Scenario praxis for systemic and adaptive governance: a critical review

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ABSTRACT:

Scenario praxis is critically explored as the theory-informed practice of scenario-ing. Our concern is to appreciate its potential in increasingly common situations that may usefully be framed as wicked problems, situations or issues and which increasingly warrant innovations that produce more systemic and adaptive governance. Our framing of the issue of scenario praxis is to move towards a realisation of structural coupling between humans and the biosphere, in which socio-ecological scenarios offer a source of creative potential for re-organisation. As part of this framing we draw attention to the need for inquiry-based learning models to complement/ counterbalance evidence-based approaches. Scenarios embody learning as social phenomena enabling transformation of a situation by mediating underlying learning processes. Scenario praxis can contribute to learning as part of generating a joint performance amongst multiple actors in a situation of complexity and uncertainty. Our method focuses on five constraining variables in the transformation of a situation: the history of a situation, extent of stakeholding in an issue, institutions and policies in the situation, epistemological constraints and contestation about the nature of the issue, and facilitation or mediation of the joint learning processes. We explore three cases of scenario praxis at the global, national and state levels to unpack what we see as critical concerns for the practice of scenario-ing in transforming understanding and practice in a situation of concern. We then consider scenario praxis as a form of systems praxis in which the co-evolution of practice-context leads to the ongoing performance of social learning. Our analysis directs us toward emergent issues for scenario praxis and implications for policy praxis, future research, governance and capability-building for 'learning systems' design.

KEYWORDS: Governance; social learning; scenario-ing; institutions; public sector practice.

> *'He was a man who saw things coming. Not shadowy premonitions before and after sleep, but real and present dangers in the daylit world. Lamp posts and trees reared up at him, splintering his shins. Speeding cars lost control and rode on to the footpath leaving him lying in a pile of torn tissue and mangled bones.' (Jacobson 2010)*

> *'In an increasingly complex and heterogeneous world, futures studies can help people to recover their agency, and help them to create the world in which they wish to live' (Sohail Inayatullah 2008).*

1. Context

This paper offers a critical exploration of scenario praxis. We use the term *praxis* rather than practice to make the point that all practice is theory informed.[1] By making this distinction we also wish to draw attention to the centrality of 'practitioners' to all practice. Because practitioners come to practice theory laden there is a need, we argue, to be aware of this as well as knowing how to use theory when engaging in any form of purposeful action. Reflexive practitioners are also aware that practice and theory inform each other – they are recursively related. In this paper the term 'scenario-ing', a verb, is used deliberately to draw attention to praxis dimensions.

All praxis is contextual and dynamic. Thus history matters as do circumstances, stakeholders, small 'p' politics, skills of those involved, and the institutional arrangements which characterise the praxis domain. For this reason we situate our critique within a governance framework. Governance encompasses the totality of mechanisms and instruments available for influencing social change in certain directions. While governance is a much broader idea than management or administration, it is not some abstract label but an action that has to be carried out. Governance is the context in which adaptive planning, designing, regulating and then managing sits. Governance that is 'adaptive' incorporates learning and change in response to uncertainty.

We interpret governance as a cyber-systemic concept associated with steering, or charting an on-going viable course in response to feedback.[2] It is gainfully captured by the metaphor of sailing in which the vessel is designed to operate in a dynamic environment of wind, water and a set of technologies with human operators and addressing issues of purpose, as when charting a course. Within this metaphor contemporary human operating capability in socio-technological systems can be seen to have dangerously exceeded capability in areas of learning and development to act effectively in a socio-ecological system (Ison 2010; Adam 2004). For this reason we argue that at this historical moment, governance of a co-evolutionary dynamic between humans and the biosphere is *the* key dynamic of concern to humans. We are thus interested in understanding how governance mechanisms and associated praxis can be more usefully employed in the on-going governing of a structurally coupled, socio-ecological system. To be actionable such a framing needs to be grounded, through practices, in everyday living. Thus, within this context we seek to explore whether scenario praxis has potential to contribute to more effective governance of this co-evolutionary dynamic.

Other contextual imperatives from which to consider scenario praxis include:

- Breaking out of pathway dependencies;
- Being aware of how sensitive to initial starting conditions purposeful human action can be;
- Appreciating how current situations are understood and/or framed from the perspectives of multiple stakeholders (reflexivity);
- Institutional complexity and 'blindness'

[1] The stance we adopt is consistent with that of praxeology – the branch of knowledge that deals with practical activity and human conduct.

[2] Following the Greek, *kybernetes*, meaning helmsperson or steersman as one who responds to feedback from wind, currents and human determined purpose.

- Need to move away from concepts such as 'decision support' to new theoretical and metaphorical framings such as 'choreography of effective performances'.

1.1 The situations of concern

There is considerable rhetoric about taking a whole-of-government approach using methods of foresight and 'joined-up' government but it seems difficult to shift the dominant culture or realise this in practice. Rhetorically at least, governments are increasingly drawn to account for a lack of joined-up awareness and actions in relation to policy interactions. Too often there are unintended, deleterious effects or worsening of situations when traditional approaches to policy development and implementation are employed in situations of complexity and uncertainty (APSC 2007; Ison 2010).

An Australian Public Service Commission (APSC 2007) account of 'wicked problems' (amongst which they included climate change, obesity, indigenous disadvantage and land degradation) described them as problems that:

> "*go beyond the capacity of any one organisation to understand and respond to, and* [where] *there is often disagreement about the causes of the problems and the best way to tackle them. …..Usually, part of the solution to wicked problems involves changing the behaviour of groups of citizens or all citizens. Other key ingredients in solving or at least managing complex policy problems include successfully working across both internal and external organisational boundaries and engaging citizens and stakeholders in policy making and implementation."*

They go on to say that:

> "*wicked problems require innovative, comprehensive solutions that can be modified in the light of experience and on-the-ground feedback*" and that "*all of the above can pose challenges to traditional approaches to policy making and programme implementation*".

A key question we pose is what roles could scenario-ing play as a praxis response to situations that could reasonably be framed as 'wicked'? [3]

1.2 History of the situation as framed

Scenario-ing is generally seen as part of foresighting and, by some, as a form of systemic practice able to respond to issues of complexity and uncertainty. The use of scenarios, it is argued, provides an opportunity to find new ways of addressing problematic issues or matters of concern that require attention beyond the short term cycles of elected government and more profoundly in relation to matters that have no apparent solution. As a planning device scenarios are regarded as a way, not of trying to get the future right, but of avoiding getting it wrong (Swartz 1991).

[3] As a means to break out of the limitations of particular conceptual framings Inayatullah (2008), in the naming of six pillars for transformation practice by using futures, suggests an additional seventh, "no concept" where "all listing of concepts becomes yet another cookbook that limits creativity, instead of creating innovation" (p. 8).

James (2001) in a parliamentary research paper assessed the practice of scenario-ing through foresighting in and beyond government in Australia. Greater institutionalisation of foresighting and scenario techniques in Asia and Europe than in the US and UK was reported:

> *"While previous efforts in Australia to provide a vision of the future have often received a hostile reception, there now appears to be growing interest in futures work. In part, this is due to the growth of external forces outside our immediate control such as economic globalisation, global connectivity, knowledge systems and national innovation trends."* (James 2001: Major Issue Summary, Research paper 18 2000-2001)

James (2001) framed the use of foresighting as looking to possible future scenarios rather than predictive or deterministic exercises or otherwise maintaining the status quo. He noted that there had been some uptake in Australia but the extent to which it had become institutionalised was limited. His work raised the question of whether the then emerging institutional context associated with new public management was inimical to scenario-ing praxis.

An earlier parliamentary research paper (de Lane 1997) examined public service reform in Australia against reform in other parts of the world under the aegis of 'new public management'.[4] De Lane (1997) noted new public management as

> "*characterised by a closer focus on results, decentralised management with stronger strategic capacities at the centre, flexibility to explore more cost-effective policy outcomes, and a greater focus on efficiency, productivity and competition.*"

Furthermore de Lane was concerned about the progression of new public management reforms as leading to a

> "*loss of institutional memory … with the increasing pace of change, change-fatigued organisations lack the time for reflection, and are 'functioning much more as forgetting rather than as learning organisations'."* (Major Issue Summary, Background paper 3 1997-1999)

The extent to which commitments to new public management remain embedded within the public sector is thus a key contextual factor for appreciating how scenario-ing might succeed or fail. A review of the literature suggests that scenario praxis in Australia is more readily adopted in non-government circles, which is where most of the experienced practitioners lie. O'Brien (2000) notes a whole of government approach using scenarios planning in Singapore and the Netherlands, which otherwise seems to remain in the domain of business (e.g., van der Heirjden 2005; Ringland 2006; Varum and Melo 2010).

There are many lineages of scenario-ing praxis. For example, there is a difference between scenario-ing and forecasting techniques with forecasting working in a paradigm of separation between what is known and unknown using probability techniques for assessing

[4] This is quite typical of the way policy develops, by examining what is happening elsewhere and applying insights to Australian contexts.

likelihood. However forecasting does not acknowledge the varied nature of knowledge including ignorance and uncertainty, which can be better understood by non-scientific sources of knowledge (Wilkinson and Eidinow 2008).

Given the diverse lineages of secario-ing, and the possibility that institutional settings carried over from new public management may be less than conducive, it is important to grasp what is at issue if a shift to scenario-ing as an aid to governing a socio-ecological system is contemplated.

2. Background theory

2.1 Responding to socio-ecological scenarios as structural coupling

Socio-ecological systems evoke certain meanings depending on the outlook of the participant or the observer. In this paper 'socio' is understood to embrace the social and technological environment in which humans have come to 'self-organise' through coercive, cooperative and consensual means and 'ecological' as that which is observed in nature beyond the domain of human control (but within the realms of human interpretation) and which is also self-organised.[5]

Structural coupling is a term used in systems and cybernetics theory to refer to the mutually influencing relational dynamics over time between two 'systems' in which the organisation of each is structurally determined i.e., the structures of each system determines what it is capable of doing (Ison 2010). For example the imposition of a three year election cycle as a rule of a wider 'government system' structures much of what is, or is not possible in the current Australian national parliament. Structural determinism operates within the biophysical world but on aggregate may be less apparent than in the social.

Our concerns are aptly demonstrated by the slow degree of response to issues like global warming. These concerns relate to a seeming incapacity to manage change under conditions of uncertainty and where a lack of desire for internal change becomes pegged to a lack of agreement about evidence that external change is being experienced.

> *"If we are to manage in a climate changing world that is essentially unknowable in advance, and where we need to take more responsibility for the systemic effects we as a species have, then adaptation as co-evolution seems to me the only way forward."* (Ison 2010, p. 12)

[5] The concept socio-ecological system' is an epistemological device, a way of knowing about our circumstances that, like the operation of metaphors, reveals and conceals. It reveals the dynamically coupled nature of humans to 'ecosystems' but at the same times conceals the idea that humans are 'part of nature' and that ecosystems are essentially constructs rather than entities in and of themselves.

