Low-carbon transition through system innovation

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Low-carbon transition through system innovation

Theoretical notions and application

Pioneers into Practice Mentoring Programme 2013

Lydia Sterrenberg, Jose Andringa, Derk Loorbach, Rob Raven, Anna J. Wieczorek
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1. INTRODUCTION

You have been enrolled onto the 2013 Pioneers into Practice programme (PiP), an initiative of six European regions within the Climate Knowledge and Innovation Community (Climate KIC, www.climate-kic.org). Climate-KIC is a European network programme aiming to providing the innovations, entrepreneurship, education and expert guidance needed to shape Europe’s ambitious climate change agenda. The programme focuses on four themes: assessing climate change and managing its drivers, transitioning to resilient, low-carbon cities, developing zero-carbon production systems and advancing adaptive water management.

The Pioneers into Practice programme was developed as a bottom-up *regional* programme within the Climate-KIC programme. The six regions involved are (see also figure 1 below, yellow dots in the centre of the regions): the Valencia region in Spain; the Hessen region in Germany; Emilia Romagna in Italy, Central Hungary, Lower Silesia in Poland and West Midlands in England.

![Figure 1: The regions involved in the Pioneers into Practice programme](image)

The Pioneers into Practice programme is special because of this regional character but also because it is based on ideas of system innovation. Key strategic principles are:

- **Place** - significant low-carbon innovations will be transitions in socio-technical systems such as mobility and household living. The social actors best placed to promote this transition are municipal and regional organisations responsible for systems that are situated in local places.
- **Practice** - the urgency of the transformation requires a change in the day-to-day practices within the current responsibilities of business, government and research.
- **People** - the transitions need innovative professionals (pioneers) with commitment and new competencies. The narrow specialisation of traditional roles is unsuited to the demands of systemic innovation and transitions ask for new ways of management. Sector specific managers need to become boundary-spanning, low-carbon entrepreneurs.
The programme combines these principles in a novel approach to knowledge exchange and dissemination:

- the creation of networks of different types of organisations (knowledge, business, public, societal); including offering the provision of placement opportunities in leading projects in a diversity of organisational and national settings;
- the sharing of new perspectives and the development of new competencies by a structured programme of learning: the mentoring programme.

By common projects the programme also aims at developing into regionally based transition platforms on low-carbon mobility and low-carbon living.

The mentoring programme

The mentoring part of the Pioneers programme is specifically directed towards the sharing of new innovation knowledge, and the development of new competences. It is based on different strands of research that were initially brought together in the Netherlands under the umbrella term of ‘system innovations’, or ‘transitions’ (see box 1). From the research and testing grounds it appeared that sustainability innovation involves major shifts in the way systems of provision, such as housing, electricity supply, and food provision etc., are organised. Such innovation is socio-technical innovation and is dependent on many actors, with their drivers and contexts. Innovation for a low-carbon society is a long-term undertaking and the management of this is not ‘business as usual’. New competences and networks are asked for.

**Box 1: Transition thinking**

Transition thinking had begun to develop in academic circles in the Netherlands by the beginning of the 1990’s, and was lightly institutionalised in 2001 by the Dutch Knowledge network and research programme for System Innovations and Transitions (KSI). KSI aimed at improving understanding, identifying and influencing the process of sustainability innovation. To this end, knowledge from relevant scientific disciplines and insights, such as ecology, complexity theory, sociology, history, governance and innovation studies, were integrated. The programme also encompassed the performance of practice-oriented research and the participation in testing grounds, in such diverse sectors as energy, manufacturing, transport, housing and spatial planning, health care and water management. See [www.ksinetwork.nl](http://www.ksinetwork.nl) for more information on the scientific programme.

From the Dutch KSI network research activities and transition practices have spread. KSI has developed into the international Research network Sustainability Transitions Research Network (STRN) [http://www.transitionsnetwork.org](http://www.transitionsnetwork.org). In addition, many local transition experiments have started in such sectors as the energy sector, health care, building, transport and agriculture. Examples are, the MUSIC programme ([Mitigation actions to reduce CO2 emissions in Urban Areas and the creation of Solutions for Innovative Cities](http://www.themusicproject.eu/)) that runs in five European cities; Urgenda, a Dutch private initiative, aiming at speeding up the transition towards a sustainable Dutch society, by connecting actors and initiatives and taking away barriers to sustainability innovation (www.urgenda.nl); Sustrans in Denmark, sustainability experiments in Asia, the transition programmes - Housing and Building, and Materials in Belgium, and transition activities in other countries, for instance Sweden, Switzerland, Australia, India, Canada and the USA.

The mentoring programme is composed of a two-day Introductory Workshop, two two-day Low-carbon Crucibles and a one-day Workshop (see Annex B) and entails learning and learning-by-
doing. On the one hand, in the programme new innovation perspectives as well as analytical tools will be taught that have been derived from the new transition knowledge. The focus is on what is different in low-carbon or sustainability innovation compared with traditional innovation. On the other hand, and in addition to this, the programme will be devoted to individual or group assignments. The assignments will relate to your own project(s) for a low-carbon society, to projects or activities of your host organization, or to regional sustainability challenges.

After successful completion of the programme you should be able to:
(i) analyse systems that provide basic human needs, such as electricity or mobility system;
(ii) situate their own projects in the context of transition to low-carbon society;
(iii) identify ways in which their every-day work can contribute to making a ‘low-carbon transition’ happen;
(iv) develop project ideas for societal change; and
(v) be able to deal with varying actors’ perspectives and interests.

**About the ‘Theoretical notions and application’ document**

In this document you will find basic transition thinking material that you can use to prepare for the mentoring programme meetings, and as a reference. Next to this document you will receive a document with examples of transition work in practice.

Section 2 of this document explains why transition thinking is important for dealing with the challenges of climate change and what the essence of the transition approach is. Section 3 summarizes various theoretical notions and tools and explains how they might be applied to understanding low-carbon initiatives. Section 4 describes practical ‘umbrella’ approaches. During the Introductory workshops and Crucibles the notions of section 3 and practical approaches of section 4 will be explained further and illustrated, and several applications will be practiced.

Finally there are 5 annexes:
- Annex A shows the front page of the website [www.transitionsinpractice.nl](http://www.transitionsinpractice.nl) that was made for practitioners. In this website you find practical ‘how to’ information, examples, literature and tools that you can use in daily work.
- Annex B gives the outline of the mentoring programme 2013
- Annex C lists the Dutch mentors
- Annex C is a Transition or system innovation Vocabulary
- Annex D, ‘Selected Reading’ refers to relevant websites and top 4 literature

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2 WHY SYSTEM INNOVATION OR TRANSITION THINKING IS IMPORTANT FOR DEALING WITH THE CHALLENGES OF CLIMATE CHANGE

Sustainable development and climate change

Climate change is one of the more recent sustainability problems (see box 2 for a definition of the term sustainable). Like many other such problems, climate change originates from the 20th century when in western societies, supported by knowledge and technology economies have grown, the population risen, welfare increased. The successes however went together with negative side effects. They relate to the climate, soil, rivers and oceans, flora and fauna and their mutual relationships. Key resources such as the available land, (fossil) fuel, water and biodiversity and certain minerals are becoming scarcer. Increasing uncertainties in, for example, food production, water and energy production are expected as a result. Wars because of scarce resources have been predicted. In addition, many non-western countries did not share in the successes. Poverty, hunger and major health problems can still be found nowadays in many parts of the world.

Box 2: The term ‘sustainable’

The term ‘sustainable’ was coined in 1987 by the World Commission on Environment and Development (WCED), chaired by Gro Harlem Brundlandt, former Norway’s prime minister, in the report Our common future. The commission was asked to re-examine the critical issues of environment and development and to formulate innovative, concrete, and realistic action proposals to deal with them. According to the Commission sustainable development was needed: “a development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. By introducing this term the Committee underlined the importance of economic and social development, in particular for people with a low standard of living, and the need of protecting the natural resource base and the environment.

In terms of the ‘ecological footprint’ - a measure of how much land and water area a human population requires to produce the resources it consumes and to absorb its carbon dioxide emissions, using prevailing technology - we are far beyond the earth’s capacity. Trends here have not been reassuring: the ecological footprint to bio capacity ratio in 1961 was still 0.6, in 2008 it had grown to 1.5 (see figure 2). And in spite of the economic crisis, there is no reason to be relieved.
Climate change

Climate change is one of the most prominent environmental sustainability problems, and the one that the Climate-KIC and Pioneers into Practice programme are focusing on.

![Climate Change-Related Risks](Image)

**Figure 3: Climate change-related risks**

Figure 3 gives an overview of climate change-related risks. The impacts entail such diverse consequences as increasing costs for natural resources, increased and severe water scarcity in many places; loss of bio-diverse ecosystems such as coral reefs, significant reductions in agricultural productivity, the extinction of world species; the flooding of coastal systems and low-lying areas and impacts on health (diseases, malnutrition, and weather disasters). Poor communities with little adaptive capacity are especially vulnerable to these changes.

Figure 4 below shows the scenarios of the Intergovernmental Panel on Climate Change (IPCC) for global surface warming. Different levels of economic growth are related to emissions of greenhouse gases, such as carbon dioxide (other greenhouse gas emissions are often expressed in carbon dioxide equivalents). A 2-degrees increase in global surface warming is generally considered a safe limit and corresponds to a limit of 450 parts per million (ppm) CO2-equivalents in the atmosphere.

