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Mapping and navigating transitions—The multi-level perspective compared with arenas of development

Ulrik Jørgensen*

Dept. of Management Engineering, Technical University of Denmark, 2800 Lyngby, Denmark

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ABSTRACT

Transitions of socio-technical systems imply the reconfiguration of institutions and politics making made evident the need to understand and intervene in existing patterns of growth and socio-technical practices in more sustainable directions. In recent decades, theories of transitions have been introduced, which include the multi-level approach indicating ways to govern transitions through understanding the interactions between niches, regimes and landscapes. An alternative approach is suggested, which takes its outset in arenas of development and increased awareness of actors and their way of interpreting context and performing interventions.

Building on three cases covering aspects of transitions since the 1970s, the article compares the two approaches based on three concerns in relation to transition studies. The first concern reflects that conflicts are important elements of change helping actors to navigate. The second concern builds on the observation that actors engage at all levels in society including visions, institutions, and innovations. The third concern addresses the role of academic theories and advice regarding governance of transition processes in which they function as entrenched actors.

The article ends by emphasising the need to help actors navigate in a field in flux. The study of arenas of development may help interpret transitions in the making, and provide a background of information about how different actors can navigate and perform strategic interventions that support sustainable transitions.

1. Introduction

Challenges to society from climate change and resource depletion resulting from the human organisation of socio-material life forms, have led to growing research interest in socio-technical transitions as a way to describe and eventually also intervene and create change. They have also opened for a renewed interest in the sustainability challenges from modern industry and consumption, as well as from population increase and growth in material consumption worldwide. Specifically, the use of fossil fuels and land for the production of energy, food and other products so intimately linked to the formation of contemporary modern life has created a need for rethinking and restructuring production and consumption within almost all sectors of society.

A prominent contribution to the analysis of transitions has been made by the 'Dutch school of transition studies' with its focus on socio-technical regimes and niches as core elements framing agency and interactions (e.g. Elzen et al., 2004; Grin et al., 2010 and a number of articles, some of which are referenced in the following). This theory has been further expanded into a three-level model to explain transition processes in general (Rip and Kemp, 1998; Geels, 2002; Schot and Geels, 2008). The three levels, entitled *niches*, *regimes*, and *landscapes*, resemble the classic distinction between micro-, meso- and macro-level descriptions of societal processes, and they inherit the idea from e.g. innovation studies (economics) that the meso-level processes are at the core of understanding the dynamics of change in society. The basic mechanism involved in this approach to transitions is that the actors involved are framed by the existing regimes, which follow certain paths of development (Garud and Karnøe, 2001). Changes leading to transitions usually come either from niche developments or from transformations at the landscape level.

This model – often summarised as the *multi-level perspective* (MLP) – has been used as a productive framework to describe and analyse quite a substantive number of historic transition cases, and to sketch possible transitions emerging by identifying niches that demonstrate potentials for new breakthroughs. In ideal-typical ways, the transition model can be used to demonstrate the processes of transition from one dominant socio-technical regime over a period of conflicting institutional and technical transformations, including the emergence of new solutions to a new dominant socio-technical regime. While such simplification is not conditional to

* Tel.: +45 21665424.
E-mail address: uj@man.dtu.dk

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using the model of socio-technical regimes, it illustrates its potential.

The presented approach to transition studies does not imply, per se, a normative direction of the resulting changes, which leaves the sustainability question open for interpretation and eventual governance intervention (Geels, 2010a). Many of the earlier socio-technical transitions in society involved in the creation of modern industry and consumption have obviously not been sustainable. Several recent transitions are questionable regarding how they contribute to sustainability, and conflicts about future changes and policies must be expected. This will lead to confrontations between different actors as well as between countries, as demonstrated by the global political negotiations about international climate responsibilities and coordinated actions.

Analyses of historic transitions demonstrate that not only do socio-technical solutions and regimes change, so do visions, values, configurations of economic and political governance, and the criteria used to assess the outcomes of transitions – e.g. whether they support sustainable change or not (Geels, 2010b). Several parallel visions and socio-technical solutions may strive to gain importance, based on rather different views of societal institutions and strategies for action.

This MLP approach has been instrumental in coining the notion of socio-technical transitions and has provided a fruitful set of tools for historical case analysis and for staging the need to understand transition processes. However, *three critical concerns* are taken up in this article addressing how to make sense of the three levels defined in MLP, especially when facing contemporary and future transitions.

The *first critical concern* takes its outset in the role of actors involved in a transition process. Do theories of transition offer navigational support for actors, reflection that the process is often characterised by conflicts over the fundamental constitution of the problems and visions that inform the directions and initiatives taken?

The *second critical concern* is based on the observation that actors engaged at several levels in transition processes and are not working in isolation. How are the levels defined and distinguished in MLP in relation to actors involved in transitions?

The *third critical concern* reflects that academic approaches as e.g. MLP used to map regimes and processes of socio-technical transitions are deeply entrenched actors in the transition processes. What role do transition theories play by informing actors and creating new political realities with their models and vocabularies?

An alternative approach to transition analysis is proposed. It is taking the outset in the *arenas* in which actors operate in networks that involve institutions, technologies, visions and practices (Jørgensen and Sørensen, 2002). The boundaries of an arena, as well as its configuration, are in flux and continuously reproduced, based on processes of ordering and stabilisation as well as restructuring. Central to the configurations and boundary-defining processes are the performances of actors seeking to stabilise or change relations. This approach does not presuppose a levelled ordering of structures, agency, and interventions, but operates with a 'flat approach', where the transition processes are outcomes of the performed reproductive and reconfiguring actions.

Instead of taking its outset in strong structural features represented by institutions and technologies, as is the case in the multi-level approach, the arena approach takes its outset in actor constellations and their collective sense-making activities. In the sense-making activities, existing configurations and institutions are reflected, but the stability of these institutions may be interpreted very differently by actors, depending on their relationship to these configurations. This opens for multiple interpretations and different strategic actions. Thus, the argument presented is, that radical transitions involve basic transformations of society at large going beyond the change of technologies and social practices.

In the following sections, this paper introduces the multi-level model and its approach to transitions, as well as the arena approach with its actor-centred analysis, and identifies their theoretical underpinnings and assumptions. The two approaches are compared for their strength and weakness informed by three 'transition cases' covering developments spread over a historic time span from the 1970s until today. The article format only allows space for brief presentations of the cases, but they all are based on richer empirical studies (Jørgensen and Karnøe, 1995a; Valderrama, 2010; Jørgensen and Strunge, 2002; Jørgensen, 2012).

The article concludes with a discussion of the findings and answers to the three critical. A final section outlines the next steps necessary to improve the theories and their usefulness in analysing transitions and support navigational strategies of intervention.

2. Transition theory: regimes within a multi-level model—a brief overview

The discussion in this article is based on what are considered the core theoretical components of transition theory so far, namely the concepts of socio-technical regimes and niches within the multi-level perspective (MLP). While regimes and landscapes were first introduced within a transition perspective with a strong emphasis on the role of technologies (Rip and Kemp, 1998), the introduction of niche developments gave stronger emphasis to the role of actors (Schot et al., 1994).

The MLP of transitions presents a quite elegant, systemic model of three inter-connected levels that are defined by the metaphorical notions of 'niche', 'regime' and 'landscape'. The model and the metaphors used have a certain intuitive and explanatory strength, which implicitly gives new content to and links between micro-, meso- and macro-level theories well known to economic theory as well as sociology often defining a hierarchy from macro to micro. MLP resembles the innovation systems approach's interest in understanding the dynamics of innovation. The 'grey zone' at the meso-level has in recent decades been given more attention due to its importance in society's coherence and change emphasising coordinating institutions and networked innovations. The focus on the 'grey zone' has been an attempt to take on the difficult task of answering social sciences' big challenge of handling the relations between stability and change, and bridging the divide between different disciplinary approaches of economics of innovation, evolutionary theory, sociology of technology, history of technology, and governance studies.

Transition theory builds on the idea that socio-technical regimes develop from the stabilisation of technologies and institutions within sectors of society, leading to path dependencies (Hughes, 1987; Rip and Schot, 2002). Such stabilisations define specific paths of development and build up momentum and strength to resist change (Garud and Karnøe, 2010). The identification of regimes is therefore a basic step in the analysis of the transition process, followed either by studies of niches that might threaten dominant regimes, or by comparison with new, changed regimes that demonstrate the transition process from one regime to another.

> Although each transition is unique, the general dynamic pattern is characterized by transitions resulting from the interaction between processes at different levels: (a) niche-innovations build up internal momentum, (b) changes at the landscape level create pressure on the regime, and (c) destabilisation of the regime creates windows of opportunity for niche-innovations. (Geels, 2010b)

Socio-technical regimes are the embodiment of agency in structured relations, as outlined in the theory of structure and agency (Giddens, 1984). Important sources of inspiration has been the economics of innovation with the introduction of trajectories (Dosi, 1982), the theory of large technological systems that point to the inter-linking of technology, institutions and practices (Hughes, 1987), and the evolutionary perspective on change in the economy (Nelson and Winther, 1982).

