Back-Casting for Environmental Sustainability: From STD and SusHouse towards Implementation

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1. Introduction

In the recently published Dutch National Environmental Policy Plan 4 (NEPP-4 2001) it is stipulated that the solution of big and persistent environmental problems requires "system innovations". According to this policy document, system innovations sometimes require a social transformation process (or transition) of more than one generation. In order to achieve this a new policy instrument will be created: "transition management". In the NMP-4 transition management is proposed for problems related to energy and transportation (the greenhouse effect), loss of biodiversity and natural resources, and agriculture.

The aim of this paper is to review some of the developments in the last decade, including the development of the 'back-casting' concept, that have lead to the appearance of 'system innovation' on the political agenda. Also, the paper will reflect on lessons learned, on unsolved issues, and it will attempt to formulate recommendations for government policy.

Transitions are loosely defined as gradual continuous processes of societal change in which society changes structurally (Rotmans et al. 2000; Kemp and Rotmans 2001). A transition is the result of connected developments in several societal domains: culture, technology, economics, ecology, institutions, behavior, and worldviews. The distinction between transition and system innovation is not very clear: it appears that transition emphasizes the time dimension of the process, while system innovation emphasizes its systemic character. In this paper we will consider them more or less synonymous.

The idea that environmental (or sustainability) problems are deeply rooted in structural aspects of society is of course not new. In the 70-ies the first environmental movements were anti-capitalistic; in their view the capitalist mode of production cause both environmental and development problems. In order to solve these, nothing less than a marxist revolution was necessary. This view is echoed in the present anti-globalization movement.

The idea that a national government is at the cradle of a system innovation thus raises a lot of fundamental questions. The first is if system innovations can be managed at all, or if they are more or less autonomous processes. Transitions are visible everywhere in society: the ICT revolution, the globalization process, the graying of the Western-European population, the international migration streams, the biotechnology revolution. These transitions are indeed complex and multidi-

mensional; they are the result of many developments in society and in technology, and they can hardly be influenced from a central point, let alone be managed. In relation to sustainability, the question arises if and how these dominant quasi-autonomous transitions can be influenced in the direction of sustainable development.

An interesting question in this context is the role of the national governments in transitions. National governments may be part of the problem rather than of the solution: in many governments there is a heavy entrenchment of policy practices and bureaucratic cultures and structures, which may act as impediments for desired transitions towards sustainability. System innovations will also affect the government system, and thus the question of 'who manages' is an interesting one. Another relevant question is if the international nature of transitions enables a national approach.

There is also the question about the relationship between technological and societal transitions. In technology dynamics a lot of attention is given to the socially contextualised character of technological innovations, and the degree in which they can be influenced. A lot can be learned from technology dynamics literature; however, in the transition discussion it is sometimes unclear if we are talking about a technological transition (a sustainable energy system, a sustainable transportation system) or about a societal transition (towards reduction of energy use by changing behavior, towards a different mobility culture)

The fact that transitions and system innovations are now on the political agenda is partly a spin-off of earlier developments in the nineties. For this reason we first review in this paper an important Dutch innovative program: the Sustainable Technological Development program (STD)[1]. This program was the first to call for deep "leapfrog' technological, cultural and structural changes in society in order to address sustainability issues on a global scale. It introduced the concept of 'back-casting', which is 'looking back from a desirable or unavoidable future'. Next we will review the project "Strategies towards the Sustainable Household" (SusHouse), because in this project the role of the consumer and of the demand side of innovations was stressed. From the STD program and the SusHouse project lessons may be learned for system innovation. We will subsequently address the role of the government and the role of private enterprises in collaboration with other stakeholders.

The general conclusion of this paper will be that in order to achieve system innovation, the role of the government should be to formulate and legitimize the direction to be taken towards sustainable development: the government should set long-term objectives but should abstain from managing too closely specific processes. Social experiments should be undertaken in multi-stakeholder setting and on a small and medium-seize scale in order to foster learning processes among stakeholders, and in order to explore directions to be taken. The government should stimulate these social experiments, and it has a role to play in the upscaling of successful experiments and in providing the relevant incentives and infrastructures. Private enterprises should be part of social experiments, which will enable

[1] In Dutch known as DTO program: Duurzame Technologische Ontwikkeling.

them to innovate in sustainable technologies, products and services, in close communication with consumer demands and with requirements of sustainable development.

2. The STD Program

In 1993 five Dutch Ministries launched the Sustainable Technological Development program (Jansen et al. 1992; Vergragt et al. 1993). This program was based on the report of the Brundtland committee (WCED 1987) which introduced the often-cited notion of sustainable development:

"Sustainable development is development that meets the needs of the present generations without compromising the ability of future generations to meet their own needs".

In this definition three basic elements stand out: the fulfillment of (basic) needs; equity between the developed and the now underdeveloped world (between 'North' and 'South'); and solidarity with future generations. Moreover, sustainable development stresses the interwovenness of three aspects: economic development, ecological protection, and social priorities like quality and quantity of labor, health and safety at work, anti-discrimination.