![Figure 4: Global warming scenarios. Source: IPCC](image)

Cutting the emissions below 450 ppm, is an enormous challenge and requires far-reaching transformations of the global energy system, including energy policies (IEA Outlook, 2011, see also figure 5, next page). According to Manuel Barosso, chairman of the European Commission, we are heading ‘for a historic step’ towards a low-carbon economy. Recent EU documents speak of a fundamental transformation of the economy.

Table 1 (next page) gives an overview of recent long-term EU targets in terms of the reduction of carbon dioxide production for the different sectors: power generation, industry, transport, buildings and construction, as well as agriculture (COM (2011) 571, Roadmap to a Resource Efficient Europe). This are necessary to remain below the 2 degrees global warming. Domestic emissions should be reduced by 80 to 95% by mid-century as compared to 1990. Actually, the targets, which are agreed by European Heads of State and governments, are quite impressive.
Figure 5: World energy-related carbon dioxide emissions. Only the green scenario is cutting emissions sufficiently below 450 ppm. Source: IEA WEO 2011

Table 1: EU targets for greenhouse gas reductions. The percentages have been based on a large number of different decarbonisation scenarios. Source: COM (2011) 571, Roadmap to a Resource Efficient Europe.

<table>
<thead>
<tr>
<th>Greenhouse gas reductions compared to 1990</th>
<th>2005</th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>-7%</td>
<td>-40 to -44%</td>
<td>-79 to -82%</td>
</tr>
<tr>
<td>Sectors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power (CO2)</td>
<td>-7%</td>
<td>-54 to -68%</td>
<td>-93 to -99%</td>
</tr>
<tr>
<td>Industry (CO2)</td>
<td>-20%</td>
<td>-34 to -40%</td>
<td>-83 to -87%</td>
</tr>
<tr>
<td>Transport (incl. CO2 aviation, excl. maritime)</td>
<td>+30%</td>
<td>+20 to -9%</td>
<td>-54 to -67%</td>
</tr>
<tr>
<td>Residential and services (CO2)</td>
<td>-12%</td>
<td>-37 to -53%</td>
<td>-88 to -91%</td>
</tr>
<tr>
<td>Agriculture (Non-CO2)</td>
<td>-20%</td>
<td>-36 to -37%</td>
<td>-42 to -49%</td>
</tr>
<tr>
<td>Other Non-CO2 emissions</td>
<td>-30%</td>
<td>-72 to -73%</td>
<td>-70 to -78%</td>
</tr>
</tbody>
</table>

**Implementation strategies**

Dealing with environmental problems is not new. Apart from regulation strategies, society in the past has made an appeal to technology. The green technology approach, initially, mainly entailed *end-of-pipe* strategies: ‘add-on’ solutions such as filters that took away pollutants. The solutions
left the usual processes and products largely untouched. In a second phase, _eco-design_ has been applied as an additional strategy: adapting or replacing processes to reduce the environmental burden, and product eco-innovation. Due to these strategies relevant environmental gains have been realised. They have, however, not been sufficient, as for example text box 3 illustrates. A major reason is because this ‘greening of technology’ has not been able to compensate for population, production and consumption growth.

<table>
<thead>
<tr>
<th>Box 3: Energy and greenhouse gas emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil fuels are a major source of greenhouse gases: approximately 60% of emissions results from fossil fuel combustion and the largest growth in greenhouse gas emissions comes from the energy supply sector (145%) and transport (120%), despite major decreases in global energy intensity (-33%) between 1970-2004.</td>
</tr>
</tbody>
</table>

What is needed now are more radical _system innovations or transitions_. They are innovations that _are directed to redesigning entire systems of practice and provisions_, instead of individual products or processes, in the domain of housing, transport, food production, or health care. Because of the functional or system boundary, instead of single technologies or product or process innovations as with end-of-pipe or eco-design approaches, the sustainability gains of these type of innovations can be much higher.

System innovations are not _only technical innovations but involve social and (infra)structural aspects_. This is because - as sociological and governance studies demonstrated - many of today’s ‘institutions’, such as financial arrangements, regulations, rules, actor configurations and the physical infrastructure, have been developed in co-production with the needs and practices of the past. The institutions and infrastructure facilitate existing practices and make the past and present unsustainable practices persistent. They allow for incremental innovation better than for more radical innovation. For these reasons and as experiences shows, sustainability innovations often run into institutional barriers. As a matter of course, one has to take into account the institutional and physical heritage, not as an unchangeable condition however, but as structural elements that might need innovation too. An example where this has been done is in box 4 on the Birmingham retrofitting programme.

System innovations have a _boundary spanning character_ – that is they surpass institutional and sector boundaries - and _are dependent on many actors_: not only researchers, scientists and technicians, but also business people, financial peoples, citizens and house-holders, people from public agencies and communities, politicians and users. Because these actors operate in different contexts and _at different levels of society_ and do not necessarily have the same ambition, this brings new governance challenges, such as those of coalition building and of dealing with dynamics and uncertainties at the local, as well as, global level.

Usually, major system innovations take _one or two generations_ to accomplish. This is because changing the institutional and physical heritage takes time. It will depend on new managerial
competencies, long-term horizon and short-term innovations fitting the long-term horizon and cannot without political support. More on this will be presented in section 3.

Box 4: The socio-technical character of Birmingham’s Retrofit Programme

Birmingham’s Retrofit Programme provides an example of a programme that departs from the socio-technical character of low-carbon innovation. This programme that is running in the West Midlands is one of the main test-beds of Climate KIC; there are other similar programmes, e.g. in Bologna and Modena. The programme is inspired by a major target for EU 2020 to tackle energy inefficiency and waste, and aims at generalising best practices and scale-up efficiency programmes.

The West Midlands has some of the oldest housing stock in Britain, most of which were built before 1975 and one quarter even before the First World War. The number of private homes in Birmingham is 300,000. The programme now aims at retrofitting 15,000 homes in 2012, followed by 45,000 homes in 2013-2015; establishing a brand, Birmingham Energy Savers (BES) and spreading across the West Midlands region of over 5 million people.

The programme, according to notions of socio-technical innovation, acknowledges the financial, economic and social dimensions that come with the environmental ambitions of the programme, and it includes work and innovative arrangements with respect to all four aspects.

- **Funding:** Financing via borrowing is foreseen, but with the golden rule of no upfront costs to the householder and the public authority as the guarantor of the process. The procurement process is shaped and organised with all the links in the chain.
- **Economy:** Engagement with companies is being realised. Good supply chains are being ensured with a range of companies. Care is taken that the companies are able to do the work, and have skilled, trained staff. No technological preferences are defined, and thereby creating space for new companies with innovative products.
- **Social:** Much attention is being paid to engagement with the citizens. Because trust is absolutely crucial, key issues are winning support in local communities; getting neighbourhood champions; the use/knowledge of the council to help the programme to target those in fuel poverty; the elderly and those in more disadvantaged communities and the creation of a new type of job: ‘the energy assessor’ who will have a pivotal role.

We end this section by listing, based on the previous insights in system innovation, the characteristics of the necessary low-carbon system innovation:

- to be challenge-led, not technology-driven;
- to be dealt with in terms of systems of practice and provision, not single innovations in products and processes;
- to be dealt with in terms of ‘socio-technical innovation’, including also, for example new rules, routines, new financial arrangements and possibly changes in physical infrastructure;
- needing a blending of a long-term strategy because of the long-term horizon and near-term implementation;
- needing changes at multi societal and multi-actor levels;
- and acknowledging a significant role for entrepreneurial, financial and public actors in addition to universities and established businesses.
3 THEORETICAL BASIS AND PRACTICAL APPLICATION

3a VISIONING/BACKCASTING

Creating a vision is - or at least should be - an important first step of a low-carbon project or programme, since for a low-carbon society we cannot just rely on incremental innovation. Visioning and backcasting are meant to open up new, guiding futures (‘Leitbilder’) and may help to prevent ensnaring into existing practices and may also have a mobilising power. Combined with backcasting, the visioning activity may also help you to identify accepted truths and existing structures that make unsustainable practices persistent and that are to be addressed in order to define consistent transition agendas or pathways. Made in a participatory way, visions may reflect collective ambitions and can contribute to collective learning about what is at stake.

Theoretical notions

In the previous section we framed sustainable development as a system innovation challenge due to the negative side effects of dominant present practices that have brought welfare and economic growth. We referred to transition literature that stresses that the present, unsustainable practices have been facilitated by ‘structural conditions’ or ‘institutions’, i.e. norms/culture, rules, actor configurations, regulation, physical infrastructure etcetera, that have been co-developed with these practices. These existing institutions or structural conditions form a barrier to a sustainable society.

Against this background transition thinking has linked with prospective studies that are interested in exploring the future. In future studies three categories of imaginable futures are discerned:

- **Likely futures**, which are based on trend extrapolation, like the weather or market forecasts;
- **Explorative or possible futures** that are not just extrapolations of the present but meant to deal with uncertainties and impact. Examples of such futures are Shell energy scenarios. They reveal different possible futures that are plausible and challenge people’s assumptions. Specific forms of explorative futures are socio-technical scenarios, which concern potential future developments driven by technology, but that also consider possible changes in the use of the technology, policies, legislation, infrastructure, networking and other institutional changes;
- **And normative, or desirable futures** like visions of low carbon societies.