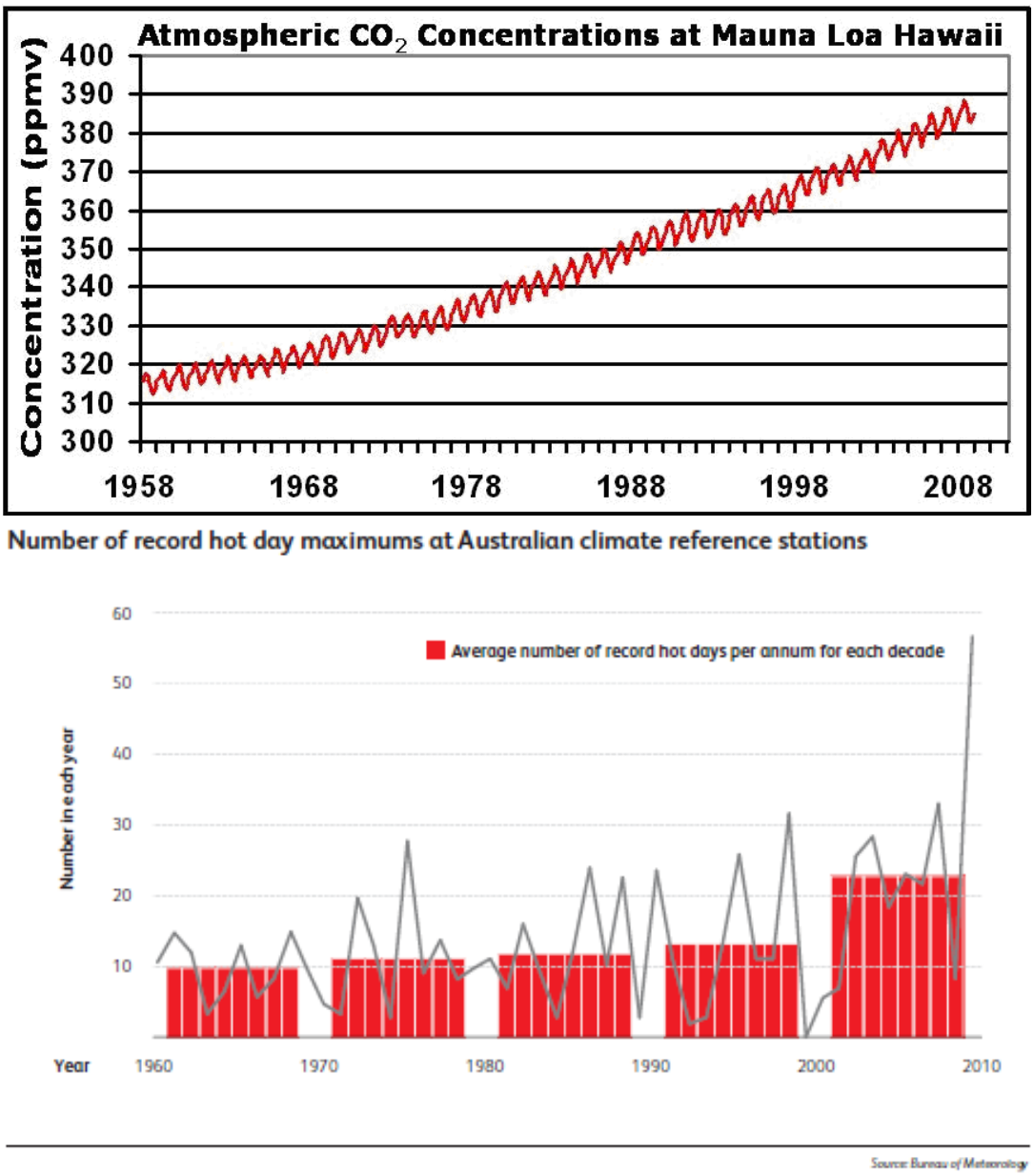

Figure 1: Different sources of evidence. Source: CDIAC 2010 and BOM CSIRO 2010

In the situation depicted in Figure 1 evidence, thus far, has not been the primary source for inspiring concerted action. Given this, our focus has shifted to inquiry based approaches focused on co-learning and co-development that might generate confidence for concerted action. Co-evolution or structural coupling of the external environment with internal choices offers an alternate view for adaptation as processes of mutual interaction. In this case responses to change are made in a 'conversation' (from the Latin *con versare*, meaning to turn together) of the social with the ecological/biophysical i.e., dynamic of co-existence and coupled function.

> "*Rather than seeing adaptation as one way, co-evolution is different – the idea of a separate environment is set aside in favour of processes of mutual interaction which, in*

> *human social systems, can be seen as processes of learning and development.*" (Ison 2010, p. 12)

Conceptually, structural coupling is also a way of relating to a historical situation as it has manifested in the present. Often we bring past interpretations as if they were still relevant to the situation which has changed. To maintain quality, or effectiveness, of structural coupling then, refers to how good we are at learning about how the situation has changed; and thereby better directing our capacities towards enhancing structural coupling by altering the relational dynamics or attempting new trajectories. The key difference here is the notion of learning and how well embedded that is in our institutions (Schön and Rein 1994; Kolb 1984). Innovation is needed. Consider the idea that we inhabit a 'projectified-world', yet the idea that humans should do 'projects' (as currently framed) only came about in the early part of the twentieth century (Ison 2010).

However the nature of our understanding does not necessarily change with the nature of our practice because of strong embodied ties to historical meanings. Even when behaviours have changed, beliefs may still be embedded in previous rationalisations of being. Sometimes it is much more difficult to de-couple historical practices in alignment with changes in understanding. For example where large scale industries dominating the 19th century supply of work are no longer the key players yet retain substantial political influence in democracies. Inayatullah (2008) illustrates the issue where Indian restaurants have now become a larger employer of human resources in Great Britain than its steel, coal mining and ship building industries combined (p. 4).

> "*And yet, even as the future disrupts, we remain tied to old patterns of behaviour. We know we are more productive when we work from home, yet the 9-to-5 still dominates. We know that creating community hubs, which combine work and home, will reduce traffic congestion and pollution, yet millions make the daily commute to the office.*
>
> *We know we need to change but we seem unable to. The image of a new future, while emergent, is pulled down by the weight of the industrial era."* (Inayatullah 2008, p. 5)

Furthermore, coupling of humans to technologies and nature has both material *and* semiotic relevance. Past interpretations are made in a language that connects material and semiotic forms that is open to revision, e.g., through conjecture and refutation of scientific knowledge (Popper 2002) or deconstruction of assembled socio-cultural and biophysical meanings (Foucault 2010). History, and so recognition, is given to the fact that all human inquiry and action is embedded in language (Ison 2010, p. 227; Maturana and Varella 1987).

> *"With language arises also the observer as a languaging entity; by operating in language with other observers, this entity generates the self and its circumstances as linguistic distinctions of its participation in a linguistic domain. In this way, meaning arises as a relationship of linguistic distinctions. And meaning becomes part of our domain of conservation of adaptation.*" (Maturana and Varela 1987, p. 211)

Other reasons for innovation include the desire for, yet weakness in, theory informed practice of doing joined-up governing. Relevant responses are the use of inquiry-based (as

opposed to evidence-based) approaches to enable sensitivity in (managing or researching for) emergence; and ethics understood in context-related action and not reduced to codified norms and practices (Ison 2010, p. 239; see also Benhabib 2005 on ethics in context). In other words a particular context produces a need for interpretive capacity, not just codified behaviours formed in and represented by historical practices of governing.

> "*The broader rationale for such an innovation is to better manage our ongoing structural coupling with the biosphere in a climate changing world in a manner that could be understood as a form of on-going systemic development."* (Ison 2010, p. 239)

Clearly there is room for improvement in the quality of the relational dynamics between humans and the biosphere, so how might scenario-ing contribute?

2.2 Scenarios as creative potential for (re-) organisation

Our emphasis is on the activity or doing of scenario-ing as a practice that is informed by, and gives rise to, learning as a social phenomenon not just a cognitive process (Ison 2010, p. 9, f.10; Collins, Colvin and Ison 2009; Ison et al 2007a). A particular focus has been social learning understood as concerted action by multiple stakeholders in complex and uncertain situations.

A key research need is to elucidate the institutional settings needed to build and sustain scenario-ing as a practice integral to governance. Unfortunately too often the thinking needed to address this concern does not come to the fore. Just as shoes mediate between a body and the ground when walking, as a practice, happens so could scenario-ing, if appropriately institutionalised, mediate between the social and the biophysical. Few consciously appreciate that for living systems the past and future are merely different manners of living in the present; all living organisms live in an unfolding present. Thus, to engage in conversation about past, present or future realises different manners of living for those in the conversation. Taking a view to the past can illuminate that past choices can be revised; particularly through realisation that meanings are 'made' or assembled in the relations with other meanings (Derrida 2001, 1982; Maturana and Varela 1987: 211).

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There is a deeper level of meaning that comes from the practice of scenario-ing referred to as 'meme change' in which the result of engaging in practice changes the ideas that govern institutions (Inayatullah 2008, p. 6; Blackmore 1998). The practice itself then becomes an intellectual activity in which understanding emerges in relation to the intention of those entering a form of scenario practice.

> "*The discursive-analytical nature of scenario processes can help ensure attention is focused on different types of knowledge and uncertainty. This is particularly useful in the context of challenges that are too uncertain to be resolved by conventional methods of inquiry that depend on assimilating expert knowledge*." (Wilkinson and Eidinow 2008, p. 3)

Theory-informed practice of scenario-ing is a means of acting in a way that reflects a higher level of understanding, than merely performing instrumentally a set of tasks. Without the

cognitive shift that occurs in recognition of the social construction of institutions based on past practices and understandings, scenario-ing does not serve its purpose. Scenario-ing moves the ground in thinking such that the unthinking continuation of practices can be called to account and judged meaningful or not. Using scenario praxis as a reflexive tool provides the conditions for the emergence of shifts in understanding of those involved and offers the potential of generating effective performances characterised by concerted action.

Scenario-ing thus becomes a metaphor for on-going structural coupling. It creates the conditions for realising how meanings are built in past relations and that such meanings, when enacted as a form of social practice, become the mediating devices for experience. Meanings and their practice mediated through expertise (economics, medicine, hydrology, ecology, etc), by bringing a certain reality (or a view of reality as distinct from other views of reality) to the surface of understanding, alter the reality that they act upon with desired and sometimes undesired effects. Subsequently scenario-ing can open the opportunity to step back from the situation and realise its historical roots of actors, institutions etc (Figure 2). By so doing understanding can be reconfigured in relation to the effects or products of earlier abstractions associated with particular expertise. Only through such recognition can scenarios be used effectively to construct alternative futures (Inayatullah 2008, p. 5-6).

2.3 Scenario praxis: theory-informed practice of scenario-ing

Scenario praxis might be seen as a support or facilitating device for governance steering. It operates between past and future where past and future are different ways of being in the present (Maturana 1995). The only world we humans (and nonhumans) can have is the one we create together through the actions of our coexistence (Latour 2004; Haraway 1992). If actions in scenario praxis are taken to support a multiplicity of futures in which decisions remain open to learning then it will have achieved a particular goal of realising possibility and conserving adaptation.