The mission of the STD program (1993-1997) was "to explore and to illustrate how, together with policy makers, technology developers, and opinion leaders, by looking backwards from a sustainable future vision, processes of sustainable technological development can be initiated and kathalysed" (Jansen and Vergragt 1992). In this mission the notion of "back-casting" (Goldemberg et al. 1985) was applied: looking back from a sustainable future vision. Other elements of the program are also visible in the mission: the necessity of stakeholder collaboration, the concept of "illustrative processes", and the focus on collective learning processes.

In the beginning the focus was on the identification of leapfrog technologies that could potentially reduce the environmental impact of activities by a factor 20 in 50 years. The idea of the factor 20 was derived from the Holdren and Ehrlich (1974) IPAT equation[2]. If in the next 50 years the world's populations would increase by a factor 2, and if the welfare of the world's population goes up by a factor of five (a condition for equity), the environmental burden per unit of need fulfillment should go down by a factor of 10-20 in order to reach a sustainable society. A sustainable society is more than just a pollution-free society; it also includes social equity, quality and quantity of labor (Ashford et al. 2001), and sustainable economic development.

The STD took the (basic) needs as a starting point, and concentrated on the following "areas of need": Nutrition, Water, Shelter (housing), Mobility, and needs

[2] The presently popular version of the IPAT equation is I=PxAxT: the environmental impact (I) equals the product of population size (P), the degree of affluence (A) per person, and the environmental impact from technology (T) used to produce one unit of affluence.

for Materials and Chemicals. For each of these areas of needs, future visions have been created together with stakeholders. From these future visions as a starting point, proposals have been developed for "Illustration Processes" in order to start leap-frog innovation processes. (Vergragt and Jansen 1993). All together, 16 Illustration Processes have been carried out, for instance 'Novel Protein Foods', 'Multiple Land Use', 'Sustainable Offices', 'the Municipal Water Chain', and C1 chemistry. Each of these illustration processes brought together stakeholders from the entire 'area of need", thus not only technology developers and business, but also consumers, environmental organizations, and government agencies.

Looking back from now, these 'back-casting' processes were the first intuitive steps to explore the possibilities of evoking 'system innovations'. Many methodologies have been tried out, in order to investigate which were most successful. Leading principles were 'learning by doing' together with stakeholders, thus the initiation and carrying out of collective learning processes together with stakeholders. Another principle was the idea of illustration and communication: not to start activities for transforming an entire area of need, but small scale experiments endorsed by science and technology in order to illustrate and communicate possibilities.

During and at the end of the program a methodology (see table 1) emerged that involves seven steps from problem recognition towards implementation (Weaver et al. 2000).

Table 1. The STD Methodology

Develop long-term vision	Develop short-term vision	Implementation
1. Strategic problem orientation and definition	4. Explore solution options	6. Set up cooperation agreement-define roles
2. Develop future vision	5. Select among options: set up action plan	7. Implement research agenda
3. Back-casting		

STD illustration processes

Nutrition:

- Novel protein foods
- High-tech agroproduction
- Integral crop conversion
- Multiple land use

Transport/Mobility:

- Underground freight transport
- Information technology for transport systems management
- Demand-responsive public transport

Buildings and urban spaces:

- Sustainable public housing
- Sustainable offices
- Urban restructuring

Services provided by water:

- The municipal water chain

Services provided by materials/ chemicals:

- C1 chemistry
- Fine chemistry
- Structural materials from natural fible composites

In the first block, long term orienting activities are carried out. A problem orientation has to be carried out in order to define the system under investigation and its boundaries, and the dimensions of the problem under study. Future visions are important but should be always open for adjustments as results from learning processes. In the second block, the result of the back-casting exercise is to explore, generate, and select options and develop an action plan for implementation. In this phase often a definition study is carried out. In the third block, the actual implementation is carried out. This may take the form of a research project, a policy project, or a social experiment. Not shown in this scheme are the feed-back loops between all stages.

Although the STD program initially focused on technology for addressing the factor 20 challenge, it soon became clear that non-technological factors (called *cultural* and *structural* aspects) were at least as important as barriers and conditions for implementations. Often technologies are more or less available but the barriers are institutional, economical, and especially cultural.

In the STD program it became clear that long-term oriented thinking was one of the most essential conditions for implementation. At the same time it became clear that this was also one of the main bottlenecks. Most industrial companies are more concentrated on short-term profits, and long-term oriented R&D is diminished over the last decade. One of the main challenges for STD is to create synergy between the long and the short term: How to create a vision and a strategy for the long term that is endorsed by stakeholders, and at the same time creating short-term spin-offs that make it attractive for private companies.

Another lesson learned is that during illustrative processes it is extremely difficult to maintain a long term perspective. The dynamics of each project, and especially in multi-stakeholder processes, is such that the short-term objectives become easily dominant. The long-term vision recedes behind the horizon and after a while is not leading any more for the realization of the short-term illustration.

This means that there needs to be a mechanism to attune the long-term vision and the operational goals on a regular basis.

