Theoretical multiplicity for the governance of transitions
The energy producing greenhouse case

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Abstract
Transition management, as a theory of directing structural societal changes towards sustainable system innovations, has become a major topic in scientific research over the last years. In the Netherlands, the concept of transition management was adopted by several governmental agencies as one of the leading principles for steering sustainable development. In this paper we focus on the governance of transitions. The question is if and how transitions towards sustainability can be steered, governed or managed, in particular by governmental actors. We suggest an approach of theoretical multiplicity, arguing that multiple theories will be needed simultaneously for dealing with the complex societal sustainability issues. Therefore, we address the governance question by theoretically comparing transition management theory to a number of related theories on societal change and intervention, such as multi-actor collaboration, network governance, policy agenda setting and adaptive governance. We argue that these related theories put the managerial assumptions of transition management into perspective, by adding other steering roles and leadership mechanisms to the picture. We will illustrate the advantages of theoretical multiplicity by analysing the case of *the greenhouse as a source of energy*. The energy producing greenhouse can be considered a revolutionary technology, with the potential of turning the greenhouse horticultural sector from a mass energy consumer into a sustainable energy user and producer.

1.   Introduction

Transition and transition management (Kemp, Loorbach, & Rotmans, 2007; Loorbach & Rotmans, 2006; Rotmans, Kemp, & van Asselt, 2001) proved to be attractive concepts for inducing sustainability and have become a major topic in scientific research. The growing recognition of the inter-related nature of contemporary societal problems and the call for fresh approaches and forms of governance has contributed to the rise of the concept (Shove & Walker, 2007). In the Netherlands, transition management (Rotmans et al., 2001) even became adopted as a guiding principle for public policy. Transitions are defined as a gradual process of change where the structural character of a societal domain transforms (Rotmans et al., 2001). Transition management aims at influencing the direction and pace of transitions towards a more sustainable society

(Loorbach & Rotmans, 2006). The recently burgeoning literature on transitions and the adoption of transition management by government agencies testifies the influence of the concept. Scholars and practitioners have been developing different frameworks to steer or to facilitate transitions towards more sustainable futures. However, interventions to initiate, steer or manage transitions are not always as effective as hoped.

In this paper we focus on the question how and to what extend transitions can be influenced or managed, in particular by governmental actors. We analyze this question theoretically by discussing a range of related theories of social change and intervention. In doing so, we follow up on the argument for avoiding to consider transition management "as the only model in town, and for exploring other social scientific, but also systemic theories of change" (Shove & Walker, 2007: 768). In the first section we will discuss theories of multi-actor collaboration, network governance, policy agenda setting and adaptive governance, and the relation of these theories to transition management. In the second section we systematically compare these theories by presenting and discussing a table where key features of all treated theories are assessed. From this selective comparison, we argue that these related theories put the managerial assumptions of transition management into perspective, by adding other steering roles and leadership mechanisms to the picture.

In the third section we will illustrate the advantages of theoretical multiplicity by analysing the case of *the greenhouse as a source of energy*. The energy producing greenhouse can be considered a revolutionary technology, with the potential of turning the greenhouse horticultural sector from a mass energy consumer into a sustainable energy user and producer. The concept has been developed within the context of the Innovation Network, a think thank created and funded by the Ministry of Agriculture, Nature and Food quality (Grin & van Staveren, 2007). Finally we formulate our conclusions regarding transition management as a theory of social change and intervention. Where transition management tries to overarch a lot of diversities in one theory we suggest an approach of theoretical multiplicity for dealing with the enormous challenge of sustainability.

2.   Transition management and other approaches

In this overview, we are necessarily selective. In the choice of approaches to discuss we opted for theories that share some basic features with transition management, especially the focus on change and innovation, and their relevance for sustainability issues, but which diverge from transition management in some other relevant respects. Because we try to capture the core ideas of these theories, we rely on a limited number of representative publications. These are often not the most recent publications, because recent publications often involve attempts of the different theories to incorporate elements from the other theories and thus provide a less clear picture of the distinctive contributions of each theory. In each of the subsections, we will first shortly summarize these theories. Attention will be paid to the analytical framework to conceptualize change and interventions, and the role of governmental actors or change agents. To clarify our point of reference about transition management we start with summarizing important aspects of transitions and transition management based on three core publications (Kemp et al., 2007; Loorbach & Rotmans, 2006; Rotmans et al., 2001).