The location of agency is at the core of discussions in transition theory. The relationship between regime, actors, and rules are seen as basic for understanding regimes (Geels, 2004). Within regimes, actors are either rule-followers or game-players defined by the frames constituted by the regime. The detailing of rules and their institutional and material grounding underpin the importance of stabilised regimes for actors entrenched in them. This is consistent with the mutual definition of regimes and actors as described by Geels:

> Actors within these groups share a set of rules or regime. As the different groups share different rules, we may distinguish different regimes . . . (Geels, 2004, p. 905).

When different regimes co-exist or tensions emerge, either within or across regimes, actors may be able to break out of their framed practices, but these situations are still conditioned by the established regimes. At the same time, actors are given some leverage concerning their actions:

> Actors interact (struggle, form alliances, exercise power, negotiate, and cooperate) within the constraints and opportunities of existing structures, at the same time that they act upon and restructure these systems. Another important point is that structures not only constrain but also enable actions . . . (Geels, 2004, p. 907).

This does not answer the question to empirical case studies regarding when and how actors are to be characterised by following rules defined by a regime in which they are embedded or from which they might be breaking out. While the theory is consistent as long as the relations between regime, actors and rules are maintained, there is no clear answer to what can liberate actors from the structural framing of their actions. This contradiction – as reasonable as it may seem when taking into account and reflecting on the complexity of understanding actions and practices – is taken up in the following discussions of the concept of actors, the dominance of regimes, and the problem of how actors are included (subsumed) within regimes.

In its earliest forms, transition theory emphasised niche innovations as the most important source of change, by creating and sometimes even sustaining challenges to existing socio-technical regimes. This aligns with models of change found in evolutionary economics, where 'variation creation' and 'selection environments' are presented as independent processes with their own structural features and actors.

> Niches are locations where it is possible to deviate from the rules in the existing regime. (Geels, 2004, p. 912)

It is also important that niches are less well-defined and stabilised than regimes, and therefore do not restrict actors to following rules in the same coherent and reproductive way. Based on the idea that niches provide the shelter for new innovations and present potentials for overthrowing existing regimes, attention to innovation policies nurturing niche developments fostered the concept of Strategic Niche Management (SNM) as a central policy concept (Kemp et al., 2001; Schot and Geels, 2008). This concept reflected existing 'niche strategies' or 'infant industry policies' in several countries. It also added to these a theoretical framework that informs policy makers about their choice of instruments, while also recognising the open-ended character of the induced change processes:

> Independent 'outside positions' do not exist. This is one reason why open-ended learning processes are emphasised in SNM. From this perspective, resistance and conflict is to be expected . . . (Schot and Geels, 2008, p. 549).

Other mechanisms may also lead to transitions while existing regimes are being identified within the MLP, since e.g. processes and tensions within regimes and between regimes are also argued to lead to transitions or at least transformations and stepwise reconfigurations (Geels, 2006b). This also adds the idea of tensions and misalignments to the mechanisms at play:

> To understand transitions from one system to another the notion of tensions and mis-alignment are useful. The different regimes have internal dynamics, which generate fluctuations and variations . . . (Geels, 2004, p. 913)

The macro-level phenomena addressed by the metaphor of landscape are defined in a variety of ways, all of which are seen as 'exogenous developments' in relation to the main concepts represented by socio-technical regimes and niches (Geels, 2007a, p. 126). Tracing the definitions of what the landscape is composed of, leads to a number of different collections of phenomena that demonstrate a quite heterogeneous field:

> The macro-level is formed by the socio-technical landscape, which refers to aspects of the wider exogenous environment, for example, globalization, environmental problems, and cultural changes. . . . It includes the material aspects of society, for example, material and spatial arrangements of cities, factories, and electricity infrastructures. . . . At some point in time, landscape changes may occur, for example, emergence of new values, changes in macro-political coalitions, wars, and so on (Geels, 2007a, p.129-130).

> Socio-technical landscapes do not determine, but provide deep-structural 'gradients of force' that make some actions easier than others. . . .[It] has similarities to the . . . concept of longer durée . . . (Geels and Schot, 2007).

This is exemplified in the outlining of transition pathways, where landscape-initiated transition processes are indicated as an alternative to niche developments (Geels and Schot, 2007), further complementing niche-internal processes with contextual changes at the landscape level, which influences the dynamics of transitions (Schot and Geels, 2008). Not least, the role of socio-political developments resulting from social movements and their interactions with policy agendas (e.g. resulting in the rise of environmentalism) play an important role. Supplementary top-down measures, based on regulatory interventions or public funding, may help set the stage for a transition, especially in cases where niche innovations strive for survival and are met with resistance from existing regimes.

> Pressures and rule changes may cause de-alignment of the existing regime, creating windows of opportunity for broader change (Geels, 2007a, p. 130).

Phenomena addressed as landscape can be identified by their long time stability as well as their status as background for the specific investigations in which they appear. This does not simply place these phenomena as 'exogenous' – as stated by Geels. They could be influenced by actors addressing political and social discourse in society to induce change during transitions and thus even act as the triggering condition for pushing a transition forward. This can be illustrated by an example presented in a study of the Dutch highway systems:

> Concerns about environmental problems and public participation were general landscape developments that affected the highway system. Pressure was enacted by new outsider groups, which placed negative side effects on the agenda ... (Geels, 2007a, p. 144).

The multi-level perspective (MLP) has shown that transitions are not necessarily driven from the bottom up but may also be initiated at other levels (Geels, 2002). Institutional actors can engage directly at the regime and landscape levels, which also entails a modification of the 'blindness' of variation included in the evolutionary distinction between 'variation creation' and 'selection environment' (Schot, 1992). Knowledgeable and resourceful actors can influence both niches and the conditions for their success. Top-down actions involve influencing public opinion, redefining public regulatory policy, and changing the structure and mechanisms of markets to influence existing regimes through inducing and framing innovations at the micro- and meso-levels (Berkhout et al., 2004).

3. Enhancements, perspectives and criticisms

The richness of case studies of socio-technical regimes utilising the levels from MLP, has delivered a number of additional findings that enhance and also modify some of the basic models suggested in transition theory. These include the studies of different pathways of transitions (Geels and Schot, 2007) and the patterns or routes in transitions and system innovations. Such studies provide refinements to the transition theories, but they still operate within the framework of the MLP (Geels, 2004) and do not challenge the ordering into the three levels of the different phenomena and observations at stake.

In empirical studies of transitions, regimes often appear to co-exist with relationships that are difficult to analyse within the framework of regimes. These difficulties result from the fact that regimes themselves are idealised constructs that tend to leave out tensions and misalignments. The multi-level perspective does not provide rigorous guidelines for the identification of regimes, their boundaries and temporal changes resulting from transition processes that make both regimes and transitions recognisable in periods of radical change (Genus and Coles, 2008). Some openings for change originate from regime interactions, but often regimes may not compete on equal terms, but rather appear from historically detached socio-technical or socio-political networks fighting for dominance on their own, disjunctive premises. Multi-regime interactions have also been studied by Geels (2006a), who notes that two regimes may interact and eventually co-evolve around some comparable elements and visions. The perspective of multi-regime interactions and co-evolution has been taken up in other empirical case studies of energy supply systems (Raven and Verbong, 2007; Raven, 2007; Konrad et al., 2008), which recognise the importance of cross-fertilising, parallel developments.

3.1. Can transitions be managed?

One obvious interpretation of the MLP is that it may act as an analytically based heuristics giving normative advice to actors that engage in transitions. Accordingly, several attempts have been made to develop strategies for niche management or even transition management (Kemp et al., 2001). This interpretation opens for more leverage for actors' interventions, without giving theoretical advice about when rule-following behaviour sets the stage and when e.g. landscape changes induce or open for alternative actions.

With reference to the Strategic Niche Management (SNM) approach, transition theory has been criticised for having a bias towards analysing bottom-up processes of transformation based on small networks of actors. These networks are assumed to support the development and protection of niches that could challenge and sometimes even overthrow or substitute existing regimes. Studies of niche development processes emphasise the importance of expectations and shared visions for supporting niche dynamics and creating institutional change and strategic visions regarding the dominant regime and landscape processes (Lente, 1993; Berkhout et al., 2004). While most innovations build on more or less explicit visions and economic expectations, the challenge is whether these are actively promoted and enter into the broader controversies in society about ongoing changes even leading to changes at the landscape level. Transition theory has also been criticised for opening up for simplistic conclusions about future transitions, based on descriptions of past transitions that present a picture of inevitable processes. This conclusion is supported by recognising how very few niche developments take off and lead to regime transitions (Berkhout et al., 2004).