In transition approaches, likely and explorative futures are often used to investigate or underpin the need for system innovation. Likely futures might be of use especially in a phase of implementing ideas. In transition literature, however, most attention goes to the normative visioning. There are four main reasons:

- Firstly, because of the normative goal of sustainability;
- Secondly, by defining a normative sustainable future one might avoid becoming ensnared too early by existing, (seemingly) dominant self-evidences, such as thought patterns, rules, existing social and financial arrangements and infrastructure etcetera. The radical innovation that is
sustainable development, asks for breaks with the traditional, and not for a continuation with the past;

- Thirdly, such visioning might become inspiring ‘Leitbilder’ (‘guiding images’) for sustainable development and may have mobilising power; sustainability visions for system innovations should, in any case, not be regarded as or used in the sense of blueprints;
- Fourthly, the process of creating the visions with stakeholders, contributes to learning between the actors; learning is important because of the different perspectives of the stakeholders that are necessary for low-carbon innovation.

As transition literature also points out, sustainability visions often contain so called key ideas of system innovation: out-of-the-box solutions, in the sense that the solutions break with dominant strategies, knowledge, domain-boundaries. An example is given in text box 5 below.

**Box 5: Key idea for system innovation: Room for the rivers**

In the Netherlands dykes have been providing safety along the rivers for decades. Building dykes was the predominant security strategy, in addition to improving water drainage through canals. In the meantime, the residents felt safe behind the dykes, and more and more houses were being built there. Two major floods in 1993 and 1995 changed all that. The link was made between the floods and climate change, which is causing the sea level to rise and increasing the volume of water flowing from the hinterland and in turn leading to higher maximum water levels. Then it was realised that increasing the height of the dykes is not necessarily the right answer because there is an inherent ‘perverse link’. After all, the consequences would be worse if the raised dykes burst or the water spilt over them because of the higher water levels. A new strategy was conceived, with the key idea for system innovation, of not increasing the height of the dykes, but lowering the maximum water level: creating more room for the river.

**Backcasting**

In a follow up to ‘envisioning for system innovation’, backcasting is suggested: from the vision, one goes back to the present to pinpoint what should be done to reach the desired future (see figure 6 below). This could be new knowledge, financial arrangements, changes in routines, rules, culture, and infrastructure etcetera.

![Figure 6: Backcasting](image)
In a third step of the visioning/backcasting process one could again do forecasting to check the first envisioned backcasting steps for change.

In text box an example is given of one of the first envisioning and backcasting processes of an early sustainability programme in the Netherlands.

**Box 6: Example of visioning and backcasting: Novel Protein Food**

One of the first Dutch applications of visioning and backcasting for sustainability was by the Programme on Sustainable Technological Development (STD or DTO in Dutch). In a first step, societal functions and subsystems with major sustainability challenges were identified. One was meat production, both because of the energy and greenhouse gas production. Together with stakeholders a vision was developed: to have in the year 2040 40% of the meat replaced by Novel Protein Foods. A backcasting approach then identified what changes, in terms of culture, technology and knowledge, would be necessary to reach this goal and what should be done. Focusing on the technological side, seven options were defined based on different resources/technologies. The ideas have been further elaborated in a transition programme that has resulted in new technological knowledge and research on consumer demands and some prototypes of Novel protein products.

Ten years later, we see many developments, which have been inspired by the initial DTO project: a multidisciplinary research programme Profetas; food companies developing new protein foods, sometimes in alliance with research institutes: initiatives for ‘a day without meat’ and a product office. There has been positive attention from NGOs (vegetarians union, environmental movement) and supermarket AH and media attention and usage by educational bodies, and the launch of ‘Valess’ one of the prototype products.

**Application**

Here two envisioning approaches are presented, one starts simply with visions. Another more sophisticated approach takes as its starting point the persistent problems that underlie the sustainability problem. This is not so strange as a starting point for visioning as it may seem, as ‘visions’ and ‘problems’ can be seen as two sides of a coin.

**The simple visioning method**

*Step 1: begin by choosing a function:* e.g. housing, mobility, food production, water management, and in the case of a group assignment form small groups around this function. In addition, choose a physical environment, such as a region, district, or collection of buildings. Also, you could probably choose a production chain, or you can combine the different points of departure. Note that as your vision creation process proceeds, you may adapt and refine your original definition as required.

*Step 2: start the visioning.* Image that you are in the future and in a low-carbon society - say in 2050 - and that you are showing your child or grandchild what the function looks like, for example, mobility in your region or housing or a food production (chain). Make it as concrete as possible, for example, when and how do you, others or goods go from one place to another other (in the case of mobility)?
Or: how and where do people live, in different stages of their life? What do buildings look like, how are they grouped, where do you find them, in what environment? Think of cross-links with other functions/assets.

**Step 3: Tell each other your dream and bring ideas together in a drawing.**

**Step 4: Discuss underlying problems, cross-links and criteria**

- Which persistent sustainability problems are solved in this vision?
- Are there any cross-links with other functions/assets?
- Which criteria are in the vision for the future system, such as low emissions, safety criteria, and criteria of accessibility, affordability, etcetera?

**Step 5: Start backcasting**, the next step is to specify further the criteria for the system, and to think back from the vision (backcasting) in order to define which are important steps on the road to the future. Are they technical challenges? Does the public want to use the envisioned system? Can you imagine financial bottlenecks?

**Step 6: Identify interesting experiments**, which experiments or pilots could contribute to the vision. Which could one learn from? Why?

**The more sophisticated approach** takes much more time and it usually done at the start of a sustainability project or programme. The first step is delineating your system. You could choose, for example:

- A physical environment, such as a region, district, or collection of buildings
- An organisational environment, such as a production chain, welfare organisation, housing association or a combination of these organisations
- A function: the provision of care, housing, mobility or a combination of these (care and housing, for example).

Or you can combine different points of departure. Note that as your vision creation process proceeds, you may adapt and refine your original definition as required.

Then usually the persistent sustainability problems are identified, as well as the underlying perverse links and the bottlenecks in the existing culture, regulations, and infrastructure etcetera. These are then coupled to the key idea for a system innovation and to an overarching vision.

At [www.transitionsinpractice.nl](http://www.transitionsinpractice.nl) you find short descriptions of methods to systematically identify problems, such as the causal analysis, causal loop diagrams, SCENE and narrative analysis, as well as methods for visioning. The descriptions refer to further literature and to people in the Netherlands who have used these methods. Click on 'Methods' at the top of the page and choose 'Creating a vision' in the menu under 'Cluster'. For more information on backcasting: type ‘backcasting’ as the search keyword.
3b ACTOR ANALYSIS

Innovation for a low-carbon society involves many actors, not only science and technology actors. An actor network map of the environment may help you to identify which are relevant actors for your low-carbon innovation. The next step is to investigate what their position is on the innovation that you have in mind. From there you may come across actions for the further exploitation and development of the possibilities for your innovation. Such an action could be to connect with actors to learn about their ambitions and vision and ideas for low-carbon solutions, to explore if they could become partners or co-creators, or to adapt your ideas for solutions or to develop strategies to deal with resistance against your low-carbon innovation.

Theoretical notions

Ideas on innovation have changed over the last decennia. Traditional scientific ideas, which still can be found in current innovation policies, involved those of a linear innovation model. The model entailed that innovation, resulting in a new product or process, was mainly research driven and technology pushed. Represented, in terms of a chain, research preceded development, which preceded production, which was followed by diffusion: Research -> development -> production -> diffusion.

According to the model, researchers, as well as entrepreneurs-developers and producers, are the most relevant actors for innovation. From later research into innovation processes, it has become clear that this model is too simple. Improved and alternative models have been developed since then. What recent alternative models, from different research strands and sources, have in common is that they talk of broader systems of innovation, whereby innovation is facilitated. Such systems encompass other actors, such as banks, shareholders, funding organisations, suppliers, governments, NGOs, users and other local stakeholders, for example, neighbours.

Included in the innovation systems’ view is that the expectations and agency of the actors are important for the outcome of innovation initiatives. This is, for example, an important outcome of historical studies on technological innovation that have become part the Strategic Niche Management perspective, which is presented in section 3c. Such broader network ideas are also to be found in the Technological Innovation System perspective and are part of the Transition management approach that you will also find in this section 3.

For your innovation practice, drawing up a list of relevant actors is relevant, since it makes you aware of actors that may influence your sustainability project. There are various literature sources that present categorisations of the actors under scrutiny. Some present them according to the role they play in the innovation process: users, producers, intermediary and supportive organisations. The Technological Innovation System approach that is presented in section 3d distinguishes between: civil society actors, government, non-governmental organisations (NGOs) and companies: start-ups, small and medium-sized enterprises (SMEs), and multinationals, large firms. It also distinguishes between knowledge institutes: universities, technology institutes, research centres, schools, and other parties: legal organisations, financial organisations/banks, intermediaries, knowledge brokers,
consultants. These different actors can all fulfil different roles towards the innovation and be supportive or hinder the innovation.

In figure 7 an actor configuration of Strategic Niche Management (SNM, section 3c) is shown. In the application below we will use this configuration.

**Application**

1. **Define the scope of your sustainability initiative**
   Start with defining the low-carbon project or programme that you are involved in. Express what it is about:
   - What exactly are you developing? What should be the concrete result?
   - In what broader context should your product/project or programme function?
   - What is the sustainability claim? And how does that relate to the broader context?

