Governance in the energy transition: Practice of transition management in the Netherlands

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Abstract: A fundamental transformation of our current energy system in the future is inevitable. To this end, this paper presents a 'fresh' perspective on the Dutch energy field based on transition theory. From this perspective, a number of starting points are suggested for energy transition management in order to influence the speed and direction of the energy transition. In the second part of this paper, these principles are used to reflect upon the way the Dutch Ministry of Economic Affairs is currently applying transition management. As such, this paper itself is part of the ongoing co-production of knowledge between science and policy, that emerged over the past few years in the Netherlands with regard to transition management.

Keywords: complexity; energy transition; governance; sustainable development; transition management.

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1 Introduction

Looking into the future, increasing scarcity of fossil resources is inevitable (Cavallo, 2004). Consequently, our energy systems will transform fundamentally: towards supply systems that draw from other energy sources. The question is not if, but when and how. What makes this transition hard to deal with is that there is neither consensus about the urgency of the problem nor what the most favourable solutions or strategies are. Governing the energy transition into a sustainable direction is highly complex: because many actors with different perspectives, values and goals are involved so that governance becomes a participatory multi-actor process by definition, and because our current system is deeply embedded into our societal fabric of institutions, infrastructures and economy. This type of complex problem has been labelled as 'persistent' (Dirven, Rotmans and Verkaik, 2002). The persistence of energy-related energy problem is illustrated by the progress made in the international arena (post-Kyoto), which is by far not sufficient to mitigate climate change.

In the Netherlands, the government introduced a new approach to deal with persistent problems. The fourth Dutch National Environmental Plan (VROM, 2001) argued that persistent problems occur in different societal systems: agriculture, mobility, biodiversity and energy. Dealing with these issues at a fundamental level requires long-term and coordinated efforts that take into account economic, socio-cultural as well as ecological and institutional factors. In response, the National Energy Council argued that using *only* current policies is not sufficient (SER, 2001; Energieraad, 2004). Therefore in 2001, the Dutch government adopted the transition management approach (VROM, 2001). The underlying theory – transition theory – provides an integrated analytical approach to conceptualise and understand complex, long-term processes of societal change as multi-causal, multi-actor, multi-level and multi-phase processes, and suggests a new mode of governance, transition management.

In this paper, five energy transition management principles will be derived by integrating the insights from transition theory (Section 2) with the lessons from the historical analysis of the Dutch energy system (Section 3). In Section 4, these five basic principles are defined. Section 5 describes the energy transition management as it was implemented in the Netherlands over the past 5 years. Finally in Section 6, we evaluate this energy transition management process based on the principles presented in Section 4. The paper is a result of participatory action research, literature review and review of policy documents…and review of policy documents, and aims to contribute to the ongoing debate on how to deal with energy transitions.

2 Transition theory

In this section, we will outline transition theory and how it relates to complex systems science. Transitions refer to large-scale transformations within society or important subsystems, during which the structure of the societal system fundamentally changes. Examples are the demographic transition, transition from industrial to service economies, from extensive to intensive agriculture or from horse-and-carriage to car-mobility (Geels, 2002). A transition is the shift from a relative stable system (dynamic equilibrium) though a period of relatively rapid change during which the system reorganises irreversibly into a new (stable) system again (Rotmans, 1994). Transitions have the following characteristics (Rotmans et al., 2001):

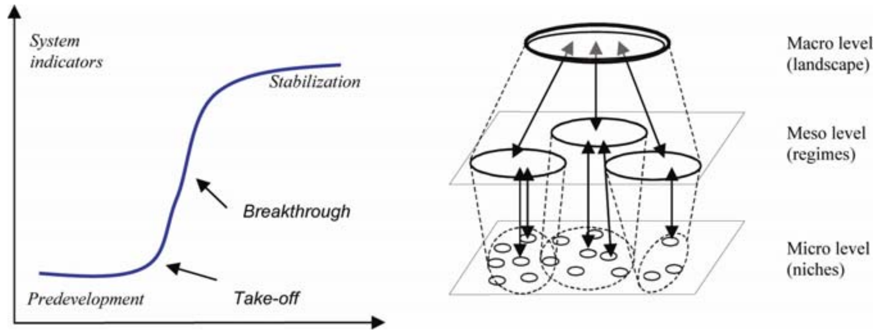
- they concern large-scale technological, economical, ecological, socio-cultural and institutional developments that influence and reinforce each other
- they are long-term processes that take at least one generation
- there are interactions between different scale levels (niche, regime, landscape).

A transition is a complex process with a multitude of driving factors and impacts. It is a process of co-evolving markets, networks, institutions, technologies, policies, individual behaviour and autonomous trends.

Historical analysis of societal transitions (Geels and Kemp, 2000; Verbong, 2000; Van der Brugge, Rotmans and Loorbach, 2005) suggests that transitions go through different stages. Rotmans et al. (2001) argue that the nature and speed of change differs in each of the transition phases (see also Figure 1 for an illustrative representation):

- In the *pre-development* phase the regime remains stable, although the social landscape slowly changes and there is increasing bottom-up innovation.
- In the *take-off* phase the process of change gets under way and the state of the system and its regime begins to shift.
- In the *acceleration* phase structural changes take place visibly way through accumulation of socio-cultural, economic, ecological and institutional changes. During this phase there are collective learning processes, diffusion and institutionalisation processes.
- In the *stabilisation* phase the speed of societal change decreases and a new dynamic equilibrium is reached.

Figure 1 Multi-phase and multi-level models of transition



Source: Rip (1998) and Rotmans (2000).

During transitions there is non-linear change as a result of developments and events that reinforce each other. Each development within the whole set has different speed and magnitudes. It is therefore necessary to take into account different scale levels and their interference. The basic multi-level approach that is used here is: focal regime at the meso level, alternatives and innovations at the micro level and long-term trends at the macro level. At the meso-level companies, governments and NGOs are distinguished that together constitute a regime of practices, structure and culture. Rip and Kemp (1998), Geels and Kemp (2000) and Geels (2002) distinguish between the landscape level of trends and autonomous developments (macro), the regime level of institutions and routines (meso) and the micro level at which individuals develop alternatives (innovation).