In summary, scenario-ing, as with any form of purposeful practice does not arise in a contextual vacuum. There are different schools or lineages of scenario-ing, which can be differentiated as different praxis lineages, and the process of engaging in scenario-ing is subject to a complex set of framing conditions (Schön & Rein 1994; Ison 2010) and more or less conducive institutional settings may exist. Capability may vary and shift as for example, with staff turnover. The critical challenges are, we suggest to:

(i) recognise the historicity of scenario-ing as a form of praxis;
(ii) appreciate different praxis lineages;
(iii) conceptualise scenario-ing as a coupled practice-context system (i.e. the long-term effectiveness of scenario-ing may have as much, if not more, to do with the context than the scenarios themselves);
(iv) understand scenario-ing as particular manner of living in language;
(v) recognise that effectiveness of scenario-ing is likely to be highly sensitive to initial starting conditions, including pathway dependencies that are in-built through the understandings of those involved.

3. Methodological approach

3.1 A systemic inquiry into scenario praxis

The activity of generating this critical review is understood as a systemic inquiry into scenario praxis. A *systemic inquiry* is device to institutionalise inquiry in situations of uncertainty that is informed theoretically by systems thinking and operationalised through systems practice. It is designed for situations in which there is a need for higher order thinking to inform purposeful human action. This need is realised through systemic design parameters which includes participation of the observer in the 'system' which is being brought forth. In this context 'we' have a concern with scenario practice which has its basis in the too frequent reification of scenarios i.e., scenario-ing as a practice that primarily produces artefacts (scenarios) that can be understood and used to carry meaning. Rather in this paper we want to see scenarios as *thinking or social technologies* (epistemological devices) through which social experience is mediated. If performed as part of a broader systemic inquiry, scenario-ing gives rise to new understanding that may or may not become a new framework for practice (Berkhout et al 2002; Wiek et al 2006). Ison (2010, Chapter 10) provides more details about systemic inquiry.

3.2 Transforming a situation of concern

Two heuristics have been used as theoretical and methodological aids in this inquiry (Figures 2 and 3). The first heuristic (Figure 2) is concerned with how situations of concern might be transformed through changes in understandings, practices and social relations of those involved. The focus of inquiry is how scenario-ing might contribute to the transformation of particular situations by mediating underlying learning processes, where learning is understood as a social phenomenon not merely an individual cognitive process.

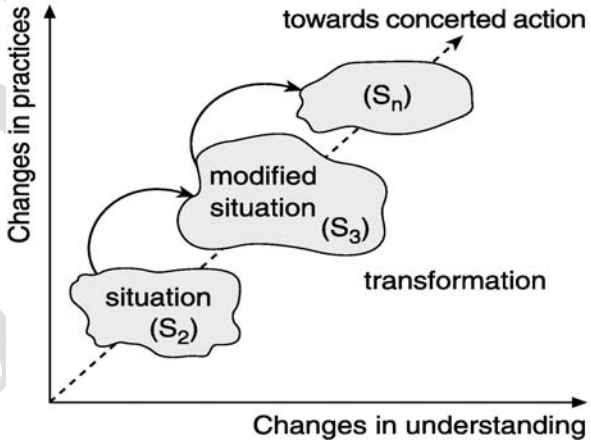

Figure 2: Transformation of a situation of concern shaped by changes in understanding and practice (Source: Steyaert, and Jiggins, 2007).

A key framing entailed in Figure 2 is that scenario praxis can contribute to the transformation of situations as part of generating a joint performance, or concerted action amongst multiple actors in situations of complexity and uncertainty (e.g. an organisation, a sector, a catchment, a ministry etc).

Three case study reports of scenario-ing and selected literature will be held up to critical scrutiny through a second heuristic (Figure 3), derived from empirical research (Steyaert & Jiggins, 2007; Ison et al 2007b), which posits that there are, at minimum, five key 'variables' that can constrain or enhance the transformation of situations depicted in Figure 2. Transformation of situations happens through the joint construction by stakeholders of what is at issue building, in the process, towards concerted action. The key constraining or enhancing variables are: 1) the history of a situation (including human/actor histories); 2) the extent of stakeholding in the issue; 3) institutions and policies in the situation in which the issue emerges; 4) epistemological constraints and contestations about 'the nature' of the issue; and 5) facilitation or mediation of the joint learning processes that can lead towards social learning.

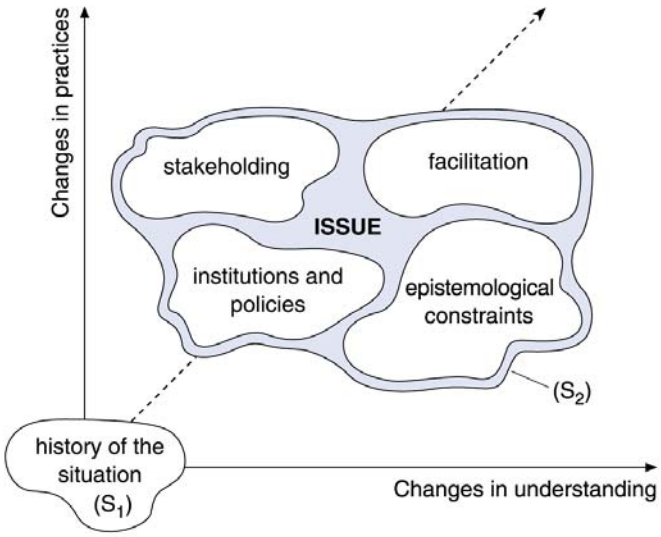

Figure 3: Five key variables which constrain or enhance the transformation of a situation (Source: Steyaert, and Jiggins, 2007).

3.3 Analysis of practice

We use three contrasting cases to explore the potential for scenario-ing practice in meeting the needs of organisational learning and how it might become institutionalised in a framework for systemic and adaptive governance. The first case is drawn from the international arena and used to exemplify scenario-ing as part of a broader platform of operations We compare this case with similar occurrences of practice in the Australian and Victorian context. The three cases were chosen on the basis of similarity and difference in three dimensions: 1) that they involved an examination of the past as well as the future; and 2a) they were multi-institutional or 2b) involved a decision context for unlikely collaborators to draw in different perspectives to the discussions. Further distinctions were made between the cases to illuminate difference on whether they 3) made consideration of ecological, social and/or technological dimensions in the analysis (see Table 1). Where possible we have attempted to engage with the case studies to elucidate the following set of 11 key praxis settings:

1. Doing the work to reach agreement to use scenarios for some purpose;

2. Process design for using scenarios in a specific context;
3. Scenario building (who, when? Who learns? Who participates?);
4. Possible contributions to epistemic (and worldview) shifts of those who participate in scenario construction;
5. Reification of scenarios – how etc?
6. Using scenarios in communication with others
7. Using scenarios as mediating technical objects (actor network theory)
8. Managing the participation/reification duality of scenario praxis;
9. Scenario praxis as a means to mediate a strategic conversation;
10. Appreciating institutional constraints and possibilities to the on-going conservation of point 8;
11. Scenario praxis as a form of systems praxis contributing to social learning.

These 11 questions were approached by first working through the following comparative structure for each case study:

- Aims/ objectives
- Other technologies/ design features
- Higher order ambition/ socio-technical outcome
- Description/ elements captured
- Analytical lens on futures
- Characterising the activity of systemic inquiry
- Any interesting surprise or discovery/ transformation trigger
- Particular use of scenarios

For the sake of brevity the details of this comparison are not presented. In the process of comparison the 11 scenarios practice concerns were elicited and addressed for each of the three cases. These are presented in Table A1 in Appendix 1. Having explored the three case studies we compare and contrast the outcomes with an example of scenario-ing that is embedded within a praxis of systemic development and draws theoretically and practically on systems thinking and practice.

The two heuristics (Figures 2 and 3) have been used as a theoretical lens to deepen our analysis of the case studies and as an interpretative framework to help structure the discussion.

4. Three cases of scenario praxis

The characteristics of each case are classified against the criteria used to select cases in Table 1. Then in the following section a brief overview of how each case study situation has been framed is provided.

Table 1: Summary description of cases* used to explore scenario-ing praxis

Case	Location	Scale	Past-future	Social parameters	Technological parameters	Ecological parameters	Collaborating institutions	Stakeholding/ participating
Agrimode 2006-2008 (phase one)	Research for Agriculture Development, Montpellier, France	Global	1965-2065	diet, population "food behaviours"	Biomass balance "technological options and trade regulations for sustainable agriculture"	Diversity "ecological intensification"	Agricultural research organisations	Researchers from different institutions, disciplines, key stakeholders
Energy Future 2004-2006	CSIRO Energy Transformed Flagship, Newcastle NSW	National	1960-2050	Perceptions/ economics/ impacts	Static energy and transport alternatives	Climate impacts	Energy sector, environmental,	Researchers, stakeholders, citizens
Irrigation Future 2003-2007	Department of Primary Industries, Tatura, VIC	Regional/Catchment	1970-2030	Irrigated agriculture	Irrigation efficiencies and delivery technologies		Irrigators, NRM, allied businesses	Irrigators, professionals, policy makers, regional stakeholders

* Reports and other sources drawn on for this analysis include for: Agrimonde - Dorin and Hubert (2010), INRA-CIRAD (2009), Hubert et al (2010); Energy Futures Forum – CSIRO (2006), CSIRO & ABARE (2006), Jones and Preston (2006), Littleboy et al (2005), Delany (2006); Irrigation Futures – Wang et al 2007a; Robertson et al 2007a; Pinniceard et al 2007; Soste et al 2007a; Robertson et al 2007b, Soste et al 2007b, Wang et al 2007b, Robertson et al 2007c)

4.1 Three situations framed

Agrimonde was a process, led by French agricultural research consortium INRA – CIRAD, of bringing together experts and stakeholders (see list in Appendix) into a discussion and analysis platform on future sustainable global food supply. Several teams had been working on long term future food studies and there was a desire to situate Agrimonde in relation to other work as an integrative platform for discussion and debate of plausible futures. Agrimonde organisers recognised that there were different hypotheses, methodologies, etc underpinning each team's study that required some open space for discussion in order to accommodate different perspectives. The platform was seen as a means of integrating qualitative analysis and quantitative data, on the premise that the model had to be able to work with existing data to provide a sufficiently valid instrument for consideration of plausible future scenarios of sustainable agricultural development. The first phase reported (2006-2008) concentrated on researcher-expert end of debate with decision making institutions and stakeholders acting in an advisory capacity (INRA – CIRAD 2009, p. 2-3)

Energy Futures Forum was instigated by CSIRO Energy Transformed Flagship, who took a hands-off approach to the scenario creation, providing only the opportunity and technical input to the process. A set of issues were impacting the long-term energy future of Australia including: a history of access to low cost energy that contributes to the economy and way of life; energy infrastructure that is in need of substantial long-term investment; pressing environmental concerns that question current fuels and technologies in use; and the need to examine a portfolio of choices and the basis for selecting energy futures. These represented a set of challenges which requires the concerted effort and collaboration of governments, industries, communities and individuals with no definitive answer to the question of energy futures. The challenge was seen as requiring a process for building consensus on how Australian society should collectively respond. The process was initiated to identify plausible scenarios and their implication for future static energy and transport in Australia. EFF was a two year project that brought together industry and community groups in a scenario planning exercise. The exercise was seen as undertaking a new approach to energy industry modelling by combining technology and economic models into a single integrated analytical tool. (CSIRO 2006, p. vi)

Irrigation Futures was initiated by a small group of irrigation farmers concerned about the future of irrigated agriculture in the Goulburn Broken region of Victoria. The process was enacted to demonstrate and provide support for others who might be interested in using scenarios as a community based planning technology. The organisers emphasised the importance of stakeholder ownership of planning process to realise outcomes and desired to facilitate stakeholders into a planning discussion. Uncertainty in climate (framed as drought), water trading and movement, and global markets were issues that impacted irrigated agriculture in the Goulburn Broken region, prompting a desire to plan for the future. GBIF was a five year project at DPI with an output of 12 final reports, designed as such to provide independent knowledge resources on an on-need basis (Robertson et al 2007a, 2007b: Wang et al 2007a, 2007b).