2. **Identify actors**
   For a technology-driven project or programme, a simple classification would be: technology, science, users and regulators. Or you could use the actor categorisation of the social map below (figure 7) that comes from historical studies on technological innovation and Strategic Niche Management.

![Figure 7: Example of an actor network from Strategic Niche Management (SNM)](image)

Taking into account the scope of your project and the goal, now identify the main actors and list them by name. For example: Friends of the Earth Germany, the Polytechnic University of Valencia or the municipality of Wroclaw.
3. Explore the nature of the actors’ involvement

The making of a map is only the first step in a transition project. You will also have to explore the nature of the actors’ involvement and their views. This can be a superficial or in depth analysis. A superficial assessment of commitment would be:

1) to assess the interest: does the actor have a large (++) or small interest (+)? Or is her position one of indifference (0) to your project or programme?
2) to assess the attitude of the actor: has the actor a negative (-), neutral attitude (0) or positive attitude (+)?
3) to assess the power position of the (most important) actors towards your initiative. Do they have a little (0), intermediate (+) or a lot of power (++) to influence your initiative?

Make an overview of your assessments (see table 2 below).

Table 2. Summarizing table of the actor analysis

<table>
<thead>
<tr>
<th>Actor</th>
<th>Interest: large (++), indifferent (0) or small (+)</th>
<th>Attitude: positive (+), neutral (0) or negative (-)</th>
<th>Power: a lot of (++), intermediate (+) or little (0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
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<td>....</td>
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<td></td>
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<tr>
<td>....</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A superficial analysis would normally take up one to a few hours. For in-depth analysis we recommend literature and Internet survey but also semi-structured face-to-face interviews, preferably on location. This would take you much more time but specifically in-depth actor analysis and interviews would show you what scope there is for your innovation.

For an in-depth analysis, you could explore:
- the actor’s views on solutions;
- the actor’s view on the problem;
- their vision and/or expectations;
- their criteria for solutions;

Ask ‘why’ questions to get a richer picture of the actor’s views and opinions.
On this point, see also the method ‘Action theory’ on the website www.transitionsinpractice.nl. The website also refers to other actor network tools, e.g. the ‘Cognition model’ or ‘ESTEEM’.

4. Define conclusions and actions
Define conclusions and actions. A conclusion could be that you do not know enough yet about specific actors that you have identified. This could, for example, result in efforts to learn more about these actors. Conclusions could also be in terms of identifying potential resistance against your initiative or potential support. This might trigger you towards other actions.
3c MULTI-LEVEL PERSPECTIVE (MLP) AND STRATEGIC NICHE MANAGEMENT (SNM)

Introduction

The Multi-Level Perspective (MLP) and Strategic Niche Management approach (SNM) have their origin in evolutionary theory and constructivist Science and Technology Studies. They can be used as tools:
- to understand and analyse the context of present sustainability innovations (projects)
- to help identify barriers and opportunities for sustainability innovations, independent of the field of innovation of, for example, mobility, energy, housing or food.

Theoretical notions

Historical studies have shown that major breakthroughs of new technologies or products and their use - or system innovations - come about through the interaction between three ‘levels’ (see also figure 8). These levels are an analytic tool:

The so called ‘landscape’ level encompasses long-term trends in social, political and cultural changes or major crisis, e.g. demographic developments, new social, cultural and environmental developments. Think, for example of climate change and the recognition that this is caused by human activities, the financial crisis and increasing oil prices. Landscape developments are sources of pressure for change especially onto the next level.

‘Socio-technical regimes’ are made of established practices and associated rules. They form socio-technical conditions of realising a particular function, such as transportation, housing, or energy production. Examples are the type of knowledge or which experts are thought to be relevant; the infrastructure, technical standards and designing rules, regulations, financial arrangements including accountancy rules, formal regulations, cultural norms, etcetera.
Regime-factors have developed in response to the needs of the past and provide relative stability. As a result, innovation is most often ‘incremental’ and geared towards optimisation, rather than disruption, of existing technologies. Examples are energy systems that are locked-in a fossil fuel track and supported by large investments, existing social networks, policies, infrastructures and user expectations, that all form barriers to change.

The regime can thus be a major barrier for alternative technologies, such as sustainability innovations. Therefore, a critical analysis of present regimes is crucial, as well as ‘out-of-the-box thinking’ to define innovative alternatives. In the text box 7 examples are given of new, innovative arrangements.

Box 7: Dealing with regime barriers, two examples

A. For many consumers the purchase price of a product is more important than the annual running costs. This is an obstacle when it comes to buying many durable goods, such as energy-efficient fridges and long life light bulbs. This has led companies to come up with new arrangements for financing a purchase. For example, if you buy long life light bulbs from your energy company, the company could charge you for them later in the annual electricity bill, which will be lower because of the energy you have saved. In this way, the customer scarcely notices the purchase price.

In the Netherlands a number of Dutch building companies have similar arrangements. For example, they make improvements to schools to increase their energy efficiency and bear the initial investment costs themselves. The schools pay from the savings on the energy costs, which can quickly rise to several thousand Euros a month.

B. The Dutch Energiesprong (Energy jump) programme is a temporary innovation programme funded by the Dutch national government. The programme’s aim is to create large scale demand and supply for houses and other buildings with zero energy costs or better (E-0 houses). The programme approach is based on a system innovation perspective. It will be running till the end of 2014.

Technologies and materials for E-0 houses are available and in the past 1,5 year price/performance improvement of over 30% has been realised. In these circumstances, the programme focuses on innovative integration of technologies and on addressing social barriers. From a regime analysis it appeared that eg. changes in the process and standard procedures in building and renovation are needed, as well as new financial arrangements, new mortgage lending rules and new regulations. Concrete activities include experiments with zero energy houses and new procedures, the development of new business models and a learning programme with different stakeholders. In this way and via advice, consultation, lobbying and agreements Energiesprong works to remove organisational and market barriers.

See for more examples of innovative arrangements: www.transitionsinpractice.nl.

‘Niches’. Niches are small-scale ‘spaces’ for experimenting with radical innovations (also called niche-experiments) that have potentially path-breaking consequences when they become widely diffused and adopted. In these spaces, innovations are shielded from the mainstream selection pressures of dominant regimes. Due to the protected space, they can be developed further, in spite of their poor technical or economic performance. A historical example is the light bulb, which initially was a specialty at the World Exhibition and restricted to factories and some urban shop windows (the niche-environments) and only later on became common in houses and streets. Present examples of such niches are the implementation of changing infrastructures for electric taxis in inner cities; the limited range of electric vehicles is less problematic there because taxis only drive short distances. Another example is the establishment of solar PV cooperatives in rural
communities; in these communities often no alternative is available and the high price of solar PV is therefore less problematic.

Table 2: Niche projects (‘transitions-experiments’) compared to classical innovation projects

<table>
<thead>
<tr>
<th></th>
<th>Classical innovation project</th>
<th>Innovative niche project (transition-experiment)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal</strong></td>
<td>Developing potential solutions to practical problems and/or developing new markets</td>
<td>Contributing to societal challenges, such as sustainable development or a low-carbon economy</td>
</tr>
<tr>
<td><strong>Nature and ambition of the innovation</strong></td>
<td>Smaller innovations and adaptations of existing processes of products. These innovations don’t need major changes in existing practices, organisation, culture, or financial or juridical arrangements (the ‘regime’).</td>
<td>The innovation(goal) is radical and involves major changes in existing practices, organisation, culture or financial or juridical arrangements (the ‘regime’).</td>
</tr>
<tr>
<td><strong>Time horizon</strong></td>
<td>2-5 year</td>
<td>Beyond the specific niche-project; middle and long term.</td>
</tr>
</tbody>
</table>

Historical SNM studies of past system innovations, such as the coming into existence of a car-culture and car-dependent society or a high tech agriculture, have given insight in the circumstances for the successful development of a niche. This happens when:
- there is sufficient pressure to change from the landscape;
- when socio-technical regimes can no longer solve the landscape problems (through incremental improvements) and become unstable;
- and when niche innovations are available and are sufficiently developed to be able to ‘break through’ and form a new regime.
The exact pathway of change in the context of time (how changes at the three levels develop and relate) depends on the context of the technological innovation, on timing and on multi-level interactions. Therefore, one cannot predict in advance the precise path of future system innovations.

SNM has delivered other useful insights and tools:

a) SNM research has concluded that experimenting or developing niche experiments - experiments that potentially could contribute to system innovation - is important for system innovation. See table 2 how they differ from classical innovation experiments. In the context of Climate KIC niche experiments for a low-carbon society are especially relevant. From a SNM perspective, the question is how these niches of niche-experiment could be made as strong as possible and provide for (sufficient) opportunities for system innovation. The ‘transitioning approach’ of section 4 that is based on SNM is an approach to adapt innovation projects and to enhance their potential for system innovation change.
b) SNM research has yielded useful **actor network categorisations**. Below is the categorisation that we already presented in section 3b (figure 7).