Transition theory is rooted in theories about the behaviour and dynamics of so-called complex adaptive systems. Complex adaptive systems are systems that consist of adaptive agents which interact. Through their interactions, patterns emerge on higher scale levels that change the conditions to which the individual actors will adapt, which then changes the conditions again and so forth. This dualistic relationship between the individual and system is of key interest to transition theory. Table 1 mentions some of the important properties of complex adaptive systems.

Table 1 Properties of Complex Adaptive Systems (CAS), based on (Prigogine and Stengers, 1984; Holland, 1994; Holling, 1987; Kauffman, 1995). These properties apply to social systems, leading to the conclusions that social systems are complex adaptive systems and that the behaviour of this category of systems may have general features

Properties of Complex Adaptive Systems
Many and divers components and interactions.
Components are organised in a network configuration.
The system is open (exchange of matter, energy and information with external environment).
Non-linearity.
Positive and negative feedback loops (reinforcing and dampening mechanisms).
Nested organisational levels.
Multiple attractors (relative stable but dynamic equilibrium states) co-exist.
Components are able to learn and respond to the environment by changing behaviour (interactions).
Co-evolutionary interaction patterns may lead to irreversible pathways.
Higher level structures spring into being as result of lower level component interaction.

Important insight from complex adaptive systems informing transition theory is the notion of multiple attractors, or multiple stability domains. The idea is that complex adaptive systems remain stable as long as disturbances remain within a certain range, bounded by critical thresholds. After crossing such a threshold, complex adaptive systems transform into a new system. Key assumption behind transition management is that by understanding the dynamics of a societal system as a complex adaptive system, new insights and levers for governance can be found.

We consider the Dutch energy system as complex adaptive. It is an open system that co-evolves with its (societal) environment and related (societal) systems such as mobility, agriculture, spatial and urban development and consumption. It consists of many components: the physical, institutional, economic, mental and technological, which are highly intertwined. It may be conceived of as a nested system: the Dutch energy system in the global context, which in itself consists of different subsystems. During the 20th century, a fossil-based energy regime has emerged and through feedbacks it remains stable. This regime is adaptive since incremental adjustments to external changes are constantly made. The negative feedback processes that control the regimes stability will only be lost when thresholds are crossed, giving rise to positive feedbacks that lead to growth of a new regime. Thresholds in the current energy system include the depletion of the resources and price rates of renewable energy vs. fossil energy rates.

In order to understand the dynamics currently at play in the energy system and the circumstances under which it might reach take-off can be understood from an integrated analysis of the energy-system, and its historic development, by using the multi-level perspective and to indicate the current phase of the energy system.

3 Historical development of the Dutch energy system

The current energy system is the product of an historic transition: from the extensive energy system, based on decentralised energy production, traditional biomass and coal, to the large-scale, efficient energy system based on Natural Gas (NG) and oil. We discern three periods; the period from early 20th century to 1945 as a pre-development phase leading to a take-off, the acceleration phase between 1945 and 1980 and the stabilisation between 1980 and 2000. This long period is chosen to emphasise the time frame of transitions, thus to put transitions to sustainable energy systems in perspective. In the description we focus on the developments in end-use applications, energy use, material infrastructure, institutional framework, fuel mix and political agenda (as also applied to the European electricity system by Verbong, Vleuten and Scheepers, 2002).

3.1 Pre-development (early 20th century – 1945)

Macro trends such as the industrialisation process and widely used steam technology stimulated the use of coal in the Netherlands, like it did elsewhere. Secondary energy carriers, such as electricity and the (coal-based) ‘city gas’ made their appearance from the 19th century with application on a larger scale from the first decades of the 20th century. They competed for coal as the most dominant energy carrier. Electricity was at first produced locally (with steam engines and later steam turbines), and the retail of centrally produced electricity and gas was a novelty. Both energy carriers were involved in a fierce competition. The first niche-markets were lighting in factories and upper-class homes, but other applications like traction, power, cooking, heating and hot water were actively pursued by the energy companies. Soon, these ‘luxuries’ became available for the majority of households in areas with an electricity and/or city gas supply. The main drivers were the increasing returns to scale due to the high fixed costs for the production and distribution of these energy carriers. Diversification and increases in the demand lead to more intensive use of existing capacity and a shift towards larger capacity installations. This combined with the emergence of dominant designs and standardisation and incremental innovation caused large cost reductions, the opening up of new markets and so on. This self-reinforcing loop and non-linear dynamics is stronger for electricity, since city gas can be buffered in the grids themselves and in the enormous gasholders that then dominated the skylines. A regional grid that produced the so-called ‘distance gas’ with central production emerged from around 1925. The diffusion pattern is both bottom-up and top-down; bottom-up through growth of local distribution networks that were connected to one or more higher voltage/pressure transport networks supplied by central power stations or gas factories; top-down when higher voltage/pressure networks stimulated the growth of local distribution grids.

Local governments had the right to issue concessions and thus the energy system at first was organised locally. The large profits, high upfront investments and the economical and social advantages associated with the supply of these energy carriers attracted local governments that started to take over production and distribution from private pioneers. In a later stage, higher level governments took over this role from the municipalities. As electricity distribution grids exceedingly crossed the boundaries of the municipality starting in 1909, the national and provincial governments became increasingly involved. In the resulting power struggle over control of the electricity supply, the joint directors of power plants manifested themselves for the first time. Finally (and in contrast to other European countries), province-owned companies were more or less granted the monopoly in the electricity sector and institutions like the SEP (the cooperating energy producers that are responsible for the planning of power plants and load-balancing). As for city gas, production on a regional scale was coordinated by large (public) enterprises that produced cokes (a coal product): the Dutch State Mines (DSM) and Hoogovens (presently part of Corus), a large producer of steel.

There was no single dominant mode of transport until around 1945, and the linkages to the energy system are therefore diverse. Electric trams, initially coal-fired trains and oil-based cars, competed with each other and with other forms of transport such as bicycles and horse-and-carriages. The competition between these modes of transport sometimes took the form of a simple, cost-driven substitution process, but more often the interaction is much more complex and influenced by market, technological, institutional and infrastructural developments (Geels, 2002). Rail transport had already peaked; and even though cars were relatively rare until 1945, their share in Dutch transport exploded from 1923 onwards.

