Managing Technological Transitions:
Prospects, Places, Publics and Policy

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1. Introduction

Transition management (TM) approaches have generated considerable interest in academic and policy circles in recent years (Kemp and Loorbach, 2005; Rotmans and Kemp, 2003). In terms of a loose definition, a 'transition can be defined as a gradual, continuous process of structural change within a society or culture' (Rotmans et al, 2001, p.2). The development of TM, much of which has occurred within the context of the Netherlands, may be seen as a response to the complexities, uncertainties and problems which confront many western societies, in organising 'sustainably' various aspects of energy, agricultural, water, transport and health systems of production and consumption. Problems such as pollution, congestion, the vulnerability of energy or water supplies and so on are seen as systemic and entwined or embedded in a series of social, economic, political, cultural and technological relationships.

The systemic nature of many of these problems highlights the involvement - in the functioning of a particular system and any subsequent transition - of multiple actors or 'stakeholders' across different local, national and international scales of activity. With this in mind, such problems become difficult to 'solve' and 'solutions' are seen to require systemic innovation rather than individual or episodic responses. The point being that 'these problems are system inherent and… the solution lies in creating different systems or transforming existing ones' (Kemp and Loorbach, 2005, p.125).

In this paper we critically engage with and build upon transitions approaches to address their 'applicability' in the context of the UK. In doing this the paper addresses the prospective potential of transitions approaches, but also their relative neglect of places and publics. Through developing an argument which addresses the strengths and 'gaps' of transitions approaches we also analyse the resonances and dissonances between three themes – cities and regions, public participation and national hydrogen strategy – in the transitions literature and the UK policy context.

The paper is structured in five sections:

- Section 1 critically engages with transitions management by reviewing the key concepts, claims and shortcomings of the approach.

- Section 2 examines the omission of place in transitions approaches and begins a process of addressing this 'gap' by developing a conceptual and empirical understanding of cities and regions in transitions.

- Section 3 examines the relative neglect of publics in transitions approaches and develops a framework for broadening participation in managing transitions.

- Section 4 takes the key themes from previous sections and analyses the 'fit' with UK policy through the example of the development of A Strategic Framework for Hydrogen Energy in the UK.

- Section 5 concludes by summarising key research and policy implications.

2. The Management of Transitions: the Importance of a Systemic Focus

2.1 Introduction

System innovation focuses on radical societal change and acknowledges a requirement, in the 'long-term', for a multiplicity of forms of innovation. The interdependencies inherent in systems may require innovation in terms of processes of production and consumption and, as such, innovation in technologies, institutional configurations, new organisational forms, new forms of knowledge and reflection on the (changing) role of government and policy. System innovation does not preclude system improvement. This is important to note as:

> 'Transition management tries to utilize the opportunities for transformation that are present in an existing system. It joins in with ongoing dynamics instead of forcing changes. Transition management also implies refraining from large-scale investment in improvement options that only fit into the existing system and which, as a result, stimulate a "lock-in" situation' (Rotmans and Kemp, 2003, p.20).

The point here is that both radical societal change and unfolding change within existing systems are 'needed for sustainability'. Having said this and acknowledging in many ways that 'the goal of sustainable development has been accepted' the background to the development of transition management is predicated on 'a paucity of concepts and tools to work towards it' (Rotmans and Kemp, 2003, p.6).

This becomes a particular issue in contexts of liberalised, privatised utility and infrastructure provision, where the potential for numbers of vested interests and

stakeholders is increased. This multiplicity and variety of stakeholders involved in a given existing system is an important focus in understanding the *transition from*, but also informs the shaping of *transition to* where the issues of how potential alternative system transitions develop 'are characterized by processes of variation and selection, by a variety of new ideas and techniques of which many "die", and only a few will "survive" and grow out into large-scale developments' (Rotmans and Kemp, 2003, p.14).

Leading proponents of TM suggest a general definition which acknowledges the long-term, multi-stakeholder, iterative, processual and stepwise steering of transitions, claiming:

> 'Transitions are transformation processes in which society changes in a fundamental way over a generation or more. Although the goals of a transition are ultimately chosen by society, governments can use them to bring about structural change in a stepwise manner. Their management involves sensitivity to existing dynamics and regular adjustment of goals to overcome the conflict between long-term ambition and short-term concerns' (Rotmans et al, 2001, p.1).

The complexity and interconnectedness of different aspects of transitions are highlighted:

> 'A transition can be described as a set of interconnected changes, which reinforce each other but take place in different areas, such as technology, the economy, institutions, ecology, culture, behaviour and belief systems. A successful transition is a spiral that reinforces itself, driven by multiple causalities and co-evolution. A pre-requisite for transitions to happen, is that several developments in different domains at different scale-levels come together to reinforce each other' (Rotmans and Kemp, 2003, pp.9-10).

The rest of this section therefore focuses on the following issues: first, can transitions be managed; second, how transitions are conceptualised; third what are the key transition phases? And finally what are the key shortcomings of transitions approaches?

2.2 Can transitions be managed?

A question that arises from advocating or highlighting systemic transitions is: are such transitions manageable? This, of course, depends on what we mean by 'manageable'. Given the acknowledgment of systemic problems, the uncertainty about how to 'solve' such problems and the timescales involved, tight management to achieve a specific goal is not what underpins transitions management, rather the emphasis is on *steering* transitions.

That is to say, transitions 'cannot be managed in the classical manner of full control and supervision, due to the fundamental uncertainties and many surprises on a transitional pathway. However, transitions can be managed in terms of influencing and adjusting: a more subtle, evolutionary way of steering' (Rotmans and Kemp, 2003, p.15). Transitions with an emphasis on sustainability thus focus on environmental, economic and social aspects which are predicated on a 'basic steering philosophy…of *modulation,* not dictatorship or planning-and control' (Kemp and Loorbach, 2005, p.132, original emphasis). The 'how' of steering or modulation we will come to in the next section, but we can highlight five key aspects and insights from TM (see Rotmans et al, 2001, p.8; Kemp and Loorbach, 2005) that strategically underpin the steering approach:

The first of these situates short-term policy within the framework of longer-term thinking and ambitions rather than specific goals. This acknowledges the incrementalism of transitions but situates stepwise movements within a wider framework.

The second point highlights the multi-level or multiscale focus of transitions, the emphasis on multiple domains and the multiplicity of different actors involved. An important example of multiple domains can be seen in the area of different departmental policy agendas. TM emphasises a focus on 'connecting' these domains but given its loose notion of control, dialogue and unfolding learning offers the potential for the maintenance of departmental agendas.

Thirdly, the focus on the two issues above places an emphasis on learning and processes of learning-by-doing and doing-by-learning. It highlights that the role of policy in systemic innovation requires ongoing iteration between 'problems', policy interventions, existing systemic contexts and the possibilities of system innovation. A key facet of TM is thus around ideas of anticipation, learning and adaptation. The fourth issue highlights the importance, raised above, of a dual focus on system innovation and improvement. The final point being that such an approach to confronting uncertainty keeps a large number of options open.

This relationship between the short-term and the long-term means that transitions have both content goals and process goals. In the short-term, policy actions and interventions

become assessed in terms of immediate targets or in respect of their contribution to the overall longer-term transition. A set of longer-term societal goals steer and are steered by processes of anticipation, learning and adaptation, which are crucial to linking up short-term measures to a long-term framework.

This highlights that the role of government must be seen in relation to this two-fold – content and process – approach. In terms of content, there is a role for government in 'realiz[ing] certain content objectives such as CO_2 reduction…and to make sure that the process of variation-selection is working well' (Rotmans et al, 2001, p.12). The process role is really about 'creating the conditions' within which transition processes can occur. Having said this, the role of government will be different at different points or 'stages' of the transition (we will return to the issue of stages). This is to acknowledge: 'The role of government in transition management is thus a plural one: facilitator-stimulator-controller-director, depending on the stage of transition' (Rotmans et al, 2001, p.11). This obviously asks bigger questions about how transitions are conceptualised and occur.

2.3 How are transitions conceptualised?

In conceptualising transitions the ideas of levels and phases become important. Focusing on levels, transitions approaches highlight a multi-level approach on three interconnected levels, landscape, regime and niche, through which the aim is to address not only the '*creation* of technology, but also its diffusion and *utilisation*' (Geels, 2004, p.898, original emphasis).

The 'nested' levels (see Figure 1) of landscape, niche and regime 'are not ontological descriptions of reality, but analytical and heuristic concepts to understand the complex dynamics of sociotechnical change' (Geels, 2002a, p.1259). This being the case the concept of landscape is important in seeking to understand the broader 'conditions', 'environment' and 'pressures' for transitions. The landscape operates at the macro level and focuses on issues such as political cultures, economic growth, macro economic trends, land use, utility infrastructures and so on (Geels, 2002b, p.369).

Figure 1 Technological Transitions: landscape, regime and niche
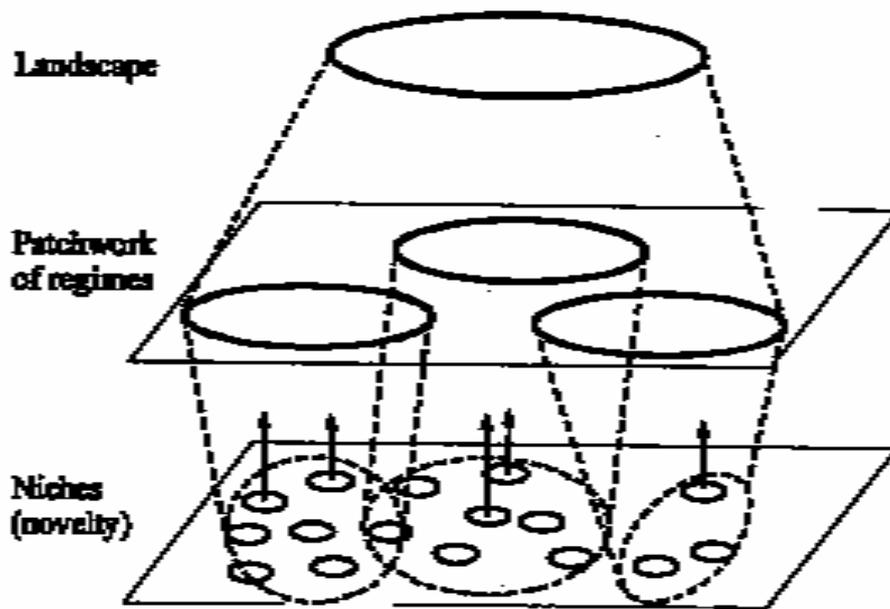
Source: Geels 2002a

The concept of regime, which operates at the meso level, relates to existing or incumbent technologies being intertwined within a configuration of institutions, practices, regulations and so on, where configurations impose a logic, regularity and varying degrees of path dependencies on technological change. Regime is defined as: 'the whole complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, established user needs, regulatory requirements, institutions and infrastructures' (Hoogma et al, 2002, p.19).