According to the idea of managing or at least orchestrating transition processes, transition theory has been considered a form of reflexive governance; and as such, it is often described as a necessary development in response to the complexity of societal regulation and the limited resources and knowledge of government (Voss and Kemp, 2005). There is no doubt that the involvement of a broad range of social actors and their knowledge is needed to perform transitions of any importance to society. At the same time the parallel existence of several regimes and niches opens for multiple directions of change, as do the different visions and interests of actors assigned to socio-technical reconfigurations. It is the very understanding of the problems and responses that are contested, which leads to multiple interpretations of how regimes and actions can be described; thus, the multiple framings themselves become the core of disputes over transitions. This raises questions about the use of transition analysis in attempts to steer transition processes within a governance perspective. Instead of viewing studies of transition governance as a tool to develop further managerial advice presupposing that centres exist from which transitions can be managed, their aim must be to identify the political role of governance (Smith and Stirling, 2007).

The approach to governance in the MLP can be characterised as 'governance from the outside', as the objects of socio-technical change can become known, made predictable to governance, and acted upon (Smith and Stirling, 2007). This suggests that governance actors should be studied in relation to their level and type of commitment, and the appraisal should be seen as 'ways of being' and 'ways of knowing'. Criticism of the managerial approach to transitions notes the essentially contested nature of sustainability and asks for a 'governance from the inside' approach, reflecting that:

> Each actor does not hold a fragment of a whole, such that all mental maps can be stitched together and the global socio-technical topography revealed (Smith and Stirling, 2007, p. 10).

Consequently, multiple ways of viewing socio-technical constituencies lead to different ways for governance engagements to position sustainability as the possible emergent outcome of actor coalitions and learning processes. Interventions unavoidably involve actors with framed and limited capacity as well as contradictory and multiple interests within the specific sector or societal sphere targeted by the transition study (Elzen et al., 2004; Shove and Walker, 2007).

These criticisms are in line with the first concern raised in the introduction asking for more emphasis given to the interplay between the actors and the structural entities of the MLP.

3.2. The role of 'landscape'

It has been argued that transition through policy decisions can only be successful when pressure at the landscape level – for example, public opinion – temporarily opens windows of opportunity (Kemp, 2007). Such decisions are most often contested, thereby leading to political controversies. The choice of concepts and the design of policies and regulatory instruments that support a transition are therefore also influenced by these conflicting interests. Often, the policies may even be difficult to analyse, since their aims may be ambiguous and supported by a lot of rhetorical policy statements, while the details and impacts of the working policy must be found in the details of its implementation in the specific sectors in question. Following this, the approach to understanding overarching policies at the landscape level has been criticised for not taking the complexity of policy seriously and thus reducing policy interventions to a consensual and corporatist model of politics (Scrase and Smith, 2009).

In addition, expectations and hype-cycles are often brought forward by actors as support mechanisms for their interventions. Even though actors may have limited capacity to assess the influence of the promises brought into play, the created expectations trigger further action (Verbong et al., 2008).

Consequently, actors cannot analytically be attached only to one level, as e.g. niche-actors, regime-actors, or even actors with special roles and emphasis on the landscape level. In empirical terms, actors are engaged in transforming and intervening at all levels, without necessarily being very explicit about distinguishing between them. Further criticism has been raised concerning the role of actors in transition that paints a picture of the theory as being predominantly functionalistic in relation to the way agency is treated. Actors are mostly considered to be structurally embedded rule-followers – who could be accused of being structural dopes; but at the same time, actors are seen as acting not only within but also in opposition to dominant regimes, and even as being enabled by them (Geels and Schot, 2007).

The risk of trying to pre-define transition strategies can be illustrated by the attempts to define transition pathways, some of which are explained as 'landscape'-initiated transition processes and designated as alternatives to niche developments (Geels and Schot, 2007). Such changes are the result of political interventions by actors.

Following up on the second concern from the introduction, the role of actors in shaping and changing elements at the landscape level challenge the foundational logic of this level.

3.3. The stability and boundaries of regimes

Instead of viewing regimes as monolithic structures with a given momentum, they could be described as constantly under pressure from other much 'weaker' formations (not necessarily satisfying regime characteristics) and from niches in the making. This forces regime actors into constant repair work and reproductive actions, but it also shows the continuous tensions challenging the adaptive capacity of a regime (Berkhout et al., 2004). Multiple practices and conflicting outcomes of the regimes indicate the need to adopt nuanced perspectives on the stability and constitution of regimes as well as the need to take the different practices, actor positions, and conflicts seriously. This leads to a request for more specified and rich descriptions of how regimes are confined and can be analysed, reacting against the linearity of many existing regime descriptions (Genus and Coles, 2008; Markard and Truffer, 2008).

Some contemporary regimes often addressed in debates of sustainable change perform well as examples within existing transition theory. Core examples are the fossil-fuel-based energy supply system and the combustion-engine-based car regimes, both of which demonstrate how niche attempts at change have been promoted but still meet the 'hardness' of existing regimes. When engaging in transitions' broader perspectives, analysis will encompass social practices of consumption, as well as other fields of technology where conflicting regimes demonstrate fuzzy relations and practices. These daily life practices may be viewed as subsumed under (multiple) regimes, but still many alternative practices will exist and actors will not be completely aligned but will often also act in contradiction with the rules laid out by the regime.

This has resulted in an important critique raised from the perspective of practice studies, stating that the socio-technical transition theory and its take on governance do not cater for the dynamics of demands and the role of practice. Instead, transition theory draws upon a narrow part of a much wider process of social systemic change, obscuring the role that practitioners play in generating, sustaining and changing everyday practices (Shove and Walker, 2010).

From the outset, no scale is implied in the notion of regimes and transitions, opening for a variety of boundary choices. The size of a regime may vary, as well as the impact of transitions. Some transitions may occur within the boundaries of a sector, where e.g. the production and supply of electricity may change from being dominated by large, centralised utilities fuelled by coal to a distributed system of utilities comprising a variety of larger and smaller energy-producing units. Others may include change in the way energy is consumed through energy-saving buildings and integrated energy-consuming components that cross sector boundaries and involve changes in daily life practices. Social mobility and wide-ranging socio-material configurations in society may also be involved, as in the case of the modernisation of agriculture, which implied industrial growth and migration to urban areas.

Several attempts have been made to bridge the disciplinary divide between the fields of innovation studies (economics), sociology of technology, and policy studies. Transition theory and the MLP are recent examples, which have resulted in the challenge of ambiguity when moving between a generalised systemic level and an actor-based level. The same movement between systemic levels, structural mechanisms, and actor-centred interventions raises questions about the boundaries and dominance of regimes and the subordination of actors within the rules of these regimes.

Because theory building is involved in the strategic mapping of transitions, the challenge is whether transition theory is capable of creating and refining research questions and complementary knowledge that can support the navigation of (multiple) actors involved in and intervening in transitions. While transition theory provides a theoretical framework for identifying dominant socio-technical structures it is important to ask questions about which positions and viewpoints these rationalised portraits represent. Consequently each of the engaged disciplinary approaches can be viewed, not as neutral attempts to understand transitions, but as professional contributions that comprises visions for governance, opening for insights as well as 'black-boxing' complexities (Shove and Walker, 2007).

These critiques reflect the third concern posed in the introduction, but also address the foundational question of what constitutes a regime and in which way does its configuration of institutional relation define the rules following practices of actors.

4. Arenas of development—a 'flat' approach to boundaries and configurations

When analysing the conditions for and processes of transitions, the arenas of development (AoD) approach provides an alternative framework (Jørgensen and Sørensen, 2002). This concept takes some of its main theoretical inspirations from actor-network

theory. Many of the results from innovation and governance studies, which have been informing the socio-technical regime concept and the multi-level perspective, have also been inspirational for development of the AoD approach. The approach was initially developed to describe and support actor policies and interventions in innovation and design processes, based on mappings of the different configurations of actors that, within certain framings, create and re-define boundaries for specific arenas of change, and are also involved in configuring relations within the arena:

> Arena of development is a spatial imagery that brings together heterogeneous elements that seem distant in geographical and conventional cultural space. It resembles the idea of the 'patchwork' of technology stories. It uses the idea of partial connections and multiple stories. In addition, it specifically addresses conflicting interests and contention about the space. (Jørgensen and Sørensen, 2002, p. 192)

Arenas define the space in which socio-material activities are located, and offer stages on which actions and dynamics can be performed.

The 'arena' is a metaphor taken from political and social theory (Fink, 1996). It emphasises the temporary and actor-dependent character of the fields that hold social ordering and in which change and transitions take place. The metaphor 'arena' in this context refers to the word's original meaning in Arabic – 'sand on sand' – to indicate the spatial and relational temporality and fluidity of the phenomena for which the approach provides the analytical framework. Arenas provide the place and space for socio-material interactions.