In several cases it proved that the collaboration between existing institutions for carrying out illustrative processes was not strong enough to survive over a prolonged period of time. In several cases towards the end of the STD program new institutions have been created for the continuation of the initiatives undertaken. It can be discussed if this fits into the STD strategy; STD's aim was more to transform existing institutions rather than adding more institutions to the already crowded institutional landscape. But on the other hand the creation of institutions guarantees continuity and creates a channel for funding.

The challenge of sustainable development is a global challenge and can never be solved on the national level alone. The STD Program has been quite active in building international networks for knowledge dissemination and for dialogue, for instance with developing countries[3].

Summarizing, the STD program has set in motion a 'learning by doing' perspective on sustainable development: it has generated a number of illustrative processes and involved a number of stakeholders into long-term thinking; it has developed a methodology and has explored the interactions between technology, culture, and structure. Most importantly, it has operationalised the concept of sustainable development from a fuzzy phrase into tangible activities that could be recognized by "hard" technology developers, and it has developed an operational approach. Still, sustainable development has not yet become a central activity of innovators and policy makers. It takes time and effort to diffuse these new notions of cooperative sustainable innovation and development deeply into society. But after more than 10 years it is now echoed in the NEPP-4 document in the form of transition and system innovation.

3. Strategies towards the Sustainable Household (SusHouse)

In the STD program most of the activities were concentrated on the supply side: on technology developers and policy makers, together with intermediate institutions and knowledge providers such as Universities and technological institutes. In the "Strategies towards the Sustainable Household" (SusHouse) project (Vergragt 2000; Vergragt and Green 2001) the focus was more on the consumers and on the demand side of innovations. Although there have been other projects concentrating on the consumers and the potential of behavioral changes (Schmidt et al. 1999; HOMES 1999), the SusHouse project added to that by applying the STD methodology in order to create future visions of a future sustainable household. The SusHouse project, an international project sponsored by the EU's Environment and

[3] On 26 March 1997 an international workshop was organized, together with the TU Delft and the Institute for Social Studies "The Sustainable Technological Development Approach: Potentials and Pitfalls for Developing Countries.

Climate program (1998-2000)[4], concentrated on three household 'functions": Clothing Care (Vezzoli 2000), Shelter (heating, cooling, and lighting) (Pfeiffer 2000), and Nutrition (shopping, cooking, and eating) (Green and Young 2000)[5]. Together with stakeholders from the entire chain (including consumers and housewives) creativity workshops have been organized in which stakeholders created future visions of the sustainable household. The challenge was to deviate as far as possible from the current entrenchment, using feasible technologies but also extreme behavioral and cultural changes.

A factor 20 efficiency improvement by 2050 requires not only that we considerably change our production processes, but also our consumption patterns taking into account that these are strongly interconnected and interdependent. Other reasons for the focus of the SusHouse project on sustainable households and sustainable consumption include:

- There is a considerable environmental burden and resource usage in consumption and household activities (e.g. Noorman and Schoot Uiterkamp 1998).
- The direct environmental burden of households has been increasing considerably during the last decades. (Noorman and Schoot Uiterkamp 1998).
- Households and their members are important social actors for achieving sustainability. They are responsible for 'demand' and could stimulate the growth of sustainable or 'green' demand.
- Together with sustainable technological innovation, cultural changes will be necessary for sustainable development. From this point of view, households and their members are also important actors.

The methodology developed and evaluated in the *SusHouse* Project (see figure 1) has been derived from the STD methodology, and more specifically from the STD Sustainable Washing Project (Vergragt and Van der Wel 1998). However, the *SusHouse* Project has made substantial changes, namely:

- less emphasis is laid upon technology as the main agent for sustainable development; rather, a combination of *technological, social, and cultural changes* is envisaged.

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4 The SusHouse project was a collective endeavor of six research groups in five European countries which are: Technology Assessment Group/Design for Sustainability group, Delft University of Technology, (the Netherlands); Szeged College of Food Industry (Hungary); Dept. of Industrial Design, Politecnico di Milano (Italy), Avanzi (Milano, Italy), CROMTEC, Manchester School of Management, UMIST (UK), Lehrstuhl Markt und Konsum (Universitat Hannover, Germany). This research has been supported by the EU DG 12 Environment and Climate RTD Programme, Contract no. ENV4-CT97-446.

5 The full reports on these functions are published on a CD-ROM, together with the final report, the methodology reports, and the country reports; see Vergragt 2000. CD-ROMs are available from the author.

- more emphasis is laid upon the *participation of non-governmental stakeholders* in the process.
- a *design orientation* is chosen, rather than a policy-making orientation. So, the aim of the *SusHouse* Project was *to develop and test a methodology* that would:
- enable companies, governmental policy organizations and NGOs to carry out their own analyses of household functions.
- identify possible product, system and social innovations which offer business opportunities and policy initiatives now.
- develop scenarios for sustainable household functions using industry-consumer-government creativity groups.
- develop methods of assessing the viability of these ways of sustainable household function fulfillment.