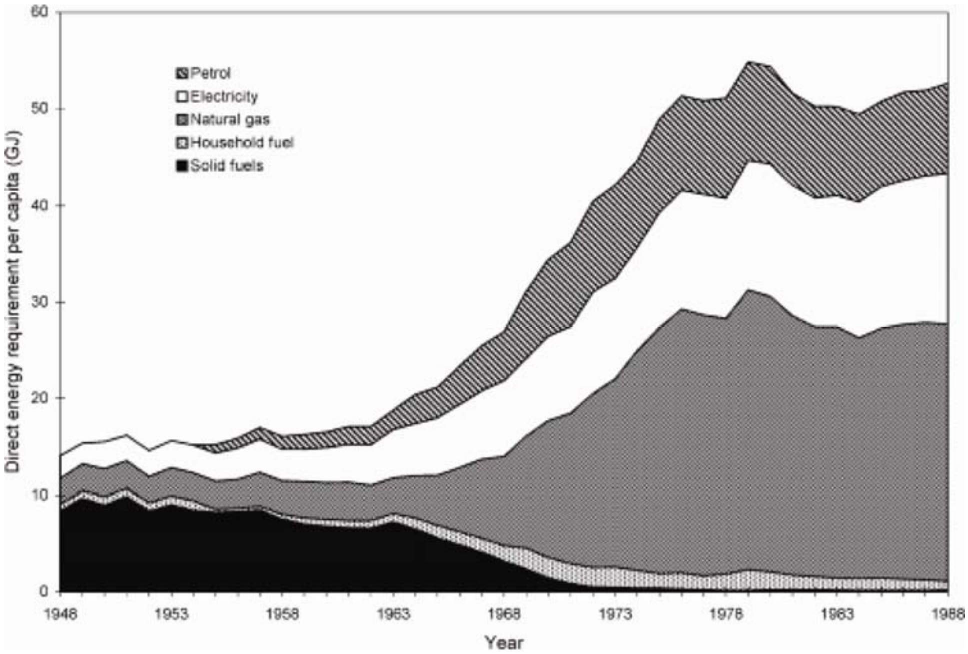
3.2 Take-off and acceleration (1945–1980)

Many of the elements that dominate the next decades and, in part, still dominate the Dutch Energy System were already in place by the end of the 1940s. Energy carriers were produced and organised centrally from fossil fuels and were grid-dependent. There were standards and dominant designs in various markets, and the main rationale was to produce as much energy as possible as cheap as possible. The energy subsystems for stationary applications and transport fuels had a different fuel mix, infrastructure and institutional set-up. Around three quarters of the Dutch households was connected to the city gas distribution grid, 90% to the electricity grid in 1940 and cars account for almost half of the individually travelled distance (CBS, 2005). In hindsight, it seems that most elements that currently constitute the Dutch energy regime were developed before the 1950s and thus before the crucial discovery of the large, Dutch natural gas field in Slochteren in 1953. The gas field in Slochteren produces cheap NG, and in the next decade would contribute significantly to the structural changes in the Dutch primary energy mix (see Figure 2).

Economic and population growth pushed energy use to a relative height around 1980 (Vringer and Blok, 2000). Based on consumption levels, there seems to be a significant shift between relatively low levels of direct energy use to relatively high levels between roughly 1960 and 1980. Underlying are several rapid transitions in subsystems:

- from coal to gas between 1950–1970 (Verbong, 2000)
- from carbon-based to petrol- and synthetic-based chemical industry in the Netherlands between roughly 1940 and 1980 (Schot et al., 2000a)
- from luxury use to mass use of automobiles between 1950s and 1990 (Schot et al., 2000b).

Figure 2 Direct energy requirements (in terms of primary energy) by households per capita



Source: Vringer and Blok (2000).

These changes, however, could not have taken place without the pre-development phase that had created the beneficial 'climate' for change. The DSM became involved in the production and distribution of the NG as they already had experience with city gas; coal mining became less profitable and (at least initially) served the national political interests. Closure of the increasingly unprofitable mines, buy-out of the city gas factories, re-fitting of domestic appliances and installation of a national transport grid were all paid for by the revenues and for a large part coordinated by the national government. The institutional arrangements for production, transport and sales of NG became known as the 'gas house'. The arrangements were influenced by the international context among which are the experiences of NG production by Exxon and tensions about the ownership of oil fields in the Middle East. The Dutch government, DSM, Royal Dutch Oil and Exxon set up a monopoly (run by Gasunie) with a pricing policy that was based on the alternative energy options at that time (as opposed to the cost of NG production). Because NG has considerable end-user benefits, it is more attractive than options like oil and coal. NG revenues accounted for up to 8% of GDP growth between 1950 and 1970, and the domestic energy mix became dominated by NG through its use in power plants, space heating by households and the emergence of new energy-intensive industries (Correlje, Linde and Westerwoudt, 2003). The discovery of the large reservoirs of NG influenced both the transition from coal to oil and the highly anticipated and expected shift from coal to nuclear energy (see for example, Verbong, Berkers and Taanman, 2005).

The sharp increase in car use was not widely anticipated in the Netherlands until WW2 (even though it had already happened abroad), but in the 1950s and 1960s it led to an enormous expansion of road-infrastructure and associated fuel-infrastructure. Institutionally, the energy system for transport was controlled by multinational oil companies like the Dutch/English multinational *Koninklijke Olie*/Shell, which was also involved in NG production and distribution. By 1980, the electricity dispatch was organised by the central power plants, owned by municipalities and provincial governments and working together as a cartel in the SEP (the cooperating energy producers). The Dutch government got more involved with the energy system in this period due to the linkages between industry policy and energy policy (both are a responsibility of the Ministry of Economic affairs), the NG exploitation and macro developments like the oil crisis. Energy policy was used to stimulate energy-intensive sectors like horticulture and regions with less economic activity. This changed the political agenda regarding energy from a focus on controlling the natural monopolies (infrastructures) and enhancing efficient production towards other political goals.

