituencies, utilising path dependencies, engaging values, anticipating learning, enabling responsiveness, supporting collaboration and operationalizing strategic insights.
7) Establish a dedicated policy capacity **to support innovation**: internally in policymaking processes and instruments (including acceptance of policy experimentation and failure), and also externally in the SA STEPE system, particularly at the micro-level.
8) Cultivate **a reflexive policymaking culture** in the SA CM policy system going forward through, inter alia: establishing regular reflexive conversations and discourses around values and ethics and requiring disclosure of perspectives in policy research and discussions.

There are clearly substantial barriers to taking up many of the suggestions above, not least their departure from current SA CM policy content and processes. These issues are engaged in the following Chapter, where I consider the usefulness of my inquiry to the SA CM CoP.

# 8

# Reflections on the usefulness of the inquiry to the SA CM CoP

> *Complex systems cannot 'solve' wicked problems in the conventional deterministic sense. But complex systems can help redefine wicked problems, and unravel them while retaining their diversity, interdependence and 'messiness'*

– Zellner and Campbell, Planning for deep-rooted problems: What can we learn from aligning complex systems and wicked problems? (2015, p. 464)

Having considered approaching SA CM policy from a complexity view in the previous two Chapters, I am now in a position to fully address the final part of the research question: 'w*hat is the usefulness of this inquiry to the SA CM CoP?*'

The inquiry has essentially explored the concept of 'approach' to SA CM policy, using a complex transdisciplinary research methodology. The inquiry's focus has therefore been on the conceptual level, and as such its usefulness to the SA CM CoP arises from its contribution to the realm of knowledge. I will discuss this usefulness under two main headings in this Chapter. First, how the inquiry calls attention to 'approach' for advancing the SA CM policy objectives, and second, how complexity thinking can be useful for approaching SA CM policy.

In Chapter Two I quoted Bergman et al., who reflect that the outcome of a transdisciplinary research process should be the 'production of new scientific insights and practical strategies for formulating relevant solutions and implementing these' (2012, p42). Therefore, in elaborating my assertions of usefulness throughout this Chapter, I move between academic and practitioner perspectives. The discussion in the Chapter draws on literature and the sixth category of my empirical data, where I

returned to various representatives of the SA CM CoP throughout the second half of my research journey to share my work and gauge how it was being received[57].

## 8.1 Calling attention to 'approach' for advancing the SA CM policy objectives

The inquiry has revealed that the SA CM CoP's approach – or metacognition – impacts our work. This is not something that we typically consider, and calling attention to 'approach' is useful to the SA CM CoP because it invites reflection. By identifying our implicit approach and bringing it into policy research and discussions, we will be able to disarm it of some of its power. We will also be able to think more clearly about what our existing and alternative approaches are revealing and obscuring, and whether they are serving us in our ultimate objectives of low carbon, high development transformation. For researchers, the inquiry opens up a research agenda considering approach to SA CM policy, and CM policy in developing and developed contexts alike.

'Approach' is particularly powerful because of its framing, curating, or orientating function. Apart from highlighting the constraining power of the current implicit SA CM CoP approach, the inquiry has also explored the potential enabling power of exploring explicit alternatives. This echoes the desire expressed from collective practice (the DevMit Forum), for a 'new conversation' around mitigation in a development context (MAPS Programme, 2014). Similarly, I encountered a perspective from academia that noted the CM policy field as an emerging and applied area of study that lacked an explicit approach, or epistemological (and ontological) positioning, suggesting that such a thing may be useful. From the outset of this thesis, therefore, I have been hinting at the value of a whole, explicit, coherent, containing, orientating and enabling scientifically valid approach to SA CM policymaking. However, the issue of wholes in the context of approach has also been one of my longest-running struggles within my research journey.

I described in Chapter Two how the research has required me to traverse worldviews, and this has included from a worldview where wholes, 'comprehensiveness', closure and certainty are possible and often considered a mark of successful research or practice, to a place of partiality, openness, and uncertainty. Initially therefore I was looking to find and develop a well-bounded scientific framework to serve as a more adequate approach to SA CM policy. As I journeyed on, this seductive and simple vision slipped further and further from my grasp. In section 5.7. I provided a response to this issue in the context of complexity. Nevertheless Chapters Six and Seven evidence ongoing instances of my struggle as I apply complexity concepts and principles with a practical contribution in mind.

[57] As discussed in Chapter Two, this data category includes seminars and presentations I gave, as well as a series of interviews conducted in Bogota with the Latin American members of the MAPS Programme.

Therefore in attempting a contribution to approach as an explicit site for progressing mitigation action, I am necessarily working with the tension of retaining what is valuable of the whole - a coherent way of organising thinking around (SA) CM policy (an 'approach') - yet not wanting to support the illusion of 'approach' as being complete, closed, bounded, or unchanging. On a conceptual / terminological level I have moved away from my initial concept of a 'framework'. In the course of the research I experimented with a number of terms including 'organising principles', 'toolboxes', and 'underpinnings', and vacillated between using the singular 'approach', and the plural 'approaches', and a number of these remain in the text as markers of the journey. Towards its end however, I find 'underpinning' a most appropriate term with respect to an explicit SA CM policymaking approach for both research and practice, as it suggests a rigor, coherence and containment but is simultaneously not prescriptive, and is supportive of evolution. It is with this discussion in mind that I turn to the usefulness of complexity thinking to the SA CM CoP.

## 8.2 Complexity thinking for approaching SA CM policy

In the light of the description of the SA CM policy issue of Chapter Four, my exploration of complexity thinking to SA CM policy in Chapters Six and Seven demonstrated how complexity thinking open up spaces of the possible for SA CM policy. This exploration is useful to the SA CM CoP on two levels. First, it generated a set of discrete practical initiatives which the SA CM CoP can consider (section 7.12). Second, it presents an argument for complexity thinking to underpin an approach to SA CM policymaking which may be useful to the SA CM CoP, particularly as mitigation implementation becomes an ever-increasing imperative. This section considers first the strengths of complexity as a SA CM policy underpinning, then challenges to it, and finally engages with the issue of how a transition towards a complexity underpinning for SA CM policy might occur.

### 8.2.1 The strengths of complexity thinking for underpinning SA CM policy

Chapter Four argued that any adequate approach to SA CM policy must be positioned **outside of the hegemonic worldview**. Complexity thinking for SA CM policy is situated within an emerging complexity paradigm, one which is based upon a rejection of the fundamental principles of the current hegemonic worldview, automatically complying with this requirement.

Complexity has the potential to retain that which is illuminated and to illuminate that which is obscured by the current dominant approach. The **systemic** nature of the CM policy situation is foregrounded (Bogota Interviewee, 2015), with all SA CM policy knowledge-making and practice situated within a systems perspective. The properties of a complex system illuminate aspects such as the dynamism of both the SA STEPE and policy systems, their multiple dimensions, interconnections, relationships and networks and the importance of context specificity. (A Bogota Interviewee (2015) responded positively to how complexity thinking enabled her to consider mitigation policy thinking at different scales, which the sectoral lens of the current dominant approach prevents; another agreed that interactions between

sectors are key and emphasised by complexity thinking.) A systemic conceptualisation further illuminates the entanglement of the mitigation-development complex, allowing for a consideration of a mitigation-development transformation of the SA STEPE system as the SA CM policy objective.

The **complexity** of the SA CM policy situation is normalised, casting the SA CM policy and SA STEPE systems as complex, interconnected and unpredictable. Complexity thinking offers a complex policymaking aligned with this complexity; one of custodianship of the policy objectives, working collaboratively, responsively and with complex systemic properties. A SA CM CoP member noted that 'the language of complexity extends us' (ERC complex policy seminar, July 2016).