The emphasis on regimes highlights the enablement and constraints on new technologies breaking through whereby incremental evolutionary change may be more likely than 'revolutionary' change:

> 'Such reconfiguration processes do not occur easily, because the elements in a sociotechnical configuration are linked and aligned to each other. Radically new technologies have a hard time to break through, because regulations, infrastructure, user practices, maintenance networks are aligned to the existing technology' (Geels, 2002a, p.1258).

Regime we may see not only as interrelated in the nested hierarchy of levels but also through patchworks of related regimes (Geels, 2002a, 2002b), including, for example, science regimes, policy regimes, technological and product regimes, etc (Geels, 2004).

The idea of socio-technical niches, which operate at a micro level, is one of '"protected" spaces in which actors learn in various ways about new technologies and their uses' (Geels, 2002b, p.365), where innovation and processes of learning by trying keep alive novel technological developments which otherwise may be 'unsustainable'. The concept of a niche provides a basis for addressing an appreciation of the circumstances within which we might understand the development of radical innovations where initially 'commercial viability might well be absent. [For example] The first applications of electricity at world fairs, theatres and public events had symbolic value; they brought excitement' (Hoogma et al, 2002, p.25). This requires 'special conditions created through subsidies and an alignment between various actors' (Geels, 2002b, p.367).

This necessitates a premise on highlighting the promise and expectations of hitherto 'unproven' technologies where to 'get the new technology on the agenda, actors make promises and raise expectations about new technologies' (Geels, 2002b, p.367) where these promises 'are especially powerful if they are shared, credible (supported by facts and tests), specific (with respect to technological, economic and social aspects), and coupled to certain societal problems which the existing technology is generally not expected to be able to solve' (Geels, 2002b, p.367).

The constitution of networks and the expectations of a technology they present is important in the creation of niches where a variety of possible radical innovations are generated. In seeking to go about generating activities in support of these developments niches may be seen as spaces for network development and learning (in some ways) 'protected' from the regime:

> 'In the niche model, lock-in and path dependency assumptions are relaxed. Various technological options can co-exist over a long period, precisely because of the existence of niches requiring other functionalities…Niches may also persist because actors such as firms and governments act strategically by keeping certain options alive which might be important for future competition or other broader societal goals' (Hoogma et al, 2002, p.26).

There is a difference in relative emphasis in TT approaches with some focusing more on the regime in terms of transitions and incremental developments (Geels, 2002a), more so than earlier work focusing on radical innovations by (Kemp, 1994). Technological transitions are premised not on radical regime shifts but through 'stepwise process of reconfiguration' (Geels, 2002a, p.1272).

Regime shifts may take place over a considerable period of time. Geels (2002a, p.1262) points out that TT involves the linking of 'multiple technologies' and that the use and development of innovations in different domains and contexts see a cumulation of niches – an important mechanism in gradual regime shift. Early linkages between niche and regime may rely on 'link up with established technologies, often to solve particular bottlenecks' (Geels, 2002a, p.1271). There is an important focus on ideas of technological add-on and hybridisation where existing and new technologies 'form some sort of symbiosis' (Geels, 2002a, p.1271; see Raven, 2006).

The TT approach highlights the importance of the nested interrelationships of wider landscape 'environments', the stability and interrelationships of regimes and the innovative possibilities of niches. It outlines a way of thinking about the relationships, resources and practices, including technologies, institutions, skills, etc, which sustain existing configurations and regimes but also addresses processes of adapting and evolving such a regime in relation to 'pressures' for, and contexts of, new technological possibilities and innovations through processes of branching, add-on and hybridisation. But how does this process unfold across time?

2.4 What are the key transitions phases?
Transition concepts operate at multiple-levels but also across phases, or stages, and thus periods of time. We can distinguish four transitions phases (Rotmans et al, 2001, p.3). These are:

1) 'A predevelopment phase of dynamic equilibrium where the status quo does not visibly change'. This places an emphasis, analytically on the regime and the constraints that regimes place on future developments. The emphasis is on the regime

maintaining the conditions which allow existing technologies 'to work' whilst seeking to improve existing technologies as a means of confronting the potential of new technologies.

2) 'A take-off phase where the process of change gets under way because the state of the system begins to shift'. 'Take-off' is informed by a 'modulation' of micro- and macro-level factors, including niche levels innovations and macro-level worldviews. The claim is that micro-level developments can inform macro-level views and vice versa (Rotmans and Kemp, 2003, p.12).

3) 'An acceleration phase where visible structural changes take place through an accumulation of socio-cultural, economic, ecological and institutional changes that react to each other'. In this respect there is a central focus on the regime, which changes through processes of 'self-examination' in responses to pressures from niches or landscape.

4) 'A stabilization phase where the speed of social change decrease and a new dynamic equilibrium is reached'. Following acceleration and a period of rapid change the stabilisation phase sees a slowing down as a new regime has developed. Although there is a degree of stabilisation, the equilibrium could potentially 'accommodate the seeds of change for another transition' (Rotmans and Kemp, 2003, p.12).

In undertaking transitions, across different phases, Jan Rotmans and colleagues outline five key steps to take (Rotmans et al, 2001, pp.8-10). These are:

The first step is the setting of a 'transition objective', which is not rigid but is more about sketching the ambitions and aspirations of a multiplicity of actors (seen widely rather than as narrowly technological) involved. The focus on the aspirational rather than on tight and rigid objectives is an acknowledgement that the transition objective informs a process of re-evaluation and adjustment over time.

The second step focuses on 'transition visions', where long-term visions inform the formulation of short-term objectives and the evaluation of existing policy. The production

of visions is an important 'participatory' process used to engage, inspire and mobilise social actors. As part of a long-term process the transition visions and the goals encapsulated in them are subject to evaluation and modification over time.

The third step is the production of 'interim objectives' as part of a process of the reformulation of objectives over time. Through 'backcasting' from long-term objectives the development of interim objectives then link shorter-term interim measures to long-term objectives.

A fourth step focuses on actors' in transitions 'evaluating and learning' around process and content through 'development rounds', particularly in relation to set interim objectives, where both transition processes and content are evaluated over time and the lessons learned articulated through a series of questions (Rotmans et al, 2001, p.10). This of course raises multiple crucial issues, including: the experiences of those involved in such processes; it raises the issue of the dominance of certain actors in such processes, the exclusion of others and also whether other forms of 'participation' could be usefully drawn upon.

This relates to a (vague) final step -'creating popular support'- where processes of 'participatory decision-making helps to create support for policies', through bottom-up 'local experimentation with new technologies', 'education' through 'the prudent introduction of new technology in suitable applications' and drawing on 'top-down' and 'bottom-up' techniques to take 'advantage of the heterogeneity of society, mobilising support and problem-solving activities' (Rotmans et al, 2001, p.10).

2.5 What are the key shortcomings of transitions approaches?
In a thoughtful contribution to this debate Frans Berkhout and colleagues (2003; Smith et al, 2005), whilst acknowledging the strengths of transitions approaches and having a broad sympathy with them, highlight seven issues:

First, by offering largely descriptive accounts, which focus on retrospective accounts of socio-technical transitions, there becomes a degree of inevitability, or a teleological understanding, 'whereby tentative, mobile and elastic socio-technical configurations are

seen to lead inexorably, through a cumulative sequence of stages, to lasting and increasingly large-scale changes in a socio-technical regime. In practice, very few local configurations developed in niches are successful in seeding regime transformation' (Berkhout et al, 2003, p.7). With this in mind, Berkhout et al suggest the issue of why some niches inform regime changes whilst others fail should be a focus of research activity.

Second, Berkhout et al claim an over-privileging of the role of the niche in transition activity pointing out that an overemphasis on the niche reduces and simplifies the conditions of regime transition. This, then, leads, to another suggestion for further research which focuses on the 'underlying processes of regime change' in a variety of contexts (Berkhout et al, 2003, p.8). This relates to a set of ambiguities in transition accounts in understandings of the relationship between the niche and regime where there is a limited understanding of how niches could be 'harnessed' in 'purposive' transition management.

Third, wider landscape pressures in terms of demographic changes or economic reform can impinge directly on incumbent regimes. This, according to Berkhout et al, highlights an important emphasis on macro-level processes, for example of government policy and public opinion, influencing regimes rather than regimes influencing landscapes.

A fourth issue is a degree of ambiguity between transition concepts and empirical levels and also with key transition concepts. The point here is that there are often inconsistencies between the two issues with:

> 'What looks like a regime shift at one level may be viewed merely as an incremental change in inputs for a wider regime. Or alternatively, a regime shift at a lower empirical level might be seen as a niche activity with regime transforming potential within a higher-level regime' (Berkhout et al, 2003, p.9).

Fifth, there are also problems with the idea of a vision. The suggestion being that there 'appears to be no necessary correlation between the character of a particular guiding vision and the scale of the ambitions that are actually realised' (Berkhout et al, 2003,

p.12). Furthermore, key questions of who becomes involved in the production of these visions, whom they 'represent' and whose objectives are favoured are unclear.

Sixth, this question of who becomes involved also relates to the role of 'the public' in such processes, where although we have a sense of configurations within niches, regimes and between the two the transitions literature says little about engaging a variety of diverse social actors (Berkhout et al, 2003).