Transition management
Basic assumption underlying the transition model is the diagnosis that environmental problems are not caused by clearly identifiable actors or factors but by failures of a systemic nature. As most policy strategies are not be able to tackle system failures they will lead to suboptimal solutions (Kemp et al, 2007). 'Sustainable development requires structural changes in social-technical systems and wider societal change, in beliefs, values and governance that co-evolve with technology changes" (Kemp et al,, 2007, 78). Transitions are linked up with system innovations (Loorbach & Rotmans, 2006), which are much broader than just technological innovations, because

the current societal *regime* is supposed to change. The co-evolution of a set of slow changes can forms the undercurrent for a fundamental change. Transition processes involve multiple actors within a societal subsystem and fundamentally change both the structure of the system and the relation among the actors.

Transitions are not linear processes, but involve a shift in the system from one dynamic equilibrium to another equilibrium, over four consecutive *phases* (Loorbach & Rotmans, 2006; Rotmans et al., 2001): A *predevelopment* phase of dynamic equilibrium where there is very little visible change at the systems level but a great deal of experimentation at the individual level. A *take-off* phase where the process of change gets under way because the state of the system begins to shift because of different reinforcing innovations or surprises. An *acceleration* phase where visible structural changes take place through an accumulation of socio-cultural, economic, ecological, and institutional changes. A *stabilization* phase where the speed of social change decreases and a new dynamic equilibrium is reached.

The promise of this whole transition approach lies in the idea that transitions can somehow be steered or managed: "Although transitions cannot be managed in terms of command and control, they can be managed in terms of influencing and adjusting: a more subtle, evolutionary way of steering. In other words, the direction and pace of transitions can be influenced, even if not controlled directly. Transition management therefore aims "to better organise and coordinate transition processes at a societal level, and tries to steer them in a sustainable direction" (Loorbach & Rotmans, 2006: 5). Transition management thus deliberately attempts to steer transitions towards a more sustainable future. Core elements of organizing transition processes are transitions arenas, agendas and goals, fostering of networks and learning processes. Transition arenas are "networks of innovators and visionaries that develop long-term visions and images that, in turn, are the basis for the development of transition-agendas and transition-experiments, involving growing numbers of actors" (Loorbach & Rotmans, 2006). Facilitation at both the process (learning, communication) and content level (feeding new information) is needed. A transition manager is expected to bring the parties together, keep an overview and mediate where necessary.

Governmental actors can fulfil the function of transition manager, with different roles in different transition phases. In the predevelopment stage, for example, there is a need for social experimentation and creating support for a transition programme (Loorbach & Rotmans, 2006), while in the acceleration phase there is a special need for controlling the side-effects of large-scale applications of new technologies. The government has both a content role (setting sustainability objectives) and a process role (Rotmans et al., 2001). The government's role is thus plural. On the one hand, state actors are called upon to steer transition whilst, on the other hand, they need to facilitate and evaluate procedures that mobilize and engage actors.

Multi-actor collaboration

Multi-actor collaboration theory (Gray, 1989; Huxham & Vangen, 2005) addresses cooperation and negotiation between multiple interdependent actors in the context of a 'wicked' problem domain in which they all have a stake, like e.g. environmental pollution, city regeneration or water management. Gray (1989) defines collaboration as "a process through which parties who see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited vision of what is possible" (p. 5). Stakeholders include all individuals, groups or organizations that are directly concerned by actions taken by others to solve the problem. A stepwise process is proposed for collaboration initiatives, which includes: 1. problem setting (culminating in a shared appreciation of the complex problem domain), 2. direction setting (culminating in a negotiated agreement) and 3. implementation (culminating in tangible actions and changes) as main phases.

Getting the necessary actors together and creating awareness of their interdependencies is considered crucial for obtaining leverage to effectively deal with wicked problem domains. One of the involved persons or organizations usually functions as a *convener* who brings the parties together. Given that wicked problem domains usually defy unilateral intervention, the convenor is

very much dependent on other actors to bring about any change in the collaboration or problem domain.