The environmental concerns were increasingly raised during the same period (Meadows, Randers and Behrens, 1972), and a number of environmentally benign technologies were put on the agenda (wind and solar) although in a very early stage of technological development. In the Netherlands, the ever-growing consumption with its associated side effects (waste and emissions) led to increasing public and political pressure and ultimately the first generation of environmental policies and energy-saving measures. These policies were aimed at technological diversification of primary energy sources (favouring a return of coal, but also large investments in wind energy).

3.3 Stabilisation (from 1980)

Despite the shifting political agenda, the Dutch energy system did enter a stabilisation phase. This phase is dominated by incremental development of the energy system. The primary energy sources are NG and oil and energy intensity and – use – stabilise, slowly decoupling economic growth and energy use. Energy efficiency improvements between 1980 and 1996, for example, cut the projected electricity consumption per capita by one third (Vringer and Blok, 2000). Optimisation through, for example, energy efficiency measures and end-of-pipe techniques were for a long time fairly successful, but more fundamental changes towards new energy sources proved to be difficult despite large government efforts. This is illustrated by the very low percentage [ca. 2.4% (CBS, 2005)] of the total energy consumption in the Netherlands, which is considered sustainable in 2005.

However, it seemed that change was already underway. The regime was confronted with changing macro-trends like an increasing environmental awareness, slower economic growth, trends towards privatisation and liberalisation (both in a national and a European context), a lock-in especially regarding infrastructure (sunk costs) and political issues now associated with energy (the debate on nuclear energy, fossil fuel sources, dependency on oil-producing countries, air quality and global warming). Institutionally, gas and electricity markets have been liberalised. In 1989, a new electricity act effectively replaced one from 1938 (Tellegen et al., 1996) and called for decoupling, the formal separation of electricity production and distribution and transportation. Liberalisation of the electricity and gas sector was completed in 2004. Production and transport of electricity and gas is becoming a European instead of a national system. The institutional changes reflect a changing political agenda. The European context, previous unsuccessful attempts to influence parts of the energy system and privatisation/liberalisation and the political problems associated with the present energy system require a change in the role of the national government.

In summary, the transition towards the present, fossil-based intensive energy system was the result of interactions between economic, technological, institutional, behavioural, other developments at different scale levels, and driven by forces outside and inside the system. The transition was in part a result of visions, interests and strategies of different stakeholders, in part driven by laws (e.g. economies of scale) and in part emergent. Relationships between technological options and actors often changed in character, sometimes positive, sometimes negative, sometimes both. Small changes had large impacts (like in the provincial organisation of the electricity sector), and changes that took place as a result of policy happened against the historical background of the energy system (adoption and institutional set-up of NG was very much influenced by previous Dutch experiences with city gas and international experience). At the same time, the dynamics was influenced by the international context. In sum, this illustrates the complexity of such processes of change in which government, planning or market dynamics can only influence part of the process. This obviously raises questions regarding the governance of such processes, which seemingly should include both formal and directed forms of management as well as informal and unplanned ways to create space for autonomous development.

3.4 History repeating?

During the last quarter of a century the Dutch energy regime has changed considerably with regard to institutional and political changes, but end-use applications, consumption levels, infrastructural developments and the fuel mix did not. Based on our analysis, we conclude that the dynamics of the energy system appear to be in a new pre-development stage. Pressure from global warming, depletion of resources (including the domestic NG reserves), political instability due to dependence on fossil fuel producers and attention for sustainable development is growing on average. In addition, there is an increasing sense of urgency due to economic and consumption growth domestically as well as in countries like India and China. Increasing bottom-up pressures at the micro level, such as cheaper renewable technologies, different user and consumption patterns, civil awareness, and debates about decentralised concepts constitute serious alternatives. From this perspective, a new energy transition seems inevitable. The fundamental question is twofold: in which direction should this transition unfold; and are we able to manage such complex transition processes into this desired direction?

4 Governance for the energy transition

In this section, five energy transition management principles are formulated to enhance societal innovations towards sustainable development of the Dutch energy system. The principles are derived from both transition theory and complex systems science, and from the historic analysis, to combine the general with the contextual. Steering in the context of complexity means transforming a complex, adaptive system from one state to another through creating the conditions under which changes can take place. Greater insight into the dynamics of a complex, adaptive system leads to improved insight into the feasibility of influencing and guiding it in a desired direction (see for example: Midgley, 2000). In other words: from applying insights from complex systems science to the energy system management principles can be drawn.[1] In doing this, complexity is no longer to be seen as a problem, but as means to find leverages for steering.

Although past and future transitions are expected to share similar dynamic patterns, namely transformation due to increasing macro pressures and micro alternatives that break through, the context is quite different. Table 2 indicates the main contextual differences with regard to the energy field between the current situation and the situation a hundred years ago.

Table 2 Differences between the historical and desired transition

Main differences between the historical transition and the presently desired transition
Instead of economic growth and technological progress, the driver is now sustainable development. The necessity of this transition is caused by problems that are in part the result of the previous transition (avoiding catastrophe instead of chasing economical, technical and consumer benefits).
The desired transition requires replacement of a much more complex, widespread energy regime crossing local to global scales. Independencies have increased, both within the Dutch energy system and with the Global or European energy system and other Dutch systems (industry, transport, services, etc.).
Larger established infrastructures and stronger interdependence of technologies.
At least on the short term, alternatives offer fewer economical and end-user benefits including increasing returns to scale.
There is a diffuse set of partial problem owners.
The power of national government and central planning has become smaller.
Consumers are accustomed to high levels of consumption and comfort at low costs.

Combining the general conceptual insights from complex systems science with the current Dutch context leads to the energy transition management principles.