We now critique these three applications of scenario-ing as a means for exploring emergent issues and their implications for scenario-ing praxis in the public sector (e.g. Victorian government) in particular.

4.2 Case comparison

As indicated earlier research recognised at least five constraining variables that impacted on changes in understanding and practice within any situation in which there was a desired transformation (Figure 3). Collins and Ison (2009) outline how this heuristic can be turned into a design for a 'purposeful learning system' employing the logic of soft-systems methodology (SSM). Taking a 'design turn' based on SSM logic draws to attention the need to design in a monitoring and evaluating sub-system which operates in relation to articulated measures of performance. Generic measures applicable to all 'systems of interest' include efficacy (does it work), efficiency (does it make best use of resources) and effectiveness (is overall purpose met). Ethicality, elegance etc could also be considered as measure of performance. Taking a design turn makes explicit an awareness of the social and cultural constraints of knowledge about the future in the present. It enables the possibility for questioning the boundaries of inquiry as initiated, with attention to those things excluded because of ignorance at the time (Latour 2004). It also enables ongoing reflection on scenarios against *in situ* action so as to improve their usefulness.- or alternatively as a means to institutionalise scenario-ing as part of 'business as usual'.

Table 2: Summary addressing five constraining variables of social learning

Variable	Agrimonde	Energy Futures Forum	Irrigation Futures
1. History	• technical view, modelled on trade flow, food production (land use) and consumption data (population); • no conscious exploration of framings held by actors and/or institutionalised in the MEA.	• technical view modelled on past patterns of various kinds – energy production, uses, etc; • no conscious exploration of framings held by actors and/or institutionalised in the technical assumptions	• active reflection of participants on key regional events, historical changes; • no conscious exploration of framings held by actors and/or institutionalised in the historical irrigation designs but more opportunity for deconstruction due to process
2.Stakeholding	• researchers, education institutions, research institution directors; • a challenge to build next phase of stakeholding in international fora	• energy sector stakeholders (generation, supply, etc), social and environmental interests groups (NGOs) including unions, ACF, community advocacy, (citizens' panel on aspects of social uptake)	• open to regional community, regional institutions such as CMA and GMW, Shires, • limited with state authorities, e.g., in planning
3. Epistemologies	• ecological modernisation versus alternative for addressing poverty (e.g. biotechnology solutions), climate change policies and transformations of biometrics;	• public vs private infrastructure investment and ownership, possibility for communication or locally based energy infrastructure development, not necessarily on a	• irrigated agriculture vs other forms of regional development, ecological constraints and community development pressures, possible to integrate agriculture to other 'systems' of ecological capacity,

	conceptual framing which challenges prevailing paradigm – based on calorific assessment	business model but a common pool resource concern	similar issue to EFF on local community or regional developments and market transformation
4. Facilitation	• an integrative platform created; mediated by technical quantitative model, means of managing integration of difference quantitative models, cultural issue not connected up to technological constraints (e.g., responses to biotechnology in different regions), key players not involved in platform initiation, limited buy-in of trade power brokers (WTO, also WHO)	• mediated by technical models, degree of social learning (SL) in scenario generation not clear or reported, only space SL evident is in the citizen panels	• highest degree of deliberation of key actors/ agents that could mobilise interest and resources to address issues, however issue of lack of buy-in of land use planners noted
5. Institutions	• public sector agricultural research and development, international trade, environmental sustainability, global development; • no evidence of institutionalising outcomes	• public sector led energy infrastructure and investment, fuel technology and production, climate policy • no evidence of institutionalising outcomes	• public sector managed water policy, regional development, irrigation infrastructure, planning policy • no evidence of institutionalising outcomes
6. Monitoring & evaluating	• no mechanism of observing action taken based on scenario generation and evaluating the performance of the modelling used to support analysis	• no mechanism of observing action taken based on scenario generation and evaluating the performance of the modelling used to support analysis	• no mechanism of observing action taken based on scenario generation and evaluating the performance of the modelling used to support analysis; • evaluation of the exercise undertaken purposefully however no future initiative to measure the effects of the process over a longer term

The Agrimonde platform offers a means of entering a technical conversation in which power relations are mediated by the quantitative tool Agribiom. To the extent that Agrimonde enables an integration of analysis between different types of model of food production, trade and consumption against ecological constraints it succeeds in opening a space for debate and analysis. However there are limits in representing the cultural dimensions of interactions between technological, ecological and political economy e.g. with existing interests in biotechnology

versus eco-intensification solutions to poverty. Yet it does bridge technical engagement between agriculture and ecosystems specifically for meeting the MDG whilst also addressing dimensions of global versus regional trade and development as well as ecological sustainability. Furthermore Agrimonde is an initiative for ongoing engagement. It is a process that has been structured through the design and development of the platform as a space for interaction using scenarios and a quantitative tool for analysis of a sustainable future food supply.

An aspiration for Agrimonde is that it can open debate about different institutional forms of investment in agricultural futures. It will be interesting to see to what extent Agrimonde is able to integrate or address biotechnology in the eco-intensification of agriculture should it realise its aims for research direction. In this regard it remains unclear how the scenario-ing process and associated integrative platform will be exploited strategically in international contexts to reframe the debate based on the new calorific model that is a central innovation of the process. It may be that there will continue to be competing paradigms in the global food system and agricultural development agenda as evidenced in the IAASTD process (McIntyre et al 2009).

One criticism of Agrimonde is that it takes a technical view of the historical situation and does not open analysis to the cultural dimensions in which the situation has arisen. For example the higher caloric intake in the diets of OECD countries compared with others' indicates a power relationship situated by a colonial past of imperial development. The extent to which this still prevails in current global development paradigms reflects a wider difference and injustice in the representational access to resources within developing countries.

In the Energy Futures Forum (EEF) case qualitative scenarios were drawn up independently of the experts modelling the quantitative or technical dimensions[6]. This seemed to be addressing a concern about scenario 'ownership' being independently generated in the process of delegate deliberations. From this perspective it seemed to create an opportunity for delegates to 'work collaboratively' on issue analysis and problem solving in the context of issues arising from expert modelling and analysis. Nevertheless, the suggestion of expert impartiality is contestable. The assumptions of experts were embedded in the technical input they provided. So this apparent distancing of the subjectivities of experts was not 'real'. Nevertheless their lack of participation in the discussion of what to do with the technical information was potentially deleterious to the aims of opening a dialogue between research and development of static energy and transport fuel technologies. In critical reflection it would seem that the desire to separate expertise from the process of social learning (Gibbon et al 2004) may be a misguided reconciliation of scenarios with a technical analysis process.

Another potential dimension that worked to establish scenarios as a particular from of practice that meshed with formal institutions was the democratic process of voting on outcomes. Emphasis was placed on driving the generation of qualitative scenarios through the interaction of stakeholders. Scenarios were thus drawn up with the input of delegates through consensus building and formal mechanisms of voting as a means of giving democratic legitimacy to the process. However, looking at the delegate base there was an imbalance in its representativeness

[6] This includes the social uptake analysis, although this was largely a qualitative analysis based in participants perspectives, it resulted in a particular reification of activities as a set of characteristic attitudes generating certain behaviours (Little et al 2005).

with greater weight of industry representation. This seems to mask the importance of scenario praxis as a process through which interaction between unlikely collaborators (through the inclusion of a diverse interest base in the selection of participants) results in an epistemic and framing shift.

Epistemic shift is one of the potential outcomes of facilitating complex and uncertain systemic issues in which capacities for action are realised in the engagements between unlikely collaborators. The convergence following divergence of views that brings new insight to the issues occurs in the process of realising 'self' in relation to 'other' in interactions between the lifeworld-systems in which different participants operate. Divergence is likely to have occurred in the process of scenario generation. In the case of EEF epistemic shifts may have occurred in the scenario-ing of the citizens' panel where, through consideration of possible futures, they evaluated technological options for energy generation and so on. In the EFF citizens' panel shifts in attitude were documented as part of the deliberative process. Effectively scenarios are inviting deliberation over futures in which one's outlook may be altered, partly from exposure to the views of others and partly a result of imagining how one might subjectively respond to various possible futures.

Scenarios, as they have been informed and developed in the EFF, seem to do little to shift the parameters of technical analysis, except insofar as additional detail on technological uptake for distributed energy and road transport is provided. The question of stocks and flows that might represent a higher order of system analysis (Lennox and Turner 2004) does not become part of the emergent awareness of the interacting participants and the situations they occupy or in which they operate.

EFF was still reliant on the forecast and static representation of its advising experts in a mechanistic view of delivering output rather than engaging others in a process of developing joint understanding. The role of social learning requires ability for the accommodation of difference in values and to reconcile differences in coming to agreement on what to do over the limits of informed action (Collins and Ison 2009). EFF was not reliant on intellectual capability of analysts as interpretative agents in the context of social learning in which they could apply discipline knowledge, in conjunction with interpretative agency of stakeholders, to the analysis of scenarios.

In the Irrigation Futures of the Goulburn Broken (GBIF) case technologies for irrigated agriculture become one of the constraining variables through which discussions are configured and the way the future is looked at. From an ANT perspective it becomes the key transcription device through which scenarios are built. Such a technological configuration constrains how conditions are framed for analysis and leads to a limited view of other community and ecological dimensions germane to the region's future (see Walker et al 2009 on ecological constraints). Furthermore this framing limited the discussion of agricultural diversity as the potential to get more value out of water, such as integrating aquaculture with horticulture or by some other means, e.g., combining grains and intensive livestock or regionalising economics to support sustainable development that maintains a presence for agriculture under water constrained environments. It is unclear to what extent scenarios focused on the way water is used to deliver its outcome of flexible irrigation technologies.

Nevertheless the GBIF represents a useful development of scenario praxis that uses local knowledge and perspectives to generate a focus on research needs. From this angle GBIF offers an alternative framing to the expert-driven construction of scenarios in the other two cases.