Finally, this, then, relates to what is often seen as a shortcoming of transitions approaches – the motivations, negotiations and unfolding aspects of actors in transitions – even amongst key transitions authors (Rotmans et al, 2001, p.15). One can think back, here, to the development of normative visions and the degree of problematisation that was often lacking from transitions accounts in dealing with this issue and raises the possibility for such processes to become a focus of research. The processes through which visions are produced requires a focus on whose views inform such visions, and importantly who is excluded, underpinned by what forms of expectations and aspirations as well as resources, through what mechanisms or foras were they negotiated, with what forms of dissent and compromise? But it also provides a way-in to thinking about a series of other issues about not only who becomes involved, but from what context (regime or niche), and in terms of spatiality at what scale, and at what point in a process and in what ways?

Following from this, Berkhout et al outline three particular aspects of transitions approaches with which they make contention. The first of these is to question the view that regime change begins in niches and works upwards and thus underplays the role of landscape pressures on regimes. Second, they are univalent in that they underplay issues of power and overplay consensus, intention and choice in the face of potentially multiple social actors and expectations. The final point, that they are unidimensional, claims that transition approaches often underplay differences in transition contexts and the balance between historical contingency and human agency (Berkhout et al, 2003).

With this mind, Berkhout et al propose an emphasis on regime change which acknowledges the multilineal, multivalent and multidimensional. In doing this they highlight that addressing the context of the regime in transition processes opens up the

possibilities for understanding *a variety of transition pathways*. Moving from an over-privileging of the niche as the predominant pressure on the regime to also thinking about the role of other regimes and the landscape in exerting pressures (the combination of top-down and bottom-up pressures) on incumbent regimes raises questions about how incumbent regimes transformations can be understood. Adaptive capacity refers to the collective capacity of the regime to recognise, respond to and influence regime transformation. In addressing the relationship between contexts of regime transformation and transformation processes, Berkhout and colleagues highlight the importance of two sets of issues:

- The extent to which regime transformation is intended or the outcome of historical processes (in effect the balance of the relationship between structure and agency); and

- The extent to which the pressures on the regime are responded to through resources and relationships incumbent within the regime or co-opted from outside the regime.

In mapping these two sets of issues along vertical and horizontal axis (see Figure 2), Berkhout and colleagues are able to characterise four 'ideal types' of transition contexts as a means of thinking about regime changes. The four are:

1) Endogenous renewal – is characterised by highly co-ordinated responses of incumbent regime actors to perceived pressures on the regime, drawing upon endogenous or incumbent regime resources. The consequences of endogenous actors and resources informing regime change is that such change tends to be incremental;

2) Re-orientation of trajectories – Berkhout and colleagues point to regimes which encounter radical re-orientation, either from inside or outside the regime, not through the radical reconfiguring of regime relationships in anticipation of pressures on the regime but through what they term a 'shock' or a radical shift through a 'conjunction of a series of uncoordinated technological opportunities, changes in market regulation and obstacles facing alternatives' (Berkhout et al, 2004, p. 69);

3) Emergent transformations – appear to demonstrate an autonomous logic and occur through uncoordinated pressures for change and responses external to the incumbent regime; and

4) Purposive transitions – demonstrate a strong degree of intention in pursuing regime transition but largely involving actors and resources from outside the regime.

Figure 2 Transition Contexts

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                            ┌──────────────┐
                            │  Internal    │
                            │  resources   │
                            └──────┬───────┘
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         │  Re-Orientation  │      │      │   Endogenous     │
         │  of Trajectories │      │      │    Renewal       │
         └──────────────────┘      │      └──────────────────┘
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┌──────────────┐                   │                   ┌──────────────┐
│  Low         │───────────────────┼───────────────────│  High        │
│  coordination│                   │                   │  coordination│
└──────────────┘                   │                   └──────────────┘
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         ┌──────────────────┐      │      ┌──────────────────┐
         │   Emergent       │      │      │   Purposive      │
         │  Transformation  │      │      │   Transition     │
         └──────────────────┘      │      └──────────────────┘
                                   │
                            ┌──────┴───────┐
                            │  External    │
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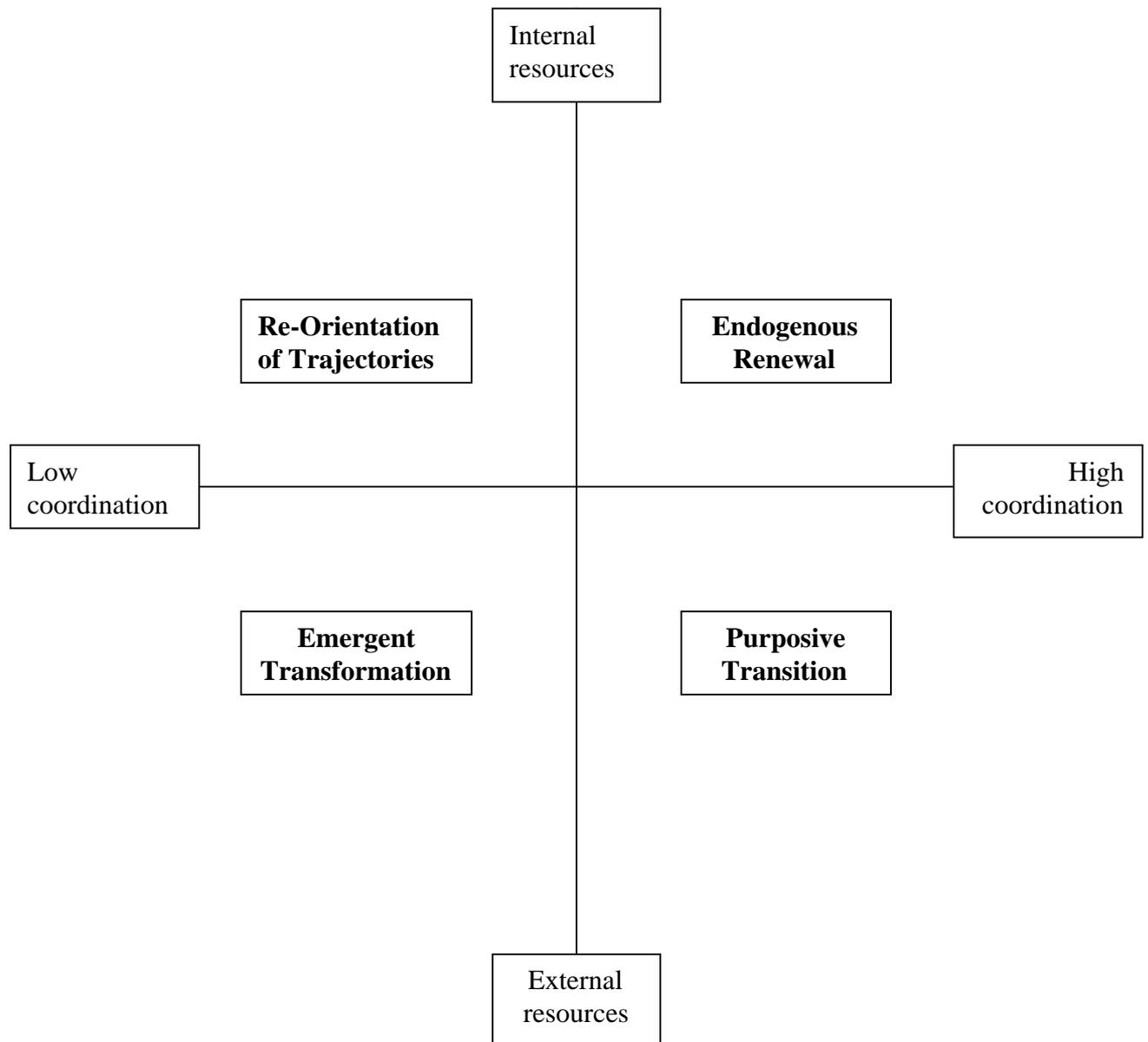
Source: Berkhout et al, 2004, p.67

2.6 Summary

The main benefit that the work of Berkhout and colleagues brings to transitions approaches is to acknowledge that context matters. The key point being that pressures for change within a system originate both within and outside a regime and the critical issue is to understand how differing social interests adapt to such signals. Consequently: 'there emerges a clear need for greater acknowledgement and understanding of *different transition contexts*' (Berkhout et al, 2003, p.18, emphasis added). However, the transitions literature says little about the 'where' of different contexts; it offers a limited sense of place. It is this issue that we now turn our attention.

3. Transitions and Place: Understanding the Role of Cities and Regions

3.1 Introduction

Thinking about different transitions contexts opens up questions about the role of place in transitions. Although we are sympathetic to technological transitions' commitment to a multi-level analysis and its insights into managed socio-technical change we have also struggled to conceptually and empirically understand the role of cities and regions in transitions. Are cities and regions simply convenient sites within which niches are developed? Or do cities and regions actively seek to pull down and make relevant landscape pressures in their distinctive local contexts? This then begs the questions of whether cities and regions can establish their own regimes within which niches and transitions are able to exist?

We can only find ways of addressing these questions by stepping outside the TT framework to look at the implications from more critical approaches to technological change that specifically address the urban and regional. The 're-emergence' of the city and region raises critical issues of how we think about the relations between place and transitions.

While the multi-level approach is useful in understanding the distributed nature of technological transitions our critical concern is that institutions, social interests and knowledge are often assumed to be 'out there' (Geels 2004, p.902). Place is implicit within the three fold division of landscape, regime and niche. Only within the niche is the notion of place more explicit as some sort of bounded, experimental local context. We

argue that TT would clearly benefit from an appreciation of 'multi-level governance' and the politics of scale in understanding attempts to shape transitions in place. Key to this is the development of a conceptual framework that permits us to analyse the entangled relations and interactions of governance at different scales which inform potential transitions. This is particularly significant in times of increased 'globalisation' and neo-liberalism, where the changing role of the state and issues of multi-level governance raise a whole series of issues not only about how we might think about the city and region but also the interrelationships between regions, the local, national and supranational. How do we understand cities and regions through multi-level governance in relation to place-based shaping of technological transitions?