4.1 Approach the energy system as a complex adaptive system in its environment

A (conceptual) systems approach enables an integrated analysis of the energy system. It offers a framework to think through interrelations between existing structures, actors, perceived problems and possible solutions. In terms of management, the systems approach implies integrated strategies that take into account formal and informal forms of governance, include a variety of relevant societal domains and involve different strategies at different levels, thereby focusing on influencing and utilising complex system dynamics. Managing the external connections between the Dutch energy system and the global energy system, and between the Dutch energy system and other systems, is essential to influence the transition, for instance, influencing international agreements and finding links with other sectors, such as the housing, transport and mobility sectors, agriculture and water management. The lock-in in of the present energy system is more than a technological lock-in, and the direction of development is shaped by more than innovation or economy alone. A transition requires changes in paradigms, infrastructure, institutions, behaviour, networks, etc. Many of these elements have co-evolved and remain stable through existing positive and negative feedbacks. All these aspects therefore offer opportunities for intervention and neither can be looked at in isolation. Variation, selection and retention play a role and can in part be influenced through stimulating new energy technologies, business models, end-use applications and alternative selection environments (e.g. market niches or semi-protected areas of experimentation) and retention of positive results in new or existing structures (e.g. through schooling, policy plans, new organisations). Central for dealing with transitions is therefore an understanding of the interactions between different levels of scale, in particular niche–regime interactions.

4.2 Deal with uncertainty

Some forms of uncertainty can be reduced by doing research (such as integrated systems analysis); some aspects are inherently uncertain (for instance, what we will learn in the future, or system responses after thresholds crossing) (Van Asselt, 2000). Uncertainties can be learned about actively through intervention in the system, but there will always be surprises. This implies that objectives of governance should be adaptable and adjusted when needed. The complexity of highly dynamic systems is at odds with formulating rigid objectives, blueprints or selecting the 'right' solution. Experts have often been wrong in predicting winning options and major societal trends. Yet this element has been important in the Dutch context, which changed its industry policy in the 1970s from the 'backing losers' philosophy (giving state support to ill-performing large industrial companies) towards picking winners (AWT, 2003).

4.3 Approach the transition as a multi-actor problem-solving process

Transitions and the issue of sustainability are inherently social issues, and therefore governance strategies should involve a wide range of actors. Planned or unplanned change results from the interaction between actors. The transition process thus has an emergent character, both with regard to how a transition issue is formulated in society as well as to what direction is desired. Governance strategies in this context should include structuring and coordinating activities as well as allowing for and creating room for spontaneous and surprising activities. Government should play an active role in this process as a facilitating party, but still as one party among many (Eising and Kohler-Koch, 1999).

4.4 Stimulate new combinations

New combinations of knowledge (e.g. multi-disciplinary knowledge), stakeholders, technologies, policy instruments, etc., might trigger innovation and set of new dynamics. Promoting and maintaining a large variety in system options, and selection environments form a hedging policy to deal with uncertainty. Diversification has been a central theme in energy policy for the past few decades, albeit often expressed in pure technological terms (Verbong, Berkers and Taanman, 2005).

4.5 Be reflexive in the management approach

Every intervention is based upon an incomplete model of the world. Each intervention will also produce unintended side effects and adverse boomerang effects, which can partially be anticipated and partially need to be responded to. A second level of reflexivity lies in the problem-solving process itself. As present issues result in part from past and present management and policies, the assumptions behind management and policies should also be scrutinised (Voss and Kemp, 2005). Governance should therefore include activities and strategies that reflect upon and draw conclusions from the activities and lessons learned.

4.6 Governance framework

In order to translate the above-mentioned management principles into an operational approach, Loorbach and Rotmans (2006) and Loorbach (2007) developed a recursive multi-level framework for transition management. It distinguishes:

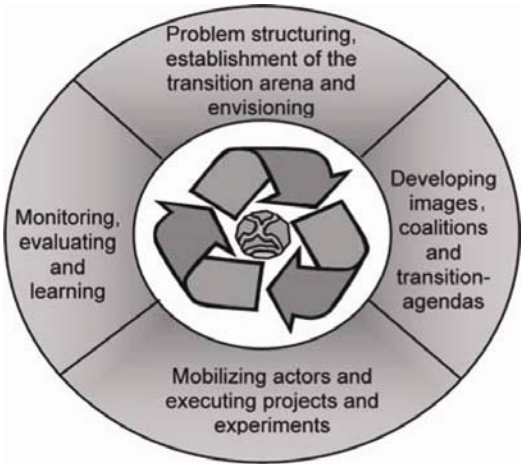
- *A strategic level*: processes of vision development, strategic discussions and long-term goal formulation. Most important at this level are the activities that give direction to social and cultural developments through leadership capacity, long-term orientation and top-down decision-making.
- *A tactical level*: processes of agenda-building, negotiating, networking, coalition building, etc. At this level the regime-structures of a societal system are re-defined through the design of totally new structures envisaged to facilitate a sustainable system, often through co-evolution between actors' interests, agendas and strategies.
- *An operational level*: processes of experimenting, project building, implementation, new practices, etc.

The transition management framework further distinguishes four activity clusters captured in a cyclical model (Figure 3):

- *Problem structuring and envisioning*: identify innovative pioneers and trendsetters, define problems and formulate inspiring alternative visions and images at system level.
- *Agenda building and networking*: representatives, actors and networks negotiate, exchange and co-produce regulations, strategies and intermediate goals (transition images and paths) at sector and subsystem level.
- *Experimenting and diffusing*: entrepreneurs, project managers and (government) officials implement and execute day-to-day operations and actions.
- *Monitoring, evaluating and adapting*: cross-cutting processes that occur at all levels and throughout all phases and designed to raise reflexivity and learning.

This transition management framework enables context specific implementation of the transition management approach based on evolving analysis of the state of a societal system. The analysis of the energy transition (section 3) for example shows that there is a growing concern about sustainability issues and the need for change, while not much debate is ongoing about the implications of a fundamental transition in terms of restructuring economies, consumption and production. In terms of strategic transition management, this would imply creating space for innovative ideas and thinkers and facilitating the development of sustainability visions and images that challenge current ways of thinking and acting by establishing transition arenas (Loorbach, 2007). In the next section we will illustrate practically how energy transition management was developed and implemented in the Netherlands and reflect upon the effects hereof.

Figure 3 Activity clusters in transition management



Source: Loorbach and Rotmans (2006).