The arena concept, which emphasises integrated socio-material relations, is a response to the need for an improved theory of transition processes that understands actors' navigations and performances. Here, inspiration can also be found in the social world and arena concept that follows in the footsteps of the Chicago School, especially in relation to detailing models of network configuration, inclusion and exclusion mechanisms, the role of boundary problems, the role of professionals, and not least the question of perspective, commitment, and framing (Clarke, 1991).

The AoD approach is characterized as being 'flat', as it does not operate with pre-classifications of social structures and institutions into levels and hierarchies. The approach does not deny the descriptive usefulness of levels for representing outcomes of stabilisation processes or multiple interpretations, but it denies the prescriptive usefulness of these. Neither does it support the rather common positioning of actor-centred approaches at the micro level of social theory. It may however resemble in some ways the focus on middle-range phenomena, but without implicitly assuming these to be framed in a hierarchy of micro- and macro-level phenomena (Geels, 2007b).

4.1. Actor-networks, spaces and boundaries

According to actor-network theory, actors on an arena comprise a heterogeneous set of entities, which include humans, technologies, institutions, visions and practices provided with their specific meaning, position and identity through their inter-connectedness in networked relations. The structuring and stabilisation within networks result from alignments and mediations. These processes of alignment and mediation are core to the configuration of networks and lead to the creation of temporarily stable actor-worlds, which besides ordering the included objects, knowledge, visions and practices also provide them with a common perspective of their core activities (Callon, 1986). Actor-worlds are semiotic networks that produce in parallel the arenas' focus, boundaries and dynamics through the internal relations and tensions created between them and the 'punctualization' of actors constituting the specific boundary of the actor-network. Tensions and misalignments inside an actor-world still result in continued processes of restructuring and readjustments. An actor-world develops visions and perspectives for action that includes ideas about what might be the coherence-shaping core of the network, but via the simplifications implied in the boundaries leads to the actor-world not reflecting all entities involved in the stabilisation and thus resulting in 'missing masses' or 'missing social practices' (Latour, 1992; Shove and Walker, 2010).

In relation to an actor-network based analysis, the arena adds a spatial dimension to the theory with a distinct way of characterising the boundaries of such networks as introduced in the concept of actor-worlds and their interaction within the arena. The actor-world theory has only in few cases been followed up in recent developments in the actor-network approach, which has left aside the difficult question of what confines networks and how boundaries are created, maintained, and destroyed. The spatial dimension of arenas provides an analytical take on these dynamics that is crucial to transformations that reframe and reshape socio-material relations.

Arenas are restructured, and their boundaries may expand or shrink, depending on the performances that actors engage in when attempting to stabilise, transform or even destabilise existing actor-worlds present on the arena. The performance dimension maintains focus on actual events – whether they are discursive, organisational or material; contributing with the triggers of transformations and their 'machination' (Latour, 1988). While actors may have visions and goals that justify their actions, they often first engage in building alliances, and then, along the way, make sense of the actions and the restructuring that results from them. What counts as performance is thus different types of practices that operate through interactions, demonstrations and other ways of creating presence in relation to other actors comprising of a variety of acts reaching from visions and sense making storytelling to materialised interventions.

4.2. Multiple identities of actors

Actors can have multiple identities and engagements and can thus be enrolled in more than one set of engagements and actor-worlds at the same time. Although knowledge and practices are constrained and framed for a specific enrolment due to the sense-making relations that dominate within one given actor-world and set of relations, conflicting meanings often exist in parallel handled within the shifting contexts of every day practices, but leading to tensions and misalignments for actors in situations of confrontations and changing boundaries. Actors may even be enrolled in several arenas at the same time and do not necessarily need to coordinate and solve either conflicting views or practices as long as these are not colliding. An example of such, at the outset, co-existing arenas of development is households' normalised consumption practices and the electricity supply networks providing power to the households. In certain periods of transformation or crisis, these arenas may have clashed or been vulnerable to demands for restructuring and policy changes, whereas they seemingly operate with marginal contact in periods of stability, even though they are completely inter-dependent from a socio-technical infrastructure point of view. In periods of crisis, alternative practices and conflicting views and visions emerge that lead to controversies and dialogues among the actors and open for changes in the configuration, both within and across actor-worlds and arenas.

The criteria for identifying the boundaries between arenas and the actor-worlds configuring them do not lie in the exclusion or reduction of the analysis to those relations supporting the standardised and regime-governed boundaries, but in the constitution of boundaries through the sense-making activities by the actors

included. The two arenas mentioned are loosely coupled with regard to their social practice, but they are not completely separated, since they co-exist, are intrinsically co-evolving, and refer to each other through the boundary object of power and other energy forms. Depending on e.g. the social tensions within the area of consumption and the tensions in the supply systems for energy, the arenas influence each other and recreate the conditions for their co-existence. During transformative periods, arenas may interact and merge. Such processes often involve conflicts, whereas periods of stability may result in the black boxing of processes, the building of actor-configurations creating new boundaries, and separation of the arena into several arenas. This also creates new boundary objects that can handle the inter-relations between the separated arenas.

Consequently, there is no global theoretical framework in which arenas unfold and actions and networks operate; the totality is a temporary product of how arenas are constituted, and how actors perform within them. It must be remembered, however, that arenas are, so to speak, the sum of all actors' performances and thereby not reduced to a narrow and voluntary selection of actors and their views. The challenge is to include the relevant actor-worlds and interdependencies for the analysis in question.

4.3. Governance and navigations

The analysis of arenas is in principle only complete if it covers the relevant totality of involved actors. This would transcend the realistic constraints of research and the build in situational dependency and uncertainties involved in the fluid and unfolding character of arenas. Consequently, the possibility of viewing and analysing the arenas from an objective, 'outside' position does not exist. The analyst's perspective and position as well as the models and descriptions produced are deeply entrenched parts in the mapping of arenas. Even though a certain level of disinterest and distance can be mobilised in analytical terms, all actors – including those providing analytical tools – are already engaging in the arena when the first analytical steps are taken and the process of categorising and ordering is initiated. Arenas are available as analytical objects, but they are mapped through the eyes and tools applied by involved actors that are entrenched in the construction of boundaries and sense-making activities. This has been discussed as the difference between analytical reflectivity and reflexivity (Smith and Stirling, 2007).

Another consequence that follows from the approach taken is that a certain ambiguity may exist in the description of arenas, which reflects the tensions and conflicts over the scope and range of the networks involved and the actors' performances. This includes the role of arenas with different scopes and different dominant actor-worlds, as e.g. policy arenas and economic market arenas compared to technology-based and institutionalised infrastructure systems (Jørgensen and Strunge, 2002). In the AoD approach, actions rationalised and legitimised within different knowledge domains, such as policy, economy, technology and social relations, are involved on the arenas in parallel with their preferred schemata and heuristics for action that interpret the entities (equipment) present in different ways.

Creating attention and recruitment are core micro-political strategies that form the foundation for both coherence and diversity on an arena. Due to the possibility for actors to have multiple identities and be involved in several actor-worlds, processes of inclusion are important. The possibility to be either loosely attached or highly included in a network is important for dealing with tensions within and across networks of actors. The performed actions are typically heterogeneous – which even works as a measure of their potential impact – and they include creating visions, supporting specific solutions, recruiting new actors, creating alliances of socio-material nature, stabilising interventions, and engaging in constructing the boundaries of the arena. The resulting interactions between rather differently constituted arenas can be quite asymmetrical with regard to the types of actions and rationales involved in the now confronted actor-worlds. Such asymmetries can e.g. exist between actor-worlds pursuing technical efficiency versus others focusing on economically optimal performance, and they can initiate and perform as – often very important – parts in the process of a transition.

To follow up on governance as it is performed by the actors involved and the need for engaging in reflexive governance as introduced in the previous section, the AoD approach does favour this view since performed action includes policy measures and coordination of the networks involved in regulation by creating coherent and coordinated rules for action. The distinct difference between the ideas of managing transitions based on identified maps and transition pathways, and navigating within an arena by working with ways of interpreting the changing relations, reflects a difference in the ontology of ordering mechanisms within the two approaches. This is also reflected in the concepts of power, which in the AoD approach have been inherited from the relational view made operational in the distinction between micro-political and semiotic power (Bijker, 1995). This is in contrast to the more traditional positional view implied in the MLP, which operates with relational, dispositional and structural powers with reference to the niche, regime and landscape levels (Grin et al., 2010).

4.4. Comparisons

The most striking difference between a MLP and an AoD approach is based on how internal coherence and stability are reproduced. Regimes are anticipated to build on a strongly coordinated set of actors, technologies, and institutions, which form and sustain path-dependent developments. Arenas may encompass a variety of different practices, including multiple identities, internal conflicts, and inconsistencies, which emphasises the continued vulnerability of the involved actor-worlds. An actor-world may resemble some of the institutional framing found in a regime, when it focuses primarily on the framings, exclusions, and stabilising relations that reproduce rule-following behaviours. But the introduction of the arena as a broader field for investigation opens for possibilities to study tensions and inconsistencies that are likely within regime configurations, as well as those found in everyday practices. While stabilised regimes and normalised practices very often account for a dominant share of actors, they tend not to include misaligned actors and may even have excluded or marginalised those that are enrolled in competing actor-worlds or perform practices that are not normalised and rule-following.