Of the three cases GBIF represents the best model of using historical perspectives to generate an awareness and understanding of futures. It does so by connecting past and future to realise how events have altered the structured relationships between local institutions. This leads those in charge of qualitative scenario generation to include key plausible events in the construction of scenarios that reflect local frames of concern in relation to external drivers. However this does not go further to realise how such events can become triggers to realising new trajectories in development. In practice it can take time to surface different values and new possible relationships in response to events. Indeed this is mentioned in the GBIF evaluators' critique (Soste et al 2007a).

4.3 Emergent insights from case study comparison

Most reports of scenario praxis say little about the contextual factors that our framing of the situations brings into consideration. Thus there is a danger of producing a superficial analysis when it is based only on document analysis and not supported by ethnographic or other forms of qualitative research with those involved. For example, through personal relationships the framing for the Agrimonde case is more critical that published material reveals. This points to another problem common in the public sector, that of sanitising communications such that all too often many of the key conceptual distinctions are lost or hidden from view. A case can be made for research, possibly framed by our 11 questions, which is conducted in real time praxis of scenario-ing.

The insights that follow require a caveat – they are based on what is reported, not necessarily with what actually happened. Our adopted analytical framework (Figure 2 and 3) points to areas that warrant attention in future scenario-ing praxis:

- *History of situation* – this includes people's mental models and thus the framings adopted explicitly or implicitly. There would seem to be scope for more purposeful engagement with issues of framing and the reification of understandings in institutional arrangements and key metaphors. There would also seem to be scope for more attention being paid amongst those involved at the outset to issues of pre and post evaluation so as to trigger purposeful reflection and learning from the experience and to bring awareness of epistemic shifts to the group involved;
- *Stakeholding* – the viability, in the longer term, of any scenario process is likely to be proportional to the number of different perspectives designed in from the start. Question of diversity and balance of perspectives involved or opportunities for differences to emerge and contestations be realised need to be considered;
- *Stakeholding/institutionalisation* - key actor/s able to take advantage of the learning from scenario-ing by having power to act on the emergent insights appear implicit in the design and purpose of scenarios but probably need to be made explicit so as to optimise the sites for institutional change, e.g., investors are pivotal in realising the EFF potential but are not necessarily captured in the process of deliberation, likewise in the GBIF planning policy seems pivotal;

- *Facilitation/ history of the situation* – processes can lead to 'learning about the enemy' which strengthen positions of difference rather than lead to new ways of understanding and accommodation. Facilitation of joint learning processes through mediating technical devices or boundary objects like maps can surface different viewpoints to build interest in and support for a reconfiguration of disputed ground. However the need to surface tensions through differences in understanding requires an environment in which trust gives people confidence to voice concerns.
- *Epistemic constraints/ historical institutional frames* – all of theses cases seem to make at least a partial transformative shift from thinking in techno-natural objects to thinking in terms of techno-natural flows. This may be a reflexive action that supports a necessary re-conceptualisation in order to find better ways of being in the world – as conditions morph and flex to new forms of institution and awareness in global and other boundary-crossing transformations.
- *Facilitation/ stakeholding/ institutional constraints* – working in a more inclusive environment of analysis raises questions of the modes in which experts operate as guiding authorities on the nature of issues, historically through a process of separating objective from subjective experience (an apartheid of the emotions). The perceived need to distance the influence of technical advisors from qualitative scenarios analysis may be misguided where expert-lay dialogic interpretation and re-construction of the issue is missed
- *Epistemic contests on the nature of the issue* – divide and conquer or control and command approaches don't work well in a more fluid context of meaning making and learning. Limited means of interdisciplinary critique is realised in scenarios praxis where expert analysis is produced externally and added-in to the context. In the Australian context the nature of the issue is compartmentalised in different epistemic frames. The need for integration occurs by reconciling contradictions that reflects the dynamics of contest and the multi-institutional nature of wicked problems.
- *Institutionalisation/ epistemic integration* - relational capacity needs to be built as an ability for interpretation of situations as experienced so as to accommodate different interests and mediate the risk of falling into fixed positions. A matter for attention in scenarios praxis is creating a new language from the interaction of critique, a new view of the situation through integration of difference, by enabling different perspectives to surface different kinds of awareness of an issue
- *Facilitation/ institutions* – behaviours of conformity e.g., not to 'critique' or send up a message that will be badly received. Indication of fragile egos in positions of power or fear of loss of power in the wider context of ambiguity or what to do under conditions of uncertainty – a leadership that is comfortable with criticism. The 'surprising consensus' achieved suggests scenario-ing may have a tendency towards group think rather than critical analysis of alternative perspectives and thus multiple possible futures
- *Epistemic constraints/ institutional transformation* – breaking out of traditions and creating a conceptual reorganisation isdifficult while there is a denial that knowledge is, at least partially, socially constructed. We are active in the assignment of meanings to things imbuing them with an ethical relation by the way we represent an external reality. The nature of creating plausible scenarios means that there is limited opportunity for boundary crossing (new relationality) in spite of many dynamics in which an uncertain context arises. This entails a responsibility to see the world through the eyes of the other as a valuable asset to learning.

Scenarios are sociocultural representations, for example, the MA GO scenario describes a set of relations that structure how futures develop and embed particular expectations such as a focus on the individual, minimal regulations and confidence in technology, which represent a neo-liberal notion of global integration. They draw on technologies and particular framings of issues and invite collaboration on such framings. The effectiveness of this process will depend on the willingness of participants to support the framing, which can be problematic if more contested interests are drawn into the process. Such prior framing can act as a device to structure dialogue. However it may become a contested representation if there is a fundamental transformation of key participants in realising new relations of self to other.

Our case studies demonstrate how modelling readily becomes part of scenario praxis. But none reflect a concern for situating scenario-ing in a broader process design. We suggest this is an area for innovation and to this end provide a short outline of an example of scenario-ing praxis that has been conceptualised and enacted purposefully as part of a broader systemic design.

5. Framing scenario-ing as part of systems practice

An example of how scenarios have been used within a broader framing of systemic development practice is that developed by Richard Bawden of the Systemic Development Institute. As Bawden (undated) outlines in his workbook used with clients the logic behind his process design is that:

i. working out desirable and feasible strategies for the future is important for most of us, whether we are working in organisations in the public or private sectors or whether we are working in communities concerned with development. Formal management tools offer considerable assistance in this regard.
ii. many formal management tools are often reduced to little more than temporary and somewhat superficial 'fads' simply because they are adopted in isolation from each other, and because their theoretical and philosophical foundations are rarely explored, let alone embraced (e.g. many corporate and institutional approaches to strategic development).
iii. organisations need to develop ways of embedding management tools within a *systems thinking with scenario planning capability* as these are the two most powerful approaches to strategic development;

Bawden and SDI's approach is premised on the notion that there is much more to systemics than thinking, and there is much more to scenarios than planning i.e., '*both thinking and planning are but activities within the process of learning and so in essence what is required are capabilities for learning about the future from the future as we imagine that it might be'*. This approach to scenario-ing praxis is embedded in a broader framing of systemic inquiry and systemic development as outlined by Ison et al (2007b) and depicted schematically in Figure 4.

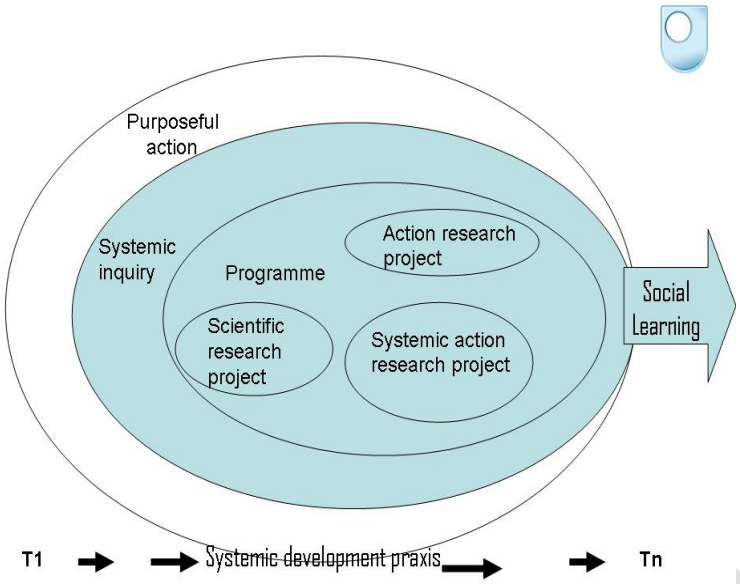

Figure 4. Different institutional forms for governing and managing purposeful action as part of an overall process of systemic development through social learning (Source: Ison et al 2008).

5.1 A multidimensional structure for exploring situations

Scenario-ing is used by Bawden to generate an holistic view of situations. This is done through the INSPECT process (Figure 5) which enables those involved to examine the interacting effects of a range of dimensions: natural, social, political, economic, cultural and technological on the historical emergence of a particular situation. In designing this process Bawden recognised that people have different constructions of these dimensions as they are linked to their particular ways of viewing the situation under investigation. This device enables a process through which different perspective can be brought to bear on how the situation is understood and where those involved are provided the opportunity to learn about difference. Appreciating difference is a necessary step in accommodating diversity and moving to accommodations which allow progress to be made.

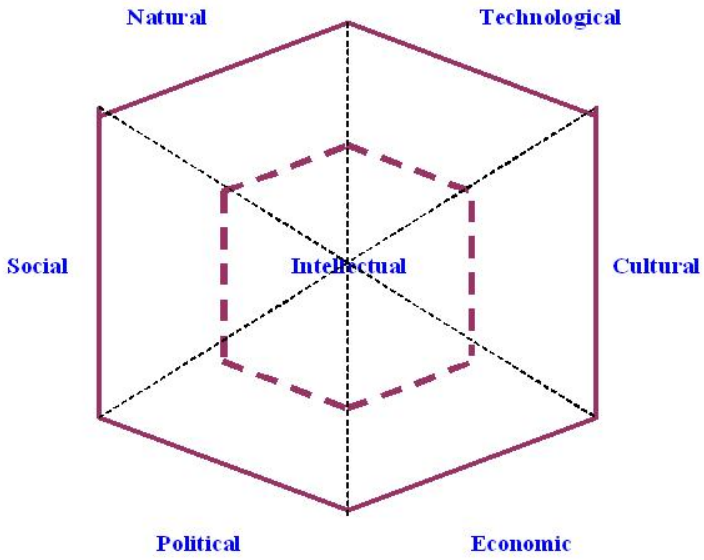

Figure 5. (I)NSPECT hexagraph for exploring situations in relation to different dimensions (Source: Systemic Development Institute)

Bawden's approach offers a particular means of engaging with the future through an exploration of tangible dimensions in the present that can give rise to particular pathways of development. His interest has emerged in a particular conceptual paradigm and practice of organisational development in which, building on Kitchener (1983), he sees the key elements of systems praxis as (i) dealing with matters to hand; (ii) dealing with ways of dealing with matters to hand and (iii) dealing with the limits to dealing with matters – beliefs about the nature of nature, of knowledge, and of human nature as a nested capability set.