Complexity thinking provides insights into the **temporal** dimension of the GHG emissions constraint, focusing on the impact of the constraint across sub-systems which evolve according to different rhythms. Leveraging non-linearity, areas of instability and path dependency offer ways of working to support urgent change.

A complexity view provides an equal weight to **policy process** as to content. A Bogota interviewee (2015) thought that complexity thinking was particularly relevant and helpful for mitigation policy implementation, as the process moved towards action. The complexity thinking emphasis on **innovation and responsiveness** directly responds to the view from practice offered by a member of the MAPS Programme at an internal workshop in response to my presentation on findings from the Conversations: 'We must start with interventions – poke the tiger – see what works, what leads to success and then replicate and scale this. There must not be a plan!' (MAPS Programme, 9 February, 2015).

From generalised and critical complexity views comes an **open, critical and integrative approach to all knowledges**, and as such complexity can engage with the knowledges of the current dominant approach and alternative knowledges (academic and societal). Complexity can therefore retain and deepen current SA CM policy insights into the GHG emissions of the constraint, its macro and sectoral scale and temporal implications; technology options; how various policy instruments work; and a focus on generation of data, with an emphasis on improving accessibility across the system. Particularly for a policy issue involving natural and engineered systems the tools, methods and foci of the classical science view are critical.

Through engaging the **social sciences, societal knowledges and humanities** (particularly philosophy), a complexity approach can also illuminate what cannot be seen by the current dominant approach: how policy implementation happens; the roles of power, values, culture and behaviour in (long-term) transformative change; and how to engage perspectives and contestation. A respondent highlighted the potential contribution of recent insights from sociology regarding power to SA CM policy (ERC, July 2016).

A **wariness of simplification** enables high-level concepts of development, transformation, and mitigation-development bridging terms to be interrogated for the work they do and the contestation they mask. From here, a complexity approach accesses a mitigation-development complex outside of the hegemonic development narrative, which in turn opens up the mitigation-development spaces of possibility.

Complexity is **sensitive to context**: Viewing the SA CM policy and STEPE systems from a complexity approach implies an inherent 'nationally-appropriate' approach, the systems of interest are local, with global systems, particularly the international CM policy system, at the periphery of the analysis. Complexity thinking also appears to be particularly appropriate for and aligned to the characteristics of a development context (Geyer & Cairney, 2015b). A Bogota Interview noted that 'Colombians don't yet do long-term planning, we are still trying to understand linearity', suggesting a nimbleness in responding to complexity's non-linearities.

Complexity thinking has been argued as having **increasing relevance** in a century easily described as one where the rate of complexification of society and its problems has accelerated (Fankhauser & Stern, 2016; King, 2015; Wells, 2013). The twenty-first is a century which Stephen Hawking, cited by Wells, predicts will be the 'century of complexity' (2013, p. 1). Change is more rapid, less predictable and more far-reaching than ever before, particularly given advancing globalisation and the expansion of information technology (Leach et al., 2007; Pueyo, 2014; Wells, 2013). Climate mitigation is a problem of the present and the future. It requires attention from a view that is adequate and appropriate to a future-orientated science and culture, even if such an approach is as of yet only partial and experimental.

For those speaking from inside a complexity-type paradigm, support for complexity thinking is emphatic: Shine (2015) argues that complex thinking has the potential to produce practical, workable approaches to persistent complex problems, particularly in areas such as public policy. Ison writes that for climate change 're-engaging with and revitalising systems thinking and practice is one of the most significant opportunities we have [for new praxis]' (2010, p. 4); Swilling and Annecke (2012) reflect on complexity as offering a hopeful way forward, without returning to the certainty of reductionism, and King argues that 'the emerging complexity paradigm holds revolutionary potential of unprecedented breadth' (2015, para.1).

### 8.2.2 Challenges to complexity thinking for underpinning SA CM policy

The challenges to complexity thinking arise both in the academic and societal realms. In the world of academia, complexity is an **emergent and immature field** within an emergent worldview. Its lack of coherence, its contradictions and confusion make it particularly difficult to access. The distinction between a colloquial use of the term 'complexity' and its more technical use is sometimes difficult to ascertain. The immaturity of complexity is especially apparent in the social sciences which are central to the SA CM policy issue. Both because of complexity's origins in the natural sciences, and because the social sciences engaged at length in the latter half of the twentieth century with a view of systems that remained within the hegemonic worldview (Walby, 2007), the **social sciences were slow to engage with complexity thinking**. Further, the **dominance of disciplinary thinking** in the academy works against both transdisciplinary and systemic approaches (Cornell et al., 2013), such as complexity thinking. That a theoretical field is immature may weaken, but does not negate, its potential to contribute to knowledge.

Complexity principles and concepts could theoretically underpin a more enabling approach to SA CM policy. It is in the area of policy practice that its challenges are perhaps more formidable.

What is primarily at issue is the **chasm between the hegemonic and complexity worldviews**, evident in mind-sets and institutions (Cairney & Geyer, 2014b), and embodied in the physicality of the SA CM policy and STEPE systems. The mismatch is obvious when considering the bureaucracy within which SA CM policymaking operates: it is centralised, top-down, focused on cause-and-effect, and target driven. A Bogata Interviewee (2015) reflected that the existing institutional structure itself operated as a constraint on the system. Ministers and civil servants are evaluated against specific performance indicators, regardless of their ability to influence these. Departments focused on particular content areas, situated in separate buildings with separate administrative and communications systems, encourage a focus on components rather than connections in policymaking.

There is no obvious opening for re-considering the 'problem presentation' (Farley et al., 2007) of the SA CM policy issue at a political or operational policy level. Resource constraints undermine intentions of iterative, participative policymaking (Giordano et al., 2011), particularly with the SA CM policy system having little experience in these approaches, and their being intrinsically difficult. The monopolistic nature of the energy system undermines data transparency (Trollip & Tyler, 2011). SA CM policy funders appear to be increasingly operating from a reductive and controlling approach, closing down options for practitioners to innovate and respond to the context (SEA complexity seminar, 18 September, 2017), with true co-creation and co-ownership of data and policy options being more difficult to support. Finally, those to whom the current dominant SA CoP approach affords power (in the SA CM policymaking and SA STEPE systems) will actively resist any change in approach. 'The CM CoP itself has a lot vested in their way of doing things' (Bogota Interviewee, 2015).

From the hegemonic worldview, **complex action is often interpreted as weak and insufficient**, characterised as it is by responsiveness, emergence and uncertainty (Emison, 1996), and tends to come across as 'wishy-washy' (Geyer & Cairney, 2015b). A Bogota Interviewee (2015) said that 'complexity helps us to identify issues, but it doesn't help us to change our inability to act'. Cilliers (1998) reflects on the western dream of a 'unifying metanarrative', and how difficult it is to accept an approach that rejects this as impossible. Individual responses to the question of what to do and how, and indeed to the complexity paradigm itself, are argued by Cilliers to be determined both by psychology and theory. Participant observations at the Sustainable Energy Africa seminar (18 September, 2017) bore this out, with one commenting that a complexity approach is 'depressing', and another that it is 'exciting'.

The issue of how to act from a complexity approach dominated responses whenever I conveyed my research back into the practitioner realm (SEA complexity seminar, 2017; ERC policy seminar, July 2016; WWF complex transitions seminar, 20 September, 2016). For most of us, the complexity view of what to do and how to do it is neither an accessible nor comfortable one (Sustainable Energy Africa complexity seminar, 18 September, 2017). There are also and financial technical ones. A SA CM CoP member asked:

'how do we act with an assumption of disequilibrium?' (ERC complex policy seminar, July 2016); a Bogota Interviewee (2015) noted how difficult it would be to assess the lock-in implications of individual projects. The up-front time and resource costs of many complexity-aligned interventions are typically much higher than continuing with the current approach. As Cairney and Geyer (2015b) note, the complexity view is a difficult position to argue in a world which values impact and identifying cause and effect. 'Getting people to agree that policy systems are complex is easy. Working with them to produce pragmatic strategies, to adapt to complexity, is hard. Getting them to prioritise these strategies, in the face of media, public and parliamentary pressures to hold them to account for their decisions, may often seem impossible' (Geyer & Cairney, 2015a, p. 464). As a Bogota Interviewee reflected: 'People ask for complexity but they don't really want it' (2015).