3.2 Competitive cities and regions and governance of innovation

Critical to understanding these shifts are changes in the international economy, through the reconfiguration of national and international financial and political institutions (see Aglietta, 1979) over the last three decades that have generated neo-liberal pressures for increased 'competitiveness', 'entrepreneurialism' and 'innovation'. This raises issues related to both governance and technology, in particular the changing role of the nation-state is important, where we are seeing a shift from the Welfare State to a Competitive State (Jessop, 2002; 1994). The competitive state, has a 'concern with technological change, innovation and enterprise and its attempt to *develop new techniques of government and governance to these ends*' (Jessop, 2002, p.96, emphasis added). Consequently new configurations of governance create and respond to increasing international economic competitiveness through encouraging (particularly technological) innovation at different scales. These structural shifts have three significant implications for our understanding of cities and regions in technological transitions:

The first of these is to highlight the pervasiveness of notions of 'competitiveness' and the ways in which this is manifest in wider 'pressures for' city and regional transformation through science, technology and innovation. A closely aligned development in the UK context has been the establishment of Regional Development Agencies (RDAs), in 1999, and many of their local and regional *economic* governance concerns around competitiveness. This emphasis on narrowly defined features of economic governance has also become a central concern of many local authorities (see Fuller et al, 2004). What

often follows is *an institutionalisation of 'permanent innovation'* (Lovering, 1999), predicated on the pervasiveness and 'naturalisation' in government and policy circles of the virtues of particular forms of neo-liberal competition, a 'race' for competitiveness and a constant search for transformation at the urban and regional scale. Cities and regions develop positions on technological potentials to position themselves in the 'global race' for economic competitiveness.

This leads to a second point, that city and regional analyses need to take account of a *complex interplay of relationships at various political scales*. Critically, this requires 'an appreciation of the complex geometry of power and the political and cultural struggles through which societies assume their regional shape' (MacLeod and Jones, 2001, p.670). A focus on the 'endogenous' city and region and 'creating the conditions' for city and regional socio-technical innovation often ignores what drives city and regional economies and in doing so underplays the differential economic and political positions of places and the wider role of the nation-state in devolving responsibility (but not power and resources) for technology and innovation strategies to city and regional development (Ward and Jonas, 2004). Cities and regions are differentially positioned within existing social, political and economic relations that delimits their capacity to shape technological transitions.

Finally, cities and regions are clearly constructed in an unfolding and structured set of social, political and economic relationships. Importantly new technology and innovation is both a product of, and produces political pressures for, institutional change. Seeing the city and regional level as merely responding, as reactive, ignores specific relationships informing a city and regional response but also ignores attempts to shape relationships across space with a variety of, for example, national, supranational, and other city and regional government departments and agencies. This highlights the importance of seeing city and regional development in relation to technological transitions not only through the lens of 'endogenous' institutional interrelationships, but also in terms of the influence of, and relationships with the nation-state. *Cities and regions actively and strategically work both internally and externally in developing the resources, networks, and relationships to actively shape technological transitions.*

There has, as we have highlighted, been much discussion of 'entrepreneurial' and 'competitive' cities and regions. By contrast there has been a relative neglect of issues of environmental governance in the politics of scale and state restructuring literature (Bulkeley, 2005). This begs questions about both environmental governance and how issues of sustainability are addressed in the literature. This is particularly pertinent in view of the increasing array of environmental commitments, developed in international forums, which are 'managed' at sub-national levels, raising questions about how these environmental aspects are incorporated into urban governance (While et al, 2004). The claim is made (Bulkeley, 2005, p.889), despite some devolution downwards from the national state of environmental responsibilities, that it is questionable whether the rescaling of environmental governance can be understood 'in terms of the same dynamic' which underpinned the reconfigured relationships between state, economic governance and a politics of scale. Yet, issues of urban sustainability have often been conceived of locally in technocratic terms, thereby, ignoring contestations involved in producing understandings of urban sustainable development across multiple scales (Evans et al, 2001; Bulkeley and Betshill, 2005). This is particularly important given the pre-dominance of discourses of urban entrepreneurialism. The intuitive sense of the relationship between economic and environmental governance is one of a paradox. Yet there is an issue about how any tensions between the two are managed and understood and questions about how we understand urban governance relationships in respect of economy and environment.

One way of thinking about this as a 'sustainability fix' has been proposed, 'which is intended to capture some of the governance dilemmas, compromises and opportunities created by the current era of state restructuring and ecological modernization' (While et al, 2004, p.551). In this sense environmental issues are not seen as counter to issues of growth but as a means 'to safeguard growth trajectories' through the 'selective incorporation of ecological goals in the greening of urban governance' both as a means of managing ecological dissent or pursuing new accumulation strategies (While et al, 2004, pp.551 & 554). An urban sustainability fix focuses attention on these tensions and issues in relation to a variety of cities.

In this respect attributions to 'sustainable development' may not only be used to inform the entrepreneurial and economic re-imagination of cities but also as an attempt to 'neutralize environmental opposition' (While et al, 2004, p.554). What this view of the tensions and negotiations between economic and environmental aspects of urban governance highlights is that 'nature' and the 'urban' are not divorced but 'produced through complex processes of "glocalization" and entangled in myriad flows of capital, things and people' (Keil, 2003, p.729).

In summary then, pressures for, and tensions between, economic, environmental and technological changes and activity inform the re-articulation of places through a series of relationships of institutions and individuals but these are predicated on (particular readings of) history, and prior trajectories that rely on processes of adaptability and reflexivity. *In this respect cities and regions' role in transitions is linked to their capability to adapt and transform through reconfiguring and adjusting urban and regional institutions of governance to technological transitions.* The key question this raises is: what are the implications of this analysis of the re-emergence of cities and regions for our understanding of technological transitions?

3.3 Sensitising technological transitions to cities and regions

A 'multi-level governance' approach allows us to re-focus on three sets of issues that are currently weakly conceptualised and understood within existing TT approaches (see for instance the sympathetic critique by Berkhout et al, 2003).

First, there is the issue of the dominance of normative visions - a key step in transition processes - and the degree of problematisation often lacking from transitions accounts. For Berkhout et al this highlights the univalent nature of transitions approaches, especially the overplaying of consensus and the underplaying of power relationships. The critical insight from the 're-emergence of cities and regions' is the prevalence of particular visions perhaps most powerfully embodied in the notion of the race for technological progress and economic competitiveness. This means that the processes through which visions are produced requires a focus on whose views inform such visions, and importantly who is excluded, underpinned by what forms of expectations and aspirations as well as resources,

through what mechanisms were they negotiated, with what forms of dissent and compromise?

This, second issue, then, relates to what is often seen as a key shortcoming of transitions approaches – understanding the motivations, negotiations and unfolding relations of actors in transitions. Even amongst key transitions authors (Rotmans et al, 2001, p.15) there is recognition that:

> 'Research must first be carried out into so-called systems of interaction. Attention must be paid to the social and material context of interaction, and processes of co-evolution'. (Rotmans et al, 2001, p.15).

Working through cities and regions allows us to look more critically at processes of interaction across scales in a way which can acknowledge differential positioning, power relations and varying capacities and potential for adapting local contexts. This brings the suggestion that: 'contemporary urban regions must be conceived as pre-eminently "glocal" spaces in which multiple geographical scales intersect in potentially highly conflictual ways' (Brenner, 1999, p.438).

Finally, it also adds to our understanding of the role of government in 'creating the conditions' for transitions. Although the nation-state is still important so also, increasingly, are various other levels and scales of governance which are related often in complex and different ways in various contexts. In particular: 'in major urban regions throughout the EU, regionally scaled regulatory institutions are being planned, promoted and constructed as a means to secure place-specific locational advantages against' (Brenner, 1999, p.440). We increasingly need to acknowledge the role of city and regional scales in shaping technological transitions as part of a wider devolution of responsibility, but not necessarily powers, to reshape the technological and economic competitiveness of places.

In summary the reinsertion of cities and regions provides a way of conceptually understanding three key insights from Berkhout and colleagues' work, namely:

1. The negotiated and potentially conflictual nature of visions of the future through technological transitions;

2. The related limited understanding of processes of interactions in transitions; and

3. The role of government in 'creating the conditions' for transitions.

This relates to our starting point that the transitions approach says little about the role of place. This, we suggest, should be rectified due to the 're-emergence' of the city and regional scale in purposively shaping technological transitions.

3.4 Mediating between cities/regions and technological transitions

With the increasing responsibilities devolved to cities and regions to shape technology and innovation, specialist network intermediaries are being developed within places to shape technological transitions. These intermediaries are usually cross-sectoral in composition, network based (rather than bi-lateral), with a focus on a broad technological sector (rather than a single technology) and can be characterised as transition managers within a particular local context. There are two key sets of activities that characterise their work.

The first is the work involved in developing place-based images of technological transitions. Intermediaries develop *an* understanding of existing city and regional contexts (either from 'within' or 'outside' the city and region) and they position themselves between technological possibilities and local contexts to re-think city and regional contexts through technological transitions. In doing this, they identify (multiple) points of intervention within existing and new systems of provision (between systems of production and consumption). In the language of transitions they develop a 'vision' of a transition of the city or region which takes (a particular) account and attribution of city or regional history and outlines a vision of transition. In short, intermediaries attempt to manage the (ongoing) production, transmission and reception of the vision of transition.

Visions are important media in *mobilising and shaping expectations* and commitment around transitions and offer *prospective views on the form, features, functions and benefits of technologies in relation to domains of application.* The purpose of visions and the goals

they outline provide a focus through which networks can be built, gaining commitments to participate, orientating the actions of potential participants and constituencies, and in persuading potential participants of the desirability of transition (see Russell and Williams, 2002, pp.60-1). Visions are not fixed and will change over time with the variety of social interests who become involved.

The second role is in the governance of place-based transitions. Intermediaries build social networks of actors who either position themselves favourably in relation to the debate or whom are positioned by the intermediary. These actors can operate at various scales (local, national, international scales) and may be public or private, governmental or non-governmental. The potential involvement of multiple actors needs acknowledgement that they are embedded in particular institutional settings with associated institutional enablement and constraints, and views of the city or region, in pursuing their expectations (i.e. they are not 'free agents').