5.2 Evidence from praxis

Bawden, based on many years of scenario praxis, and associated with the work of the Systemic Development Institute (see http://systemicdevelopment.org/), has developed a framework for both designing scenario planning/learning projects and evaluating their outcomes (Table 3). The effectiveness of praxis is essentially time-dependent - the more time the practitioner has (and the more serious the intention and commitment of the 'client'), the more capability there is to extend the focus of the exercise from the narrowest 'cell' (the First Order Transformation of strategic appreciation by individual participants) through to the most comprehensive (Third Order Transformation of the strategic direction of entire organizations and the establishment and development of a foresighting culture) – see Table 3..

Reflecting on his experience, Bawden says:

> '*I have been involved personally in different exercises that have spanned only some through to all of these 'targetted transformations'. There are times when, in a half-day quick and dirty exposure of folk to the scenario planning process, the target can be little more than First Order Personal Appreciation Transformation.*

> *When foresighting is included as only one aspect of a course in systemic development - as has been done in recent courses run for the Victorian Department of Primary Industries - the target transformations are extended to at least illustrate the flavour and significance of all three levels of individual transformation and, to a lesser degree, of group (collective) transformation. These are greatly reinforced in exercises when there are several spaced out days available for workshopping and researching the generation of rigorously developed scenarios by nominated participants and their critical application to the different stages of strategic formulation from the identification of relevant strategic domains through to the modelling of actual strategic intentions as human activity systems (following soft systems methodology or SSM – see Checkland & Poulter 2006) . It is these latter that have dominated my own foresighting work which has seen me working in more than a dozen such exercises over the years since 1990ish.'*

Amongst his many scenario-ing assignments, Bawden says that there have been only three actual scenario planning/learning projects where the grand aim has been "the bottom right cell" (along with all of the others as described in Table 3): whole organizational (or community) transformation with respect to embedding foresighting as a cultural norm in the process of strategic development (and this was the aim of those at Royal Dutch Shell back in the 1970s who first developed the scenario planning process). He goes on to say:

> *'I would have to admit that in none of my own three experiences were I and my colleagues successful at reaching this grand goal'.*

The three examples were:

1. A year long project with the Australian Business Foundation (ABF) a decade ago was too ambitious in that the target was not a single organization like the ABF itself but the entire Australian Business Community. While reference is often made, within the ABF, of the four scenarios that were generated at that time, they have not become pervasive as contexts for strategic conversations within the wider business community.

2. An eighteen month long project with (what was) the National Australian Institute for Teaching and School Leadership (NQITSL) was immensely successful at the individual and group level (55 senior teachers and principals from across all of Australia) but was scuppered by politics when it came to the 'highest' level of organization. This project was greatly confused by the fact that it was focused on the Future of the Teaching Profession - and not on NQITSL itself - and this is a profession that currently does not even exist. A couple of the scenarios that were developed by the groups were considered to be "too hot to handle".

3. A significant scenario planning exercise within a state government department which also proved to be "too hot to handle" and it died on the vine (or more accurately was killed). In this particular case the practitioners were threatened by legal action if they talked about the work in any public forum!! This is a cautionary tale for those who would play in the scenario/foresight sand pit!!

There are those in the literature who claim very considerable success across the matrix outlined in Table 3, including a number where whole nation states have been the target of the transformations, including South Africa, Canada and Singapore. Others claim great success within individual public service organizations as well as those within whole corporations.

Table 3. A matrix developed as a framework for both designing scenario planning/learning projects and evaluating their outcomes (Source: Bawden pers. comm.)

	Individual	***Task groups***	***Organization***
First Order Transformation **Scenarios and Strategies**	Personal Development of Strategic Appreciation Generation of Scenario(s) Identification of Strategic Domains	Development of Collective Strategic Appreciation Collaborative Generation of Scenario Sets Collaborative Identification of Strategic Domains of Relevance to Nominated Task Areas Collaborative Modeling Strategies as Human Activity Systems of Relevance to Particular Task Areas	Distributed Strategic Appreciation as Organizati Capacity Adoption of Scenario Set as Context for Strateg Developments Identification of Strategic Domains and Modeli Human Activity Strategy Systems Relevant to Organizational Strategic Direction
Second Order Transformation **Planning and Learning**	Development of Personal Strategic Planning Competencies Scenario Planning Method Competency Development Development of Appreciation of Individual Processes of Learning	Development of Collective Strategic Planning Competencies Scenario Planning Method Competency Development Collaborative Development of Shared Appreciation of Processes of Collective Learning	Development of Organizational Strategic Plann Capacities as functions of Distributed Group Stra Planning Competencies Development of Shared Appreciation of Processe and an Organizational Culture Characterised b Collective Learning
Third Order Transformation **Epistemes and Culture**	Personal Worldview (Epistemic) Identification and Development Development of Self-reflexive Foresight Competencies	Transformation of Collective Group Worldview and Reflexive Foresight Capacities	Transformation of Prevailing Organizational Worldview. Development of Organizational Foresight Capac through the Distributed Development of Foresig Competencies by Individuals and Task Groups a

6. Discussion - implications and recommendations

In reflection of the issues discussed in relation to our 11 points on scenario-ing praxis we suggest posing the following questions as a means for institutionalising scenarios in a form of systemic and adaptive governance.

- To what extent do scenarios open up new understanding?
- To what extent do scenarios bring together disparate people/perspectives?
- To what extent do scenarios provide an opportunity to realise 'self' in relation to 'other'?
- To what extent do scenarios generate higher order coordination?
- To what extent do scenarios offer a device for recognising historical conditioning/ logic of practice?
- To what extent do scenarios provide a space for critical reflection and redesign?
- To what extent do scenarios realise an integrated whole as a desirable performance?

The question of whether disparate people find something new in their understanding of 'the other' can generate new relational capital where a purposeful human system becomes aware of its limits to constructively impact on its environments. Each of the cases had particular limits in which issues were framed: as agricultural development for sustaining a future population within ecologically sustainable limits; static energy generation and transport fuels; and irrigated agriculture. Furthermore each of these were contained by a geospatial boundary in the humanly occupied global landmass, in Australia and in the Goulburn-Broken region. In each of these situations there are actors, stakeholders and others who are affected that are not drawn into the analysis. An awareness of where and how one draws the boundaries can focus attention to what gets excluded that may impact on any desired action resulting from analysis. As a simple example there are perceivable constraints for each of these which we have outlined in Table 2 as environments with which the scenarios interact. These constraints were acknowledged by the developers of scenarios but not used as a basis for exploration of how they might impact on actions taken. From this perspective, acting on the relational capital build through scenario analysis could be used to generate a system of monitoring and evaluation of the efficacy of quantitative models built to inform decision making and scenario building as well as the scenario process itself..

Table.2: Perceivable constraints that emerge from the ways that scenarios are framed

Case	scenario framing	perceivable constraints
GBIF	irrigated agriculture	ecological sustainability and community development
EFF	static energy generation and transport fuel	social or technological change that alters the course of development, such as the GFC; distributed community-based energy systems.
Agrimonde	ecologically sustainable global agricultural systems	biometric shifts arising in climate change, such as increased/ decreased plant growth in different regions

In practice these scenario case studies do little to link together the different dimensions of their analysis – economic, technological, sociocultural, biophysical – to build an interpretative capability between analysts and potential users of scenarios for exploring emergence (Norgaard 2008; Bawden and Espinoza 2010). Despite holding much promise in terms of the multi-institutional and past-future analysis there was a limited degree of linking scenarios to the dynamics of an integrated platform that could explore transformations in understanding and

practice. History provides a valuable reference to re-explore the conditions through which new technologies or institutions emerge. If viewed systemically, i.e., as arising in a complex set of relations between things, transformative potential may more readily be realised as developing relational capital between existing institutions of research and its applications. This may then increase the possibility for new organisational learning to support the emergence of desired goals realised in the practice of scenario-ing.

Furthermore there is a need to generate the capital that can respond to unanticipated events through the practices of scenario-ing by building the dialogic relationships between participating institutions. When future challenges arise a concerted effort in scenario-ing can start over, such that investments in futures may be adjusted to accommodate the new dynamic that challenges the present arrangements.

What Bawden refers to in 'dealing with the limits to dealing with matters' is the epistemological constraints through which we address issues, either individually or as a group or collective of people. These constraints are part of the cultural inheritance we acquire through living and being in the world that place certain socially acceptably conditions over what we witness and how we represent or document that. Such constraints are what inherently make us human. They provide a certain anchoring of perspectives that helps share and reach agreement on experiences and what constitutes an acceptable means of social (and technological and ecological) life. Nature itself is shaped in this anchoring. From this perspective what we witnessed is filtered through cultural norms. Our so-called reality is only a partial picture of existence mediated by cultural norms and practices.

Scenario-ing is thus strictly a means to generate a particular manner of living. Historically it has privileged a conversation about futures that, in most forms of scenario praxis, ultimately become connected to a conversation about the present**. More attention needs to be paid, we suggest, to conversations-in-context about the past, particularly the traditions-of understanding of those in the conversation (Russell & Ison 2007).** As an example take the concept of 'stationarity' in water engineering and modelling. Milly et al (2008) make the point that 'stationarity--the idea that natural systems fluctuate within an unchanging envelope of variability--is a foundational concept that permeates training and practice in water-resource engineering'. They further argue that: '…stationarity is dead and should no longer serve as a central, default assumption in water-resource risk assessment and planning' because 'climate change undermines a basic assumption that historically has facilitated management of water supplies, demands, and risks'.

It is when human organisations close off from experience that they stop learning about the interaction between things in social, technological and natural worlds. From this perspective unintended consequences are realised because those involved are unprepared to witness them happening; and that results from the fundamental problem of 'objectifying' nature. **Nature is objectified when humans stop participating and learning and reify the experience as an object of discovery. Unfortunately it has been the Western tradition in knowledge praxis that we can't see ourselves in its construction**. Western societies are too boxed-up in 'expert systems' and isolated from situational complexity (socio-techno-ecological relations) because of the tendency to reduce interpretation to linear causality through the search for evidence to

substantiate theory. This generates a rationality which can only be substantiated if nature is seen as outside of human experience, i.e., 'objectified'. By so doing, rejecting the co-constituted nature of actions, humans are left with little capacity to see the environment in which reactions and unintended consequences are realised.

In realising the move from participation to reification which characterises much scenario praxis we posit that 'making' decisions operates at the level of closing off of possible options, which reduces the capacity to realise alternative pathways. It is the closing off of possible pathways which is what 'science' (applied in this context) tends to do. Scenarios create conditions for choice by bringing certain realities into focus and the subsequent decision making is that which becomes deterministic in a 'path dependency' (Berkhout 2002). A fear of error in judgment often hampers the capacity to take any action on what is known to be a bad situation (Levidow 2001; Sunstein 2003). **A better understanding of how we close off the 'other' as a possible alternative pathway is needed to maintain an open end to learning such that actions can be taken in the present and revised in the light of experience which is purposeful in monitoring and evaluating the consequences of actions (Schuler 2008: 129).** If this approach is followed uncertainty becomes a resource for learning and development rather than background 'noise' for elimination in risk assessment and decision analysis (see also Berkhout et al 2002).