Network governance
Network governance refers to theories that take into account the interdependencies of public, private and semi-private actors in policy networks (Klijn & Koppenjan, 2000). The theoretical shift from 'government' to 'governance' indicates a shift from hierarchical and well institutionalized forms of government towards less formalized, interactive forms of governance in which state authority makes way for an appreciation of mutual interdependence in policy networks. Core concepts to analyze networks are rules, interaction patterns and perception patterns. Processes within networks are understand by analyzing the dynamics of games, actor perceptions and strategies (Koppenjan & Klijn, 2004)

Rooted in the network approach to policy (Klijn & Koppenjan, 2000), network management focuses on mediating and co-ordinating policy making in policy networks. Two types of network management strategies can be distinguished: *process management*, focused on improving the interaction between actors by seeking convergence of perceptions, creating temporary organizational arrangements and managing conflict; and *network constitution*, focused on changing the institutional characteristics of the network, by changing the actor constellation, changing the network rules or reframing ideas about the functioning and the substantive problems of the network.

Governmental actors have multiple options when confronted with network-like situations (Klijn & Koppenjan, 2000): (1) not joining in network games and trying to unilaterally impose their ideas and goals; (2) co-operating as a partner in networks with other public, semi-public and private actors; (3) taking up the role of process manager and facilitating interaction processes in networks; or (4) taking up the role of network builder, for which governments, with their special resources, are well suited.

Policy agenda setting
Theories of agenda setting focus on the politics of attention for policy issues and the concomitant punctuated equilibrium dynamics of policy change. Punctuated-equilibrium theory tries to explain the pattern of policy stability (or small incremental changes), which are occasionally interrupted by abrupt major policy changes (True, Jones, & Baumgartner, 2007). Policy is executed by a small number of officials, experts, and stakeholders, working together in a small network of various (public) organisations; sometimes referred to as a policy community. Usually, this community does not make major policy changes and operates without much political interference. Exogenous events, such as a crisis or a natural disaster, or an endogenous event, such as an accounting scandal or a big organisational failure, can cause heightened media attention for a specific issue.

These events are focussing events which create windows of opportunities for policy entrepreneurs to change policies. If certain issues rise to the top of the media agenda pressure on politics increases to take action, and new actors may be mobilized to attack current policies. The punctuation of the stable period is complete when media reacts to politicians, and politicians reacting to each other in an accelerating manner, causing an overkill of attention. Once the policy is changed, or other issues has captured the attention of media an politics, the policy is likely to been drawn back into a new period of stability and incremental adjustments. Steering policy change is considered to be impossible because nobody is in control of change. The only thing left is that people can be prepared to act in times with shifting priorities.

Adaptive management
Adaptive management can be defined as "a systematic process for improving management policies and practices by learning from the outcomes of management strategies that have already been implemented" (Pahl-Wostl et al., 2007: 4). Originally developed as a management approach for ecological systems, adaptive management has evolved into an interdisciplinary field of research and action, often referred to as 'adaptive governance of social-ecological systems' (Folke, Hahn,

Olsson, & Norberg, 2005). Adaptive management assumes a world that changes continuously in unpredictable directions. These changes can be gradual, but abrupt or turbulent changes tend to become more prominent. In turbulent change episodes, available experience and expertise often proves to be incomplete, consequences of action are unclear and the future of the system is uncertain. Vulnerable ecosystems, for example, can rapidly shift into undesired states and stop providing ecosystem services (like food or scenery) to society. Similarly, social-ecological systems can loose their resilience to keep fulfilling basic functions in conditions of change or disturbance. In this sense, adaptive management pays attention to both 'change as growth' and 'change as destruction'.

Attempts at managing or steering have to take into account uncertainties and both gradual and abrupt changes. Therefore, learning plays a central role in adaptive management, as a way of keeping knowledge up to date with continuously changing conditions. Social networks and social memory are considered important bases for building and maintaining the capacity to learn (Folke et al., 2005). Combining different types of knowledge (scientific, professional, experiential, indigenous, etc.) is an important feature of this learning. Learning is not a goal in itself but serves to adapt management strategies and policies as changing conditions require. As not all uncertainties can be 'learned away', another focus in adaptive management is on devising measures or strategies that are robust (stay functional under a range of different scenarios) or flexible (can be adjusted as needed or applied only when necessary). In sum, critical factors for adaptive management include learning to live with change and uncertainty, combining different types of knowledge for learning, creating opportunity for self-organization and nurturing sources of resilience for renewal and reorganization (Folke et al., 2005).