This raises the possibility of a variety of expectations (see van Lente, 1993) of city and regional technological transitions from multiple institutional positions and the 'voices' that dominate. In short, intermediaries 'manage' processes and governance of city and regional transitions.

3.5 Summary

Our argument is that transitions take place in particular places and that places are differentially positioned in terms of their ability to inform transitions. The concept of systemic intermediaries allows us to address the extent to which particular places, here cities and regions, strategically shape technological transitions. In doing this, we suggest that understanding the early stages of transitions in particular cities and regions mean we address the following:

1. Outlining the vision that has been developed for a particular place-based transition.

2. But also to understand the negotiations of these visions:
    i. The social actors involved

ii. The expectations from different positions embodied in them - this requires a focus not only on 'endogenous' relationships within cities and regions but also on the 'exogenous' relationships with national government, private capital etc.

The step between 1 and 2 allows us to look not only at the vision but also the extent of any 'gap' between the vision and issues of capacity in relation to the extent to which cities and regions may shape (and be shaped by) transitions.

4. Shaping Transitions: Understanding and Broadening Participation in Transitions
4.1 Introduction

Although we are sympathetic to transitions approaches and their illumination of the possibilities for broadening 'participation' in 'managing' technological transitions, such approaches not only say relatively little about the places in which transitions take place and the role of different social interests in shaping the production of societal visions but they also say little about the wider role of 'publics' in transitions,.

Our concern primarily is that given the transition approach addresses understanding (and with shaping) systemic transitions in the socio-technical organisation of large scale systems and infrastructures the approach has a relatively narrow conception of users that focuses on the users of the approach and policy makers. The role of publics and wider societal engagement is not systemically considered within an approach that would often require 'publics'' involvement in transitions.

But if we are to move the debate forward we want to constructively engage with the role of 'publics' in relation to issues of place and power relationships that we have previously highlighted; via the development of an approach through which we can more productively analyse social-technical innovation, publics, place and power. In this section we, therefore, critically assess and positively contribute to wider debates around transitions by developing a framework through which 'public engagement' in local contexts can be connected to transitions debates. In doing this we address the interplay between 'public engagement', technological development and the local context of its (non-)appropriation. The context within which we address the role of 'publics' is one in which the dominant discourse of 'downstream' 'risks' and 'impacts' in technology assessment, which has been

dominant for many decades, is being challenged from a number of perspectives (see, for e.g. Schot and Rip, 1997; Wynne, 2005).

4.2 Disconnections of transitions, 'publics', place and power

In developing an understanding of the role of 'publics' in transitions in place we first of all consider the disconnections between publics, place and power in conventional transitions approaches. As we have previously pointed out, transitions approaches (Geels, 2004; 2002; Elzen et al, 2004; Rotmans et al, 2001) have developed a multi-actor, multi-factor, multi-level framework for exploring and interrogating socio-technical *systems* and in understanding the possibilities and constraints on systemic transitions. A key feature of the technological transitions literature is the development of a long-term vision which informs the formulation of short-term objectives and underpins evaluation of existing policy. In transitions approaches, the production of visions is an important participatory process used to engage, inspire and mobilise social actors. As part of a long-term process transition, visions and the goals encapsulated in them are subject to evaluation and modification over time (Rotmans et al, 2001).

There are, however, difficulties with this particular conceptualisation of a vision (see Berkhout et al, 2003). For instance there remain questions about 'who' becomes involved in producing transitions' approaches normative visions. The processes through which visions are produced requires a focus on 'whose' views inform such visions, and importantly 'who' is excluded, underpinned by what forms of expectations and aspirations as well as resources, through what mechanisms or foras were they negotiated, with what forms of dissent and compromise? This, then, relates to what is often seen as a shortcoming of transitions approaches – the motivations, negotiations and unfolding aspects of actors in transitions – even amongst key transitions authors (Rotmans et al, 2001, p.15).

Yet transitions approaches, however, do not explicitly say an awful lot about the role of 'the public'. As transitions approaches are predicated on multi-actor, multi-factor and multi-level aspects (Elzen et al, 2004) this is undoubtedly an important but challenging issue to address. Often when this 'gap' is noted and flagged-up by transitions researchers it is in terms of developing the transitions research agenda around understanding of the

role of 'users' (Elzen et al, 2004) and moves to 'explicitly incorporate the user side in the analysis' of technological change (Geels, 2004, p. 897). There has also been acknowledgement of the desirability of a focus on aspects of 'consumption and ways of life' (Elzen et al, 2004, p.283). A key figure in transitions approaches, Frank Geels (2004, p.901), acknowledges that '[t]echno-scientific knowledge has become more distributed over a widening range of actors (universities, laboratories, consultancies, R&D units in firms)', that '[c]ultural appropriation of technologies is part of consumption' (Geels, 2004, p.902), but that 'in many studies, markets and users are simply assumed to be "out there"' (Geels, 2004, p.902) and that it therefore necessary that we must pay more attention to interactions between actors (Geels, 2002).

But when we start to think about interactions between actors, the existing notion of 'users' is far too narrow. Critical to an understanding of systemic innovation and the possibility through transitions of fundamental shifts in the ways in which 'publics' conduct their everyday life, are questions about who, when, how, on what terms and in what ways 'publics' become involved in transitions. Transitions approaches imply significant shifts in the relationships between technology and society, and consequently the politics of how technological change is managed (Schot and Rip, 1997), in the widest sense of that term.

When addressing the challenges and consequences faced by, for example, systemic change in energy, water and mobility systems, Constructive Technology Assessment (CTA) an approach closely linked to transitions approaches, offers some pointers as to how we might think about the role of 'publics (see Schot and Rip, 1997; Schot, 2001; Genus, 2006),'.

Rather than 'assessing' 'black-boxed' technologies in terms of their 'impacts', CTA broadens out the assessment of technologies to focus on the design of technological developments and the 'participation' of non-technical experts in shaping technological development. This broadening of participants in technological development projects and the aspirations for dialogue should be viewed in the context of wider debates in recent decades around the 'decline' of trust in expert knowledge (e.g. Beck et al, 1994) and with the deficiencies of what has been termed the 'deficit model' (Wynne, 1991) of the process

of one-way expert-public science and technology communication predicated on notions of an ignorant public.

The move CTA makes is to bring technology developers together with 'interested parties' of policymakers, users and citizens to become involved in the design process. By contrast to traditional technology assessment approaches, which focus on the 'impact' of technologies, there is an important role for human agency across a range of interested parties. In particular there is an emphasis on the anticipations of the future consequences of technologies with the assumption that this encapsulates the values and interests of social actors from various different perspectives. These anticipations may be subject to change as part of an unfolding process and, thus, the reflexivity of various social actors becomes an important facet of CTA approaches, as does the interactions between social actors which underpin this and consequent social learning. Processually, there is an ongoing modulation of demand and supply issues through the interests of different social actors. In this respect there is not just an important contribution in terms of initial phases of design but also through demonstration projects and ongoing processes of social learning.

With a focus on an unfolding assessment of technologies through dialogue and interaction, CTA draws on various methods which are not specific to CTA, including: consensus conferences, scenario workshops, electronic consultation, public inquiries and citizens juries (Genus, 2006, p.14). In short:

> 'A basic tenet of CTA is that the design of technological development should be a broader, interactive process including a variety of societal actors in addition to technical experts. The effect of broadening the design process is that the designers', users', citizens' and policymakers' ideas and values are articulated quite early, and are negotiated and renegotiated throughout the course of the technology development process (which is itself a process of constant design and redesign). This will counteract the prevalent tendency to organize technology development in a basically linear fashion (from development, to market introduction, to regulation) and will allow for more continuous evaluation and modification of new technologies in the making' (Schot, 2001, p.41).

CTA undoubtedly has aspirations to move on from what Johan Schot suggests is the 'the current patter of technology management…[which] is to sponsor development and regulate application' (Schot, 2001, p.40). There are also significant potential benefits of

debate, dialogue and the development of more 'socially robust' knowledge prior to the development of physical infrastructures and their associated sunk costs.

CTA does offer some significant and important insights that could begin to re-populate transitions approaches with its missing publics. But there are also four issues raised by CTA researchers that mean we cannot simply and uncritically import this approach into transitions approaches. First whilst CTA broadens out the possibilities to 'participate' in technology design this usually takes place after the decision to develop a technology has been made and, as such, focuses on the design of technology rather than issues of purpose prior to the business decision. Second, this begins to make visible hidden aspects of power relationships and structural concerns including issues of 'access' and resources (Genus and Coles, 2005) and, in particular, asks questions about who frames what, in CTA terms, is a focus on technology development? Third, if there needs to be a focus on who frames an issue there are also necessary concerns about what their expectations are and for what purpose is an issue framed in a particular way. Finally, there is importance in analysing the methods and processes via which these expectations are translated into action and through which attempts are made to engage others in negotiating and renegotiating expectations in processes of 'engagement' and 'participation'.

Consequently we argue that if we are to develop an approach to transitions that takes publics seriously then it is critical that we address the following four issues:

- The role of publics in framing visions of the future through technologically-informed change before they are closed.

- The issue of who frames visions of the future and with what expectations?

- The 'engagement' or 'participation' processes and methods in negotiating and renegotiating the future.

- The analysis of the relationship between vision and actuality and the lessons we can draw from this.

4.3 Developing a conceptual framework for analysing publics and transitions

These four issues are now addressed by developing a framework for analysing the role of 'publics' in framing and translating into action technologically-informed visions of the future.

Framing a vision of the future

CTA highlights the critical importance of human agency, contingency and the possibilities of socially shaping technologies (Williams and Edge, 2000 [1996]; Mackenzie and Wajcman, 1999). But by focusing on the design of technologies after the business or policy decision has been taken to develop them, CTA then frames (see Goffman, 1974) technology development as 'designing in action' rather than addressing issues of the purpose of technological development (Wynne, 2005). Our argument is that in view of the challenges to the legitimacy of expert knowledge and the increasingly porous boundaries of scientific and technological knowledge production, the aspirations of CTA, whilst laudable aspirations, do not go far enough. Or to be more specific, they do not go far enough 'upstream' (see Wilsdon and Willis, 2004).