From our analysis we suggest the following implications emerge:

6.1 For policy praxis

Through a strategic awareness of self (body of government) in relation to others (diverse stakeholders) in the praxis of governing, scenario-ing praxis can become a resource for developing relational capital between policy makers and their constituent groups (who may be stakholders or may require their stakeholding to be actively built). However our view, exemplified in the three praxis cases, highlights the implications of lack of buy-in by key players who are likely to be pivotal in institutionalising the outcomes of scenario analysis. In the case of Agrimonde it is the international negotiators in world trade and development interests. In the case of EFF it is the public and private investors in new energy technologies in generation and supply. In the case of GBIF it is the regional planning institutions and policy developers that can veto creative change. This would suggest that scenario praxis could benefit from application of systems techniques which identify key institutional actors in the environments they seek to affect and build in their participation and ownership of the process.

6.2 For future research

There is a set of emergent issues in the practice of scenario-ing that can be used to drive improvement (as identified above). Furthermore, our analysis draws from theory of systems as a broader analytical framework for utilising scenarios in which scenario-ing as part of business as usual practice could be explored.

6.3 For governance

The implications for governance are in the importance that scenario-ing could play, through its capacity for forward thinking, if contextualised in a higher order 'learning system' (see below) as an innovation in systemic and adaptive governance. Scenario-ing however, needs

to be reconciled with experience so actions taken based on scenarios can be re-evaluated against expectations and outcomes. Scenario praxis is essentially an active research agenda that warrants further investment. The process of systemic development praxis (Figure 4) also offers a model in which scenario praxis could perform as a *thinking technology* in the space of programmes that implement social learning, in any of the activities of scientific research, action research or systemic action research.

6.4 For capability-building

Our findings suggest that there is clearly a need for greater awareness of the socially constructed nature of knowledge. The social construction of knowledge, in its weak form, provides a means to investigate how cultures of understanding and practice constrain the ability to see a situation differently. Social learning, if pursued purposefully through the practice of scenario-ing, provides a possibility in which actions can be taken with confidence to begin to create a future that we would want to live (Haraway 1991). Such a future is not something owned only by policy authors and directors but by people who implement and are affected by policy as public servants and ordinary citizens (Fischer 2009; Jasanoff 2007). We suggest that the means and processes for social learning as collaborative inquiry in which a better understanding of relations of self to other is created can lead to greater confidence in taking action and at the same time address widespread critical distrust in scientifically knowable futures.

6.5 For 'learning system' designs

Consciously taking a design turn in the pursuit of scenario-ing as a practice opens up an opportunity to address, in the one process, first and second order learning processes (e.g., learning about a situation or issue of concern as well as learning about the learning processes of pursuing tan inquiry). With awareness and skill the outputs of first and second order learning process can become inputs to subsequent designs of learning systems operating at different levels of organisation e.g. the developers of Agrimonde, if they were to see the outputs of their process as inputs to a new learning system, say one to engage the international policy community, then they would exemplify truly reflexive practice as well as opening up new pathways for learning and change in a systemic and adaptive manner.

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Appendix 1

Table A1: Eleven scenarios praxis concerns examined for each case

Praxis concern	Agrimonde	Energy Futures Forum	Irrigation Futures
1. Doing the work to reach agreement to use scenarios for some purpose;	**Conducive institutional setting:** • articulated strategic concern; • research needs of meeting Millennium Development Goals for feeding forecast global population in 2050 within the ecological limits of sustainable development; • extant community of interest - researchers involved in future food supply studies; **High level buy-in (stakeholding):** • through the engagement of the directors of INRA and CIRAD; • working from the perspective of reforming international agricultural research systems; **Attention to framing:** • strategies and options to define priorities at an international level; • a mechanism for reflexivity and in-depth discussion amongst future food supply researchers; • to contribute and shape international debates on sustainable food production in global and regional development	**Initial starting conditions:** • CSIRO Energy Transformed Flagship had thought about an energy stakeholder forum at its inception. **Conducive environment emerged**: • after two years of encouragement and input from industry and government, enhanced concern about the future of the energy sector came at a critical moment e.g climate change and emission abatement; end of life cycle of current infrastructure; and growing demand pressures on energy supplies. • mismatch between infrastructure life cycle and a highly uncertainty investment environment created a desire for a *consensus building process* to enable discussion about futures across community, government and industry stakeholders	**Local leadership in a 'crisis':** • this was the initiative of a small group of community leaders confronted with challenges of climate uncertainty (drought), water trading and movement, and global market variability; • secured DPI buy-in and resources; • unclear what stakeholding was built in wider community as a primary focus was on facilitating key stakeholders building consensuses on preferred regional options for future irrigation, and recommend regional follow-up actions.
2. Process design for using scenarios in a specific context;	• A platform was designed for facilitating collective scenario building among a research community of interest, along with a model that could integrate quantitative and qualitative data.	• Process developed and implemented as a model for use in similar contexts integrating economic modelling, risk analysis and social uptake mapping in the development of qualitative scenarios of future energy paths with forum delegates. It was assumed that energy sector would have to transform to meet new social, economic and environmental demands.	• The process was to be developed as a methodology that could be applied elsewhere, for experimental use of scenarios modelling in a context of uncertainty, to support similar decision contexts. • Technical input from locally generated 'best available' knowledge and process of regional stakeholders' engagement in

			qualitative scenario development was facilitated by a professional engagement team. • Stages were designed to adapt processes to knowledge gained as process of project development, capturing community perspectives, conducting analysis, and enabling change by examining the implications in collaboration with agencies and organisations
3. Scenario building (who, when? Who learns? Who participates?);	• a first phase comprised expert analysis, discussion with advice from key stakeholders in the re-processing of two existing scenarios for the specific purposes of comparative analysis. At this stage experts were involved in learning in the development of a quantitative tool and scenarios to support an integrated analysis of agriculture and ecological systems. • scenario building between 2006 and 2008 was seen as the initiation of a platform for continued discussion that could integrate other economic and biophysical models of agriculture and ecosystems. • Platform participants included a research team, governance committee and expert panel comprising researchers from INRA and CIRAD and other French institutional actors with an interest in global agricultural research and development.	• scenarios were built by forum delegates comprising representatives of energy industry sector, government, and public interest organisations; • each involved qualitative processing of quantitative and modelled analysis using methods of consensus building and voting rights. Technical input was provided from economic, climate rand social analysts but analysts did not participate in the qualitative dimension of scenario generation. Therefore technicians learnt nothing of how forum delegates recognised and reconciled differences in their worldviews for generating a discussion framework. • Technical analysis and scenario building was conducted over a 21 month period between 2004 and 2006. Forum delegates included key industry organisations in transport and static energy, environment and social public interest groups.	• stakeholders within the regional community were engaged in a series of four forums to formulate scenarios, explore impact, consider implications, and develop appropriate response strategies. • a technical working group (TWG) was selected for the purpose of analysis from voluntary forum participants to achieve diversity of experience and expertise in the group to discuss and analysis inputs and generate scenarios. • The TWG met 18 times over a year from May 2004 to June 2005. Four workshops hosted in six centres with a total of 120 community and regional stakeholder participants. Forum participants included key regional institutions such as the water authority, catchment management authority, local Shire, and community and irrigation industry interests.
4.Possible contributions to epistemic (and worldview) shifts of those who	• new modelling parameters that enable a view of the world and role of agricultural research within it in were developed but there is no evidence of whether or how epistemic shifts were made.	• surprise in the degree of convergence in the group thinking regarding generation of scenarios is reported. However it is not clear whether new relationship formed in which questions of how scenarios were	• the report documents surprise in the degree of convergence in the group thinking regarding the generation of scenarios. • evaluation focused on community

participate in scenario construction;	• nevertheless gathering and using historical data in this way gives rise to new way of conceptualising the relationship of research to the problem. Novelty and analytical capability emerged from the discussion and development of design parameters for those involved in scenario generation. For example an analytical language was built around calories in biomass resources and use in food production to trace plant, animal and human calorie transfer. • the process generated a common sense of language and meaning which in turn creates an issue when it has to be conveyed to others with vested and embedded interests; this process is yet to be realised in the international debates it is intended to address.	generated and confidence in meeting future challenges was built. • the level of transformation that leads to energy and transport sector innovation is yet to be realised and is not something that the report or process captures. • based on the outcomes in terms of areas of investment in research and development there appears to be two key transformations proposed: (i) the view that a mix of low emissions technologies would produce the lowest cost energy futures and (ii) end-user efficiency, demand management and urban design will work in conjunction to lower costs and GGE	capacity building and an assessment of efficacy and changes in thinking; • understanding and confidence was gained from involvement; • shifts in awareness of social issues, e.g., from a negative to positive view of 'lifestyle properties' occurred, yet others felt that there was not enough discussion of issues to change understanding, most prevalent in relation to economics; • changes in understanding of other viewpoints occurred but not necessarily a shift in respect for difference, (the process may have strengthened existing positions); • a profound personal change was reported by TWG participants in how they viewed and responded to irrigation issues in the region or in their personal confidence. • significantly the process provided a space to engage in 'debate without attacking', an important social function of coming to terms with uncertainty and reasoned debate without seeing things in black and white; • changes were reported in broadening thinking about futures, a more realistic understanding of the potential of growth and willingness to speak in public forums. • changes in strategic thinking as a result of having a better understanding of the industries in the region was gained from interaction with other members; • one of the new domains that emerged from the process was a flexible form of irrigation technology, which indicated a key transformation from the static view of supply, delivery and use of water.
5. Reification of	• existing scenarios from the Millennium	• technological advisors were not part of	• scenarios were generated by the TWG

scenarios – how etc?	Ecosystem Assessment (Global Orchestration) and Michel Giffon's sustainable agriculture scenario ("Doubly Green Revolution") were re-processed using data sets on population, diet, production and trade statistics. • Agrimonde was framed as an integration platform that could work with other models of ecosystems, food production and consumption. • a new lens for framing the issue as one of caloric interaction between species at regional and global scales and to generate a view of balance between biomass resource base and use in human activities. • provided a view of the world that could enable new conversations at the level of international relations.	the qualitative scenarios analysis - rather the reification of scenarios had to be driven by stakeholders interacting in their development. • this seemed to be addressing a concern about scenario 'ownership'; • however the assumptions of experts were embedded in the technical input they provided. So this apparent distancing of the subjectivities of experts was not 'real'; • their lack of participation in the discussion of what to do with the technical information was potentially deleterious to the aims of opening a dialogue between researchers and developers; • scenarios were drawn up with the input of delegates through consensus building and formal voting to 'give democratic legitimacy to the process', but the delegate base was imbalanced in its representativeness with more industry representation. • nine scenarios were generated based on 'key drivers' in energy technology futures	who transformed 28 scenarios generated from regional community forums into four key narratives, drawing also on technical input from a technical advisory panel focused on best practice; • in evaluation there was criticism of the lack of detailed economic analysis as applicable to the region *but* the slow deliberation in consensus building was valued as best practice in scenario building; • the process of engaging the community was documented as a guidebook along with scenarios for use of others and analysis of complex open systems.
6. Using scenarios in communication with others	• scenarios are re-processed not just as a means of information transmission but are reflected on, critically assessed and re-interpreted in view of objectives and so on. • an expectation is to contribute to discussions of international standards and to develop concepts, rationalities and results that apply to future food studies and global agricultural development; • communication is aimed at enabling a 'scientific', 'reasonable' discourse, 'commonly' accepted by experts to shape actions of international organisations and	• scenarios seem to be used to legitimate discussions in technically informed debate amongst stakeholders in the energy sector. • using economic, technological, social and climate risk inputs to communicate with those producing qualitative scenarios. • there was broader circulation of the scenarios with wider industry groups, although it is not clear whether this process meant direct engagement and discussion of them with those who participated in the process as deliberative delegates or technical analysts.	• the design and process was for using scenarios and learning from them to embed in others' planning processes. • in the report document it's not clear how or whether those involved in the scenarios generation process were linked to organisation and groups that were involved in planning. • there was a deliberate attempt to link the scenario praxis to existing planning activities by encouraging those involved to translate their experiences to planning organisation.