Leadership plays an important role in adaptive governance networks by providing key functions, such as "building trust, making sense, managing conflict, linking actors, initiating partnership among actor groups, compiling and generating knowledge, and mobilizing broad support for change" (Folke et al., 2005: 451). Important as this leadership may be in steering adaptive management, it does not involve a position like 'adaptive manager'. Apart from leaders, bridging organizations fulfil an important role in directing adaptive management efforts.

3. Comparing multiple approaches to social change and intervention for sustainability

A search for theories implicitly or explicitly related to transition management results in a whole range of paradigms, concepts, methods and tools. Of course, the overview is not complete. The list of relevant theories could easily be expanded with concepts such as soft systems theory, innovation literature, cultural theory or economics amongst others. Because transition management is both a field of research and a field of practice, it also will continue to grow and to develop.

In the following table we compare the theories on a number of aspects (the columns of the table) to summarize differences and similarities. The theories make different assumptions about the *nature of change*: what is it that changes and in what direction. They variously focus on change in a societal domain, change in policy, or the relation between both. Differences are also apparent in assessing when change has occurred. Is it about changes in understandings, networks, structures, technologies, policies, markets, problem domains or entire societal domains? The change can be directed towards structuring an under-organized domain or on changing existing structures. Transition management is among the more ambitious theories, focusing on structural changes in entire societal domain. Conceptualizations of the *change trajectories* vary in their focus on short term versus long term changes, and assumptions about the continuous (change happens all the time) versus episodic (change comes in big shocks) unfolding of change. Transition management focuses on long term changes (one or more generations), with gradual or continuous changes in the first phases, episodic change in the acceleration phase, and again more gradual changes in the stabilization phase.

Table 1. Transition management and other theories of change and intervention

	Nature of change	Change trajectory	Main actors	Relationship between actors	Steering/ influencing	Leading figures	Role for government	Success
Transition management	Long term structural change of a societal domain	S-shaped curve, with pre-development, take-off, acceleration and stabilization phases, over the course of an entire generation	Regime players and niche players (innovators) Public authorities	Conflictive and competitive on the short term, shared long term goal of sustainability	Creating transition arenas, starting transition experiments Niche management	Transition manager Visionary innovators	Transition manager, creating support and conditions for a transition programme	More sustainable societal domain
Multi-actor collaboration	Negotiated structuration of an under-organized problem domain	Stepwise exploration negotiation and implementation over a number of years	Representatives of organizations having a stake in the problem domain	Interdependent, conflictive/ collaborative	Leadership through participants, processes and structures. No one is in control	Convener	None, convener or participant	Negotiated agreement (win-win) on the future direction of a problem domain
Network governance	Change in policy and/or change in policy networks	Policy games in successive rounds in policy networks	Public and private actors linked in networks, supporting or hindering policy strategies	Sustainable interdependencies between actors, engaged in overlapping policy networks	Providing incentives for co-operation, process management, network constitution,	Network manager or process manager	Partner, process manager, network builder or staying out	Win-win situations Enriched chance of policy implementation Democracy
Policy agenda setting theory	Change in policy input, agenda and output	Incremental changes punctuated by abrupt and large policy change	Politicians, administrators, media, interest organisations	Competitors and allies for attention on the policy agenda	Connecting problems and policies during windows of opportunity, framing of policy images, inserting these in policy venues	Policy entrepreneur	Policy entrepreneur, responsive to societal or political demands	New agenda for policy
Adaptive governance	Adaptation to the changing conditions in social-ecological systems	Dealing with gradual and abrupt changes through close monitoring and learning	Scientists, policy makers, ngo's	In need of each other's knowledge, jointly adapting to changing circumstances	Bridging science and policy, bridging networks of actors	Adaptive network leaders, bridging organizations	One of the multiple decision units	Social-ecological system keeps fulfilling basic functions