The development of the methodology was backed up with case examples of imaginative scenarios developed during the Project (Young and Vergragt 2000). For the fulfillment of functions of the sustainable household; the scenarios were subject to environmental assessment (Bras-Klapwijk 2000), economic analysis (Young and Simms 2000) and consumer acceptance analysis (Bode 2000)[6], and have been 'endorsed' by the social partners in the project.

The project's approach was briefly as follows. (Vergragt and Green 2001). With the help of experts from different stakeholder groups, and with the help of brainstorm techniques, the project research group formulated normative scenarios of sustainable fulfillment of these household functions by the year 2050, including technological, cultural and institutional innovations. The scenarios were evaluated as to how much they decreased the overall environmental burden, whether they were economically credible, and whether they were acceptable to European consumers. After this it was possible in a second set of stakeholder workshops to define the trajectory leading towards this sustainable future.

An essential element of the *SusHouse* methodology is the creation of 'micro' normative scenarios for a sustainable household function. These scenarios are based on the creativity workshops and the ideas generated by the stakeholders. The scenarios are based on the following general notions:

- Technological innovations are necessary but insufficient to bring about factor 20 sustainability improvement.
- A shift from products to services may offer new options for changes towards sustainability.
- Sharing household activities offers a potential for sustainability gains.

The scenarios are intended to generate visions of sustainable household function fulfillment that differ radically from the present. This is why workshop participants were asked to focus on the year 2050 to envision futures that might breach

[6] These methodology reports are also published on the SusHouse CD-ROM; see previous footnote.

current trends. Such visions may open up new ways of thinking, researching, designing and acting *in the present* (or, at least in the next few years) and thus offer a way out of the present consumption deadlock. The project developed the concept of the *Design-Orienting Scenario* (DOS), as opposed to the more common notion of the Policy-Orienting Scenario (POS) (Manzini and Jegou 2000). A Design-Orienting Scenario is defined at the micro-level of the (future) household, rather than the whole society of economy, and is supposed to create inspiration for 'designers', whether in industry, government, universities or NGOs, to design products, services and social arrangements that might help to realize steps towards these scenarios .

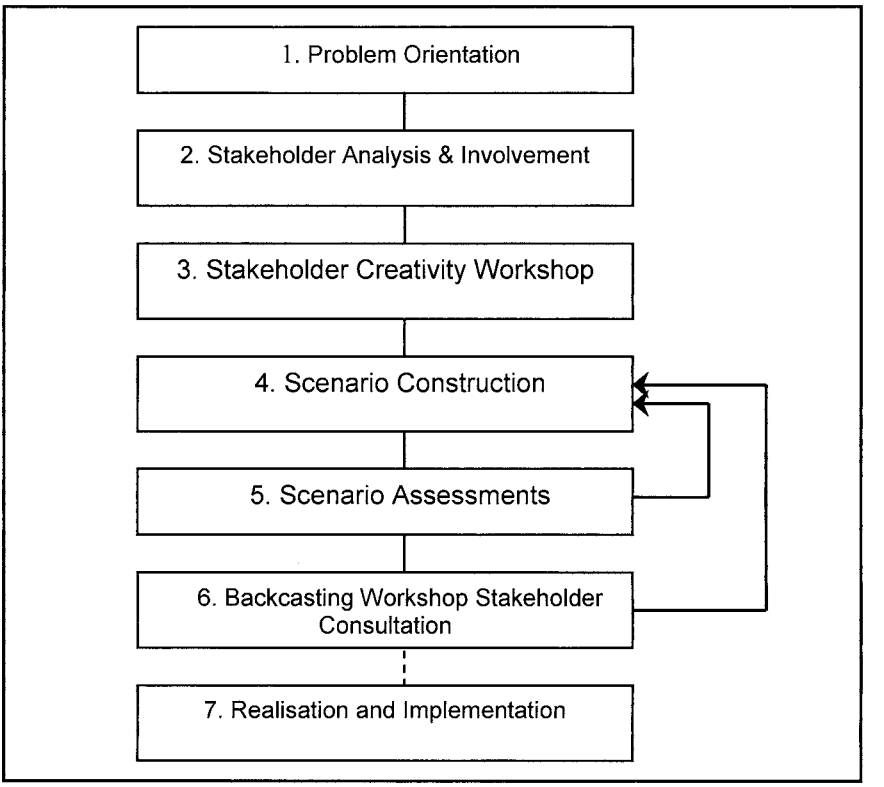

Fig. 1. SusHouse Methodology

A DOS should contain the following elements:

- Various "Proposals" developed as concrete products and/or services
- A global "Vision" picturing the effect of the implementation of the Proposals and their possible impact

- The "Essential Characteristics" explaining the main effects and benefits the DOS is expected to have in terms of sustainability, economics and user acceptance
- A story board, describing "a day in the life...." for the household function in the year 2050

Each of the 'Design orienting Scenarios' devised in the *SusHouse Project* was assessed with respect to three criteria: environmental improvement; economic viability, and consumer acceptance.

The last stage of the process was to reconvene the stakeholders in a backcasting or implementation workshop, in which steps towards implementation have been investigated. In this workshop both new business coalitions have been investigated, research agendas have been constructed, and policy agendas have been drafted (Quist et al. 2000). However, the jump towards actual implementation of these projects appeared to be very large.