![Actor network from SNM](image)

**Figure 7: Actor network from SNM**

Network analysis can be used to learn about expectations (see below) and for establishing and strengthening the social network for the low carbon innovation.

c) SNM-research found that **expectations** of entrepreneurs and other stakeholders are important. Expectations are basic drivers in social interactions. They are promises that reduce uncertainty for the stakeholder about the future, this can mobilize people, and when framed carefully and expressed by the right or enough people, expectations can have a legitimizing function. This is why SNM underlines that innovators should explore the expectations of actors; articulate these expectations; and negotiate them with others. SNM specifically suggests provoking actors to articulate and negotiate their (sustainability) expectations and interests in relation to wider regime problems and landscape pressures.

d) SNM research has stressed the **role of learning** within and between niche experiments. To increase the chances of success, learning processes should be:

- Deepened: learning about the innovation and the direct context of the niche experiment in terms of regime and landscape, and what changes would be needed for the niche to become mainstream practice.
- Broadened: learning between niche-experiments and their context and about how those niches could be linked (for example a niche within the government and a niche within the building industry, or an experiment with novel small scale infrastructure).
• Scaled-up: learning about how niches could influence the regime level and develop into mainstream practice or about how and to which regime they could best be related: this is especially useful when a niche-experiment is an experiment that crosses sectorial borders.

e) The SNM perspective also recognises the importance of two different types of learning:

• So called first-order learning. The leading question here is: are we doing the things we have planned in the right way? In a project setting, this is, for example, about ‘answering the questions we asked at the start of the project’.

• Second-order or reflexive learning. Here the leading question is: are we (still) doing the right things? This is the sort of learning that is critical about dominant knowledge, insights, and arrangements etcetera.

The second-order learning is essential for system innovation, because of its radical character. In a project setting, this is for example about ‘answering if we were actually asking the right questions at the start of the project’.

f) Last but not least SNM-research emphasizes the relevance of temporarily shielding niche experiments to protect them from mainstream selection pressures and prevent premature failure. Simultaneously nurturing them (e.g. improving technical or economic performance) and empowering them to break through and ‘do their job’ for system innovation. Such protection could be in terms of several different aspects, for example:

(i) Financially (e.g. subsidies)
(ii) Geographically (e.g. specific location)
(iii) Institutionally (e.g. regulatory exemptions)
(iv) Socio-cognitive (e.g. attractive visions)
(v) Politically (e.g. ministerial commitments)
(vi) Culturally (e.g. dedicated environmentalists)


Application

Below is a description of a simple MLP/SNM analysis that can be applied to innovative sustainability-projects. The analysis may help you to identify chances and hindrances that the project could meet. It can be the basis for adapting your project in order to increase its potential to contribute to system innovation for sustainability.

In the description it is presupposed that you perform the analysis with others who are involved in the project. The assignment below is to help you to get a first grip on the socio-technical environment you are working in, and to assist you in learning how the concepts might help in structuring and
analysing it. For a complete MLP or SNM analysis you might want to involve MLP or SNM experts. You may find these, for example within the scientific network http://www.transitionsnetwork.org/.

START

1. **Define the niche project or experiment that you want to analyze from a MLP/SNM perspective**
   Describe briefly: what is the niche-project about? See for an explanation of the concept of a niche project, or transition experiment as it is sometimes called, table 2 and figure 9.

![Figure 9: Explanation of ‘niches’](image)

VISION

2. **Answer the next questions about the vision involved and score. Collect your scores in the table below**
   - Does a leading long- or medium-term vision exist? 
     In case of a score of more than 1, continue with the following questions:
   - How innovative or different is the vision from business as usual? (1: almost business as usual; 10 quite different from business as usual?)
   - Do you consider the vision to be an attractive vision, easy to convey? (1: no; 10 yes)
   - Does the vision pay attention to non-technical aspects of the low-carbon innovation included (for example cultural, financial aspects)? (no = 1; yes = 10).
   - Is the vision spread and shared? (1= no; 10 yes, it is a vision that is shared by many, including major stakeholders. In case you need an example of possible stakeholders, see figure next question).
### Vision/expectation aspects

<table>
<thead>
<tr>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a leading, long or medium-term vision?</td>
</tr>
<tr>
<td>How innovative is the vision?</td>
</tr>
<tr>
<td>Do you consider the vision attractive, easy to convey?</td>
</tr>
<tr>
<td>Are non-technical aspects included?</td>
</tr>
<tr>
<td>Is the vision spread and shared?</td>
</tr>
</tbody>
</table>

Total score/number of questions answered

### ACTORS

3. **Quickly determine: which are the relevant actors for your project and project ambition?**

*Jot down your results in the table below.*

<table>
<thead>
<tr>
<th>Actor group</th>
<th>Present in the niche-project network?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes or no?</td>
</tr>
<tr>
<td>Financial actors</td>
<td></td>
</tr>
<tr>
<td>Suppliers</td>
<td></td>
</tr>
<tr>
<td>Users</td>
<td></td>
</tr>
<tr>
<td>Producers</td>
<td></td>
</tr>
<tr>
<td>NGO’s</td>
<td></td>
</tr>
<tr>
<td>Public authorities</td>
<td></td>
</tr>
<tr>
<td>Relevant actors from the research network</td>
<td></td>
</tr>
<tr>
<td>Others, nl.............</td>
<td></td>
</tr>
</tbody>
</table>

### Assess the quality of the social network around your project

Answer the questions below and score. Put down your scores in the table below.

- Do you think that important actors are missing? Score 1 if many important actors are missing; score 10 if all important actors are in the network.
- Are the actors involved able to provide the necessary resources? Score 1 in case of 100% no; 10 in case of 100% yes.
- Do you expect major resistance from any particular actor or social group and if so, do they have enough power to affect the project? Score 1 in case of resistance of powerful actors; 10 in case of no resistance.
<table>
<thead>
<tr>
<th>Network quality aspects</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are many important actors missing?</td>
<td></td>
</tr>
<tr>
<td>Are actors involved able to provide the necessary resources?</td>
<td></td>
</tr>
<tr>
<td>Is major resistance to be expected?</td>
<td></td>
</tr>
</tbody>
</table>

**Total score/3**

**LANDSCAPE AND REGIME**

5. **What, in your case, are relevant landscape developments?**

Determine major ‘landscape’ developments. Use figure 10 for an explanation of the ‘landscape’ concept. Which landscape developments support your project or can be made supportive and which not? Jot down your results in the table below.

<table>
<thead>
<tr>
<th>Landscape developments</th>
<th>Supportive, neutral or impeding?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Figure 10: the SNM ‘Landscape’**

- Exogenous and autonomous trends and major crises
- Long-term developments: demographic, environmental, macro-economy, political culture, world views
6. What are the most relevant ‘regimes’ for your niche project?

Use figure 11 for an explanation of the ‘regime’ concept. Then determine the most relevant regime(s) for your project. One could for example think of the electricity regime; scientific regime; building/housing regime; etcetera. Do think about whether or how (much) your project (conditions) defer from the dominant regime. Low-carbon projects do often operate in more than one regime. Therefore, think about whether more than one regime is important for the project. Note your results in the tables below.

<table>
<thead>
<tr>
<th>Regime 1:</th>
<th>Different from mainstream: yes or no?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural aspects (e.g. norms on ambitions, expected behavior, scientific knowledge), routines</td>
<td></td>
</tr>
<tr>
<td>Rules and regulations and for example financial arrangements</td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regime 2:</th>
<th>Different from mainstream: yes or no?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural aspects (e.g. norms on ambitions, expected behavior, scientific knowledge), routines</td>
<td></td>
</tr>
<tr>
<td>Rules and regulations and for example financial arrangements</td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
</tr>
</tbody>
</table>

**Socio-technical regimes**

[Diagram: Socio-technical regimes with explanation]

=> barriers for radical change, causing lock-ins (e.g. fossil fuel lock-in); once adapted supporting new practices

- Established /mainstream practices and accompanying culture, actor configurations, financial and juridical arrangements, infrastructure

Figure 11: The socio-technical regime
7. Given your answers to questions and score in the table the opportunities that your project ambitions come through (1, no opportunities; 10, very likely regime breakthrough)?

<table>
<thead>
<tr>
<th>Regime breakthrough</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunities for regime breakthrough?</td>
<td></td>
</tr>
</tbody>
</table>

LEARNING

8. What could you learn about from your project and related innovative projects, given your ambitions and analysis of landscape and regime, that would be relevant to you or others involved. Think about lessons about technical aspects, cultural lessons, policy lessons, about markets, new financial arrangements, juridical conditions etc. Jot down your insights in the table below.

<table>
<thead>
<tr>
<th>Aspects</th>
<th>In case of yes, you could probably specify</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td></td>
</tr>
<tr>
<td>Cultural</td>
<td></td>
</tr>
<tr>
<td>About markets</td>
<td></td>
</tr>
<tr>
<td>About financial arrangements</td>
<td></td>
</tr>
<tr>
<td>Juridical conditions</td>
<td></td>
</tr>
<tr>
<td>..</td>
<td></td>
</tr>
</tbody>
</table>

9. What is the present quality of the learning process in this case (score 1-10)?

Answer the following questions and jot down your scores in the table below:
- Is a learning process organized about the project in its regime- and landscape context (e.g. workshops, lectures, publications)? Score 1 = no; score 10 is yes.
  If yes: ask the following questions
- Are other actors involved? Score 1 = no; score 10 = yes, all relevant actors involved.
- Do you discuss from time to time if you are ‘doing the right things’ (reflective learning)? Score 1 = no; score 10 is regularly.