Theories focus on different *main actors,* playing different *roles,* and standing in different *relations* to each other. The actors that are portrayed as the crucial ones in the different theories can be roughly classified as policy actors, business actors, societal actors, science actors or a combination of these. Transition management distinguishes itself by addressing a broad range of actors. The range of roles that actors play includes innovator, manager, entrepreneur, user/employee, policy maker, politician, gatekeeper, facilitator, expert. The relationship between actors is also conceptualized in different ways, in terms of competition (multiple actors competing for attention in agenda setting theory, or competing technological niches in transition management) or mutual interdependency (most of the other theories) (Powell, 1990). With multi-actor collaboration, transition management shares the idea of bypassing. Change trajectories are organized outside the standing organisations, drawing a distinction between actors in the centre of change, the innovators or negotiators and actors in the margin. Policy and network governance theories explicitly focus on actors hindering change, like gatekeepers or the 'usual suspects' in resisting change by using power. Transition management mentions the dominant regime as resisting change, but simultaneously assumes that important governmental actors (supposedly part of the current regime) have to pave the way for the transition to a new regime.

Steering or influencing concepts are based on assumptions about how people or things change. In blue print approaches of change, for example, it is assumed that people change if clearly specified results are laid down beforehand and incentives (or punishments) are sufficient (De Caluwé & Vermaak, 2004). Transition management is not explicit in this respect, but we infer the assumption that people can really innovate and induce system innovations when actions are coordinated in the right settings. Transition management also reflects confidence in the potential of new technologies to reach a sustainable society, provided that they become part of new dominant technological regimes. Assumptions from other theories are that people change when interests are integrated in win-win situations, when they are encouraged and motivated, when they interact and learn or when space exists for spontaneous adaptation.

The prominent figures in steering change range from facilitators who limit their influence to the process (e.g. possible facilitators in multi-actor collaboration or adaptive governance), over entrepreneurs (e.g. the convener as a social entrepreneur in multi-actor collaboration, or the policy entrepreneur in punctuated policy change, or the technical entrepreneur with an innovative idea in transition management), to managerial figures (e.g. transition manager or network manager). Most approaches consider governmental actors as possible incumbents of these leading roles, though in different degrees. Apart from the hierarchical role in the blueprint approach to policy, government can act as facilitator as one of multiple change agents or as (network) manager of the change process. In some of the approaches the government appears in the possible role of taking part as one actor amongst others, especially multi-actor collaboration. In this approach and in the self-organising varieties of adaptive governance, approaches societal change can very well occur without the involvement of governmental actors.

4. The energy producing greenhouse

In this section we illustrate the different approaches by analysing the case of *the greenhouse as a source of energy* from different theoretical models. These descriptions are based on a secondary analysis of studies and documents (Grin & van Staveren, 2007; van Staveren, 2007; Roza, 2006; Innonet, 2007; Hoes, 2009; Stijfer, 2002). First we give a brief description of the case.

With 10% of the national natural gas consumption, the sector of greenhouse horticulture, was traditionally a large energy consumer (Grin & van Staveren, 2007). A ground breaking innovation was the idea of transforming greenhouses in sources of sustainable energy. This design is based on a greenhouse that captures the excess heat from solar radiation during summer. The heat is stored in underground natural water reservoirs (aquifers) and used for warming the greenhouse at night or during the winter. In addition, the greenhouse supplies tap water, treats wastewater, recycles carbon and produces electricity (Innonet, 2007). The first energy producing greenhouse was established in 2006.

To gain momentum as a real system innovation, the focus would need to broaden from the individual greenhouse to clusters of greenhouses within the horticultural sector, and further towards regional *energy webs* where firms and households exchange energy. The surplus energy of the greenhouse in the form of medium temperature water could then, for example, be used for heating in a cluster of houses. The take-off and acceleration of this transition thus starts to depend, amongst other things, on significant changes in regional arrangements, in spatial planning (including the underground) and in access to the 'liberalized' energy markets (Roza, 2006). However, these innovative greenhouses are not welcomed enthusiastically everywhere. Local communities are not very interested in becoming a part of regional energy webs. On another front, the emerging competition between greenhouse energy producers and traditional energy companies seems to delay further accelerations. Until now, few entrepreneurs are making the necessary investment. On top of this a recent initiative of 17 growers to set-up a joint energy firm got bankrupted in 2008.