In addition to being uncomfortable and elusive from the current hegemonic worldview, **complexity practice and action is also not easy**. Richardson et al. (2001) write that whilst complexity thinking brings to the fore aspects of 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. A new report with clear quantitative findings underpinned by complicated expert modelling, or a definitive policy instrument whose provenance can be traced to an eminent orthodox economics text are far more easily recognised as contributing to progress in SA CM policy than slow-moving stakeholder engagements, or the almost invisible tweaking of regulatory calibrations in a seemingly unrelated policy area, or the decision not to regulate and to 'wait and see'. This might be due to an inherent reluctance in humans to accept responsibility for our role in the complex systems of which we are a part, rather than wishing this away and onto some remote, top-down expert authority.

The **urgency of the SA CM policy issue exacerbates many of these challenges** to complexity views – and increases the attractiveness of strengthening the attempts to control, top-down. A Bogota Interviewee (2015) responded that there is no time for bottom-up efforts, leaving only top-down. Another reflected that 'the ticking clock means that people are increasingly uninspired to innovate'.

In presenting my complexity thinking explorations back to the CM CoP, I was excruciatingly aware of how poorly I felt I was communicating what I was learning. On reflection, I suspect this is largely part and parcel of the territory. **Complexity thinking is confusing, contradictory and directly at odds with many aspects of the hegemonic worldview**. I often felt very alone, with little institutional or collegial support as I journeyed far from my starting point to an isolated view at the interface of climate mitigation and complexity for policy research and practice in South Africa. I was keenly aware of my need to provide scientifically rigorous justification of what I was arguing – keeping myself from slipping into the 'easier' realm of intuition and emotive calls for complexity thinking as being more aligned with reality. Yet complexity thinking actively resists any linear or once-off 'communication'. As a result I encountered quite a bit of what I perceived to be frustration on the part of the SA CM CoP members I engaged with: Could I not be more clear? More conclusive? More definitive? I realised that this frustration also stems

from their full appreciation of the complexity of the SA CM policy issue itself, and that many of the challenges to a complexity practice were aspects they had already identified as constraining their work.

Whilst all the challenges to complexity for an SA CM policy approach discussed above are very real, this does not justify a priori abandoning what complexity thinking has to offer, particularly given its theoretical potential and progressiveness. An approach underpinned by a worldview better aligned with our experience of the policy issue may eventually be more effective than staying within what we know. Throughout my research journey I have often been reminded of the anecdote of a man looking for a coin under a streetlight in a parking lot at night. When asked where he lost it, he points to a spot a few metres off. 'But why are you looking here then?' the observer queries. He replies, 'because the light is here'.

For me, as for many, the trappings of the hegemonic worldview dominating my upbringing and education are heavily engrained. And yet I am strongly attracted to what a complexity paradigm offers, reflecting the human tension described in Chapter Seven on which a complexity practice turns. As a Sustainable Energy Africa seminar participant reflected, a complexity approach 'seems to fit with life so much better!' (SEA complexity seminar, 18 September, 2017). The journey that this PhD has afforded me, our rapidly evolving world, and an existential need to counter the overwhelm that insight into the climate situation threatens are three of the most easily identified sources of this attraction. Another is intellectual; the analytical rigor of complexity thinking is to my understanding sound, if unorthodox. From a complex view the illusion of control is faced head on, and however challenging the alternatives there are at least some on offer. There also remains the promise that these alternatives might be more deeply satisfying, ultimately.

### 8.2.3 Transitioning to a SA CM policy approach underpinned by complexity thinking

If the practical barriers to a SA CM policy approach underpinned by complexity principles and concepts are largely due to the chasm between worldviews and their physical and social manifestations, the issue of transition (of approach) becomes relevant. Therefore to assess the usefulness to the SA CM CoP of motivating for complexity thinking, I need to engage with this: how the current SA CM CoP 'approach' could transition to one underpinned by complexity thinking.

Similarly to my journeying to - and promoting - a partial view of 'approach' in 8.1., at this point in the thesis I find it appropriate to respond to the question of how the SA CM CoP could transition to a different approach from the worldview of complexity. As such, I view a transition of approach as involving the transformation of a complex system; the 'metacognition' of the SA policy system itself. Such a transformation is characterised (from sections 5.5. and 6.3.) as being non-linear, episodic, involving both the creation and destruction of structure, exploitative of areas of systemic instability, and with systemic agents mindful of not driving the system to collapse. Finally and probably of greatest relevance here is the complex systemic property of many small changes across a system resulting in the entire system tipping into a new attractor. This suggests that it need not take many SA CM policy practitioners to start experimenting with a complexity lens to disrupt the current dominant approach. The inherent criticality of

complexity thinking suggests less effort is required than that needed to build and defend an alternative position.

Because the transition under discussion is towards an explicit approach (following the discussion in 8.1.), it would need to be driven by the human agents in the SA CM policy system desirous of such a change. This task of supporting a change in metacognition can, similarly to that of policymaking itself, be conceptualised as a journey, experimental and responsive. Whilst the complexity inspired initiatives of 7.12. were offered individually, to be taken up in a piecemeal way, I refer to them again extensively in this section because they were identified as the priorities revealed by complexity thinking, and in order to ground the present discussion in practice.

Because the systemic change desired is on the level of metacognition, reflexivity would appear to be a critical part of the purposeful adoption of aspects of a different approach. This is reflected in initiative 8 of 7.12. (*cultivate a reflexive policymaking culture)*. A small number of individuals, institutions and funders could start to develop reflexivity within the SA CM CoP. As individuals and groups we can bring reflexivity explicitly into our own verbal and written practice, acknowledging the values and assumptions upon which policy initiatives are based, and even by specifically hosting conversations within the SA CM CoP around approach. This is undoubtedly difficult and risky work; the current dominant SA CM CoP approach does not value reflexivity, and the link between reflexivity and action is not immediately apparent. Nevertheless, even a few instances of reflexive practice make an impression. I take encouragement from responses from within the SA CM CoP to this aspect of my research. The Conversation Series, which could be argued as itself an exercise in reflexivity, was well received by the majority of participants, some of whom remarked how rare and valuable such spaces were in the course of their daily work lives (Cities Conversation, 19 September 2014; Poverty Conversation, 6 November 2014). Similarly, SA CM CoP members attending seminars or lectures where I presented on the SA CM CoP approach remarked on how interesting and fresh the content was (SEA seminar, 18 September, 2017; ERC masters course, October 2016; ACDI students conference, March 2016). In the domain of research, writing, discussing and critiquing aspects of approach can similarly contribute towards the creation of a reflexive body of literature.