<table>
<thead>
<tr>
<th>Learning aspects</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is a learning process organized?</td>
<td></td>
</tr>
<tr>
<td>Are other actors involved?</td>
<td></td>
</tr>
<tr>
<td>Are you prepared for discussing from time to time whether you are doing the ‘right things’?</td>
<td></td>
</tr>
<tr>
<td><strong>Total score/number of questions answered</strong></td>
<td></td>
</tr>
</tbody>
</table>

SUMMARY AND ACTIONS

10. For a visual summary of your analysis, put the scores of questions 2, 4, 6 and 8 in the spider diagram on the next page and decide what your two favorite actions are.

Here are some indications or actions that SNM/MLP theory says could be relevant:
1) Framing your project in terms of landscape developments that you yourself cannot change (e.g. by smartly phrasing your innovation/vision of innovation and instruments). In this way you can make your ideas and vision more attractive and a mobilizing feature;

2) Linking up with other actors that are important for the innovation at stake. A way of doing this is, for example to develop a collective, shared vision and/or by building coalitions;

3) Developing ideas to deal with potential barriers and opportunities at the regime level;

4) Creating temporary protected spaces, for instance, by
   - Protecting against harsh prevailing regimes (‘shielding’), for example by choosing the most favourable geographical or institutional location. When your innovation surpasses the traditional sector boundaries you might swap between regimes and try to work with the most favourable regime-elements;
   - By providing resources for development (‘nurturing’): for example by finding relevant subsidies;
   - By stimulating niche communities to think about institutional or regime change and work on that (‘empowering’).

RESULTS OF THE MLP/SNM ANALYSIS

Project title: ..........................................................

SNM diagram

![SNM Diagram]
Action 1: what is your first action based on the SNM analysis?

Action 2: what is your second action based on the SNM analysis?
3d TECHNOLOGICAL INNOVATION SYSTEM (TIS)

With the Technological Innovation System (TIS) approach you can describe, analyse and understand the diffusion of (a) particular innovation. The TIS approach has been successfully applied by many innovation scholars and practitioners to evaluate and monitor the dynamics of such TIS’s as for example: PV, offshore wind, biofuels or aquatic biomass. TIS is concerned with ‘functions’ that are relevant for the diffusion of innovations. It can be used to identify barriers and potential for the diffusion of the new technologies and to arrive at policy recommendations, in order to accelerate the diffusion and implementation of the new technologies. The approach differs in focus and scope as it follows from the Multi-Level Perspective, see table 3.

Table 3: TIS and MLP compared

<table>
<thead>
<tr>
<th></th>
<th>TIS</th>
<th>MLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focused on:</td>
<td>Prospects and dynamics of a particular innovation</td>
<td>Prospects and dynamics of broader transition processes/variety of innovations</td>
</tr>
<tr>
<td>Concerned with:</td>
<td>Successful diffusion of a particular technology or product</td>
<td>Successful transformative societal processes</td>
</tr>
</tbody>
</table>

Theoretical notions

The most important insight that has dominated the field of innovation studies, in recent decades, is the fact that innovation is a collective activity. It takes place within the context of a wider system. This wider system is coined ‘the innovation system’. The success of innovations is to a large extent determined by how the innovation system is built up and how it functions.

Various innovation system models have been described, for example National Innovation Systems, Regional Innovation Systems and Technological Innovation Systems.

Presented here is the approach that is based on an analysis of Technological Innovation Systems (TIS), which is a specific kind of innovation system. It refers to a dynamic network of agents that interact in a specific industrial area under a particular institutional infrastructure. Which are involved in the generation diffusion and utilization of technologies or technology based products. The reason for choosing TIS here is twofold. Firstly because the transition to sustainable development or the low-carbon society depends on system innovations, and technological innovation is most often a part of it. Secondly because the TIS approach has been developed into a validated analytical tool for scholars and practitioners.

The TIS methodology is meant to ‘take a snapshot’ of the current state of the Technological Innovation System. A central and novel element in the TIS approach is the analysis of the systems functional pattern. Functions are processes that are important for (technological) innovation systems that are performing well.
Figure 12: Functions of the Technological Innovation System approach

The 7 TIS functions are (see also figure 12):

- **F1 Entrepreneurial activities**: The role of the entrepreneur is to turn the potential of new knowledge, networks, and markets into concrete actions, in order to generate – and take advantage of – new business opportunities. Entrepreneurs can be either new entrants that have the vision of business opportunities in new markets, or incumbent companies who diversify their business strategy to take advantage of new developments. Indicators to measure this function are, for example, the number of new entrants, experiments or start-ups in a certain domain or the number of diversification activities;

- **F2 Knowledge development** R&D and knowledge development are prerequisites within the innovation system. This function encompasses ‘learning by searching’ and ‘learning by doing’. Indicators for R&D projects are, for example patents and investments;

- **F3 Knowledge diffusion through networks** in a heterogeneous context where R&D meets government, competitors, and market. Here policy decisions (standards, long-term targets) should be consistent with the latest technological insights. At the same time, R&D agendas should be affected by changing norms and values. This way, network activity can be regarded as a precondition to ‘learning by interacting’. When user producer networks are concerned, it can also be regarded as ‘learning by using’. This function can be analysed by mapping the number of workshops and conferences devoted to the specific technologies or product groups and by mapping the network size and intensity over time;

- **F4 Guidance of the search**, this function refers to those activities within the innovation system that can positively affect the visibility and clarity of specific wants among technology users. Indicators are, for example: long-term targets of governments and industries, the presence of visions and the alignment of the expectations of relevant actors, or the state of the debate;

- **F5 Market formation** refers to the creation of a niche market in order to protect a new technology that has difficulties in competing with embedded technologies. New technologies do not fit the institutional settings of the current system and actors are not used to the new
technology. This function can be measured by the following indicators: the number of niche markets, specific tax regimes or new environmental standards that improve the chances for new environmental technologies;

- **F6 Resources mobilization** is about the availability of financial and human capital. This function is difficult to map by means of specific indicators over time. The recommended method here is to detect by means of interviews whether or not inner core actors perceive access to sufficient resources as problematic or not;

- **F7 Creation of legitimacy** New products or technologies might be controversial because they may overthrow vested interests or values of interest groups. The function can be analysed by mapping the rise and growth of interest groups and their lobbying actions.

All system functions are relevant and need to be positively fulfilled in order for a TIS to be built up and for the innovation to be successfully diffused and implemented. By assessing the fulfilment of each function, drivers and barriers can be identified that aid or hamper the building up of a TIS. By identifying the barriers, handholds for policy recommendations are provided.

**Application**

The following section explains how the TIS approach can be deployed in practice (see also figure 13). A set of questions has been included to guide the implementation of each step.

To begin with, you are asked to select a low-carbon innovation and to define its Technological Innovation System. Analysis of the systems’ structure and functions should lead you to identification of problems that hinder the system’s development. Based on the identified problems you may speculate about the policies and instruments that might be deployed in order to overcome the obstacles.

![Figure 13: Steps of the TIS application](image-url)
0. **What low carbon innovation did you select and how mature is the selected technology?**

As a general characterization, first give an indication of the phase of the low carbon system innovation you are working on: is it premature and at the stage of R&D or is the sustainable practice well developed and well functioning (stabilization). Use the graph (figure 14) to show results.

![Figure 14: Phases of system development](image)

1. **What is the structure of the selected technological innovation system (TIS)?**

Use the categories on table 4 (below) to identify the structural dimensions of your TIS.

**Table 4: Structural elements of TIS**

<table>
<thead>
<tr>
<th>Structural elements</th>
<th>Subcategories:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actors:</td>
<td>- Civil society</td>
</tr>
<tr>
<td></td>
<td>- Companies: start-ups, SME’s, large firms, MNC’s</td>
</tr>
<tr>
<td></td>
<td>- Knowledge institutes: universities, technology institutes, research centres, schools</td>
</tr>
<tr>
<td></td>
<td>- Government</td>
</tr>
<tr>
<td></td>
<td>- NGOs</td>
</tr>
<tr>
<td></td>
<td>- Third parties: legal organisations, financial organisations/banks, intermediaries, knowledge brokers, consultants</td>
</tr>
<tr>
<td>Institutions:</td>
<td>- Hard: rules, laws, regulations, instructions</td>
</tr>
<tr>
<td></td>
<td>- Soft: customs, common habits, routines, established practices, traditions, patterns of behaviour, norms, expectations</td>
</tr>
<tr>
<td>Interactions:</td>
<td>- At the level of networks</td>
</tr>
<tr>
<td></td>
<td>- At the level of individual contacts</td>
</tr>
<tr>
<td>Infrastructure:</td>
<td>- Physical: artifacts, instruments, machines, roads, buildings, networks, bridges, harbours</td>
</tr>
<tr>
<td></td>
<td>- Knowledge: knowledge, expertise, know-how, strategic information</td>
</tr>
<tr>
<td></td>
<td>- Financial: subsidies, fin. programs, grants etc.</td>
</tr>
</tbody>
</table>

In short, analyse if all relevant actors are present, if they are positive or negative about the system and if they have the capacity to innovate. Are all institutions in place and supportive to the analysed
TIS? What are the interactions; are they bilateral or are they within one actor’s group only? Infrastructure – is it sufficiently developed to support the creation of the system or is it, for example missing specific knowledge?