Transition management. It is possible to analyse this project as a 'textbook example' of transition management and diffusion of technologies. From that point of view this trajectory started with two members of the Innovation Network, who developed into real technical entrepreneurs. The 'Innovation Network' was created and funded by the Dutch ministry of Agiculture, Nature and Food Quality. Its tasks were to develop and identify new paradigms and concepts for agriculture, agribusiness and rural areas and to bring concepts into practice. These two people met and developed the idea of *the greenhouse as a source of energy*, a system innovation they felt has the potential to transform the greenhouse sector. Their core idea is that the solar energy captured in a typical greenhouse exceeds the amount of energy needed for the plants to grow on a yearly basis. This surplus energy could be used to deliver energy for other purposes. This idea of the Innovation Network project leaders initially met with scepticism of other actors, and the project leaders decided

to take the idea forward themselves. They went and talked to technical experts to find out what combination of existing and new technologies could deliver the energy producing greenhouse. The idea turned out to be feasible, through a combination of existing techniques and storage of the energy surplus during summer in underground aquifers, using a highly efficient heat pump.

When they were convinced their idea was technically feasible, they entered the next transition phase. Although they deliberately decided not to install a transition arena, they did broaden the discussion by involving new actors. In bilateral contacts they contacted many people and tried to set up pilot experiments with horticultural entrepreneurs and sponsoring from the ministry. They expected the ministry to take control of the project, but in practice it was a difficult obstacle to take and the momentum was almost lost. It took some time until the idea became widely embraced. A real breakthrough was reached an the moment the innovators received the prestigious innovation prize.

The members from the Innovation Network played out the role of visionary innovators. At the moment they tried to transfer the transition leadership to the ministry problems arose and they felt obliged to fulfill the role of transition manager. The main contribution of government was the establishment of the innovation network, a kind of transition arena as a bypass of existing institutions. The innovation network got a lot of freedom to act. To satisfy the ministry they had to produce at least one innovative concept and that was, the energy producing greenhouse, amongst others.

Multi-actor collaboration. From the beginning, the technical entrepreneurs deliberately decide to develop the concept in a very small group. They did not believe that creative concepts could be developed in mixed interests groups (Grin and Staveren, 2007:50). However when the project became delayed the project leader wondered whether he worked too solitarily or underestimated the resistance in the horticultural sector (Grin & van Staveren, 2007). In spite of that they still believed in the concept: "interest in it will grow again… our way of thinking supersedes conventional thought." (Stijger, 2002:4). The moment the concept was being embraced by national politicians and sector leaders these doubts faded away.

More problems arose at the regional level. Because there would be sufficient energy left to heat a large number of houses (2 ha greenhouse can heat up to 200 houses) the next ambition was the development of greenhouse powered neighborhoods (Innovation network, 2007). The assumption was that these so called greenhouse villages or local energy webs could restore the lost connections of modern cities to their surrounding rural areas (Innovation Network, 2007). However the primary reactions of local governments and civilians seem to get in the way of the construction of local energy webs. As a result the first energy producing greenhouse were constructed at a certain geographical distance of the surrounding settlement, which reduces the potential energy benefits radically.

From a multi-actor collaboration perspective it's obvious that integrating greenhouse production with houses, companies, and recreation centers in the region might be very challenging. Collaboration between a large number of stakeholders is needed, and all of them need to see something in it for them. Conveners of a multi-actor collaboration would try to get these stakeholders around the table from the start, to avoid that a wonderful technological innovation has no chance of being actually implemented and used. Instead of assuming that "inhabitants will become aware of the importance of new interactions between urban and rural areas and become involved with these relations" (Innonet, 2007), technological entrepreneurs, growers, urban and rural stakeholders would be invited to develop and negotiate the future direction of this problem domain among themselves. The effectiveness and innovative character of the results of this process would depend, amongst other things, on the quality of interaction between the involved actors.

Network governance. From a policy network perspective it's important to highlight the changing interdependencies during the last decade. Up to the end of the twentieth century, agricultural policy came into being in a closed policy community, consisting of the Ministry of Agriculture, the

farmers' organizations and the agricultural specialists from Dutch Parliament. It was in this community that special energy prices were negotiated in order to compensate greenhouse farmers for increasing energy costs. With the growing societal and political concerns on the negative site effects of agricultural modernization this community was opened up. The arrival of two ministers of Agriculture in succession without agricultural roots, accelerated this process. This gave also room for the development of new agricultural interests organizations. In the horticulture sector the new organizations 'Glaskracht' developed itself as a powerful and innovative organization. Next to this, liberalization of the energy markets structurally changed the interdependencies in the energy policy network. Retrospective, changing the dominant perceptions and relations in the agricultural network and changing the interdependences in the energy network can be considered as examples of networkstructuring.