5 Energy transition management; a new direction in Dutch Energy policy

In this section, we describe how the transition management approach was implemented the ministry of Economic Affairs (EZ see also: www.energytransition.nl). The Energy Transition management process (ET) started with a scenario report from the working group *'long-term vision for the energy supply-system'*. This report, 'Energy and Society in 2050' (EZ, 2000), linked economic growth and industrial development to energy consumption in terms of yield and supply of (alternative) energy resources. The report identified four possible future worlds. In each of these 'worlds' (the scenario's 'Global solidarity', 'Global markets', 'Regional networks' and 'Regional isolation'), energy demand was analysed. Based on the different scenarios, three sustainability criteria were defined: security of supply, economic efficiency, minimal environmental and social impact (EZ, 2000). Only four alternatives (biomass, NG, energy efficiency and wind energy) proved to be robust across worlds.

Hence, the following four main routes (transition paths) were identified (see Figure 4):

1 New (efficient and green) gas.

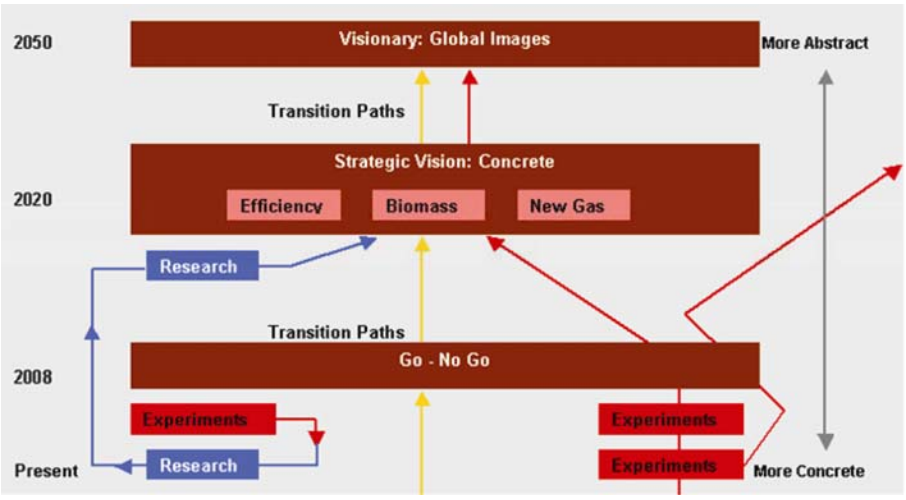
2 Modernisation of energy chains (efficient energy and material use throughout production use chains).

3 Biomass International (for products, materials and energy).

4 Sustainable Rijnmond (an industrialised and urbanised region in the Netherlands).

After a successful preparatory phase, the ministry decided to continue the approach and funded different sub-projects. For each transition theme, platforms (transition arenas) were set up to enable and facilitate discussions within the framework of the overall ambition and the context set by the scenario-study. Stakeholders involved in the platforms were predominantly organisations from business and science that were explicitly active in the areas of interest. They were not so much selected based on (individual) competences, democratic representation or their specific roles within networks, but rather on their possible contribution to development of new technologies or markets. The selection was done by the chairs of the platforms (who were selected by EZ because of their networks and experience in the platform's theme), often from their own network.

Figure 4 General overview of the energy transition process



Source: EZ (2003).

The platforms were given the explicit task to develop shared visions, transition paths and transition experiments as concrete as possible. Within the context of these thematic visions, paths were further refined by the transition teams 'new gas', 'biomass international', 'sustainable Rijnmond' and 'modernising energy chains'. Most platforms then started to develop thematic visions, some quantitative [Biomass: 'green resources have replaced 30% of the resources used for our energy supply in 2030. This implies: 60% of total fuels, 25% of resources in the chemical sector, 25% of resources for electricity and 17% of resources for heating which will be 'green' (Van Herwijnen et al., 2003)] and some qualitative [Sustainable Rijnmond: 'To *C* or not to *C*, that's the question'; vision describing a transition to carbon-free and renewable carbon-based Rijnmond (Bosma et al., 2003)]. In addition, 80 ideas (70 proposals) for transition experiments were collected in the areas of new gas, biomass, energy efficiency and industrial ecology.

Simultaneously to the development of the sub-trajectories, the ministry tried seriously to alter the existing financial instruments so that they fitted the ET. New policy and financial instruments were developed, such as the 'Regeling Ondersteuning Transitie Coalities'' (Support Transition Coalitions, OTC) for transition experiment coalitions and the 'Unieke Kansen Regeling' (Unique Opportunity Scheme, UKR) of 35 million euro for transition experiments. In order to qualify for support, the experiments should

- be part of an official transition path
- involve stakeholders in an important way
- have explicit learning goals for each of the actors of the consortium.

For transition experiment coalitions, a total budget of 1.5 million euro was made available for feasibility studies with a maximum support of 50,000 euro per coalition. Both instruments came on top of the 173 million euro for energy innovation. The ministry's budget for transition policies is estimated to have risen from around EUR 200.000 in 2000 to roughly EUR 80 million for 2005. Part of this budget is 'relabelled' money, which would otherwise also have been invested only in more traditional energy research and experiments. Part of the money, however, is in new funds such as the UKR and the OTC funds. Besides these investments, the ministry is also committing a growing number of officials to the process, creating an evolving learning community within the ministry. Two other noteworthy funds are the Bsik-funds, a national research fund of over EUR 800 million, out of which close to 200 million is spent on innovative energy research, and the Energy Research Subsidies (EOS) which is now directly linked to the ET.

In its role as facilitator, the ministry has also undertaken efforts to remove institutional barriers. A good example is the Trendsetters Desk, a government service point that is meant to service initiators of experiments and transition-related activities. This includes both financial support and support in the areas of policy and legislation. For example, it helps businesses whose ET projects are hampered by permits, legislation or regulations, but is also frequently visited by Small and Medium Enterprises (SMEs). The Trendsetters Desk looks for solutions to the bottlenecks. The service point received some 50/60 questions in 2005, but in 2006 received over 10 a month. Most questions come from SMEs and relate to financial and institutional barriers. An interesting observation is that most of the problems could be solved, the only category in which only a very small percentage of the problems could be dealt with was 'government coherence'. In 2005 a platform for sustainable mobility was added to the ET (previously a separate transition process), and in 2006 two new platforms on sustainable electricity and on energy and built environment were established.