CTA in questioning the focus of technology assessment on 'impacts' does seemingly move some way upstream yet, through neglecting issues of purpose, still ultimately takes a focus on assessing impacts of technologies (see Wynne, 2005). Brian Wynne has pointed out that in terms of what is frequently claimed to be upstream engagement 'this radical apparent potential is compromised by deeper, less manifest cultural assumptions and commitments framing most such initiatives, and that these problematic foundations have yet to be identified, confronted and changed' (Wynne, 2005, pp.66-67). The key point for us here, if we think about Wynne's argument which he makes in the context of the upsurge in contemporary 'participatory' initiatives, is in terms of the ways in which CTA encourages dialogue after the business or policy decision has been made, which crucially:

> 'reflects an assumption that the public meanings, or issue definitions, are naturally and properly the sovereign domain of authoritative expert institutions, and that citizens have no capability or proper role in autonomously creating and negotiating such collective, and potentially more diverse, public meanings' (Wynne, 2005, p.67).

If one thinks back to the guiding normative visions fundamental to the iterative process of steering transitions, this then suggests that diverse public meanings may be framed-out or closed-down at the earliest 'upstream' stages of the production of visions (Stirling, 2005). This is important as visions are important media in mobilising and shaping expectations and commitment around transitions (see Russell and Williams, 2002, p.60).

Visions have been used in the Science and Technology Studies literature to offer prospective views on the form, features, functions and benefits of technologies in relation to domains of application. In this sense, visions articulated at an early stage of development can be viewed as highly aspirational and be seen largely in terms of their symbolic representational articulation of a future rather than a material one (although this is not to neglect the material production and media of communication of the vision). In this respect visions are 'culturally anchored' (Borup et al, 2006) and offer particular characterisations of the future from the present, often invoking particular attributions of the past. The purpose of these visions and the goals they outline provide a focus through which networks can be built, gaining commitments to 'participate', orientating the actions of potential participants and constituencies, and in persuading potential participants of the desirability of transition (see Russell and Williams, 2002, pp.60-1). Although visions are not fixed and will change over time with the variety of social interests who become involved, the key point is that there is an issue of whether visions are initially articulated around narrow self-interests rather than in terms of a broader sense of societal purpose.

Making-up a vision of the future

The issue this raises is who, or which social interests became involved in producing this vision, with what expectations and with what views of particular 'publics'? The literature in the sociology of expectations (see Borup et al, 2006) offers a fruitful focus here, although we are necessarily selective in drawing on this emerging literature. In the early stages of framing and producing a vision of the future in relation to technological change – given the importance of visions in the subsequent mobilisation and shaping of expectations – the issue becomes one of articulating the variety (or otherwise) of expectations which inform the early stage production of a vision and importantly the ways in which these are communicated.

In focusing on the social construction of visions, through the variety of expectations which inform this, we also acknowledge the differential capabilities and positioning of social interests to meaningfully engage in this process of framing the future. The degree of contestation and the breadth of expectations involved in producing a vision may be narrowly or broadly framed. The importance of whose expectations inform the early stages of a vision are that expectations are 'constitutive', particularly at the early stages of innovation, in defining roles, attracting interest and building mutually binding obligations (Borup et al, 2006). Additionally, and importantly in view of the spatial shortcomings of transitions approaches, there may also be a significant socio-spatial variability of expectations (Borup et al, 2006), from and of particular places.

Captured within these expectations, either implicitly or explicitly, are views of the relationship between those producing the vision of the future and 'publics'. This relationship can be seen in a number of ways, but it is useful here to highlight views of 'publics' and 'participation' in terms of Andy Stirling's conceptualisation of forms of 'participation' in the social appraisal of technology as normative, instrumental and substantive (2005, pp.220-222).

The first of these, the 'normative' approach, is underpinned by a sense of the democratic empowerment of citizens participating in decision-making around technological decision-making as 'the right thing to do' and 'an end in itself'.

Second, the 'instrumental' approach can be seen as 'a better way to achieve particular ends' from the strategic viewpoint of incumbent interests, through, for example, the extraction of strategic intelligence from 'participatory' relationships which may also be used in the presentation particular, already determined, decisions.

Finally, the 'substantive' view focuses on issues of the 'social robustness' of particular technological developments and possibilities in respect of the diverse potential array social knowledges, values and meanings and the ways in which appraisal is sensitive to differences in this respect and thus produces 'authenticity, robustness and quality in choices that actually result from appraisal' (Stirling, 2005, p.222).

(Re-)negotiating and materialising a vision through 'participation' and 'engagement' processes

Rather than a neutralised or depoliticised view of processes of 'participation' and 'engagement', the expectations of particular social interests and the ways in which they are embodied in a vision of the future frames unfolding processes of the negotiation and renegotiation of the future. What is crucial to this is not only the symbolic construction of the vision and the expectations underpinning the vision but how these aspirations inform and translate materially.

Important here are the formal and informal processes of 'participation' and the methods mobilised. The types of methods that are mobilised, the questions asked, by whom, the timing of their mobilisation in terms of a socio-technical transition and the alignment of social interests and the concomitant resources they can draw upon highlights the politicised extent of 'participatory' methods which are often viewed as de-politicised and neutral. It also highlights, in terms of Andy Stirling's three-fold classification, possibilities to 'open-up' or 'close-down' (Stirling, 2005) processes of socio-technical innovation. In addition, with the upsurge of new 'participatory' methods, alongside the plethora of existing techniques and mechanisms, evaluating the role of participatory (engagement) methods becomes extremely confusing. Indeed what may or may not constitute participation has a long history (see Arnstein, 1969), with key concepts not particularly well-defined even taking into account the fruits of this long history (Rowe and Frewer, 2005). With this background in mind, views of what might constitute 'effective' public participation are not only unclear (Rowe and Frewer, 2004), but require a sensitivity but not a capitulation to the local context within which they are mobilised.

Consequences: from vision to actuality?

The issue, when moving from a vision and its production, through unfolding forms of participation in trying to translate a vision into action, and the issues that are raised by such processes and the extent to which the vision resonates with actuality or otherwise.

4.4 Implications of the Framework

This section has developed and demonstrated a framework for analysing the interplay between 'public engagement', technological development and the local context of its (non-)appropriation. We have developed a framework that attempts to re-connect

transition approaches to the role of publics, the specificity of places and competing visions of socio-technical change. By sensitising transitions approaches to these issues we have attempted to develop transition perspectives in the following four ways.

First, we have highlighted the critical role and importance of symbolic and often highly partial visions of the future, in the present, through the development of technological change. Critically we need to understand how such visions are constructed, the degree of inclusivity, the assumptions that underpin their conception of socio-technical systems and the model of social change that is implied by that vision.

Second, we have demonstrated the potential variability and particularity of those social interests whose expectations inform a particular view of the future. Critically we need to understand who is involved in developing visions of technological transitions. Which social interests are involved in the construction of visions, who is excluded – either implicitly or explicitly - from the development of visions, and how socially robust and or inclusive are such visions as a consequences of the contingency and selectivity of their production.

Third, we have illustrated the potential consequences of these differences in the ways in which particular social interests, and their domination of power relationships, informs the negotiation and renegotiation of a vision of the future in its translation to practice. Critically this involves carefully tracing the unfolding of visions and expectations as they interact with unanticipated social interests that challenge or question the validity or social robustness of a vision.

Finally we highlighted that key lessons can be learned from processes of moving from Vision to Actuality.

4.5 Summary
The key issue, and focus for future research, thus becomes developing a better understanding of the interplay of vision, expectations, processes and methods in specific contexts. This call is not to be totally reducible or to capitulate to context but to develop sensitivity to context. In doing this, development of cases in particular contexts are not an

end in themselves but should be used to inform comparison of patterns, trends and regularities. Through such a programme of work the transitions approach could begin to, more carefully and systemically, become sensitised and transformed to a wider politics of publics, place and expectations that recognises and works within differential and asymmetries of power.

5. Comparing UK Policy with Transitions Management: The Case of Hydrogen

5.1 Introduction

The purpose of this section is to provide a short review of the UK national approach to hydrogen economy developments and to assess the resonances and dissonances with a technological transitions approach. The focus being: how does the transitions management literature match against current policy processes in the UK? We use a transitions approach as a way of trying to illuminate and understand how the development of a shift, move and evolution to a hydrogen economy is seen in Whitehall. We are not therefore arguing that the UK currently does or should use a transitions approach – rather we are trying to understand what sort of approach it does adopt when contrasted with a transitions management perspective

The key message of transitions approaches is that long-term systemic change can be shaped or managed. Transitions approaches, and critical engagements with these approaches, also highlight the complexity of relationships, scales and issues which figure in attempts to manage transitions. We use these insights to aid understanding of policy processes in the development of a national UK Strategic Framework for Hydrogen Energy. We characterise this through addressing three aspects of the process:

1) The rationale for creating a Framework;
2) The production of the Framework; and;
3) Responses to the Framework.

In addressing these issues, we undertook 10 interviews with policy and consultancy officials who had a 'close involvement' in the production of the Strategic Framework and we also analysed the Strategic Framework (E4Tech et al, 2004) and key policy documents.

5.2 Rationale for the Framework – 'The threat of the race'

Prior to the Framework, the policy context was dominated by a concern with 'not picking winners' as the government 'doesn't like to make big bets and doesn't have anything like the sort of funding that several other leading nations do in fuel cells and hydrogen'. Yet at the same time there was concern about the UK's absence from the 'international race for hydrogen' given the emergence of European, US and Japanese initiatives around the hydrogen economy. There was a degree of recognition that 'falling behind' in the 'race' 'required' action by government:

> 'at the time of kick off [of developing the Framework]…from a government perspective…they where very much exercised by the fact [other] governments seemed to be spending a lot more and doing a lot more and making a lot more noise, and I think that's probably…the single biggest thing that was exercising that [interest in the hydrogen economy]'.