Within the context of this policy network the two project leaders unsuccessfully tried to convince the ministry to subsidize the pilot project. It was the chairman of the Innovation Network who took over the process management role. As a former politician, he activated his 'old boys network'. Through some phone calls he arranged new commitments. Three ministers promised to subsidy the pilot on the condition that the horticultural sector also would pay their part. At that moment both the sector organizations and the technical entrepreneurs felt they were overruled and had lost the initiative.

Policy agenda setting. Against the background of policy change we firstly focus on the dynamics of politics of attention for policy issues. The fact that the greenhouses are big energy consumers was known for many decades. However energy reduction was not a political priority. Indeed politicians defended the low and partly subsidized fuel prices. As the export of horticultural products amounts to 5 a 7 billion euro per year the preservation and development of a flourishing greenhouse sector was the main priority. At the end of the twentieth century this situation changed. Due to rising fuel prices together with increasing environmental awareness and a negative image as polluting sector change was considered necessary. Together with the growing political attention for innovation and sustainability a window of opportunity was created. Policy entrepreneurs from the innovation network, the sector and the ministry made use of this window by introducing a new greenhouse design in which fossil fuel dependency was largely reduced.

However the momentum can also be lost. That nearly happened when the entrepreneurs asked the ministry to take control by subsidizing the project. At that moment the governmental investment in this particular transition trajectory competes with other projects who end up at the loosing side. Besides the above mentioned explanations the positive decision of the ministers can also be explained by the raise of a new political issue, namely the growing political concerns of being too dependent on energy supplying states such as Russia.

Adaptive governance. From a perspective of adaptive governance, change is never finished and cannot be reduced to only one starting point and one change agent. A closer look at the energy and greenhouse domain reveals ongoing change and adjustment. Already in the nineties the horticulture sector was engaged in a negotiating process with governmental and environmental organisations, resulting in a covenant, by which the sector committed itself to reduce pollution and energy consumption. In the same period glasshouses developed contracts with industrial firms to recycle their gasses as CO_2 fertilizer in the greenhouses. Next to this many glasshouses invested money is so called Heat Power Installations, through which they can reduce energy consumption and can deliver superfluous energy to energy institutions. Besides the Innovation Network, also other change networks provided breeding grounds for transitions such as the inter-ministerial energy transition team, the transition team for sustainable agriculture at the ministry of Agriculture, Nature and Food Quality, the Innovative Greenhouse Foundation and the national COOL-project (Climate Options in the Long-term). It was already in the nineties that a civil servant launched the idea of a climate neutral horticulture during a workshop on climate change.

The role of government is that of a sense-maker who redirects change in the direction of sustainability and who helps to prevent that these changes become bogged in existing policy. In our case we can see that it were the people from the innovation network who were sensitive for ongoing dynamics and who organized smart couplings between different innovative developments. The different ministers and politicians played a role in publicly supporting the concept of the energy producing greenhouses. Although from the start on civil servants have pleaded for inventorying the governance aspects, that possibly could block this innovation, the primary focus was on the technical development trajectory.

Government ambition is that by 2011, 7% of the Dutch greenhouses use the 'closed greenhouse system', and in 2020, 25% (Hoes, 2009:1). To achieve this ambition, government supports the up-scaling of the closed greenhouse by subsidizing the physical building of the closed greenhouse (Hoes, 2009:1). However up-scaling cannot be reached through simple copy and paste techniques. Each grower experienced unexpected (positive and negative) events concerning technical complexities, crop behavior and energy production. Starting a platform of growers who installed semi-closed greenhouses can be view as a micro-scale example of an adaptive management strategy. By doing so these growers started a systematic process for improving practices by learning from the outcomes. "The green growers open-up the pilot system and re-contextualize the bits and peaces to create a system that fits their context" (Hoes, 2009:3).