The activities of EZ have been quite successful. During the 5-year period, the experimental transition management process has matured and the result is the commitment of hundreds of professionals that share the agenda and carry out innovative projects. In addition, the transition management process contributed to the increased sense of urgency and political attention. According to the ministry itself, the transition approach gives new impulses to the innovation system in three ways (EZ, 2004):

- the process of visioning in the sub-trajectories with active involvement of business, governments and societal organisations and knowledge institutes, resulting in shared sense of direction

- novel coalitions have been founded of parties who traditionally were each others' enemies (an example being the biomass coalition of business and the environmental movement and the involvement of Greenpeace in offshore wind energy)
- niche markets are being sought for a number of transition paths.

In the next section, there will be a reflection upon the process by using the energy transition management principles formulated in Section 4. When the ministry started, the transition management concept was sketched only roughly. It has engaged in transition management as a side-track next to regular energy and innovation policy. Since then, the concept has been further developed in three co-evolving fields: theoretically by scientists, as an operational policy-process by policymakers and as an energy governance approach involving all sorts of practitioners. One of the consequences of the openness of this process is that it has grown into a learning network in which there is strong co-production of knowledge. It is co-evolutionary in the sense that new insights from each side of the science–policy–practitioner triangle influence the direction of the whole, all adapting to the questions or insights one has. This is exactly what one desires in terms of social learning for transitions. The reflection in the next section could contribute to this.

6 Reflection upon the energy transition management process

6.1 Approach the energy system as a complex adaptive system in its environment

In hindsight, it seems that the ministry in the first phase underestimated the importance of providing a solid basis for the transition management process in terms of system analysis, problem structuring and development of an integrated process approach. In terms of analysis and in terms of process, the transition analysis was limited to the supply side and (primarily the) regime actors from the energy field. In a sense the ministry presumed that the problem was already well-defined. Although a scenario study was part of their preparatory stage, the scenarios were not based on a systems' perspective but explored possible societal futures and different energy sources in these futures. This way they primarily focused on subsystem level and on energysupply in the Netherlands. They did, however, include mobility and housing as issues and are currently also developing interaction with other transitions in water, agriculture and chemical industry.

Although the focus thus widened during the process (also including overall visions and actor-groups, increasing attention to demand-side and related societal regimes), the focus is still on the existing regime and the supply side. In other words, by limiting the 'energy transition' to an issue of creating sustainable energy business, the behavioural, institutional, structural and cultural changes needed are more or less ignored. The ministry so far left out important dynamics in the areas of politics, innovation policies, innovative outsiders and alternative lifestyles. Because such elements and developments were not involved, the reflexive element of the ET remains limited to the existing and dominant elements and dynamics within the area of industry and technology. Although already a major step forward from the fragmented and purely bottom-up approaches in the 1990s, the ET so far thus does not yet fully benefit from the systemic approach underlying transition management.

In the context of the ET, governance strategies were developed at all three levels (strategic, tactical and operational) to deal with the internal system dynamics. Best developed are the tactical level, at which platforms, transition paths and transition agendas are developed, and the operational level, at which transition experiments are developed and funded. At the strategic level, the forecasting studies and the long-term vision were developed, and in 2005 the Taskforce and the IPE were established. However, a fundamental reflection on problems, their origin and the future of a sustainable energy system were so far barely touched upon. Although the experiments also involve societal and institutional aspects, they are still insufficient to amount to a fundamental debate, let alone change, at the level of societal culture and structures. Such debate can induce a broader public interest and participation in the problem-structuring process, something that is undoubtedly important for the development of support for measures, creating awareness and involvement (Van de Kerkhof, 2004). When debate did occur, it was not (systematically) influenced by the ET. Except for the taskforce and some debate initiated by individuals, a high-level public and political debate around sustainable energy seems to only have been really sparked since visits from Al Gore and Bill Clinton to the Netherlands. The ET has not really influenced regular policies such as investments in traditional research and technology, existing unsustainable infrastructures, resource use and consumption. In other words, the selection environment in societal and regime terms is changing, but more autonomously than as a result of active governance, while this is an essential role for government in transition management. Based on the outcomes of ET, the ministry can develop strategies and actions to influence the selection environment (existing regulation, markets, consumption, etc.) in a more top-down approach and role.

6.2 Deal with uncertainties

Most important uncertainties related to the energy issue are energy prices and availability, development of new technologies and resources. The ET did explicitly take these uncertainties into account by developing a portfolio of options and strategies based on scenario studies. The ministry executed a forecasting scenario study and an assessment of sustainability-related problems. They did also establish a forecasting trend analysis in which issues such as climate change, instability of oil-supplying regions and energy prices were seen as critical factors. Obviously, these issues all came to the forefront the past 5 years, which has stimulated the ET. The second outcome of the explorative preparatory phase was to focus the attention on a number of energy options present in any scenario. In terms of anticipating, the process has this way proven to be context-aware and based on different themes that are still, perhaps even more than when they were selected, relevant. In terms of dealing with uncertainties, a portfolio strategy of exploring multiple options simultaneously has so far proven to be a relatively 'safe' approach. This can also be said of the way that the processes and the outcomes are structured within the different themes. For each theme a portfolio strategy was developed (the transition agenda's), in which target images are related to different transition paths that in turn comprise multiple experiments. At the operational level, the ET has been successful in addressing innovators, supporting and setting up transition experiments (over 70) and creating attention within the energy-related community. A number of concrete successes such as the Heating Company and the Energy-producing Greenhouse illustrate this.