What in the MLP has been ordered in three levels of analysis – each with distinct features and characteristics – is illustrated within the arena approach as different configurations of temporary socio-material configurations. The individual obduracy and reproductive stability of these configurations is dependent, on the one hand, on their internal networked relations based on a multiplicity of supporting and aligned actors, and on the other hand, on the potential overlap of boundaries of arenas, which open for conflicts and possible reconfigurations. As regimes may turn out to be vulnerable and break down over a short period of time so may political and economic systems and ideologies. While geographic structures, climate events and other phenomena may be accounted for as exogenous, the chosen responses and the situated resilience of actor configurations are crucial to the interpretation and specific importance assigned to them.

A transition is an ideal-type defined as the movement from one state – or regime – to another, thus emphasising the finalised transformation process. This resembles the use of the transition notion in

Table 1
Comparing the multi-level perspective with arenas of development.

Topics of comparison	Multi-level perspective (MLP)	Arenas of development (AoD)
Main theoretical inspiration	Socio-technical systems and evolutionary economic theory	Actor-network theory and sense-making processes
Transition concept	State changes from one to another	Inclusive and fluid transformation processes
Change dynamics	Discrepancies between regimes, niches, and landscapes	Tensions between actor-worlds resulting in changing alignments and boundaries
Core, framing configuration	Socio-technical regimes leading to focus on stabilisations and innovation processes	Actor-worlds emphasising their frames of interpretation and conflicting perspectives
Role of actors	Rule followers/niche builders	Navigators, performing visions and socio-material practices
Researcher's position	View from the outside providing an analytical map	Included as another actor, though privileged
Challenge to the researcher	Critically reflect and overcome a stylised regime concept	Search for boundaries and stabilising configurations

the MLP approach when studying transitions of regimes–at least in anticipating an end-point regime, such as an energy system based on renewable sources, even while it may still be in the making. Transitions in the arena approach are still introduced with implicit reference to the ideal-typical model, but the focus is more on the performances that actors engage in – deliberately or even without explicit intentions – which trigger and move transition processes forward. The focus has moved from identification of the stylised start- and end-point to the intermediary processes, which opens for transitions that change course or 'go wrong' when seen from the eventual anticipated aims of the actors (Table 1).

Compared to the MLP, there are still possibilities for and a need to elaborate and detail the AoD approach. As demonstrated in the next sections, however, its deliberate take on the mapping of actor configurations, their performance and navigation provides valuable insights needed to improve the field of transition studies.

5. Digging deeper – three exemplary cases

To compare the strengths and weaknesses of the two outlined approaches, three cases are used to illuminate how they respond to the critical concerns raised in the introduction. The cases are selected, because they have informed the points of criticism presented and provide historical rigour, which can be a stepping-stone to further investigations and critical dialogue. The cases are mainly based on developments in Denmark, which in this context provides the necessary exemplary value.

The first case covers controversies over renewable energy after the oil crisis in the 1970s. It demonstrates the importance of controversies over guiding visions for sustainable futures despite the agency of existing energy regimes and leading to repeated changes in regime configurations, partly separate niche developments and vulnerable landscapes.

The second case illustrates how a dominant car and highway regime reached its limits when meeting the city infrastructures in the 1970s and the resistance of social activists. This created a state of limbo for planning opening for experiments with alternative city infrastructures and demonstrated the impact of social action.

The third case illustrates how change may be based on internal tensions within regimes as well as different incongruent, competing regimes, some of which may be dominated by socio-technical and others more by socio-political configurations. The role of professional as well as political ideologies of liberalisation demonstrates how other types of regimes may be important for transitions.

5.1. First case: renewable energy and conflicting societal visions

In many cases, new energy technologies have been objects of controversy and conflict among actors. The controversies have been about the technologies' usefulness and contribution to sustainability and their anticipated role, either within existing systems or as alternatives providing completely new qualities that envision changes in societal structures and social practices.

Over time, wind technology has been considered a major solution to fossil fuel scarcity and later to climate change, but is has also been deemed unsuccessful and without a future in modern energy supply systems. These different judgements relate to basic qualities assigned to the technology by the different actors involved. These qualities are not intrinsic properties of the technology; they depend on the network of relations to actors specifying these qualities, and reflect the perspectives assigned in relation to the socio-technical context in which the technology operates. Assessments depend on whether engineers or economists have the upper hand in giving advice to public authorities and investors. But they are not able to deliver good projections of the outcomes of innovative and learning processes in a longer period of historical development (Smith, 2005). Otherwise, how can it be explained that a technology is sometimes envisioned as the solution to climate problems and at other times is discarded as an inefficient energy provider?

The first utilisation of wind energy for electricity production in Denmark can be found in rural experiments with electrification in the late 19th century. Its development was related to the Danish public high-school movement that initiated the building of wind turbines delivering electricity for local farm production connected to the technical improvements in farm machinery of the time (Klitmøller and Thorndal, 2008). But in the 1920s, rural wind turbines were outperformed by petrol-driven power generators following declining fossil fuel prices and problems with storing electric power.

A new wave of experiments with wind technology occurred in the1940s, due to the fuel scarcity during the WWII followed by growing post-war demand for electricity for industrial growth. This led to a series of operating turbines and the construction of a

test turbine of 200 kW in Gedser, which was used to analyse the potential for further technical improvements (Christensen, 2008). Once again, reduced fossil fuel prices during the 1950s made wind turbines less attractive and the Energy Commission's 1962 report stated: *Wind energy will never play an important role in Danish energy supply*, arguing for the price per kWh from wind turbines to be twice the price for coal-fired power plants (Jørgensen and Karnøe, 1995a,b; Thorndahl, 2005).

With the oil crisis in the early 1970s and the emerging controversy over the risks of nuclear power, a new urgency arose to find alternative energy solutions. During the Cold War period, public distrust of government information regarding nuclear war resulted in scepticism towards the idea of 'peaceful utilisation of nuclear power'. While conflicts over nuclear facilities resulted in violent confrontations in Germany and the United Kingdom, experiences with non-violent resistance to nuclear warfare in Denmark inspired the Danish anti-nuclear power movement, Organisation for Information on Nuclear Power (OOA). This fuelled political tensions in the 1970s over society's energy strategy, but it also set the stage for alternative solutions.

Criticism focused on the social impact of centralised energy systems and institutions associated with police action and security measures (Jungk, 1977). Created as an anti-programme, focus on local supply made wind turbines a preferable small-scale alternative, together with other energy technologies like biogas (OOA, 1980). The critique not only attacked fossil fuels and nuclear power plants, but stated that technology was core to the distribution of 'power' in society. Nuclear power was part of a technocratic dream of continuous growth in consumption supplied by the centralised power utilities established during the 1960s. In contrast, small-scale energy alternatives benefited from local production and management.

From the perspective of large power utilities, wind turbines were considered an inferior alternative in any realistic future strategy supplying the growing need for power. These visions were shared by government and power utilities, also including the Nuclear Energy Commission, which were preparing for nuclear power in Denmark. In the view of grassroots movements, locally owned energy facilities satisfied the concept of a renewed focus on more local responsibility and less material consumption. Both these social visions were setting the stage for socio-technical developments, though pointing to very different pathways and innovation agendas. The anti-nuclear movement created a separate branch organisation: Organisation for Renewable Energy (OVE), with focus on alternative technologies developed outside existing institutions and building on local and self-organised experiments.

Environmental movements and wind energy entrepreneurs crossed the barriers of earlier experience by taking the small-scale wind turbine seriously as a power-producing unit, inspired by the vision of independent energy supply. Without this consensus-building, socio-technical vision and belief in the potentials of wind technology, the willingness to risk failure – in contrast to the risk-averse behaviour of utilities and grid investors – would not have been likely (Jørgensen and Karnøe, 1995a).

The 'bottom-up' practice of the small industrial entrepreneurs was the most important source of new technological know-how. They based their designs on series of experiments that resulted in a slow process of up-scaling and optimisation. By contrast, the 'top-down' approaches followed by governments investing in large-scale testing facilities based on knowledge from the aircraft and space industry made no significant contribution to the development of today's functional wind turbines (Karnøe, 1991). Only after the new concepts were developed and had demonstrated their performance did research adopt alternative solutions and small-scale technologies as objects of study (Jørgensen and Karnøe, 1995b; Gipe, 1995).