2. What is the system’s functional pattern?
Use the following scale to evaluate each of the seven functions: absent, very weak, weak, moderate, strong, very strong. See for indicators, the text explaining the functions, or the article by Wieczorek and Hekkert (2012) in the selected reading.
F1 entrepreneurial activities: 
F2 knowledge development: 
F3 knowledge diffusion: 
F4 guidance of the search: 
F5 market formation: 
F6 resources mobilisation: 
F7 creation of legitimacy: 

3. Why some functions are weak or absent?
Analyse briefly each function through the perspective of structural dimensions to explain its weakness or absence. For example: are specific actors missing and this blocks entrepreneurial activities? If yes – please specify which ones. Or perhaps actors are unable to innovate (e.g. are dependent on knowledge development). Are interactions among the actors missing (e.g. there is no connectivity in the system), or interactions exist, but are they too weak or too strong (e.g. favouring existing system)? Are specific institutions absent or are they too weak/ too strong (e.g. laws exist that negatively influence the development of the aquatic biomass system). Perhaps F1 is weak because the physical, financial or knowledge infrastructure is absent or insufficient? Summarize the results in the table 5 below.

Table 5: Scheme for the evaluation of functional patterns and the identification of systemic problems

<table>
<thead>
<tr>
<th>Function</th>
<th>Evaluation of the function</th>
<th>Reasons why the specific function is absent/weak/strong etcetera</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 Entrepreneurial activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2 Knowledge development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F3 Knowledge diffusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4 Guidance of the search</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5 Market formation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F6 Resources mobilisation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F7 Creation of legitimacy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. What are the systemic problems that block the development and functioning of the system?
Based on the coupled functional-structural analysis, identify what types of systemic problems block the analysed system. Use the categories below.

**Actors’ problems** may be of two kinds:
- Presence related: relevant actors (within the categories listed earlier) may be absent;
- Capacity related: actors may lack competence, capacity e.g. to learn or utilise available resources, to identify and articulate their needs and to develop visions and strategies.

**Institutional problems** may be of two types (hard and soft):
- Presence related: when specific institutions are absent;
- Capacity related: when there is a problem with their capacity/quality:
  - Stringent institutional problems may result in the so-called ‘appropriability trap’ and favour incumbents;
  - Weak institutional problems may hinder innovation, e.g. by insufficiently supporting new technologies or developments.

**Interaction problems** may be of two types (referred to by some as lock-in problems or network problems or unbalanced exploration-exploitation problems).
- Presence related: interactions are missing because of cognitive distance between actors: differing objectives, assumptions, capacities, or lack of trust;
- Quality related: there is a problem with interactions’ quality/intensity:
  - Strong network problems – when some actors are wrongly guided by the stronger, and they fail to supply each other with the required knowledge. They may be caused by:
    - Myopia - internal orientation favoring the incumbent set up and relationships and thus blocking the necessity to open up to external forces.
    - Too strong involvement of incumbent actors
    - Lack of or weak ties, (external to incumbents), valuable for breaking through a too strong internal organization
    - Dependence on dominating partners due to assets specificity.
  - Weak network problems (caused by weak connectivity between actors), hindering interactive learning and innovation.

**Infrastructural problems** – referring to physical, knowledge and financial infrastructure. They may be:
- Presence related: when a specific type of infrastructure is absent;
- Quality related: when an infrastructure is inadequate or malfunctioning.

5. What policy needs to do, in order to collectively address the identified obstacles?
Use the chart, ‘goals of systemic instruments’ (below) to define the policies that you would employ to accelerate the systems development (table 6).

Table 6: Goals of systemic instruments per (type of) systemic problem

<table>
<thead>
<tr>
<th>Systemic problem</th>
<th>(Type of) systemic problem</th>
<th>Goals of systemic instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actors problems</td>
<td>Presence?</td>
<td>Stimulate and organise the participation of relevant actors (1)</td>
</tr>
<tr>
<td></td>
<td>Capabilities?</td>
<td>Create space for actors capability development (2)</td>
</tr>
<tr>
<td>Interaction</td>
<td>Presence?</td>
<td>Stimulate occurrence of interactions (3)</td>
</tr>
<tr>
<td>problems</td>
<td>Intensity?</td>
<td>Prevent too strong and too weak ties (4)</td>
</tr>
</tbody>
</table>
Institutional problems
Presence? Secure presence of hard and soft institutions (5)
Capacity? Prevent too weak and too stringent institutions (6)

Infrastructural problems
Presence? Stimulate physical, financial and knowledge infrastructure (7)
Quality? Ensure adequate quality of the infrastructure (8)

6. **What systemic policy instrument can you propose for the analysed system?**

Think of the smartest policy mix that will address the identified systemic problems in an orchestrated manner. You may find the overview of individual tools (below) useful for the design of your instrument (table 7).

Table 7: Potential of individual policy tools to contribute to the systemic instrument goals

<table>
<thead>
<tr>
<th>Goals of systemic instruments</th>
<th>Traditional instruments that have the potential to contribute to particular goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulate and organise the participation of various actors</td>
<td>Clusters; new forms of PPP, interactive stakeholder involvement techniques (snowball method; networking (NoE); public debates; scientific workshops; thematic meetings; transition arenas; venture capital; risk capital)</td>
</tr>
<tr>
<td>Create space for actors capability development</td>
<td>Articulation discourse; back casting; foresights; road mapping; brainstorming; education and training programmes; platforms; technology platforms; scenario development workshops; policy labs, pilot projects</td>
</tr>
<tr>
<td>Stimulate occurrence of interaction among heterogeneous actors</td>
<td>Cooperative research programmes; consensus development conferences; cooperative grants &amp; programmes; bridging instruments (centres of excellence, competence centres); collaboration and mobility schemes; policy evaluation procedures; debates facilitating decision-making; science shops; technology transfer</td>
</tr>
<tr>
<td>Prevent too strong and too weak ties</td>
<td>Timely procurement (strategic, public, R&amp;D-friendly); demonstration centres; SNM; political tools (such as awards and honours for innovation novelties); loans/guarantees/tax incentives for innovative projects or new technological applications; prizes; CAT; technology promotion programmes; debates, discourses, venture capital; risk capital; contracting</td>
</tr>
<tr>
<td>Secure presence of (hard and soft) institutions;</td>
<td>Awareness building measures; information and education campaigns; public debates; lobbying, voluntary labels; voluntary agreements</td>
</tr>
<tr>
<td>Prevent too weak or too stringent institutions</td>
<td>Regulations (public, private); limits; obligations; norms (product, user); agreements; patent laws; standards; taxes; rights; principles; non-compliance mechanisms</td>
</tr>
<tr>
<td>Stimulate physical, financial and knowledge infrastructure</td>
<td>Classical R&amp;D grants, taxes, loans, schemes; funds (institutional, investment, guarantee, R&amp;D), subsidies; public research labs</td>
</tr>
<tr>
<td>Ensure adequate quality of the physical, knowledge, financial infrastructure</td>
<td>Foresights; trend studies; roadmaps; intelligent benchmarking; SWOT analyses; sector and cluster studies; problem/needs/stakeholders/solution analyses; information systems (for programme management or project monitoring); evaluation practices &amp; toolkits; user surveys; information databases; consultancy services; knowledge brokers; tailor-made applications of group decision support systems; knowledge management techniques and tools; TA’s; knowledge transfer mechanisms; policy intelligence tools (policy monitoring &amp; evaluation tools, systems analyses); scoreboards; trend charts.</td>
</tr>
</tbody>
</table>
3e REFLEXIVE MONITORING

Monitoring and evaluation of a transition project or programme is not ‘business as usual’. This is because of its long-term character, the multi-actor involvement and uncertainties due to multi-level dynamics. As a consequence questions arise as to what one could or should monitor and/or evaluate.

Reflexive monitoring is an answer to problems of traditional evaluation. It conceives of monitoring and evaluating as important learning activities, which should be continuous activities. Such Reflexive monitoring activities could include the Multi-Level analysis, SNM and TIS analysis explained in the previous sections.

Theoretical notions

![Evaluation scheme](image)

Figure 15 depicts a scheme for monitoring and evaluating of projects or programmes. The scheme differentiates between inputs into the projects, activities, outputs, direct outcomes, indirect outcomes and final outcomes. Inputs/resources are in the control of the organization in charge of the project or programme; but as the figure shows, direct outcomes, indirect outcomes and final outcomes are not. They depend on external influences.

This dependence on external influences applies especially to low-carbon innovations, which are (part of) long-term system innovations: the system-innovative effect of your experiment or programme is uncertain because of dynamic processes at different levels of society (niche, regime, landscape). It depends, furthermore, on other projects and programmes and is partly determined by changes in the regime and developments in the landscape. This poses challenges for monitoring and evaluating for reasons of accountability.

Another problem is that a low-carbon innovation programme or project in the short-term will, at best, lead to early signals of system innovation. But such early signals are often weak and the link to the final outcomes unsure.

Finally, and when aiming at a low-carbon society, because of the uncertain, complex and dynamic nature of transitions, you might want to revise your point of departure and approach. You may even want to revise your actual objective during the experiment or programme, to direct it more
efficiently to your long-term goal. Traditional monitoring and evaluation approaches do not deal with such changes because of normative long-term goals.

Transition studies have been dealing with these issues and have concluded that given the normative ambition of sustainable system innovation, learning should be an important objective in the monitoring and evaluation of a transition programme. They have called this preferred learning-oriented monitoring and evaluating approach for system innovation reflexive monitoring.