As an example we present here one of the scenarios of the Clothing Care function (Knot 2000):

Example of Clothing Care DOS: Eternally Yours

Vision. Clothes are similar to jewels: clothes are precious and durable goods that have high emotional value to the user. Clothes are functional and comfortable, but also have an important function in reflecting a personal style of living and life-stage (personality and identity). In this sense, clothes are in fact part of the person, and regarded as a 'second skin'. Personal style is far more important than fashion. Clothes are closely related to ceremony: the purchase of new clothing is linked to memorable events (changes in life-stage), and is in itself a very special and festive occasion. People own and use a limited amount of clothing, which is used intensively for a long time. Clothes are made to measure: unique pieces, mass-individualized pieces, personally finished semi-products. Cleaning and maintenance is organized as a service, which is paid for at purchase (service contracts). The need for cleaning and maintenance is minimized and optimized because of the use of durable materials and designs, anti-dirt fabrics, dirt-indicators, local stain-removers, care while wearing, dark colours, etc.

Product-service proposals. The scenario involves many different products and services:

- Made to measure high quality clothing, mediated by information technology: unique pieces, mass-individualized pieces, semi-finished pieces;
- Adaptable and repairable fabrics and designs;
- Flexible and multi purpose fabrics and designs;
- Dirt indicators and anti-dirt fabrics;
- Service contracts;
- All-round clothing centers, co-ordinating all business activities concerning clothing and clothing care (manufacturing, maintenance, adaptation, waste

processing), and offering many other services related to body care and recreation;
- Fiber-rights or –quota.

To help gain an understanding of how the DOSs differ on the conceptual level, and how they relate to one another and to the present situation, they were clustered on a matrix presented in figure 2, with the two axes thus:

- *social/collective* (members of the household will tend to collaborate as a social community) versus *individual* (members of the household will behave as separate individuals); and,
- *do-it-yourself* (technical infrastructure enables the members of the household to fulfil the functions on their own) versus *service* (technical infrastructure involved in the functions tends to provide the household with finished, ready-to-use products or services).

The 18 DOSs can be clustered into five groups: ***Care Socializing, Care Outsourcing, High Care, Soft Care, and Easy Care***. The five clusters can be characterized thus:

- The **Easy-Care** household is characterized by high-tech equipment helping users in their daily life.
- The **Care Outsourcing** household actually involves a certain 'deconstruction' of the household as it is traditionally conceived as a place for the fulfillment of domestic functions.
- The **High-Care** household is based on a lifestyle in line with 'natural' models.
- The **Care Socializing** households are based on a certain level of community life, of collective resources, of sharing of products and services.
- **Soft Care** describes a household characterized both by a high attention/active involvement of the household members in the fulfillment of domestic tasks and a highly sophisticated system assisting them in these tasks.

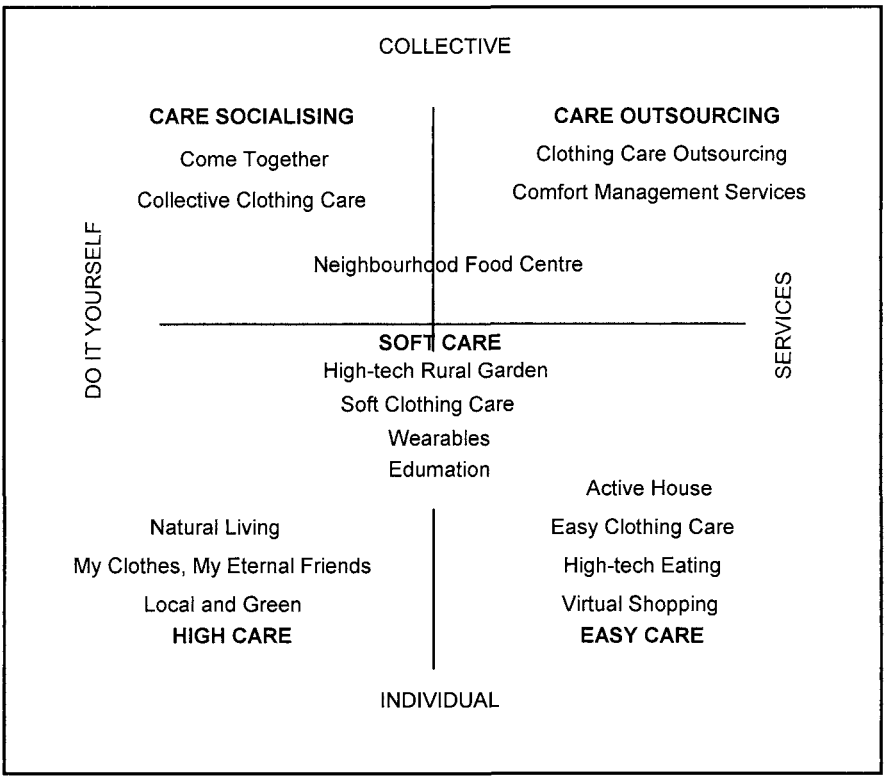

Fig. 2. Integrated Vision of Household DOSs (Manzini and Jegou 2000)