The controversy resulted in the publication of an alternative energy plan in 1976 written by energy researchers supporting renewable energy. Several years of public controversies and the engagement of various groups of actors made government open for grid integrated wind turbines and define feed-in tariffs, which forced energy companies to pay for surplus power from wind turbines connected to the grid. Since in this first phase of investment almost all single turbines and turbine parks were owned by cooperatives and local communities, the feed-in tariffs created a predictable investment horizon for wind turbines. An important element in the effectiveness of this 'market-oriented' policy instrument was the continued reduction of feed-in tariffs providing incentives to improve the efficiency of wind turbines (Jørgensen and Strunge, 2002).

During the late 20th century, wind turbine energy became an accepted part of governments' future energy plans. New system control strategies were needed to maintain the variety of energy-producing technologies attached to the grid. These strategies have included changes at the institutional to prepare for an increase in the contribution from wind turbines from the actual 20 percent to a goal of up to 50 percent. The network of supporting actors and the qualities assigned to wind turbines have changed from alternative energy entrepreneurs and local investors to utilities investing in offshore wind turbine parks. New constellations of actors have taken over, and today, local investors are marginal. The transformation of wind energy from being an alternative vision for societal development to a substitute for fossil fuel based electricity has been temporarily stabilised.

5.1.1. MLP analysis: Independent niches, regime changes and vulnerable landscapes

The contemporary transition prospect from centralised and fossil-fuel-based energy technologies to renewable and partly decentralised technologies only presents a partial picture of the historic regime developments since the 1960s. In earlier phases, several parallel regimes-in-the-making appear that compete for different types of energy use in the countryside and in cities, implying the emergent and pervasive use of electrical power. While wind turbine developments in the 1950s resemble a niche, wind energy was still operating in relation to an uncertain development path for centralising the grid and power utilities based on steam turbines first unfolding during the 1960s.

While often viewed as a first step in niche building (Smith, 2006), the alternative energy movement had radical visions of substituting the complete energy system and did not consider creating a competitive niche within the existing socio-technical regime. The actors did not confine themselves to working at niche level; they also sought visionary changes of politics, value systems and societal organisation, and thus acted to recruit among the public and politicians to achieve changes the landscape framing the energy system.

The case also demonstrates the importance of how actors get involved in building socio-technical vision, their willingness to experiment, and their perseverance in the quest for solutions and technical improvements. Expectations and assigned qualities – or lack of qualities – are crucial to an actor's focus and choice of specific energy technologies, as well as the technologies' eventual combination and integration into existing institutional settings and distribution networks. Power utilities were unlikely to experiment seriously with wind turbines as long as they considered them to be basically inefficient and unstable small power units. Later, when they e.g. could assign positive properties to them within CO_2 emission reduction initiatives, they became willing to overcome problems of grid integration and formulate backup strategies to stabilise supplies.

The framing conditions shaped at the landscape level demonstrate the impact of WWII while the implication of a 'peaceful' transition from coal and oil fuelled utilities to nuclear power were more complex at both the landscape and niche levels. Fundamental controversies over societal development and modern lifestyles of consumption were involved. Together with the Cold War controversies, they worked as a backdrop and experience base for how social action was organised. Two contradictory but significant outcomes were the result: the abandonment of nuclear power in Denmark, which broke with the already laid out road map for futures energy supply, and the transformation of a decentralisation strategy for society into niche development of wind turbines, which subsequently became an accepted part of the now much more heterogeneous energy supply system.

5.1.2. AoD analysis: actors' visions and reconfigurations

From the arena perspective, developments at the beginning of the 19th century, as well as the social conflicts of the 1970s, were rooted in tensions encompassing wider aspects of societal transformation and social welfare. In the first period, the improvement in living conditions in the agrarian countryside, and in the later period, the controversy over growth and mass-consumption, were already leading to serious doubts about the fossil fuel dependency of modern industrialised society. On both arenas, a variety of material objects were part of sense-making and the controversies that were leading to attempts to innovate alternative solutions parallel with social and political engagements.

Actors in both periods were engaged in societal discourse about changing socio-material practices and to build the visions and motivations they needed to convince and recruit a larger public that was sympathetic to the endeavours of the activists and their interventions. They actor-worlds were confined to the vision of distributed, rural development in the first phase and building local, socially interdependent self-sufficient socio-technical systems in the second.

The anti-programmes installed by the energy utilities had to include new sources of energy (e.g. natural gas) and enhance the repertoire of existing technologies in order to maintain the centralised and grid-based power system. Within their actor-world and institutions they were able to maintain the vision of a centralised and growth based energy utility supply system for a period of time until the build alliances between local wind turbine owners, political intervention and changes cost structures lead to a restructuring of the institutions created with large, energy efficient and coal fires steam turbine generators as the technical core.

It can be questioned whether the Danish use of alternative energy sources, including wind turbines, is the result of a fight between a regime and an emerging and successful niche, or whether it is the result of a broader political compromise in which the defeat of nuclear power plans and the forced grid connection of wind turbines are the more important elements. In this perspective, governance cannot be divided into the sphere of techno-economically dominated regimes and the visionaries and politics involved in creating new regulatory instruments.

5.2. Second case: City resistance—the end of highway planning?

In the 1970s, the planning and construction of highways to connect all parts of the US and Europe, respectively, in support of the growing car regime, started expanding through the new suburbs and into the older city centres. While building highways in the countryside had met only little and very local resistance, contact with cities not only sparked controversies among city planners and other groups of actors, it also collided with the established city infrastructures that had resulted from earlier forms of mobility and localisation.

In Copenhagen, the foundation for city development until the early 1970s was the 'finger plan' outlining the city's expansion after WWII. The plan build on public trains as the trunk lines connecting the suburbs located along the 'fingers' stretching from the city centre. The plan's intention was to provide large green areas located between the 'fingers' and thereby open the city to close connections with nature. However, this plan had not anticipated the huge growth in private car ownership throughout the 1960s, which resulted in fast-growing loads on the roads. The Danish government's response was to establish a new authority responsible for highway planning with the aim of extending the existing main roads and building motorways, following German and American principles. At the end of the decade, growth in car traffic in Copenhagen and other large cities, and the need to construct feeder lines from the motorways into the cities, demanded a renewal of city planning that until then had focused on public transportation.

The response was that a system of ring roads were planned to divert car traffic from crossing through the city centre. In the late 1960s, the first attempt to connect a motorway with the city centre was the construction of a tunnel and an elevated piece of highway to circumvent some of the existing local streets (*Bispeeng-buen*). This resulted in heavy controversy, since the elevated highway required the demolition of several multi-storey dwellings. As a result, traffic now passes close to people's windows at the third and fourth floor levels. This had an eye-opening effect and led to political unrest among groups of citizens and confrontations in parliament between homeowners and car owners. The controversy resulted in a political stalemate that put the new traffic plans on hold until some new agreement in the future could be reached that would cater for the conflict between traditional city values and the new rationales that accompanied traffic planning for highways and cars (Frederiksen, 1996; Munch and Jørgensen, 2001).

The determining confrontation concerning change in Copenhagen's city centre came in 1972, when squatters occupied a road that was planned to connect motorway trunk line traffic with a planned ring-road placed along the shoreline of the lakes circling the centre of Copenhagen. Despite the use of heavy police forces to remove the squatters – ironically, the roads name was 'Peace Road' (*Fredensgade*) – the confrontation made the Copenhagen municipality postpone their plans. The planned ring-road was assigned the number 1 in the Copenhagen ring-road system, and visitors to the city may note that even today this 'Ring 1' does not exist. Instead a public park can be observed where the feeder road was to be located.

5.2.1. MLP analysis: destabilising regimes and blurring the landscape

The case demonstrates how a quite stabilised car and highway regime, supported by strong institutions and government decisions, was temporarily blocked by rather marginal groups without broad public support for their actions, but who still addressed tensions and misalignments between the traditional path in city planning and a dominant regime. While the socio-technical regime involved had well established momentum, it met resistance from groups and a broader societal discourse that opposed the car regime, demonstrating the ambiguous discourse on mobility and the co-existence of multiple values and preferences.

This controversy could be described within a system of co-existing regimes, since, in the present case, the national highway planning on the one side and public-transport-based city planning on the other were clashing at the boundaries of the older city centre. No resolution resulted from this confrontation, which ended in a stalemate between regimes and an ongoing public discourse that did not provide any common ground for change. But at the same time, neither the niche nor the landscape level can fully account for the role of public opinion and the intervention of the squatter

movement. It set the stage for indecisive city planning in Copenhagen for the next two decades. Eventually, however the landscape level may be able to cater for an 'outside chock' that can re-orient regime developments (Geels and Schot, 2007, pp. 401, 409), but does it make sense to view this social confrontation as an 'outside chock'? The events and the public discourse newer the less changed the landscape by de-legitimatised continued regime action as also seen in somewhat similar studies of the Dutch highway system (Geels, 2007a).