	most governments; • the scenarios and modelling tool are designed to influence international negotiations on agriculture, trade and development aid and debates that support the action of multilateral organisations.		• irrigation futures scenarios were reported as being incorporated into planning activities of regional organisations GMW, GBCMA, and to a lesser extent in SCC
7. Using scenarios as mediating technical objects (actor network theory)	• Agirmonde scenarios are a translation device that acts to develop 'interessment[7]' on poverty and hunger, development and ecological dimensions of future food supply. • Agribiom enables translation of other modelling activities into a quantitative tool to envisage and debate possible futures and articulate means of realising them. • as with existing models and practices Agribiom renders a view of regions and the globe as sites of food production, population and trade flows. • the social, economic and ecological dimensions are technologically mediated by the construction of flows of calories and biomass balance in production and consumption for a regional-based accounting system. • Agrimonde reconfigures diverse technologies in each future food study to an integrative tool and model for comparative analysis of futures with existing knowledge resources.	• the qualitative scenarios and their respective economic modelling, climate impact and energy technology uptake assessments offer a form of abstraction on relationships of human behaviours. • there is a recognised limitation of prediction in cultural responses and emergent technologies; instead analysts focus on the existing capabilities of the known technologies and the cost effectiveness of them as plausible alternative futures for energy generation and transport. • some social dimensions are modelled such as the use of distributed energy sources that are localised but the significance of things like change in the global financial market or the effects of distributed technology availability on local consumption or the regionalisation of markets are not included in the modelling; • the generation of technical models and analysis is based on current plausible alternatives - qualitative discussion is configured thus by the technical models that are claimed to have 'no influence' on the qualitative analysis.	• plausible futures for planned irrigation were generated explaining the extent of driving forces, regional response and flow on impacts relevant to irrigation infrastructure. Scenarios represent possible opportunities and future challenges over 30 years. • possible events are used as triggers to structure a response, and are indicative of how situations shape social responses, based on plausible actions but not to be taken as future policy intent. • scenarios intended to stimulate discussions on strategic approaches to irrigation infrastructure planning, and how the region can ensure its robust under a range of possible futures. • scenarios used as a means of mediating past and future where past drivers of change were examined and aspirations for irrigation futures extracted as values and used to explore indicators of community aspirations in scenario analysis. • flexibility in future irrigation becomes an emergent consideration in which technical input is sought from consultancy on flexible future irrigation technologies;

[7] Interessment is a term coined by science and technology studies scholars Bruno Latour and John Law to indicate how various stakeholders in a technology are actively interested and drawn into engagement with the technology by its designers or proponents. This entails using the technology to think differently about their own environment and practices in performing certain routine tasks which otherwise might have unknown presence or effects on their practices.

			• scenarios also generate a number of other spin-off projects including an education module for high school students and a land use planning workshop with local shire executives and planners. • a practicing entrepreneurial perspective is also generated as a model of constraints in realising alternative possible futures.
8. Managing the participation - reification duality of scenario praxis;	• the expert panel chose the scenarios to build and the principles underlying their construction. They then quantified inputs, region by region, on food biomass resources and uses. The regional state of resource-use balance as well as the coherence of scenarios and comparison, and identification of levers of action specified the qualitative dimensions to complete descriptions for 2050 scenarios. • the intention of Agrimonde was to analyse the MA scenarios in depth and to translate them to food and agriculture scenarios. The implications of the scenarios are discussed, e.g., questions such as what changes are feasible, necessary, desirable, that enabled structured arguments as to the most desirable, necessary, feasible and raised new questions to consider in depth. • possible interpretation was made on three main points (not as consensus) in a revival of debate and raising new questions for future food studies: diet changes and food behaviours; technological options; and trade and regulations.	• in EFF technical input was deliberately separated from delegates as a source of advice and information to support the task of qualitative scenario generation. • Economic modelling used two existing models of Auregion and GTEM (ABARE) and developed a third to specifically address the energy sector (ESM) (ABARE and CSIRO; Graham et al 2005). • the strands of technical analysis were drawn together at the end of the process, which represents an analysis that ensured clear divisions between actors in different fields (in this case 'everyday citizens', 'industry stakeholders' and 'technical experts' rather than using their expertise to counter positional viewpoints and lead to learning. … • raises questions of how scenarios get locked down...	• the process of locking down meanings and descriptions was done with the committees of the organised structure, namely the GC and the SRC. However a long process of TWG analysis and its engagement with technical advisers translated the material from 28 into 4 scenarios to support decision making. • technical advice was sourced from local irrigation research and global developments. • this case, of the three, represented the longest of the deliberative processes in scenario generation that integrated local community perspectives with technical advice raising questions such as: - to what extent did these change the way the key regional institutions operate both at the level of formal arrangements (CMA, GMW, Shires) and at informal practices of social norms? - are people engaged in a process that creates critical awareness of the limits of scenarios and how they can help realise alternative futures and break from unsustainable pathways? - did participation help to decide useful abstractions and then put them into operation through decision support ... then

			monitor and evaluate against learning from observation thus driving a need for future participation and scenario-ing?
9. Scenario praxis as a means to mediate a strategic conversation;	• opened up dialogue amongst researchers to focus diverse inquires on food supply futures. • accounting for current status with existing data and integrating research activity was postulated as the space for providing direction. Discussion could then focus on the extent of and direction for regulation involving trade and environmental concerns. • discussion sought 'ecological intensification' of food production in which new technologies could integrate social and ecological parameters into economic development performance. The researchers were working to generate a scientifically robust analysis to engage wider international development debate in food and agriculture futures	• encouraged a discussion amongst research stakeholders to explore the possibilities for static energy and transport futures. • scenario discussion was designed to support investment in the sector and to direct R&D to support reaching the goals of emissions abatement and energy use efficiencies. • scenarios praxis was framed by the urgent need to act with respect to reducing the impact of human activities on climate. • EFF involved a strategic conversation about energy and research futures directed toward abatements and efficiencies, and working to initiate futures discussion with key sector stakeholders as a means for collaborative direction in energy futures investment.	• supported a regional community engagement about possible futures of irrigated agriculture in region. Strategic conversation held during and after the development of scenarios. • it was largely the technical working group that participated in the scenarios reification although this was mediated by conversations with other parties. • there were two dimension of strategic conversation: engaging communities in futures discussion, analysis and development of futures scenarios; and opening further discussion within existing regional stakeholders in resource planning. • some attempts to communicate scenarios with strategic others (Shire planning) met with difficulties that could not be mediated by the processes employed or reifications produced
10. Appreciating institutional constraints and possibilities to the on-going conservation of point 8;	• there was a commitment of the leading research institutions to support development of a discussion platform with a quantitative tool that could be applied in multiple settings of agriculture and food development with other data sets and models. Agrimonde was described as an integrative platform. • two steps have not yet been realised to embed this process in international interactions. One is the extension and inclusion of others as stakeholders in the activities of analysis. The other is the process of evaluation of the tool in light of	• purpose of EFF was one-off to support direction of new institution but not capable of future reflection of developments. • the tool as the, technical basis, quantified models and reification of scenarios is there for future analysis, possible us in other settings; • institutional constraints were seen as issue not solvable by acting in isolation. • changes in funding support from existing stakeholders resulted in issues of succession and how ongoing support was realised with withdrawals from process.	• funding provided specifically for project design and methodology capture to support other similar activities with method but little in the way of ongoing resourcing of activity; • there were limited processes of engaging in strategic conversation with planning bodies through the IF tool; • there was no support or discussion of revisiting activity of scenario-ing or using approach in other contexts e.g. population change with shire as a regional development dynamic - IF represented an isolated view of the region with limited

	new knowledge, e.g. when the effect of institutional change takes place.		regard for the ecological or broader community context.
11. Scenario praxis as a form of systems praxis contributing to social learning.	• Agribiom invites the possibility for its use in other contexts beyond the question of how the tool can be used to support research direction but it is not clear what response will be realised and how Agribiom will mediate various interests of those not involved in its development • there were plausibility concerns, ensuring that the tool for scenario development could work with existing data and results. • the platform had to work as a system of interaction with a range of experts as researchers, deciders and more generally, stakeholders and actors. While there was possibility for historical analyses of data there was no overt use of cultural analysis in the data tracking process. • facilitation was oriented toward agreement on a technical basis and it is assumed that the cultural basis of resource flows is unproblematic, and the conquest for ecological modernisation a driving assumption in sustainable food production	• as a form of systems praxis there was limited social learning between experts and stakeholders in EFF - it seemed important for the organisers to keep experts at a distance from interpretative discussion of forum delegates, as sources of technical advice and free of subjective judgements. • the citizen panel offered the only evaluative exercise. This is a good technique for supporting institutional reflection not employed in other case studies; • there was limited awareness of constraints between lay practices and industry knowledge and the possibility for innovative thinking was limited and a great opportunity for collaborative research design was lost; • EFF was not enlivening scenarios praxis in an ongoing dialogue with multi-institutional and multidisciplinary actors. It represented a "jigsaw" model of systems praxis in which the richness of dialogue across diversity was limited to the realisation of relationship of self to other in economic relations of consumer and investment choices. • capacity for realisation of collective agency in social and technological innovation for action under conditions of uncertainty was therefore limited.	• the core team of TWG did the most learning. This limited 'system' building for enabling the presence of an ongoing irrigation futures forum with external parties with a stake in GBIF. • There may have been some significant transformations of the members of this group with potential to lead to an ongoing institutionalisation of scenarios praxis. However that cannot be assumed. • it is unclear whether the practice of scenario-ing has become normalised within planning processes of the regional groups and organisations. • a greater capacity of group to dialogue with others on futures has the potential to increase future collaboration of regional planning and socio-technical innovation. A key aim was to develop leadership discussion and in this respect it was an effective tool for enabling social participation and cultural change relevant to future irrigation polices and instructional design. • there was a limited opportunity to reapply the scenarios themselves to other contexts, e.g., shires, CMAs and GMW because focused on reification rather than expertise and insight gained from participation. • GBIF was industry led which means that the constraints of socio-ecology were not viewed or drawn into the picture. Rather environments and community analysis were added to the focus of the future systems in irrigated agriculture.