At the 'kick-off' stage there was some potential recognition that transformation and the shift to a hydrogen future was potentially systemic. Underpinning this potentially systemic shift was an interest in the potential that hydrogen may offer as a replacement (or a hybrid) for the carbon economy. Yet this met with a recognition that in scoping out such a strategy the capacity and/or expertise to do this did not currently exist within Whitehall as one official stated: 'I think the problem is that it's still pockets of activity at the moment'. The limitations of capacity and expertise need to be viewed in addition to the cultural contexts encountered by many policy officials where 'thinking time' was restricted. As one official argued: 'we simply don't have the time to always have a coherent approach – what I am saying is there's not necessarily a lot of thinking time in developing grand policy strategies'.

The public policy role in managing transitions, in a context of 'not picking winners' and limited Whitehall capacity and expertise, underscored a UK view that:

'whilst public policy has a role we are currently really a catalyst society at the moment and the view is that we are helping early demonstrators to show that technology can be commercially viable'.

With these constraints – 'not picking winners'; disconnected governmental activities; restrictive capacity and expertise; limited 'thinking time'; and the view of the role of policy in the 'catalyst society' - as a context, the production of the Strategic Framework was outsourced.

5.3 Producing the Framework – 'Outsourcing Hydrogen Strategy - UK energy priorities'

E4tech, Element Energy and Eoin Lees Energy, were commissioned, initially in autumn 2003, by DTI – which leads on hydrogen and fuel cells policy at central government level – to produce the Framework. Following the outsourcing of the work the consultants 'came inside' Whitehall and attempted to support various departments in working up a strategy which, given the limitations of resource, they would have been struggling to achieve. This included working within and across government departments - including Department for Transport, the Treasury, Department for Environment, Food and Rural Affairs, Foreign and Commonwealth Office and others - to develop an understanding of the contribution of hydrogen to UK energy priorities

The central question was, why is hydrogen interesting to the UK? The work was primarily framed in relation to the national energy debate and around related aspects of CO_2 emissions reduction and national energy security. Within this context, there was a strong focus on identifying the applications that in the conceivable future would be able to contribute strongly to CO_2 emissions reductions and national security of supply. The process from the consultants' perspective was 'driven from a national policy objective firstly because this is in effect a national intervention strategy'.

This emphasis was underpinned by a series of interviews and meetings with national officials across government departments and in 'trying to take government on the journey with us. We had a steering group that included [national officials]'. The focus was on engaging national policy officials 'because we didn't see this, at this stage, as being a "what does the industry need at this stage"…The needs of the industry are extremely

relevant but at this stage we were to think…how does the UK engage in hydrogen economic activity with the maximum benefit?'

A linear model of innovation with some other 'inputs' along the 'innovation chain' (see figure 3) informed the development of the strategy where there was a strong sense of 'pulling the technology through', but given the context of the 'huge failure' of national leadership the Framework was designed to create a context rather than 'pick winners'. The language of linear innovation remained prevalent in discussions we had with national officials, who were often searching for 'mechanisms to help pull them [technologies] through towards deployment'. At the same time there was recognition that the linear model of innovation was discredited:

> 'And we certainly would try not to inculcate in the DTI, [in] government's mind that there is an innovation chain and you feed it in one end and commercialised products would come out the other. This is just visually convenient to do'.

Figure 3 Representing Linear Innovation
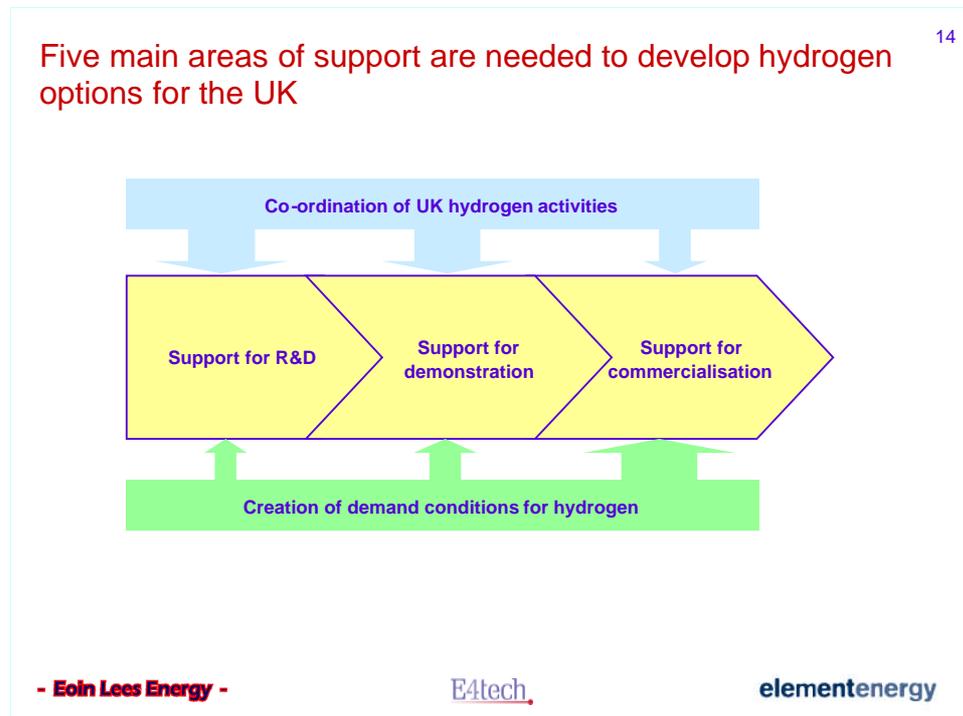
Source: E4Tech et al, 2004

The Framework's recommendations focused on five issues:

- The development of six hydrogen transport chains (see figure 4).

- A co-ordination body – a Hydrogen Coordination Unit (HCU) - was needed for UK hydrogen energy activities.

- A UK hydrogen energy industry association was required to represent the commercial interests of the sector.

- Government action was needed to support hydrogen R&D, demonstration, commercialisation, and demand stimulation.

- R&D and demonstration activities needed to be coordinated by the HCU.

Figure 4 Six Hydrogen Chains

The six options require 17 areas to be addressed, 13 of which [11] are unique to hydrogen

Areas to be addressed

Hydrogen chains

Biomass gasification

Nuclear electricity

Renewable electricity

Novel H$_2$ technologies

Natural gas with CCS

Coal with CCS

1. Fuel cell road vehicles incl. storage
2. Other hydrogen and fuel cell vehicles
3. Hydrogen pipelines
4. Road transport of hydrogen
5. Refuelling infrastructure
   Biomass and waste supply
6. Biomass gasification to hydrogen
7. Hydrogen integration in biomass systems
   Nuclear electricity
   Renewable electricity
8. Hydrogen integration with renewable energy
9. Electrolysers
10. Novel hydrogen production technologies
11. Natural gas reforming
12. Hydrogen integration in natural gas systems
13. Coal gasification to hydrogen
    Carbon Capture and Storage (CCS)

Common to all chains

Common to 2 chains

Common to 2 chains

- Eoin Lees Energy -   E4tech   elementenergy

Source: E4Tech et al, 2004

5.4 Responses to the Framework and next steps – 'more demonstrations rather than strategy'

It became apparent that the government's response was unlikely to match the hopes and expectations embodied in the Strategic Framework. Recognising this, in the stage just before the publication of the report there was both a public and private set of recommendations. What became apparent was that government was only going to provide limited resource and that this would be focused on more demonstration projects of which hydrogen could be a part.

First, there was a tension in action, between the transition frequently talked about to a low-carbon economy, the issue of setting carbon targets but not 'picking winners' and maintaining a 'technology neutrality'. In short the response constituted, a 'light touch', 'market measures' approach to transition. However, in this policy context of 'not picking winners' the Framework was technology-specific (even though it could also be seen as generic – for example as a suite of hydrogen technologies). Within this context, therefore, hydrogen was but one option. When national officials were asked about how a hydrogen economy would materialise if there was a 'light touch' national approach, there was a frequent recognition of the need for a strong political leadership and that this leadership was in the regions (London was mentioned frequently as a key exemplar) and not in Whitehall!

Second, the response of more demonstrations, however, remained largely lacking in strategic underpinnings, where: 'there is concern that we fund niche projects that are going to remain niche projects'. Where one view in particular was that: 'hydrogen will happen in the areas where there is strong political leadership'. But where there is

> 'a great deal of blurred thinking about demonstrations… because I think people mix up technology-proving demonstrations…and market-awareness and stimulation type demonstration which is a totally different thing'. With the consequence that 'you need to be very, very clear about your objectives for demonstration'.

Third, the co-ordinating role of the HCU offered the potential for addressing some of these issues and interrelationships strategically in relation to the six transport chains. Yet, despite the acknowledgement of the desirability of a HCU in the government's response there has been little progress in this respect.

Fourth, developing the six hydrogen transport chains (ironically in view of the focus on national security of energy) with the lack of a large British automotive manufacturer meant that 'partnerships' were needed with international car manufacturers. This highlights the centrality to policy of attracting foreign direct investment, but also that there was a sense from the officials we talked with that given this there was an 'outward facing' position where the issue of sub-national politics and agency was relatively underplayed. In discussions we had with officials, it was clear that there were few if any attempts to link the different parts of DTI, here the Automotive Unit to those other parts of DTI developing demonstrations. Overall, there was a sense of numerous sorts of disconnections, predicated on different aspirations from departmental positions and consequently limited 'join-up'.

Fifth, there was a strong sense from talking to policy officials that it was not for central government to provide leadership ('we only do the targets'). The consequence of this was that when officials talked about the development of a hydrogen economy they frequently referred to the role of London in hydrogen, through not only the CUTE fuel cell bus demonstrations in London but also via frequent reference to Ken Livingstone. This was part of a trend which emerged strongly in the interviews, where every time discussions took on a systemic transitions focus national officials distanced themselves from a role in 'delivering' this.