The SusHouse project can be seen as an experiment in methodology development for system innovation with an emphasis on the demand side of the production-consumption chain. It has taken the STD methodology as a starting point, and adapted it to become a working back-casting methodology oriented at system changes in a multidimensional (technological, structural, cultural, behavioral) way. Although it has been developed for functions in the household, and more generally at the consumption side of the production-consumption system, it can be adapted to other societal systems as well. The methodology calls for stakeholder collaboration, vision development, and back-casting towards experiments in the present. The methodology has been tested on an experimental level; the bottleneck lies in the implementation of niche experiments in the short term, and in upscaling from successful experiments toward large-scale innovations (system innovations). The government could facilitate here by fulfilling boundary conditions in order to facilitate working experiments.

4. The Role of the Government: New Governance Models

From the STD program and the SusHouse project a clear message stands out: future visions that are shared among stakeholders are a necessary but not sufficient condition for achieving system innovation towards sustainability. Another lesson learned is that stakeholder management is very important: understanding the culture and the interests of stakeholders, trying to understand their motives for collaboration, and understanding in which phase of the process they can play a role. Further we have learned that even on a small scale level these type of innovations are extremely time-consuming and costly, especially because they deviate from existing development paths and explore new cultural and structural options.

In the beginning of this paper we stipulated that the role of the government should be a restricted one. Here we argue that the role of the government is indispensable because of the long time horizon, the complexity of the processes, and the need for an actor that guard the general direction of sustainable development. However, the government has also to reflect upon its own functioning, and has to develop a concept of governance that is suitable for influencing transitions.

In a paper to be published in Dutch, Van de Graaf et al. (2002) explore the contours of a governance policy concept for steering system innovations or transitions. In this paper they argue that it is time to develop a third generation environmental policy, after the second generation based on stakeholder orientation and social learning. The boundaries for this second-generation environmental policy are reached because of structural impediments in society: the physical infrastructure, social conventions, existing regulations, available knowledge and the knowledge infrastructure. They take as example the car and the mobility system. The car system has become heavily entrenched in society because the developments in car technology have become heavily intertwined with developments in the infrastructure and in societal culture (Sachs 1984; Mom 1997). The challenge is how to formulate a policy that addresses this cultural and structural entrenchment without falling into the trap of planning by blueprints? Van de Graaf et al. (2002) argue that not a great planned attack on the existing system, but system changes may be brought about by "*....concrete contextual practices that, to a certain extend, do not follow the existing rules....*". Various practices may reinforce each other and eventually may lead to a system innovation. For the government there are two roles: *foster innovative practices*, and *foster mutual reinforcement* of these practices.

The recommendation that the government should foster innovative practices was also made in the SusHouse project (Vergragt 2000) and even in the earlier SMEC project (Social Management of Environmental Change (Irwin et al. 1994). Often the development of these practices is done by small innovative firms or by citizens initiatives, and they are the result of 'slumbering reverse salients' (Moors 2000): the growing understanding that certain problems on the system level may prove to be insoluble without system changes. The difficulties of access by the increasing car traffic jams could be an example here: sooner or later the traffic jams

and the lack of accessibility may prove not to be soluble within the present car mobility system, and new systems need to be developed.

Mutual reinforcements of innovative practices may be achieved by developing connective infrastructures, regulation on a more general level, technologies that fulfil needs in various contexts, and research programs aimed at investigation of knowledge gaps. It may be added that forms of network management aiming explicitly at connecting innovative practices may be useful here.

Future visions may play an important role here for contextualizing and connecting individual innovative practices, and to provide them with a meaning that goes beyond the innovative practice itself.

In an advice to the Ministry of the Environment about the follow-up of the STD program, Diepenmaat and Te Riele (2001) advice the establishment of two interactive layers: a strategic layer and a practice layer. The strategy layer creates the boundary conditions and sets the stage. They concentrate on long-term signals and develop visions; and they interact with the practice layer. The practice layer consists of changing coalitions between five types of stakeholders: Government, Companies, Knowledge infrastructure and advice, Intermediates, and Citizens/Consumers. They collaborate on specific innovative issues. It is important that each of the five stakeholders is present in each of these projects. This is a change with respect to the present situation in which government and companies dominate together with the knowledge infrastructure. The policy agenda for transitions includes among others network formation, collective vision formation, organization of consistency within the government, growing importance of intermediate organizations, research for endorsing social sustainability experiments, and co-existence of different time scales. They advice a new institution at some distance from the government, somewhat similar to the SER (Social-Economic Council, responsible for the famous Dutch Polder Model).

The recommendations by Diepenmaat et al. point into the same direction as the analysis and recommendations by Van de Graaf et al.; they point at the importance of bottom-up experiments and citizen initiatives (Irwin et al.), and they assign specific roles to the government. It is to be hoped that the government listens very carefully to these recommendations, because they are based on ten years of experiments in the STD program and in projects like SusHouse, and they are endorsed by a deep policy analysis.