5. Towards theoretical multiplicity

Comparing transition management with other theoretical approaches to societal change and intervention, what strikes us is the attempt to incorporate a very wide range of aspects into a single theory. Where other approaches to complex societal problems are more inclined to make a choice when faced with the recurring dilemma's that complicate every attempt at societal steering, the answer of transition management mostly consists of embracing both sides of the dilemma. Transition management addresses multiple actors (many actors needed and often maintain a conflictive relation, multiple sectors (system innovations affect multiple sectors), multiple levels (co-evolution of developments at niche, regime and landscape level), multiple time scales (both short and long term orientation), multiple objectives (maintain multiple images of the future) and multiple options (keeping options open by developing multiple innovative niches).

In this manner, transition management tries to integrate a broad range of varieties into a single theory, thereby drawing upon concepts and methods from the other theories we discussed. It is not very clear within transition management theory how all this variety needs to be handled. A lot more theory and practice seems to be needed to face the enormous challenge to overarch all this multiplicity. Therefore a paradoxical aspect lies in the very attempt to integrate everything into one theory. Another option, which we would like to put forward, is an approach that rests on the multiplicity of theories. The basic argument is that multiple theories (the ones we discussed here and others) will continue to be needed simultaneously for dealing with the complex societal sustainability issues. Only variety beats variety, also at the level of theories, which function as a box of conceptual tools to analyse situations and to design interventions. This does not mean that each of the theories should proceed as if the others were not existing. In fact, by writing this chapter we're assuming that it is worthwhile to compare theories and to look for points of connection and difference. This approach can be understood as a meta-paradigmatic approach (Gioia & Pitre, 1990), which recognizes the value of the distinctiveness of each individual theory and the value of exploring zones where theories overlap or can inform each other, but does not try to integrate everything into one paradigm.

This has implications for the question we started this chapter with, namely if and how transitions can be managed or steered. A distinctive trait of transition management appears to be the assumption of an overarching position of (governmental) transition managers who can apply management tools, niche-building machinery, and engineering devices from a privileged,

knowledgeable and external position (Shove & Walker, 2007), towards a clear and one-dimensional target. As we have shown, quite different assumptions on this issue appear in related theories. Any transition management arena, however, is likely to be only one of the arenas where sustainability-relevant issues are discussed or sustainability-related decisions are taken, and the sustainability issue at hand may get framed quite differently in those other arenas. Also in transition management, "steering for sustainability typically surfaces as isolated moments of reflexivity amid a sea of everyday politics" (Hendriks & Grin, 2007: 334).

This illustration of the energy producing greenhouse shows how different theories highlight different aspects of the process and provide different insights in steering, managing or influencing transition processes. It also reveals some blind spots in the different theories and in the greenhouse transition trajectory. Inevitably this analysis suffers some methodological shortcomings because the documents used are secondary sources, biased by the author's theoretical assumptions and preferences. Still, different pictures of steering emerge from applying multiple theoretical lenses to the greenhouse case. The technological entrepreneurs in the case seem to assume diffusion on the condition that the technology is well developed. Network governance puts the attention on how existing networks are activated and new networks formed, by pulling strings both publicly and behind the scenes. Policy agenda setting emphasizes the steering potential of being prepared to jump in when a window of opportunity emerges in an otherwise pretty unpredictable policy process. Multi-actor collaboration emphasizes the steering potential of bringing important parties around the negotiation table and pragmatically addressing those issues which are of common concern. Adaptive governance emphasizes the ubiquity of slow and abrupt changes, and the potential of linking and adjusting these ongoing change processes. The case illustration also puts the managerial assumptions of transition management into perspective, by adding other steering roles and leadership mechanisms to the picture. Some were deliberate attempts at steering at the time, while others can only be identified as steering roles in retrospect. Some of the steering roles are open and visible, while others are accomplished behind the scenes. Some steering roles target a small part of the system, while others aim to influence the whole system, etc. In our opinion, our rudimentary multiple theory analysis of the greenhouse case reveals more and more varied steering moments and roles than could transition theory alone – or any other single theory for that matter.

Steering societal developments in areas as complex as sustainability is unlikely to be successful when only one theory is used, especially when the relevant time frame extends over one or more generations. A broad base of different (and partially overlapping) theories is probably needed to deal with the multiple challenges that present themselves at any point in time – especially because these challenges (and available theories) will also change over time. Sustainability issues are complex and important enough to warrant the generation of insights and interventions about them from the variety of conceptualizations of change that the human mind has developed.

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