5.2.2. AoD analysis: local performances re-frame visions and infrastructures

This case has some resemblance to the breakdown of the plans for nuclear power plants during the early 1980s. In both cases, seemingly strong socio-technical configurations, with well defined visions for the future and a well established and stabilised development path, were disrupted by social movements that may have addressed tensions in public opinion but definitely could not expect majority support. These groups acted on their views in such ways that they also corresponded to broad opinions and doubts and created a presence on the political agenda. Regimes with institutional strength and policy support, which a few years earlier might have been seen as unstoppable based on the momentum they had achieved, turned out to be much weaker than anticipated when confronted with articulated and performed action. Even though configurations seem to be well established and dominant, they may be vulnerable and break down over a very short time, not least because the assigned stability is not put to a test, and its symbolic value (semiotic power) is what most detached actors would respond to (Bijker, 1995).

The inclusion of actors not engaged in car-based mobility and its related institutions and practices is one of the important additions taken into account in the arena approach. Their actor-worlds may remain invisible as long as they do not actively demonstrate their presence, but they can also influence and change the conditions for using cars in important ways. Bicyclists, bus passengers, elderly, commuters, citizens etc. may be engaged in many other activities while they are only marginally engaged in car-based mobility. They are excluded from the configured actor-world of car owners and users, and even within this network, a large share of the actors may have a low degree of inclusion. This opens for situation-based changes in the acceptance of plans and visions.

It was not before a policy induced change in the status of Copenhagen as a metropolis, and the revitalisation of the public transport regime with the construction of Metro lines that support city centre development, that the stalemate situation seems to have been resolved (Frederiksen, 1996; Munch and Jørgensen, 2001; Valderrama, 2010).

5.3. Third case: system complexities, policy frames and constructed markets

Although much emphasis in transition studies has been placed on the stability and momentum of the contemporary centralised power-producing energy system, this system really first took off in its present form in the 1960s based on large scale steam turbine driven generators illustrating that the energy supply regime has undergone several modifications over time. In parallel different types of power-producing technologies have co-existed for a rather long period. For example, the technologies and institutions utilising co-generation of power and heat were initiated already in the 1920s in Copenhagen and other large cities in Denmark. Co-generation was developed to gain an overall improved efficiency from fossil fuels, which led to reduced costs. Co-generation was also involved in strengthening the existing fossil-fuel-based energy supply systems since the 1970s. It not only provided higher efficiency to the overall energy system, but it also opened for flexibility in regulation, based on the possibility for fast changes in output. With the entrance of new types of fuels, e.g. waste and bio-mass, the co-generation system has even been able to become a core part of a potentially more sustainable future energy supply system, as it has opened a temporary avenue for the established power plants to be rebuilt into environmentally friendly facilities.

Contemporary experiments with electricity for both public transportation and private cars open for a possible redefinition of the grid into what has been coined a smart-grid, where short-term storage is possible through integrated management systems. In addition, private households can be transformed into energy producers by installing solar cells and small-scale energy technologies. These developments change some of the fundamental boundaries between producers and consumers and the energy systems technologies and institutions. Especially, the new organisation of consumption practices become an integral part of the energy system opens up the regimes monolithic base in the power supply system by adding a much higher degree of diversity. A strategic choice has surfaced concerning ownership and engagement as large utilities mainly see the potential in taken even more control over the total system while consumers may see the potential in becoming more active partners in building and maintaining a sustainable energy system. Where this transformation will end is still an open question, but it will indeed challenge the existing institutions and practices as well as the division of responsibilities.

Other complexities are challenging existing norms and stabilised practices based on the rapid changes in energy policies during the last decade. The Kyoto Protocol and the European Emissions Trading System (EMS) have provided a framework defining new mechanisms for the energy supply systems in Europe operating with a constructed market for trading quotas covering the emissions of CO_2. The impact of the trading system measured by the resulting emission reductions is dependent of the specific national institutions set up and their decisions concerning the total amount of quotas and their distribution. It was designed to favour heavy 'polluters' by providing them with 'free' emission permits instead of giving the quota to renewable energy suppliers. This illustrates that such market constructions are deeply embedded in the existing power structure framing the new regulatory instruments.

The initiation of a market-based trading system has resulted in a focus on the short-term optimisation of energy supply systems–thus favouring, for example, combined cycle gas turbines for their short payback time and their lower CO_2 emissions in comparison to conventional fossil fuel plants. Combined cycle gas turbines have existed since the 1920s but were primarily used to handle marginal loads, since they were considered less cost efficient than the larger steam turbines; but the new focus on emissions changed their assigned qualities quite suddenly, making them into a feasible and sometimes even preferable energy technology (Winskel, 2002). The inflexible adjustment of the total amount of quotas and their distribution have resulted in very low CO_2 prices, which has resulted in reduced investments in developing new energy technologies (Jørgensen, 2005).

European liberalisation policies have changed the configuration of actors in the power arena. The new market construction favours established utilities and proven conventional technologies, which in the case of wind turbine investments has resulted in a major shift from local investors and entrepreneurs to conventional financial markets and large investors, thus leading to short-term optimisations (Jørgensen and Strunge, 2002). While today's wind turbine technology is considered an important contribution to the general energy supply system, other renewable energy technologies based on e.g. solar, wave, or geothermic power still need some form of niche protection. Much higher prices for fossil fuels are required before economic rationales will favour long-term

sustainable solutions. Even though the renewable energy directive opens for national support policies and development programmes the overarching liberal market strategies have been transformed into a dominant political economics regime.

Economic rationales as such are not neutral instruments that help identify optimal solutions, but political tools in the continuous struggle over the direction of change. The case demonstrates that eschewing conflict and only focusing on one policy measure or one central economic agent to provide expected results can easily destroy the general capacity to adjust to changes.

5.3.1. MLP analysis: multiple regimes and landscape interdependencies

The co-existence of regimes of power and heat supply, which have co-generation as a socio-technical merging point, can strengthen and sustain the overall regime and provide it with new vitality and momentum, not least due to the flexibility in handling capacity and pricing. The energy supply regime has been changing rather fast from a distributed system into a centralised system based on large steam turbine generators into a system that combine large scale utilities with a distributed system of local biomaterials and gas based fuelled co-generation, individual wind turbines, wind turbine parks in parallel with the 'old' large scale generators. These regime changes have created tensions and transformations that challenge the questions of what boundaries are most relevant from an analytic point of view as in the case of the utilities resistance to small energy systems including hostile moves ending in a policy induced integration of small and large facilities.

In relation to theorizing transitions within the MLP, the question is whether the impact of liberalisation on the dominant fossil-fuel-based energy regime demonstrates a struggle between two co-existing regimes that were detached in the beginning or a clash with a landscape-based change in policy that introduces a top-down regulatory framework into the existing power regime. The interpretation and ordering of observations into what is part of a regime and what is outside rests to some extent with the transition analyst. Socio-technical regimes are heterogeneous configurations that coordinate different regimes, e.g. a policy regime, a user and market regime, a technological regime, etc. (Geels, 2004).

The latter interpretation, which can be considered the more orthodox application of the MLP, has been dominant in studies of the impacts of liberalisation on the energy utilities and the energy regime presented until now (Markard and Truffer, 2006; Verbong and Geels, 2007). These studies consider liberalisation policies to be external to the energy regimes and to represent overarching policy tendencies that penetrate infrastructure activities seen earlier as natural monopolies that were core to national strategic priority not to be left to private, commercial actors. As such, liberalisation is black-boxed as an exogenous landscape development not influenced by the energy regime and its possible transformation.

The question is whether this interpretation is satisfactory, since, in both the infrastructure interpretation and the liberalisation policy are intrinsic parts of the regime's configuring the rules of engagement within the energy supply regime, thus changing its focus from energy consumption (cost) minimisation to energy sales (profit) optimisation which results in radical changes in internal steering principles and also leads to more short-term investment plans.

Not surprisingly, the use of MLP leaves several interpretative and ordering decisions to the analyst. The consequences of these choices in the form of analytical results concerning agency and considered longer-term stability may have quite important implications for actors attempting to navigate and intervene with a change perspective.

5.3.2. AoD analysis: collisions between models of socio-technical regulation

In either of the perspectives outlined above, the analysis pose difficulties, since the two implied 'regimes' – or in the context of the AoD approach, two different configurations – are asymmetric in their composition of actors, technology representation, institutional set-up, and policy visions. They may at the outset be analysed as two different arenas of engagement that have different historic origins; and for quite some time, they have been living 'peacefully' side by side, due to the rationale that energy infrastructures were considered the basis for modern society's competitive economic growth, while liberalisation was related to mass produced, competitive goods.

With the EU's new broadening visions of trans-national economic efficiency based on the creation of an 'inner market' that introduced more radical, neo-liberal schemes of competition, the boundaries of the two arenas were breaking down, leading to a clash between neo-liberal political visions and engineered technologies. Actors on the two arenas were either engaging in merging the two or trying to maintain stability between the two different configuration. In this perspective, the merger added complexity to the restructured arena that now covers activities which were becoming more intermingled and heterogeneous. Such mergers result in the reconfiguration of the actor networks based on new relations implying new types of qualities in the technologies, institutions, visions, and regulatory instruments. Within the 'flat approach', such large asymmetries are analysed as boundary conflicts and as ways of enacting strategic measures to 'colonise' and subsume other arenas.