Whilst the remaining initiatives in 7.12. are perhaps more the components of a different approach than aimed at transitioning of approach directly, doing more of these may in themselves expand the systemic spaces consistent with a new approach, thereby establishing positive path dependencies. Many of these appear currently to be in the remit of the government representatives in the SA CM CoP, including particularly initiatives 1 (the *stakeholder platform*), 3 (the *strategic policymaking function*), 4 (*a policymaking re-organisation*), 6 (*complexification of the policy suite design*) and 7 (capacity to *support innovation*). Whilst these are likely the most difficult transitions to make given the current structure of government more broadly, in line with complexity thinking on transitions, the progression of these initiatives can be influenced from anywhere within the SA CM policy or STEPE systems. In particular

though individual civil servants and Ministers can play a significant role. The LTMS is an example of how complex policymaking can gain traction when championed by far-sighted policymakers (Tyler & Torres Gunfaus, 2017). The SA CM CoP engaged in the NCCC can push to expand its constitution and remit to function along complexity principles. Academic and civil society institutions can establish the beginnings of a foresight network informally or formally. Similarly strategic considerations can be raised in the media and through informal policymaking networks. Independently funded analyses of the mitigation policy suite can enter the policy system. Innovation can be supported in various ways across the SA STEPE system. Initiative 5 (*complexify research efforts*) can be taken up by academia.

In all this, individuals and institutions championing change on the level of approach could utilise aspects of a complexity practice, including: responding to events, mindful of the system's structure and power patterning, utilising non-linearities, and paying attention to the values which orientate the system's self-organisation. Each of the 7.12. initiatives can be taken up experimentally, doing more of what works and less of what doesn't. Throughout our practice we can pay greater attention to how we prioritise and design policy research and initiatives, in strategic areas fostering the disruption and instability required for paradigmatic transformation.

A transition of approach is likely to be both episodic and differentiated across the SA CM policy system. SA CM CoP members considered at the ERC complex policy seminar whether we might not need different approaches for different contexts (July 2016), or taking that thought further, for different SA STEPE sub-systems. Responding to and linking with complexity aligned approaches in other policymaking areas may yield sub-systems underpinned by complexity principles.

Academia and research have a crucial role to play in a transition towards an explicit SA CM CoP approach underpinned by complexity thinking. Interpreting policymaking experiments in practice from the view of complexity theorising can assist both in situating these experiments from a complexity perspective and in refining and testing the complexity underpinning itself. SA CM policy is currently taught with no awareness of approach. Changing this and introducing complexity explicitly as an underpinning will orient incoming policymakers in a different direction.

A transition to a complexity underpinning to SA CM policy approach is likely to be supported by broader changes on the level of metacognition. Capra argues (along with others – notably Morin (2006), Bhaskar et al. (2010), Funtowicz and Ravetz (1993), Sheldrake (2012) and Jasanoff (2010) although these arguments all take different forms) that the current hegemonic worldview is on the decline, whilst a more complex, systems based and holistic paradigm is emerging. At some point in the future this complexity-type paradigm will predominate. Capra was writing in the 1970s suggesting that we are now closer to the point where a complexity paradigm gains ascendency. As the two paradigms reach the point of intersection, the institutions of the declining paradigm become increasingly rigid and fragmented, whilst those of the ascendant paradigm increase in cohesion, coherence and power. Authors writing on the evolution of paradigms acknowledge that two paradigms can and typically do co-exist, as paradigms take

time to emerge (Capra, 1974/1983; Kuhn, 1962/2012)[58]. Within SA CM policy's history, the LTMS stands out as having contained many aspects of complex policymaking, and this experience remains available to the SA CM policy system as a space of possibilities towards which the SA CM CoP can move. The broader transformation of the hegemonic worldview could support and accelerate a transformation of approach within SA CM policy.

Finally, that South Africa is a developing country, and as such it is less structured, less stable, less steeped in the hegemonic worldview and more fluid than its developed counterparts, could well make a transition of approach easier here.

[58] Complexity thinking is not the only field responding to the paradigmatic evolution Capra describes. Spurred on by the challenges of global environmental crises, significant work is being done under many headings to explore approaches which, to various degrees, locate themselves outside of the hegemonic worldview. These include southern theory (Connell, 2014), critical realism (Bhaskar, 2010; Isaksen, 2012), transdisciplinarity (Leavy, 2011; Nicolescu, 2014), non-orthodox economics (Constanza, Cleveland, & Perrings, 1997; Farley et al., 2007; Grubb et al., 2014), work in transformations (Geels et al., 2016; O Brien & Sygna, 2013), and science and technology studies (Jasanoff, 2010).

# 9 Conclusion

In this doctoral thesis I have used a complex transdisciplinary methodology to explore approaches to South African climate mitigation (SA CM) policy, with a four-part research question acting as the central attractor to this exploration:

5. *What is the current dominant approach to SA CM policy?*
6. *What does the dominant approach illuminate and what does it obscure about the policy issue?*
7. *How can a complexity approach contribute towards revealing SA CM policy more fully?*
8. *What is the usefulness of this inquiry to the SA CM Community of Practice (CoP)?*

The resulting journey has traversed the territories of practice and academia, the specifics of South Africa and the breadth of global environmental and societal change, disciplines, perspectives, paradigms and worldviews. Essentially, the journey - and thesis - comprise a heuristic move which calls attention to the relevance of policy approach in increasing the pace and depth of climate mitigation action in a development context. As such the research has been broad rather than deep, scoping rather than definitive, and questioning rather than concluding. As a transdisciplinary inquiry its academic labour is one of integration; across research and practice, development and climate mitigation, the hegemonic and alternative worldviews, with this integration encapsulated in a tentatively scoped complexity underpinning for SA CM policy.

The primary contribution of the thesis lies in this heuristic move, and as required by a transdisciplinary inquiry this contribution has both societal and academic relevance and expression, and is elaborated here by way of conclusion. Because I have grounded the research in the specifics of the SA CM policy case, the specifics of my contribution are for the SA CM CoP. However, I believe that insights from my research journey offer useful contributions to other related contexts, issues and fields.

With regards to 'approach', I have argued that the current dominant approach of the SA CM CoP both illuminates and obscures aspects of the SA CM policy issue, and that considering approach is therefore relevant to making progress towards its policy objectives. As such, the work invites the SA CM CoP – and by implication other CM CoPs into a reflexive practice, and offers some experimental methods (the Development Provocateurs and the Conversation Series) as examples of collective ways of doing this. In the academic realm, the focus on approach opens a new multi-disciplinary research agenda at the intersection of climate mitigation, energy, public policy, and development studies more generally, asking

questions not typically encountered in this space. My articulation and critique of the dominant approach of the SA CM CoP further contributes to the academic task of elaborating the field of CM policy more generally, in a way responding to the observations that the CM policy field lacks conceptual coherence or an organising frame.

The exploration of complexity thinking as an underpinning for SA CM policy in the latter half of the thesis contributes a set of practical initiatives which the SA CM CoP (and others) could take up, borne of a complexity view. The exploration also bolsters the argument for why approach is relevant, and again invites the SA CM CoP to reflect; here on the new policymaking spaces opened up by complexity thinking.

The complexity exploration contributes to the realm of academia on a number of levels. It scopes out a complexity interpretation of the mitigation policy issue in a development context, often alluded to but not yet systematically worked out – albeit tentatively, and at a high level. This also goes some way towards a response to the critique of the CM policy field as lacking an organising frame, offering complexity thinking as a contemporary and scientifically rigorous underpinning for CM policy. This interpretation would benefit from being engaged, critiqued and extended by further research. There are many relevant complexity literatures which this thesis did not manage to cover, or covered only very superficially, including planning, political economy, management, southern theory, social change theories, development, engineering, energy and evolutionary economics, and these require investigation as to what they might be able to contribute. Experimenting with a complex SA CM policymaking in practice is necessary to support any academic engagement with the complexity underpinning offered here. Further, future research could engage insights from the complexity field as they emerge, and indeed contribute to their emergence. It is an agenda which itself is situated within a complex global system of research and practice attending to issues of global environmental and social change, and as such can engage and influence work within this system, offering in particular a perspective from a development context.

Complexity literature argues that complexity thinking must progress primarily in the form of empirical applications and through engagement with different fields and disciplines. The complexity exploration of SA CM policy in this thesis is a contribution towards this progression of the complexity field. Given South Africa's development context, my contribution is also in an area that complexity authors suggest is particularly underexplored from a complexity perspective (Geyer & Cairney, 2015b).