5. Towards Implementation in Coalitions with Business

At the end of the day, system innovations need to be implemented by private companies that innovate successfully, which means bring new products and services successfully to the market. In the past ten years we have seen a shift from cleaning up production processes towards the design of environmental friendly products (ecodesign), and then towards the design of sustainable product-services. Presently methods are being developed how to develop sustainable services

(Brezet 2001), and how to innovate together with several companies (the Kathalys method) (Van der Horst et al. 2001).

It has to be stressed that the bulk of the industrial companies is still in earlier stages of these developments. Although the implementation of clean technologies in business is quite far in the Netherlands, the implementation of ecodesign, and especially the development of eco-efficient services stays behind and needs more attention. Beyond these, innovative practices towards system innovation are quite new and hard to organize with companies. What is necessary here is (social) business experiments in which short-term business success and consumer acceptance is achieved in the context of an explicitly formulated long-term vision.

As an example we take the Wash-in project. This project is both a spin-off from the Sushouse project and an innovative design by an industrial design student.

"The Wash In (Van den Bremen 1999) is a new concept for integrated clothing maintenance. It offers not only laundry services, but also various upgrading services for clothes and textiles, contributing to their life extension: taking-in and selling used clothes, reparation and adaptation, re-coloring. The collective laundry processes can be environmentally more efficient than washing at home due for example to the larger scale processes, the professional equipment, faster technology replacements, decreased use of equipment and professional handling. The Wash In uses green electricity from own generation (wind, solar) or from energy providers. The water for the laundry process is filtered rainwater, that is collected on the premises; also less softener is needed because of that. Experimental full-enzymatic detergents are used, making bleaching agents unnecessary, and allowing lower washing temperatures. The use of hotfill washing machines makes it possible to heat the water more efficiently, outside the machine.

The upgrading services for life-extension can however be at least as important for environmental savings. For example, more than half of the total energy and almost all of the water that is used for "being clothed" is not due to the washing, but due to the production and distribution of the clothes (Knot 2000). The laundry services that are offered by the Wash In are washing, drying, ironing, aqua-clean, dry-clean, 'hand-wash'. There is choice between self-service, full service and fast-service. It is not necessary to wait until the laundry is ready. The laundry can be dropped of and poicked up at any time, at the wash In or at service points. The transport of the laundry to and from the Wash In or service points is as much as possible integrated in existing activities and facilities (train stations, petrol stations, childcare, supermarkets).

The Wash In is meant as trendy, modern and fresh. It offers its large choice of services on a 24-hour basis, allowing clients to fit the service in their different daily lives in a flexible way. In this way, the Wash In is designed to attract new target groups for collective laundry processes (compared to the current launderettes): single person and two-income households who are able and willing to spend money but have little time. And although the Wash In is presented as comfort service rather than as a 'green alternative', it can play a role in environmental education concerning washing and clothing related themes inconspicuously. Furthermore, in cases the Wash In may fulfil social functions, like local and green

employment for deprived, a neighborhood meeting place (coffee-corner), and a neighborhood information point.

Like the product-service systems in the SusHouse scenarios, the Wash In is meant as a new, attractive arrangement with environmental advantages. It proposes a whole clothing maintenance concept rather than a mere 'green' laundry concept, combining elements that have not been combined before and that can strengthen each other. An example is the combination of laundry and second hand services. About one third of the clothes that people possess sits unused in their wardrobes. The handing in of clothes for re-use becomes easier in the Wash In concept. No extra efforts have to be made (like finding a second hand boutique, washing and ironing the clothes, bringing the clothes to the boutique), and people may get something back for it (clothes exchange points, service points). Also the selling of used clothes becomes different. The users-group of used clothes may enhance through this concept. The Wash In shows a sphere of hygiene and freshness and it is evident that the clothes are thoroughly clean. Furthermore the 'second chance' collection may be an extra 'fun' element for the clients.

The Wash In concept is furthermore related to the SusHouse Clothing Care scenarios in the sense that similar strategies and principles can be recognized:

- The service-strategy, which is central in Wash In, is present in almost all SusHouse scenarios, the most clearly in the Outsourcing scenario.
- The principles of caring for your things and life-extension which are the strongest in the SusHouse Eternally Yours scenario, is also recognizable in the Wash In concept: your clothes are professionally taken care of and get exactly the treatments they need. They are worth it to have them repaired or re-colored.
- The principle of enhancing the use-intensity by successive use, which is central in the SusHouse Chains of Users scenario, is present in the secondhand service of the Wash In. This 'second chance collection' of the Wash In is however also connected to the SusHouse Outsourcing concepts: it may grow into a professionally managed collection in which the clothes change from user to user.

By 'selling' these principles through being on the market, the Wash In may facilitate the upcoming of Wash In concepts or other services, extended or adapted with other, longer term (SusHouse-like) ideas." (cited from Knot and Vergragt 2002)

The problems of implementation of the Wash-in concept as a business concept illustrate the problems of starting up innovative practices or social experiments. The economic success of the business is unknown in advance, and thus private parties are reluctant to invest in this stage. The project in its present form does not fit in existing financing schemes. First a business plan needs to be written but, within a consortium of parties, no party is the prime mover or the most interested stakeholder. Without a product champion parties wait for each other to act. A complicating factor is that extra money is necessary for necessary monitoring activities, like consumer behavior and environmental gain. The project needs to be set up as an experiment, in a flexible way, in order to enable learning processes underway; this does not fit in existing business practices.