6.3 Approach the transition as a multi-actor problem solving process

The basic starting point for the ET was a multi-actor process in which public–private cooperation was sought and government acted mainly as facilitator and possible partner, rather than director or central authority. It seems that the mere idea of ‘energy transition’ has provided a shared goal, which helped actors to relate, cooperate and develop a sense of common responsibility and possibility. So far, the involvement has been mainly realised within business, science and NGOs, and those groups most active were perhaps already involved in the issue. In that sense, although it has led to more convergence of interests and more cooperation within the sector, the question is whether the fundamental issues related to the desired transition are addressed when consumers and citizens are so far not involved. The ministry, perhaps in its desire to achieve concrete results and to stimulate business, opted for the creation of networks within themes that already had ongoing developments and where large companies were active. The focus was on creating business based on the belief in market forces to facilitate the transition to a sustainable energy system. In terms of transition management, however, the ministry did not sufficiently involve private outsiders and civil society. The few large companies that dominate the present Dutch energy system are also dominant in the ET, as reflected in the Taskforce composition. At the level of the platforms more niche-actors are involved, but it has proven to be difficult to organise interaction where niche and regime actors treat each other like equals.

6.4 Stimulate new combinations

In terms of new connections at the tactical level, one of the major results of the ET is an inter-departmental cooperation between five ministries. This has resulted from the emerging interactions and obvious overlap between different domains and strategies. Also at the operational level, new coalitions and integrated projects have been developed, for example, the Heating Company (involving different types of actors). In a general sense, the ET creates room and direction for interaction and cooperation, thereby enhancing the chances for new combinations. They require, however, hard work, especially by the government who should facilitate this process through regulatory and financial action. The ministry did set up the Trendsetters Desk helping innovators, but much more should be done to discourage unwanted combinations and enable new ones. Striking example are the difficulties the Heating Company encountered in terms of regulations prohibiting cooperation between industry and government and between government and housing companies. The actions needed from government should be formulated at the strategic level and be part of the reflexive debates within the IPE, Taskforce and similar forums. So far this reflexive process has been underdeveloped, meaning that the attunement between the different levels of transition management both in terms of substance and process is absent: because a process architecture is missing, there is neither a convergence between vision, images, paths and experiments nor a convergence between innovative regime-actors and innovative outsiders.

6.5 Be reflexive in the management approach

It is already remarkable that it has been possible to develop a radically innovative governance approach in the context of an existing energy and innovation policy regime.

The ministry struggled to overcome existing routines, structures and culture and in a sense did not yet succeed in doing so: the market- and technology-based approach is still dominant, as is the bottom-up approach and the limited role of government as facilitator. Although this facilitating approach is highly flexible, adapting to changing compositions of networks, new initiatives and actions developed, it is still relatively close to the regular policies and approach. It is, however, remarkable to see how the ministry itself has, by implementing transition management, gradually learned, adapted and innovated their own practices and therewith influenced their own (policy) culture.

This is illustrated by their reaction to discussion about a perceived lack of strategic governance activities, the strong focus on supply side and the emphasis on technological innovation. In all areas the ministry has developed new initiatives because of criticism, debate and internal evaluation. Especially, the internal evaluations combined with broader debates between energy officials and experts has led to a new and evolving way of thinking about the role of government in this transition and how they should operationalise this role. It is therefore an excellent example of policy learning in which concrete experiences as well as analytical discussion and evaluation related to an ideal–typical transition management gradually lead to improved processes and governance: an example of learning-by-doing and doing-by-learning. Perhaps, even of more importance than the learning that occurred within a small group of directly involved individuals, the changes in thinking and acting also diffused more widely within the ministry and to other ministries via the inter-departmental cooperation.

The ET started out as an experiment, but by now has gained so much speed, drawn so much attention and involved so many actors that it can no longer be regarded as an experiment. Already noticeable is the regimes' response strategy that aims to bring the ET into the mainstream. For the coming years, it will therefore be crucial to build further on the achieved successes, claim and create new space for innovation and learning, and maintain a reflexive approach. However, the dynamics will necessarily shift more towards harvesting concrete successes, realising fundamental changes in the regime and diffusing the process on a wider scale, at least to involve consumers. This will evidently require new and adapted strategies, approaches and instruments, which in part need to be discovered, developed and tested. Evidently, this is at the heart of managing transitions: learning-by-doing and doing-by-learning.

7 Conclusion

The current energy system is deeply embedded in our economy, consumption patterns, regulations and infrastructure. However, transitions to radically different energy systems are inevitable. The uncertainties about these future transitions are high, which is one of the reasons why different actors make different assessments regarding the urgency of the problem and the desired direction. Historical analysis suggests that the Dutch energy system is currently in the pre-development phase …, possibly near take-off. Important is to understand that the history of our energy regime determines to a large extend the possibilities for shaping and governing a desired transition to a sustainable energy system. This implies that we need to consider time frames which are much longer than normally used in policy. It also implies that new kinds of governance are needed to manage to transition to sustainable energy systems. The complexity of the energy transition, the changing role of the national government in the energy system and the importance of developing a sustainable energy system have led the Dutch government to start with energy transition management.

Based on transition theory and the historical analysis of the Dutch energy system, several starting points for energy transition management have been suggested that are translated into an operational transition management strategy (Rotmans and Loorbach, 2006). This strategy distinguishes between strategic, tactical and operational levels of governance and between four activity clusters. Reflecting on the way the Dutch Ministry of Economic Affairs implemented energy transition management – using transition management as an evaluative framework – we conclude that it contributed to the convergence between actors in the field, to a strong innovation dynamic that includes domains outside the primary energy domain and growing acknowledgement of the need for change. The involvement of hundreds of actors, from business, science, government, NGOs and others, has laid a fruitful basis for further experiment, development, change and innovation in this field. However, based on our analysis, the ministries' approach so far, has not addressed all energy transition management principles to the fullest. Important reason for this was that the transition management process itself was embedded in the existing structures of the ministry, which are likely to constrain radical experimentation. Nonetheless, the ministry showed a strong reflexive capacity and continuously improved the process. In this late pre-development phase of the upcoming transition, government should – aside from facilitating innovation – also select those innovations that fit their sustainability vision and discourage innovation that supports existing regimes. The energy transition management has been quite successful as an experiment in reflexive governance. The coming years will show whether the developed transition networks and innovation agendas will break through to regular policies and networks, and thereby actually lead to the desired structural changes in the Dutch energy system.

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Note

[1]These guidelines are based on the analysis described in the previous sections, which suggests that the energy transition is in a pre-development phase. Other phases will require different strategies (Loorbach, 2007).