The complexity exploration of SA CM policy also makes a contribution to the field of sustainable development. Whilst the relevance of complexity to issues of sustainable development has been identified (for example Swilling and Annecke (2012)), its use as an underpinning is not commonplace in either research or practice. The complexity thinking elaborated in this thesis can find useful societal and academic application in many instances where tensions between environmental sustainability and development issues are being grappled with (see for example, Tyler and Cohen (forthcoming)).

The thesis makes a final academic contribution to the emerging scientific approach of transdisciplinarity, providing a methodological example of transdisciplinary research in the climate mitigation field. This contribution includes the two experimental empirical methods which can be considered for inclusion in the growing complex transdisciplinary method toolset. In so doing, a toehold is achieved in the climate mitigation policy space for transdisciplinarity, which adds to that of reflexivity. It is my hope that both will prevail to become paths well trodden.

# 10

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# 11

# Appendix: Details of the empirical data

## A.1. The Development Provocateurs

Document A.1: Development Provocateur Terms of Reference

- *The Development Provocateur will attend the Forum for Development and Mitigation for the full two and a half days (27, 28 and the morning of the 29th January 2014).*
- *They will reflect on the discourse at the Forum from the perspective of their own area of (South African focused) expertise, and note:*
- *The priorities and discourse elements in their own areas of expertise*
- *What they see as the priorities and discourse elements in the climate mitigation field*
- *What is unclear or jargonised in the climate mitigation discourse*
- *Compare the climate mitigation discourse with that of their area of expertise, mapping overlaps, connects, disconnects and other points of contact*
- *Areas where further work at alignment between the two fields could be productive for one or both; how can each discourse enrich and influence the other*
- *Any observations which could be generalised to the international level*
- *Participate in specific Forum sessions related to the Development Provocateurs area of expertise if required (not more than one session per Development Provocateur)*
- *Participate in a panel of Development Provocateurs on the final day to present their reflections*
- *Write up their reflections in a briefing paper (approximately 4 pages) after the Forum, to be submitted by 24 February 2014 (MAPS Programme, 2013, p 1).*

## A.2. The Conversation Series

Table A.1. List of the Conversations and Participants

| Conversation | Participants |
|---|---|
| Cities Conversation:<br>19 September, 2014 | Susan Parnell: African Centre for Cities, UCT<br>Megan Euston-Brown: Sustainable Energy Africa<br>Marta Torres Gunfaus: MAPS Programme director, ERC<br>Louise Tait: ERC, researcher<br>*Emily Tyler: Participant observer: MAPS Programme and ERC*<br>*Lisa Kane: Facilitator, MAPS Programme* |
| Adaptation Conversation: 15 October, 2014 | Adrian Stone: MAPS Programme and ERC, modeller<br>Hilton Trollip: MAPS Programme and ERC, researcher<br>Dr Mandy Barnett: Director: Climate Change Adaptation; Director: National Implementing Entity, Adaptation Fund; South African National Biodiversity Institute (SANBI)<br>Dr Gina Ziervogel: Lecturer, Department of Environmental and Geographical Sciences, linked to the Climate Systems Analysis Group, UCT<br>*Emily Tyler: Participant observer: MAPS Programme and ERC*<br>*Lisa Kane: Facilitator, MAPS Programme* |
| Consumption Conversation: 16 October 2014 | Tara Caetano: MAPS Programme and ERC, modeller<br>Michelle du Toit: MAPS programme manager and SouthSouthNorth (SSN)<br>Ilana van Wyk: Humanities faculty, UCT<br>Myles: Public relations in advertising firm with a sustainability focus<br>*Emily Tyler: Participant observer: MAPS Programme and ERC*<br>*Lisa Kane: Facilitator, MAPS Programme* |
| Employment Conversation: 20 October 2014 | Tara Caetano: MAPS Programme, modeller<br>Bruno Merven: MAPS Programme, modeller<br>Alfred Moyo: MAPS Programme, economist<br>Murray Leibbrandt: Southern African Labour Development Research Unit (SALDRU) and Pro-vice Chancellor on poverty, UCT.<br>*Emily Tyler: Participant observer: MAPS Programme and ERC*<br>*Brett Cohen: Facilitator, MAPS Programme* |
| Finance Conversation:<br>21 October, 2014 | Blaise Dobson: MAPS Programme and SSN<br>Stef Raubenheimer: MAPS Director and SSN Director<br>Christina Golino: Independent, ex-Development Bank of Southern Africa<br>Roland Hunter: NT, City Support Unit<br>*Emily Tyler: Participant observer: MAPS Programme and ERC*<br>*Brett Cohen: Facilitator, MAPS Programme* |
| Poverty Conversation:<br>6 November, 2014 | Poovan Moodley: Oxfam, South Africa<br>Laura Poswell: SALDRU<br>Britta Rennkamp: MAPS Programme, ERC, researcher<br>*Emily Tyler: Participant observer: MAPS Programme and ERC*<br>*Brett Cohen: Facilitator, MAPS Programme* |
| Economic Growth: | Harald Winkler: ERC Director, MAPS Director |

| | |
|---|---|
| Conversation<br>20 November 2014 | Jim Petri: Economic Development, Provincial Government<br>Barry Standish: Stratecon consultancy, and Rotterdam University<br>*Emily Tyler: Participant observer: MAPS Programme and ERC*<br>*Lisa Kane: Facilitator, MAPS Programme* |
| Transport Conversation:<br>24 November, 2014 | Richard Gordge: Transport Futures consultancy, Cape Town<br>Gordon Laing: SEE Sustainability consultancy, Cape Town<br>Gerhard Hitge: Ex-head of transport and planning at CTCC<br>Tanya Visser: ERC modeller<br>Mamahloko Senatla: ERC modeller<br>*Emily Tyler: Participant observer: MAPS Programme and ERC*<br>*Lisa Kane: Facilitator, MAPS Programme* |
| SA CM CoP Reflective Conversation:<br>27 November, 2014 | MAPS Programme and ERC Conversation participants and interested individuals: Adrian Stone; Bruno Merven; Mamahloko Senatla; Louise Tait; Kim Coetzee; Michelle du Toit; Michael Boulle; Anya Boyd; Hilton Trollip; Brenda Martin; Tara Caetano; Emily Tyler; Lisa Kane. |

## Document A.2. Post DevMit Conversation Series: September – November 2014

Dear Colleague,

Thank you for agreeing to be part of the upcoming Conversation. This is a short note to give you some information about the Conversation, what to expect, and what is expected of you. It also serves as the 'informed consent' document for the purposes of ensuring an ethical approach to this research.

**Background**

From 27--29 January 2014, over one hundred professionals working mainly in the climate change mitigation field in the global south gathered at the Cape Town Waterfront for the Forum on Development and Mitigation, and event supported by the international Mitigation Action Plans and Scenarios Programme (MAPS). The DevMit Forum contained an experiment. It opened up a gathering of climate mitigation experts to the critique of their counterparts in other areas of development work (employment, transport, urban settlements, poverty, trade and industrial policy, land use, energy security, cities). Nine South African 'Development Provocateurs' participated in the Forum, and fed back both verbally through a panel session on the last day, and in written form through a series of retrospective briefing notes.

These perspectives suggest that continuing to understand how to work with a large range of communities of practise is valuable and productive, both for the climate mitigation community and hopefully for others working towards 'development' objectives. In the light of this, and as an experiment with aspects of the 'new approach' hinted at in the Forum (and see the DevMit Ideas Kit), MAPS is continuing the DevMit conversation, exploring what can emerge from inter-disciplinary interactions at different scales and across different ideological positions on what constitutes development.