Sixth, not only was there frequent recourse to London but also to an intermediary organisation, Cenex. Cenex was the UK's Centre of Excellence for low carbon and fuel cell technologies. Its roles were numerous but importantly looked 'outwards': 'to actually showcase this UK expertise on an international stage'. This 'outward facing' focus was underpinned by Cenex's role in

'pulling together hitherto disparate actors and activities [where] we are not talking about traditional automotive suppliers. So we are looking at a whole new community and…they would be new entrants, there would be a lot of university spinouts. So we have got to try and engage these people, but we've also got to engage the industrial gas people, the energy sector and it involves a sort of cross-sector working which is always difficult'.

Cenex's role was in trying to facilitate and build these 'new' supply chain relationships. The development of supply chains was seen as a means of attracting foreign direct investment in low carbon technologies, including hydrogen and fuel cells. There was an outward-facing 'showcase' function here but in doing this the supply chains would 'somehow, join up some of the regional activity…and then use Cenex to forge the relationships with the global automotive industry'.

Finally, a well understood and widely shared 'vision' of the transition to a future hydrogen economy was largely missing. The 'vision' was differentiated by departments but can be characterised by the differential role of various government departments in a linear model of innovation. Different government departments took a particular responsibility around research (OSI), between development and demonstration (DfT; DTI). The space between demonstration and deployment was largely abdicated by government and public subsidy and the leap required for a technology between demonstration and deployment was across what numerous national officials characterised as 'the Valley of Death':

'where the "Valley of Death" really occurs between the demonstration phase and the deployment phase because that's when the public subsidy tends to run out and we are expecting these things to go commercial'

5.5 Issues

Thinking about the multi-issue, multi-actor and multi-level approach to systemic transitions reveals a stark contrast with the linear, departmentalised and largely unsystemic government response to the Strategic Framework. Crucially:

1) There was little sense of a shared vision instead there was a centrally developed set of targets as a prelude to market delivery.

2) There was little sense of configuring social interests (or even other elements of Whitehall). The result was very little connection between those elements of government that could link a (discredited) linear model of innovation.

3) There was limited capacity centrally to develop a transition. With this as context, there was a strong sense of out-sourcing strategy to consultants and implementation to intermediaries, with central government focusing on demonstrations and funding schemes rather than purposive shaping.

4) There was a strong sense in the interviews of absences in systemic transitions and those being filled by others (consultants, other departments, cities and regions, intermediaries), and consequently an understanding that policy was not systemic or transition-based.

5) The transitions literature highlights the importance of this type of steering role and this is what is required. In the context of national government there was a 'distancing', an expectation that 'others' would provide that coordination and work.

5.6 Summary

In terms of the UK national policy context, it is important to understand the following three styles of thinking within which the development of the Framework was strongly shaped which highlight the dissonances (but also potential resonances) with a transitions management approach :

First, policy has a strongly technological focus but this co-exists with an emerging recognition of systemic issues. Energy issues were generally seen in policy circles in terms of technologies – e.g. renewable, oil and coal, nuclear etc – with a concurrent strong techno-economic interest rather than a transitions focus. Yet there was some evidence that this is changing with an emerging focus on sustainable low carbon futures.

Second the focus on the development of a framework for markets and the use of a linear model of innovation. There was a strong emphasis, in policy documents and through discussions with national officials, on 'not picking winners'. This privileged a view of technological neutrality (despite the focus on different sectors outlined above) and, therefore, the role of policy was ambivalent, with a simultaneous emphasis on government providing a framework for innovation in energy systems but then not picking particular systems. The dominant discourse was that it was for the market to decide how energy targets are achieved. Yet, at the same time transformation in energy systems was also understood and characterised as a linear process: one of 'pulling the technology through' the process of 'research', 'development', 'demonstrations' and 'deployment'.

Finally, a highly distributed governance context with outsourcing of strategy formulation and relationship management to intermediaries. Responsibilities for hydrogen were distributed across many different departments (e.g. DTI, DCLG, HMT and DfT) with very little sense of different departmental activities being widely understood or shared in a strategic sense across departments. Capacity to engage with developing a policy position on the hydrogen economy – both in terms of human and financial capital - was limited and the tendency was to outsource strategic work and coordination of this agenda to consultancies or other agencies. Consequently, there was little sense of what a strategic approach might represent.

6. Conclusions

In this paper we have engaged with and added to the body of transitions literature. We critically and sympathetically engaged with this literature in respect of four broad issues is managing transitions:

1) Prospective views of the future through transitions;

2) The role of places in managing transitions in context;

3) The role of publics in transitions processes;

4) And the resonances and dissonances between transitions approaches and the UK policy context.

First, we reviewed the technological transitions approach focusing on the following issues: i), can transitions be managed; ii), how transitions are conceptualised; iii) what are the key transition phases; and iv) what are the key shortcomings of transitions approaches. We focused on three particular issues raised by Berkhout et al, (2003). The first of these is to question the view that regime change begins in niches and works upwards and thus underplays the role of landscape pressures on regimes. Second, they are univalent in that they underplay issues of power and overplay consensus, intention and choice in the face of potentially multiple social actors and expectations. The final point, that they are unidimensional, claims that transition approaches often underplay differences in transition contexts and the balance between historical contingency and human agency (Berkhout et al, 2003). With this in mind, Berkhout et al propose an emphasis on regime change which acknowledges the multilineal, multivalent and multidimensional. In doing this they highlight that addressing the context of the regime in transition processes opens up the possibilities for understanding *a variety of transition pathways*. Moving from an over-privileging of the niche as the predominant pressure on the regime to also thinking about the role of other regimes and the landscape in exerting pressures (the combination of top-down and bottom-up pressures) on incumbent regimes raises questions about how incumbent regimes transformations can be understood. Adaptive capacity refers to the collective capacity of the regime to recognise, respond to and influence regime transformation. In addressing the relationship between contexts of regime transformation and transformation processes, Berkhout and colleagues highlight the importance of two sets of issues. The first being that pressures for change within a system originate both within and outside a regime and the second is that the critical issue is to understand how differing social interests adapt to such signals. Consequently: 'there emerges a clear need for greater acknowledgement and understanding of *different transition contexts*' (Berkhout et al, 2003, p.18, emphasis added). However, the transitions literature says little about the 'where' of different contexts; it offers a limited sense of place.

Second, we developed a perspective that views transitions as being embedded in particular places and that places are differentially positioned in terms of their ability to inform

transitions. The concept of systemic intermediaries was developed as it allows us to address the extent to which cities and regions can strategically shape technological transitions. In doing this, we suggested that understanding the early stages of transitions in particular cities and regions mean we need to understand two sets of social processes. First, outlining the vision that has been developed for a particular place-based transition. Second to understand the negotiations of these visions in terms of the social actors involved and the expectations from different positions embodied in them - this requires a focus not only on 'endogenous' relationships within cities and regions but also on the 'exogenous' relationships with national government, private capital etc. The step between 1 and 2 allows us to look not only at the vision but also the extent of any 'gap' between the vision and issues of capacity in relation to the extent to which cities and regions may shape (and be shaped by) transitions.

Third, we have developed and demonstrated a framework for analysing the interplay between 'public engagement', technological development and the local context of its (non-) appropriation. This attempts to re-connect transition approaches to the role of publics, the specificity of places and competing visions of socio-technical change. By sensitising transitions approaches to these issues we have attempted to develop transition perspectives in the following four ways. First, we have highlighted the critical role and importance of symbolic and often highly partial visions of the future, in the present, through the development of technological change. Second, we have demonstrated the potential variability and particularity of those social interests whose expectations inform a particular view of the future. Third, we have illustrated the potential consequences of these differences in the ways in which particular social interests, and their domination of power relationships, informs the negotiation and renegotiation of a vision of the future in its translation to practice. Finally we highlighted that key lessons can be learnt from processes of moving from Vision to Actuality.

Our review of place and publics demonstrates that the key issue, and focus for future research, thus becomes developing a better understanding of the interplay of vision, expectations, processes and methods in specific contexts. This call is not to be totally reducible or to capitulate to context but to develop sensitivity to context. In doing this, development of cases in particular contexts are not an end in themselves but should be

used to inform comparison of patterns, trends and regularities. Through such a programme of work the transitions approach could begin to, more carefully and systemically, become sensitised and transformed to a wider politics of publics, place and expectations that recognises and works within differential and asymmetries of power.

Finally, we reviewed the affinities between the UK national policy context for the hydrogen economy and technological transitions approaches. We demonstrated that it is important to understand the following three styles of thinking within which the development of the hydrogen strategy was strongly shaped which highlight the dissonances (but also potential resonances) with a transitions management approach. First, policy has a strongly technological focus but this co-exists with an emerging recognition of systemic issues. Energy issues were generally seen in policy circles in terms of technologies – e.g. renewable, oil and coal, nuclear etc – with a concurrent strong techno-economic interest rather than a transitions focus. Yet there was some evidence that this is changing with an emerging concern with sustainable low carbon futures. Second the focus on the development of a framework for markets and the use of a linear model of innovation. There was a strong emphasis, in policy documents and through discussions with national officials, on 'not picking winners'. This privileged a view of technological neutrality (despite the focus on different sectors outlined above) and, therefore, the role of policy was ambivalent, with a simultaneous emphasis on government providing a framework for innovation in energy systems but then not picking particular systems. The dominant discourse was that it was for the market to decide how energy targets are achieved. Yet, at the same time transformation in energy systems was also understood and characterised as a linear process: one of 'pulling the technology through' the process of 'research', 'development', 'demonstrations' and 'deployment'. Finally, a highly distributed governance context with outsourcing of strategy formulation and relationship management to intermediaries. Responsibilities for hydrogen were distributed across many different departments (e.g. DTI, DCLG, HMT and DfT) with very little sense of different departmental activities being widely understood or shared in a strategic sense across departments. Capacity to engage with developing a policy position on the hydrogen economy – both in terms of human and financial capital - was limited and the tendency was to outsource strategic work and coordination of this agenda to consultancies or other

agencies. Consequently, there was little sense of what a strategic approach might represent.[47]

Consequently, we have critically highlighted key sets of themes and issues to be considered in both thinking critically about transitions which provide a basis for guiding and informing those undertaking transitions as to the issues, potentials and difficulties in undertaking transitions.

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