These points illustrate on a small scale the problems encountered in small scale social experiments that may the stepping stones of eventual system innovations. The government's approach, advocated in the previous section, should be such that social experiments like these get an easy chance for implementation without extensive paper work and waiting times, and enable research in action about the success and failure factors, the consumer acceptance, and the environmental gain. Another problem to be tackled is how to organize temporarily coalitions and how to protect knowledge that each of the partners brings into this temporary coalition.

Much experience needs to be obtained in the setting-up, managing, monitoring, and evaluation of these small-scale innovative initiatives, before one can even start to think about transition management on a large scale.

6. Conclusions and Recommendations

In this paper I have essentially looked back upon ten years of experience with back-casting in the Netherlands, and looked forward towards implementation of social experiments in the direction of system innovation for sustainable development. Ten years ago the early adopters of the concept of back-casting in the Netherlands (Jansen 1991; Vergragt 1992) stipulated that the setting of long-terms goals was essential, in order to mobilize creativity and commitments in society. The concept of back-casting, originally seen as looking back from a desired or unavoidable future (a sustainable global society in which 12 billion people will live) has eventually developed into a methodology of incorporating future visions in short-term oriented social experiments and innovative projects. Conceptually, back-casting has also indicated that sub-optimal short-term oriented choices should be avoided if they hamper desirable long-term developments. It calls for keeping many options open as long as possible, and choosing robust options that fit into many future visions (Knot et al. 2001). Back-casting has become as accepted as forecasting, and in the mean time has been transformed into concepts as transitions and system innovations, which always presuppose that they go into a certain direction (towards a sustainable society).

One of the problems is of course that it is not known what a sustainable society will look like. There are many notions about sustainability, but it is fairly sure that in a sustainable society basic needs will be fulfilled, that a certain social equity will be reached (including enough cultural diversity), and that the ecosystem will be safeguarded. In this sense the 'factor 20" should not be taken too literally, but should be seen as a symbol for a sustainable society. Because we do not know exactly what a sustainable society will look like, transitions need to set up *iteratively* and *interactively* in order to allow *flexibility* in the process and to enable adjustments and collective learning processes during the process.

In the last ten years we have learned that technology is not the bottleneck, although it is always advantageous to try to influence technological developments into directions relevant for a sustainable society. In this respect it is important to reinforce the knowledge infrastructure, and to remove the barriers for implementa-

tion the result from the separation between the knowledge infrastructure and innovative companies. The present Dutch ICES-KIS-3 investment impulse contains both Sustainability and System Innovation as themes, and this is a very promising sign.

The bottlenecks for system innovation towards a sustainable society are more in the separation of networks, in short term thinking, in the dominance of short-term thinking in financial circles, and in risk-averseness of social actors. Also the consumer behavior of citizens is an impediment; the same citizens that as voters behave environmentally conscious, behave in the opposite way as consumers. Further the present regulatory, bureaucratic, and policy system does not foster societal transitions towards a sustainable society.

What we have learned is that it is important to develop future visions that are endorsed by stakeholders. It is very well possible to bring together actors not only from the production chain but also from other stakeholder circles and develop entirely new ideas about future function fulfillment (see for instance Partidario et al. 2000 about the paint chain). Future visions may be based on a combination of expert knowledge and free brainstorming. It is essential that they are elaborated to such an extent that they are concrete enough to mobilize, and open enough to accommodate a variety of experiments.

Stakeholder management is also identified as an essential aspect. Stakeholders are primarily concerned about their own interests and they have their own view on future developments. By creating interactive networks of stakeholders around issues that are recognized as relevant, stakeholders broaden their view and learn to accommodate other perspectives in their own thinking.

Transitions cannot be managed from a central point and certainly not by the government alone. The government will be subject to the transition process too, in the sense that new forms of policy making need to be developed and new bureaucratic rules and structures need to be developed in the process. There will be a need for a center of facilitation, legitimized by, but on a certain distance from the government, which will operate on two levels: a strategic and a practical level. On the strategic level the overall goals will be guarded, and consensus will have to be created by most important societal stakeholders about the general direction of the process. On the practical levels stakeholders including intermediates and consumers/users around certain specific issues will organize social experiments. This may lead to innovations (new products, services, subsystems, infrastructures, and behavior) that may eventually become part of an overall system innovation.

The role of the government will be to legitimize the transition process: by seeking political support by the political parties; to guarantee its support by the creation of a high-level institution that fulfils the strategic function and facilitates the social experiments; to fund the bottom-up experiments, and to create the conditions for upscaling of successful experiments, to attune the infrastructure developments in line with the sustainability strategy, and, more generally, to reform itself and to take away existing institutional and economic barriers to sustainable development.