This year, this is being done through a series of Conversations between MAPS International climate

mitigation experts who are working out of the Energy Research Centre at the University of Cape Town, and experts in other areas related to development. The themes of these Conversations have been derived from the areas that emerged from the Forum as being possibly productive ones to focus on, and have emerged from the perspective of a 'multiple-benefits future', not only one where emissions are appropriately constrained. They include: finance, economic growth, transport, consumption, employment, cities, climate change impacts, poverty, infrastructure and housing.

We have already discovered that the fit between typical climate mitigation research topics and these priorities is not a good one, which is interesting in itself!

Each Conversation is planned as a 1-2 hour small-group discussion. There will be approximately six participants in your Conversation: two MAPS International researchers working on climate mitigation issues in a developing country context, yourself and one other expert on the Conversation theme, a MAPS associate in a facilitation role, and myself for continuity across all Conversations. There may also be a MAPS communications staff member present to capture aspects of the conversation as MAPS material.

The format of the Conversation will be that of a semi-structured discussion. The facilitator and myself will guide and steer the conversation with some open questions, we may open with trying to draw a mind map of the topic, but where it goes is really up to the mix of participants and our collective appetite for learning.

**Objectives and Outcomes**

Objectives:

- *To expose both groups (climate mitigation and 'other development') to each other in a neutral setting.*
- *To scope out the space inbetween the two areas of expertise, and to allow for cross-pollination of ideas and understanding of each other's world*
- *Potentially to identify productive areas for further exploration in the (shared) objective of working towards a 'multiple benefits' future as suggested by the DevMit Ideas Kit.*

Outcomes: My hope is that all participants will gain in their understanding of a different field, that we may uncover unanticipated linkages and points of contact between our areas of work, and that the Conversation series might build bridges between communities working in relative isolation from each other.

**Preparation**

There is no need to prepare anything for the discussion. I have challenged the MAPS contingent to bring an open and inquisitive mind in way of preparation, and to push themselves to get out the mitigation box and to use the opportunity to ground their work in the reality and priorities of a development context. So

I hope that you will likewise use the opportunity to discover what climate mitigation researchers are working on, and why, and how. And enjoy brainstorming what links there may be between the two areas of work.

**Informed consent component**

Please be advised that participation in the Conversation is completely voluntary, and if you choose not to participate at any point there will be no negative consequences for yourself or your organisation. However, we are eager to hear expert perspectives from your field, and anticipate that we can all use the opportunity to learn and enhance what we do. There will be no formal record of the Conversation held in the public domain, however, the discussion will be recorded, and notes taken, which may help to inform my PhD project and future MAPS research.

You will be invited at both the start and end of the Conversation to indicate if there are any instances where you would prefer not to be attributed to any particular inputs you might have made, and this non-attribution will be respected in any papers written using the Conversations as basis. Please note that this non-attribution does depend on the entire Conversation participants respecting your wish, which is something outside the control of myself as researcher.

Finally, I might ask you to clarify some of your inputs via a follow up email afterwards, which you are free to respond to or not as time and enthusiasm permit.

Please direct any logistical questions you may have to Pieter Krog pieterkrog@gmail.com, and any other questions to me Emily@tyler.co.za (0722255619).

We look forward to an interesting discussion.

Best wishes,

Emily Tyler

MAPS Programme

## Document A.3. Post DevMit Conversations: Facilitator Notes 20 October 2014:

**PreAdmin**

- *Room set-up*
- *Whiteboard and pens*
- *Phone set up with charger*
- *Tea / coffee / waters / biscuits*

- *Documents table with DevMit Ideas and ProvNotes (Emily has these)*
- *Draw diagram on board*
- *Write up questions list on flipboard*

**Conversation areas to cover: (Lisa / Brett)**

Outcomes 1&2 below are equally important to me. We have to do the first properly in order to make the second meaningful.

I would like to come away with a high level understanding of the 'development' area of work (Outcome 1), the 'headline issues' which will form my frame of reference for that area when I do the reading later. This will be important for the other MAPS Participants too.

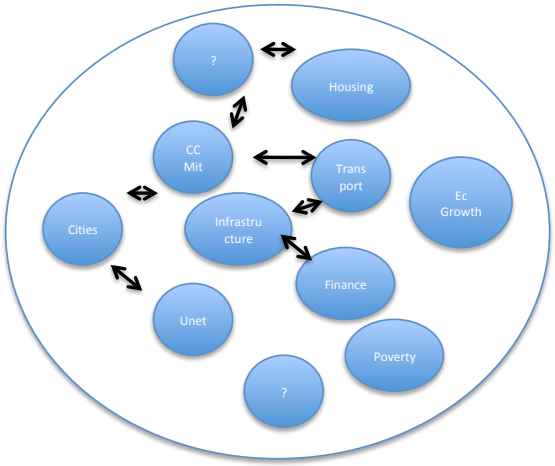
I'd like to see what happens when we aim for Outcome 2. This feels very experimental, what happens when sets of experts in two areas aim to understand each other and seek opportunities to support each others work objectives in an open way? I really want to avoid putting any framework on this conversation upfront, rather letting what emerges emerge. So for example, I'd prefer that we don't need to use the terms 'synergistic' or 'misaligned' in outcome 2 unless they emerge. This is the conventional mitigation thinking which I want to get away from. I want us to explore how and if the two areas of work connect, and what these connections look like. I'd prefer us to go broad on this rather than deep initially. If there is time to explore individual connections in depth that would be a bonus. Otherwise this can be left for a second phase.

**Intro: (Lisa/Brett )**

What do you do (in a sentence)? (done as a tour de table at the beginning)

**(Emily)**

Towards a 'multiple benefits' future:
understanding systems and connections



This is conversation between experts working in different areas. The ultimate intention is to explore the space in-between these areas, but to do so we need to be open to understanding the other's area first.

Whilst I know that the 'development experts' have an interest in mitigation work, as a mitigation community we are interesting in finding out about your work outside of any contact with mitigation people, we are interested in what we don't know, your community of practise.

Outcomes:

- *To all increase in our understanding of a different field,*
- *that we may uncover unanticipated linkages and points of contact between our areas of work (in the Conversation or in reflecting afterwards),*
- *build bridges between communities working in relative isolation from each other.*

Will be attributed, please state if you want anything held off the discussion notes?

I might use the Conversations (recordings, my notes) to inform my PhD.

Questions?

**Outcome 1: gaining in understanding of each other's area of work (Ensure we get this from the development experts in the Conversation)**

1. *What are the top three issues in your field? (state, don't explain at this point)*
2. *What are the greatest levers for transformation / progress in your area? How you access them?*
3. *What are your key challenges in advancing the objectives of your work?*

**Outcome 2: Uncover linkages and connections (as the conversation unfolds, try to extract these)**

1. *Can we see any areas of connect between the two? (These could be in terms of scale, timeframe, people, regulations, topic, supply chains, ideology, approach, data, other…). This might be a chance to draw?*
2. *If so, what do they look like: challenging? obvious? Do they offer opportunities?*
3. *How could these be exploited / re-aligned?*

**Outcome 3: Build bridges (no active work in Conversation)**

(I will circulate emails afterwards, plus any docs / websites that were mentioned)

- not sure we can do anything more explicit towards this outcome.. If it will happen it will happen, and most likely after the meeting.

**Closing (Brett / Lisa):**

Self reflection at end. What would you like the mitigation community of practise to take on board? What will you be taking away into your work?