This implies, at least at the outset of the analytical work, that market liberalisation is not assigned a different status than the minimisation of energy consumption within the old configuration of the energy supply network. Both are regulatory measures based on models used to structure and simplify actor practices. The other implication is that politics must be analysed in detail as constructed outcomes of temporarily stabilised networks that are open for change and reconfiguration and not taken for granted as some exogenous condition (Scrase and Smith, 2009).

Especially the new forms of outreach into the social organisation of consumption practices from the side of utilities makes them part of how energy systems need to be analysed with less emphasis on the power supply system as the dominant part. This also challenges the traditional socio-technical regime by adding a much higher degree of diversity. In this perspective, inclusion of wind turbines and local biomass and natural gas is just the first step toward a distributed network of production and consumption units.

6. Challenges and lessons learned

The challenge of transition theories is to combine an analytical understanding of the stability and path dependent dynamics of dominant societal configurations of production and consumption with a process oriented understanding of situated actor's possibilities of engaging in transitional processes. The previous analysis of this article has discussed the strength and limitations of the MLP in combining these two aspects, and suggested the AoD approach as a potential alternative.

From an analytical perspective the key notion of socio-technical regimes is found to be a useful tool to analyse such dominant societal configurations. At the same time, the concept tends to focus on the coherence of mechanisms and rules instead of their vulnerability when analysing existing structural and institutional relations. The consequence is that tensions and destabilising dynamics are analytically assigned to the strategically exogenous 'landscape

level'. The empirical analysis on the contrary demonstrates that actors attempt to engage in coordinated change across all levels without operating according to clear distinctions between levels of engagement. Actors develop navigational strategies for transitions by establishing visions for societal change, engaging in technological innovation and changes in institutional frameworks, advising new patterns of use practices, and engaging in micro-political actions targeted at all levels, including changes in values, regulatory frameworks, and market configurations.

In this way, the case studies indicate that the 'landscape' level conflates societal values, visions, knowledge systems, and regulatory interventions to a strategically exogenous level, even though all these are also elements in 'niche-strategies' as well as in the constitution of socio-technical regimes. From an empirical point-of-view the 'landscape' level does not produce a stringent sphere of its own, but seems to operate as a 'garbage can' able to cater for elements that otherwise would be referred to as the natural boundaries as well as the societal or cultural level of analysis. In the MLP literature, the landscape level has represented values and societal frameworks of a longer time span and cross-cutting regimes; it is therefore more difficult to change than temporary experiments at the local level or in socio-technical regimes. This interpretation is somewhat self-referential and is not consistent with the lessons from the three case studies, where visions and regulatory frameworks in specific situations are changing within very short time periods.

To conclude: the MLP offers a framework and a heuristic – a check list – that can help social actors understand socio-technical constituencies and provide tools to identify potential change resulting from innovations. As such, it provides a well developed critique of simplified disciplinary models of change, based on technological, economic, or political hegemony in society. It tends however to favour an entrepreneurial position and provide a managerial perspective in governance advice, in which public authorities and networks of innovative institutions are placed at the centre.

While the regime concept and the MLP seems well suited to cater for the configuration of traditional socio-technical production or supply systems in which core institutions are easily identified, it is not very helpful in describing spheres of consumption and normalised everyday practices (Shove and Walker, 2010). The concept is less useful in explaining what tensions and contradictions may exist in visions and practices within and between consumption and production.

Compared to the MLP the AoD approach downplays the consistency of rules and mechanism of the regimes level, as the introduction of regime level tensions and inconsistencies allows for studying situated actors political engagement in conflicts and sense-making dynamics through their performed interventions. The AoD approach is thus largely in line with modern governance theory which places networked governance structures at the centre. The notion of governance emphasises the networked character of regulations and interventions involving a distribution of agency among the involved actors. These actors require knowledge, since action does not emanate from a central governing body but resides with other actors in the network. Governance also takes into account the need for negotiations of means and ends in circumstances where translation from general political goals to specific implementation targets is crucial to the effectiveness and legitimacy of the regulation (Smith, 2005). Acting within a context of conflict and constant negotiation is part of the challenge, since trying to find optimal solutions at every stage of development may not provide satisfactory long-term solutions – when seen from the perspective of society's need for the sustainable transformation of its energy system.

6.1. Answers to the introductory concerns

The AoD approach outlined in this article can be summarised as a potential answer to the three concerns presented in the introduction. These were (1) the need for recognising conflicts as an important condition for change to help actors to navigate (2) the observation that actors engage at all levels in society including visions, institutions, and innovations and (3) the need to addresses the role of academic theories and advice regarding governance of transition processes in which they function as entrenched actors.

In relation to the first concern it has been demonstrated that the ideal of a descriptive mapping of regimes, landscapes and niches provided by the MLP likely limits the analytical sensitivity towards role of tensions and conflicts between dominating institutions for situated actors' navigation and performances. The AoD approach takes its outset in situated actor's conflict-ridden sense-making within temporarily stabilised actor-worlds and arenas, configured to cope with experienced tensions between established institutional components. In this respect, the cases demonstrate how transition processes are influenced by complex interventions performed and motivated by conflicting interpretations of challenges, aims, measures, and anticipated outcomes.

Regarding the second concern the AoD approach entails that strategic transition processes includes very practical experiments with new practices and solutions as well as policy and vision building. Non of these are activities are seen as exogenous conditions for one another, but they are rather seen as co-evolving activities of an un-stable nexus of sense-making, alliances as and performed interventions, in which specific configurations may emerge and struggle to gain foothold. Changes in the division of responsibilities between market and state as well as between public authorities, property owners and households are likely to follow from the pervasive character of these activities.

The third concern addresses the role of the analyst and the provided theoretical descriptions. Here the AoD approach suggests that the emergence and institutionalisation of new academic positions and vocabularies, that provides new ways of mapping problems and prescribing solutions, could themselves be seen as actors within arenas. Academic theories and analysis cannot claim to be observations from some neutral, outside position. Like other types of situated sense-making academic theorizing also operates by constructing boundaries, purifying dynamics and assigning agency.

Due to its ability to address these three concerns it is argued that the metaphor of the 'arena' may provides the researcher with a better approach in addressing the strategic dynamics of transitions in-the-making than the metaphor of the 'landscape'. The arena does accordingly not create a discrete level that operates above actors and regimes, assuming consistency or long-term institutionalised stability. It allows working with a weaker set of relationships within the configuration of the arenas, as well as with the different interpretations enacted by the actor-worlds involved. This entails that less attention is given to existing, dominant practices in favour of a focus on tensions and change patterns – e.g. toward more sustainable practices – that may have evolved in certain areas. This approach could inspire to more specific studies of e.g. new mobility patterns, emerging consumption patterns in relation to local, organic food, new housing practices and the like.

6.2. Concluding remarks

Since changes in the configuration of societal order is at the core of transition analysis, interventions that initiate transition processes should be more in focus in the theoretical framework. Transitions do not occur as smooth transformations but through a series of conflicts that change over time the details involved in visions, aims and means that are crucial for the engagement

of actors throughout the process. Thus, transitions cannot simply be assumed to build on societal consensus comprising either visions of the future or ideas of practices to come, but they are still crucially dependent on shared recognition of the urgent need for change. Historical experience tells us that transitions have involved extended periods of controversy in which both alternatives and the need for change have created broader public, political and economic interest. In such periods of increased attention and engagement of societal actors, the possibilities and directions of change are also prepared.

While dominant regimes may still have discursive power, tensions in the existing regimes and social practices are overlooked when such regimes and normalised practices are studied. Several examples exist that demonstrate situations where experts have claimed temporal stability with no further change to be expected, only to experience the surfacing of radical shifts shortly thereafter.

This article presents what can be described as an unfinished journey motivated by the search for theories and methodological empirical approaches that can highlight and produce a better understanding of changes that may lead to transitions and of how such changes can be induced by actors capable of structuring a social agenda for transition. Transition theories have had a tendency explain change without giving explicit attention to the important tensions and temporal situations involved. In many cases, these specific situations have in retrospect been envisaged as sudden and unexpected. Based on critical reflection and discussion of the dominant transition theories, the article argues for a model that reflects the basic challenge where the boundaries are fluid, as are the relations and conceptual frames used to describe them – a fragmented picture rather than a complete theory. The outcomes of actors' intervention in and engagements with transitions cannot be prescribed within a complete theoretical framework, because the field works with radical social and technical change. In this respect, the theoretical framework should be judged by its ability to foster relevant research questions, as well as its ability to provide tools to investigate phenomena of importance.

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