(MAPS participants could usefully be reminded that they need to give me a list of bullet points on this either in handwriting afterwards or emailed within a week)

Perhaps draw up the interlinkages at the end to reflect? (Perhaps 'zoom in' to the space in between the two areas in my graphic above, and try to detail it a little? But this requires a bit of time to do, which could be fine. So its less of a closing and more of a consolidating and feeding back. Depending on the session this could be useful, or may not be)

## Document A.4. Post DevMit Conversations: Stocktake report:

**19 October Conversation stocktake (for Lisa and Brett)**

Complete:

- *Cities*
- *Adaptation*
- *Consumption*

Still to do:

- *Employment*
- *Finance*
- *Economic growth*
- *Transport*
- *Poverty*

Objectives: How to enhance the quality and usefulness of these conversations for all participants; how to feed back into MAPS?; am I getting what I need for my PhD, how can I increase this?

- *It really helps doing them shortly one after another, I get more fluent, and learn how to direct the conversation better. Finding the juggling / travel / shift between work types very stressful.*
- *Most external participants speak deeply from their experience. There are some 'expectations' that seem to get in the way (for me) of what I'm wanting to tap into (Myles and sustainability credentials, adaptation and its positioning vs mitigation). How to get these out of the way earlier?*
- *Definitely some very new and pithy 'content' ideas coming up: religion a determinant of consumption; cities are complex and understood by their experts; adaptation is more project based and starts with development; mitigation has a well organised campaign against it*

*which attacks the science; the wealthy and the very poor have very different aspiration drivers; I want to hold and ensure I understand these.*

- *Some emotionally charged moments: Sue Parnell on climate adaptation experts being arrogant; Ilana on mitigation experts being naïve; Hilton on adaptation / mitigation being in competition; Ilana on education not predicting consumption patterns. This is fine, interesting.*
- *From the primer: We haven't asked MAPS experts how they see the development theme from the perspective of climate mitigation. I'm not sure whether this is useful or not? It was very useful to ask more specifically what the top three issues / levers for transformation / challenges are. And to try to keep these separate from the comparison with mitigation.*
- *I felt we fell into 'saving the world' in all three conversations, and this is unhelpful.*
- *It would be useful to ask people how much of their work is SA context specific.*
- *Is my greater and more directive involvement helpful?*
- *All three have been fairly distinct, but also sufficiently similar. There are themes which emerge, the emotional charge is driven by individuals, it is enjoyable, we all end up thinking how to fix the world. There is not too much sunk time (people on tangents).*
- *Reflections on mitigation's science basis: models (Adrian), pricing (Tara). The conversation itself demonstrated the fallibility of these approaches; Very clear that mitigation experts don't understand the texture of the areas we are getting into; How to link this to the science based approach? Modelling and MCDA? How does this very descriptive work interface with the needs of models, for numbers and representation?*

## A.3. LTMS Interviews

Table A.2. LTMS Interviewee details

| **Interviewee** | **Position at time of LTMS** | **Current position** | **Interview Date** | **Interview Location** |
|---|---|---|---|---|
| Richard Worthington | Earthlife Africa: Manager Sustainable Energy and Climate Change Project | Freelance researcher and activist | 21 Aug | Johannesburg |
| Alan Hirsch | Presidency, Economic Policy & National Treasury Policy Unit | Direct Graduate School of Development Policy and Practice, UCT | 15 Sept | Cape Town |
| Bob Scholes | Council for Scientific and Industrial Research, Environmentak | Wits University | 18 Sept | Cape Town |
| Shaun Vorster | Special advisor to the Minister of Environmental Affairs and Tourism | Special advisor to the Minister of Tourism | 19 Sept | Cape Town |

| | | | | |
|---|---|---|---|---|
| Peter Lukey | DEAT Chief Director: Air Quality Management & Climate Change | DEA Chief Policy Advisor: Strategic Environmental Intelligence | 23 Sept | Johannesburg |
| Laurraine Lotter | Executive Director of CAIA | Chairperson of the BUSA Environment Committee | 23 Sept | Johannesburg |
| Ian Langridge | Chairman of the National Business Initiative's business and energy working group | Independent | 14 Oct | Johannesburg |
| Mandy Rhambaros | Eskom Chief adviser on climate policy and strategy | Climate Change and Sustainable Development Manager | 14 Oct | Johannesburg |
| Alf Wills | DEAT Deputy Director General Environmental Affairs, Chief Negotiator Climate Change | DEA Deputy Director General: Environmental Advisory Services | 16 Oct | Cape Town |
| Tony Surridge | DoE, Director Oil and Gas | South African Centre for Carbon Capture and Storage | 23 Oct | Johannesburg |
| Judy Beaumont | DEAT Chief Director of International Negotiations | DEA<br>Deputy Director General Climate Change and Air Quality | 28 Oct | Cape Town |
| Neva Makgetla | Policy Co-ordinator Congress of South African Trade Unions (COSATU) | Department of Economic Development Deputy Director General: Economic Policy | 31 Oct | Pretoria |
| Stefan Raubenheimer | Thokisa | Director SouthSouthNorth and MAPS | 17 Nov | Cape Town |
| Andrew Borraine | SA Cities Network | CEO Western Cape Economic Development Partnership | 18 Nov | Cape Town |
| Harald Winkler | ERC | Director ERC, MAPS | 20 Nov | Cape Town |
| Alison Hughes | ERC modeller | ERC modeller | 24 Nov | Skype |
| Joanne Yawitch | DEAT Deputy Director General Environmental Quality and Protection | CEO National Business Initiative | 26 Nov | Skype |

Document A.5: Information sheet and consent form – MAPS Programme LTMS Review research

**August to November 2014**

Dear Interviewee,

As discussed via email / telephone, the MAPS Programme is undertaking reflective research into the LTMS process. We want to understand with the benefits of hindsight what role the LTMS played in the development of SA's mitigation policy, with the hope that this may be useful to policymakers both in SA and beyond going forward. I'm leading the research, with Marta Torres Gunfaus (a MAPS Director) co-authoring. I may also use the research to inform my PhD project.

As a key member of the scenario building team, and particularly given your role in the development of the Climate Change Response White Paper, we would greatly value your insights and perspectives as part of the review. The interview will be structured as an open-ended conversation with some 'starter questions', and you would be interviewed strictly in your personal capacity, without attribution.

**Starter questions**

1. *What were the objectives and expectations of the LTMS (yours personally and your understanding of the official objectives)?*
2. *What do you think the LTMS' contribution to CC-mitigation SA policy was, both at the time, and with a longer perspective (7-years after completion), both negative and positive?*
3. *How did it do this?*
4. *Retrospectively, what defined the LTMS and what were its core elements?*
5. *How did it relate to South Africa's development agenda?*
6. *Was implementation discussed and if so how?*
7. *How did you understand the Required By Science (RBS) trajectory at the time and in retrospect what role did it play? How does this relate to mitigation ambition in South Africa?*
8. *In retrospect, was a LTMS process necessary for the evolution (positive or negative) of SA climate mitigation policy? And how different might SA mitigation agenda look like today in absence of the LTMS process?*
9. *What were the LTMS (formal & informal) outcomes, and did it meet objectives and expectations?*
10. *What do you think could have been done differently to (more) effectively contribute to the evolution of SAs climate mitigation policy?*

Beyond LTMS (if there is time / appetite):

- *Where is SA at in terms of mitigation policy development, and how are we doing?*

- *Do we have overly high expectations of development policy?*
- *How do you feel the evolution of mitigation policy in SA relates to SA's development agenda?*

**Informed consent component:**

Whilst we are delighted that you have agreed to be interviewed, please understand that participation is completely voluntary and that you are free to withdraw from the interview at any time with no negative consequences for you or your organisation.

We will always be seeking your personal perspective, as opposed to an organisational view. We will check with you both before and after the interview whether there are any comments you would prefer not to have attributed to you, and we are also happy to respect anonymity within the report if you would prefer.

The interview will be recorded, and notes taken. These will be used for the analysis and writing of the research paper and PhD but will not themselves be made public.

Please feel free to contact me should you have any questions at this point, otherwise we look forward to the interview.

Best wishes,

Emily Tyler / Marta Torres Gunfaus

## A.4. Ethnographic notes

Document A.6. Questions and prompts for revealing tacit knowledges:

- *What are the fundamental assumptions at play?*
- *How are various perspectives in use constructed?;*
- *What are the different frames and different perspectives that most researchers and practitioners work within?*
- *What concepts are used?*
- *What tools?*
- *What networks are accessed?*
- *Which methods?*
- *What terminology?*
- *That which is left out as well as that which is included;*
- *What are some of the tension lines within the CoP on approach (activists etc).*
- *What beliefs?*
- *What values?*
- *What language*

- *Which rules*
- *What is competence?*
- *What is good research?*
- *What is being served by the way the mitigation community works currently?*
- *What keeps the momentum of this status quo?*
- *What is taken for granted here?*
- *What is universally held as true, right, wrong here?*
- *What practices are allowed in and kept out?*

Table A.3. List of relevant events attended during the course of the research

| **Event** | **Capacity** |
|---|---|
| South African Research Project on Employment, Income Distribution and Inclusive Growth (REDI 3x3) Workshop, 2013, Department of Economics, UCT, Cape Town. www.redi3x3.org | Workshop attendee |
| Seeds of Good Anthropocenes: A Southern African Perspective. Open science dialogue, 3-4 November 2014. Stellenbosch Institute for Advanced Study. | Delegate |
| 2014 National Climate Change Dialogue, 10-13 November 2014, organised by the DEA, Johannesburg. https://www.environment.gov.za/event/deptactivity/2014national_climatechange_responsedialogue | Delegate |
| Our Common Future Under Climate Change, international scientific conference, Paris. 7-10 July 2015, www.commonfuture-paris2015.org | Delegate, poster presentation |
| Seeds of Good Anthropocenes: Urban Futures Diagologue, 12 August 2015. Stellenbosch Institute for Advanced Study. | Delegate |
| Zero emissions, zero poverty? ERC workshop, 9 May 2016. Hosted by the 'Climate Change Mitigation and Poverty Reduction' project. | Participant |
| Parliamentary Colloquium, 28 October 2016; Unpacking COP21: Implications for the Nation. Business, government (DEA and the Portfolio Committee on Environmental Affairs plus a couple of additional parliamentarians), academia and civil society were in attendance. | Attendee |
| Restitution conference, Cape Town, 9-10 November, 2016, www.restitution.org.za/2016-restitution-conference/ | Delegate |
| Resilient Urban Development Seminar, November 2016. Lauren Hermanus: Perspectives of the Massive Small Collective. African Centre for Cities, Cape Town. | Seminar attendee |
| Institute of Security Studies, seminar, 1 November, 2016. Dissecting South Africa's current political turmoil, Cape Town. | Attendee |
| Public stakeholder consultation of the draft climate change bill, Hotel Verde, Cape Town, August 2018. | Attendee |

# A.5. Exploring a complexity approach to SA CM policy with the SA CM and development CoPs

Table A.4. List of Seminars and presentations

| Event | Capacity |
|---|---|
| MAPS Programme internal workshop, 9 February, 2015. Monkey Valley, Cape Town. | Presenter, midway update on DevMit workstream. |
| City of Cape Town, Green coffee club, March 2015. | Presenter and discussant |
| Our Common Future Under Climate Change, international scientific conference, Paris. 7-10 July 2015, www.commonfuture-paris2015.org | Delegate, poster presentation |
| SouthSouthNorth lunchtime discussion. 5 November, 2015. #feesmustfall. | Facilitator |
| Development and Mitigation – What have we learnt and where to from here? MAPS DDP Conference, Paris, December 2015 | Presenter |
| African Climate and Development Initiative, student's conference, March 2016. | Thesis research presentation |
| Exploring a complexity underpinning for domestic climate mitigation policy in South Africa. ERC lunchtime seminar, July 2016. | Presenter |
| Science Policy Research Unit, University of Sussex, lunchtime seminar, 6 June, 2016. Brighton, United Kingdom | Thesis research presentation |
| World Wide Fund for Nature complex transitions seminar. September, 2016. Policy and Futures Unit, Cape Town. | Presenter |
| ERC Energy and Development masters course, October 2016. Complexity, climate and development, UCT, Cape Town. | Lecture |
| Centre for Complex Systems in Transition, University of Stellenbosch, lunchtime seminar, May 2017. | Thesis research presentation |
| Seminar: Complexity for climate mitigation action at the municipal level. Sustainable Energy Africa, Cape Town, South Africa. 18 September, 2017 | Presenter |

Document A.7. Bogota Interview information sheet August 2015

**A complex dynamic systems view of mitigation in a development context**

Emily Tyler, MAPS Programme, 17 August 2015

**Research background**

Through a series of four reflective MAPS papers, I'm exploring *how* we (climate mitigation policy practitioners) approach low carbon policy in a development context. Two of these papers are complete ('What was the contribution of the LTMS to South African climate mitigation policy?', and 'Reflecting on climate mitigation policy: how we do what we do', both are available at www.mapsprogramme.org/category/publications/papers/). The second two deal with generalised complex dynamic systems thinking as a potential conceptual underpinning to our work.

My basic proposal is that we as a community of practice have relied fairly heavily on classical / modernist thinking, which values aspects such as linearity, reduction, stability, 'knowability', measurement, normality, and control. These aspects are increasingly at odds with the world we observe in the twenty-first century, and I argue with the development context in which we work.

I'm therefore exploring generalised complex dynamic systems thinking as an alternative conceptual underpinning, and hope then to describe what this might imply for our work going forward. According to this complexity perspective, a country's economy and society is one, or a set of, complex systems. Generalised complex dynamic systems theories provide a way of describing such systems, and suggest aspects that may contribute towards systemic resilience and 'flourishing' rather than collapse. In addition, there is an emerging literature on the nature of the complex policies which attempt to influence these systems, and tools to approach and support these.

Using a complex systems perspective, I would like to test out what the climate mitigation policy challenge may look like in the various MAPS countries. The conversation will be exploratory in nature, with the following questions as starting points. I hope to be able to adequately explain any unfamiliar terminology, and give examples in order to enable a good discussion. I'm aware that for those not familiar with complex systems theories the questions may appear very foreign, but I'm only aiming for a descriptive outcome, and will be grateful for whatever we can manage during the interview.

**Starter Question examples:**

- *What does the complex system that is your country / economy / society generate? What emerges from this system? Are there any patterns?*
- *What do you think are the key 'known unknowns' and the 'unknown unknowns' which are relevant to the climate mitigation challenge*
- *How does this system learn about low carbon development, and the risks of high carbon development?*
- *Can you think of some examples of unintended consequences of climate mitigation policy interventions?*
- *What are the key constraints on the system (in terms of social norms, regulation, fixed assets etc)*
- *What are key nodes or hubs related to climate mitigation? What networks can be seen at both a policy and practical socio-economic level?*
- *What thresholds are there in the system?*
- *What is non-renewable in the system? What is irreversible?*
- *What vicious cycles exist relating to low carbon? What virtuous cycles?*
- *What evidence is there of non-linearities?*
- *Where are examples of self-organisation in the system?*

- *What is the perspective you are observing this system from?*
- *Is there evidence of marginal returns from increasing complexity in the system?*
- *How do researchers and practitioners from different disciplinary perspectives view the system?*
- *What outcomes of the system are fed back into it?*

**Attribution**

I would like to record the interview, use for PhD and potentially published papers pre / post

Please state at any time if anything is off-record, I intend to come back to this at the end to check whether you are comfortable being attributed, and if there are any parts you would prefer not to have attributed.