**Reflexive monitoring:**
- is a participative process of gaining an insight into the progress of the project or programme;
- also provides insight into the intended and unintended effects of the project or programme, in relation to, and in interaction with, the environment and including the structural and regime aspects;
- provides the (critical) reflection on that regime and the personal points of departure and deeper convictions and values;
- in addition, it translates the findings back into the design of the project or programme or any follow-up activities in order to preserve the ambitions for system innovation.

Reflexive monitoring involves a series of activities: observation and analysis, reflection and adjustment and/or future development (see also figure 16 below).

*Observe and analyse*: This may include observation and analysis of:
- Group processes: networks and interactions within networks
- Physical and socio-technical systems and their internal relationships. Use here, for example, the Technological Innovation System analysis.
- Effects of the project or programme on networks and interactions and on physical systems
- Landscape developments, the regime and obstacles inherent in it (you could use the Multi-level perspective here and ideas of Strategic Niche Management, SNM).
- Other interesting niche experiments, according to SNM.

For methods of observation and analysis, see also the [www.transitionsinpractice.nl](http://www.transitionsinpractice.nl) database 'Methods'.

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**Figure 16: Activities of reflexive monitoring**
Reflect: What follows is a critical reflection on the observations and analyses. Essential questions include:

- What are the implications of the observations and analyses for the ambitions for system innovation and the aim and strategy of the project or programme?
- Which developments can your project, or which programme can you take advantage of?
- Which developments could strengthen your project or programme?
- Are structural obstacles inevitable, or could hindering institutions or infrastructure be modernised in a creative manner?

This process calls for participants to reflect critically on their own (theoretical) principles, deeper convictions and values (the obvious ‘mental models’), see also text box 8. This is particularly important when one is encountering barriers to the system innovation.

Adapt: The reflection process may make it necessary to revise the objectives, target groups, strategies or activities of the project or programme. It might also lead to the development of follow-up projects or programmes.

Reflexive monitoring is a participative activity. Participation is important for two connected reasons. Firstly, stakeholders have their own particular way of looking at the progress of a project, changes in the environment and possible connections between the two. It is useful to integrate and make use of these different impressions. Secondly, stakeholders engage in a joint learning process in interactive settings. During that process they may revise their perceptions of problems and their deeper preferences and values. It is important to remember, therefore, that participation is more than just providing information for a report. It also involves taking part in system or actor analyses or in reflection sessions.

Box 8: Leading question for reflection

The leading question for reflective sessions is not, as in traditional monitoring and evaluation “Am I doing things right?” but rather “Am I doing the right things?” As stated elsewhere in this reader, institutional or structural obstacles should not be seen as inevitable. At least it should be discussed if hindering institutions or infrastructure could be modernised in a creative manner. Such out-of-the-box thinking is therefore important. See www.transitionsinpractice.nl for inspiration for creative financial, social, and new legal arrangements.

Application

Monitoring and evaluating activities for transition sustainability initiatives are to be tailored to the specific circumstances. The priorities among different target groups and goals determine the precise focus of the monitoring. What you will monitor also depends on the actual project or programme and its environment and on ideas (hypotheses) about the spill-over effects of the transition. It is therefore impossible to describe the questions you should ask or the indicators you should use in general terms. An additional factor is that in practice the monitoring and evaluation of system innovation projects or programmes is not usually confined to the instruments of reflexive
monitoring. It may be necessary, and useful, to make use too of more traditional forms of monitoring and evaluation.

The application below is to experience how to design a monitor and evaluate scheme for your system innovation project or programme. We are following here an M&E approach inspired by Strategic Niche Management. An alternative would be to use an approach that includes the Technological Innovation System or TIS analysis. Such an approach is described (but only in Dutch) in Reflectieve Monitoring van Innovatieprogramma’s en Innovatiesystemen by TNO and AgentschapNL (see website www.transitiepraktijk.nl).

Ideally, the assignment below results in an initial inventory and basis for further selection and/or negotiation with your management, board or funder. Alternatively, the assignment at least will contribute to conscious-raising about what is at stake and possibly needs to be done.

Note:
- You will probably need several hours to go through this assignment
- You can do this assignment alone, but it is recommended to do it with your project group or a selection of those involved in your project

A. Start with choosing a concrete programme or project and defining the system and sustainable future (eg. a low-carbon future) that are involved

- 1a. Begin with choosing a concrete programme or project that is meant to contribute to sustainability or a low-carbon society, for example a sustainable transport programme or project, or a retrofitting project that is aiming at more sustainable housing.

B. Define the system in which your innovation should function

B1. Define the goals of the programme or project

B2. Define the system in which your innovation would function, eg. the city X, the mobility system in city X, the water management system in region Y, housing in neighbourhood Z.

B3. Finally define what this system would look like in the future and advanced by your project or programme (your vision or, alternatively you could use here the TIS method as mentioned in the introduction). Define which conditions should be met, for example regarding the technology, the culture and daily practices, financial and juridical arrangements, infrastructure, and how your programme (activities) are going to contribute to the goals.

This forms the background to determine in the next steps what could be important ‘milestones’ or aspects to monitor if you are on the right way to contribute to system innovation, to learn from it and possibly to adapt your project or programme or to account for it.

C. Choose milestones for your system innovation project of programme

Having done step B, now answer the following questions:
- Via which steps will your programme or project contribute to the low-carbon future goals?
- What then could be short term and longer term ‘milestones’ or parameters to determine progress in terms of the system innovation that is your ambition (output and outcome, see figure 17)?

Use Table 8 below to collect the results in terms of milestones or output and direct and indirect outcome indicators.

Table 8: M&E milestones/parameters

<table>
<thead>
<tr>
<th>Programme or project:</th>
<th>Output parameters and connected goal</th>
<th>Outcome parameter and connected goal</th>
</tr>
</thead>
<tbody>
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</table>

C. In section B we asked you to define the system innovation goals. But for M&E there are possibly additional goals. To check this, define your most important target groups and define the objectives in which these groups are (possibly) interested. Use table 9 to collect the results.

Possible target groups are
- your project manager
- direct participants in the programme or project
- stakeholders around the programme that that you possibly would like to have involved or convince
- the CEO and/or Board of your organisation
- external financiers of the project/programme
- clients
- the wider public
- the media

Possible objectives are
- learning about system innovation
- learning for adapting to have a maximum change for sustainability innovation
• accounting
• generating enthusiasm

Table 9: Target groups and M&E objectives

<table>
<thead>
<tr>
<th>Target group</th>
<th>M&amp;E objectives of this target group</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

D. Now comes the most challenging step of bringing together the information of B and C. For this use table 10.

E. Use table 10 to specify what you could and probably should (because of obligations) monitor and evaluate.

Table 10: Possible indicators

<table>
<thead>
<tr>
<th>Type of indicators</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Process indicators | • (Predicted) changes in the behaviour, perceptions and attitudes of stakeholders  
|                    | • Changes in the composition of the network                              
|                    | • Convergence of vision                                                  
|                    | • Numbers of press releases on the topic                                 
|                    | • Number of meetings held on the topic                                  |
| Early signs of practices representing a system innovation | • Number of – external - participants / actors involved        
|                                                              | • New firms involved in the innovations                                 
|                                                              | • The scale of the use of new technological applications             
|                                                              | • Numbers of innovative experiments                                    
|                                                              | • The existence of new routines                                        
|                                                              | • Reductions in energy use and reductions in energy bills of households |
| Longer-term institutional adaptation | • New sustainability standards  
|                                            | • New business models                                                  
|                                            | • New teaching programmes, eg. transition standards                   |
Adapted rules/legislation
• New financial arrangements

Adaptations of physical infrastructure
• New physical infrastructure (eg. electricity infrastructure)

More traditional indicators of sustainability
• For profit: examples include economic indicators, such as productivity, efficiency or profit
• For planet: examples include CO2 emissions, biodiversity parameters or the use of space
• For people: examples include social indicators, such as well-being, income, employment or child labour, less air pollution (reduced concentrations of particulate matter in the air)

F: Finally now, you have a first inventory of what to Monitor and Evaluate and a basis for further selection and/or negotiation with your management, Board or fIancer.

More often than not the inventory will be much too much and for reasons of restricted money you will have to choose what to do or not. In addition you probably will have to decide what to select also because of tensions between what to monitor and evaluate because of different goals. For example, there is often a conflict between monitoring and evaluation for the purposes of learning and adaptation (reflexive monitoring) and monitoring and evaluation for accountability purposes. Aspects in which this is reflected include:

*Flexibility versus fixed targets and results* Accountability brings pressure to adhere to rigid, predefined results and to maintain control over a project or programme. This can limit the scope for making changes in the project. In that sense there is a contradiction between the learning and adaptation objectives of reflexive monitoring and the objective of accountability.

*Transparency versus 'only the good news'* The learning objective of reflexive monitoring calls for transparency about ‘failures' and unexpected results. For the purposes of accountability one may focus solely on the successes.

*Details versus the big picture* The learning objective also often calls for detailed information about the approach taken and the progress of the project or programme. For accountability purposes, it is usually better to provide general information about how the budget is spent, the planning and the results. With a limited budget, this can also create tension.

The programme owner and the client should therefore consult on the objectives of the monitoring and evaluation and indicators of progress. It is sometimes possible to formulate sets of questions and indicators that can serve both the objective of learning and adaptation and the objective of accountability. If not, a good strategy is to start with monitoring and evaluation that provides a clear impression of the progress and results of the programme, in other words for learning purposes. On the basis of that information you can start additional monitoring and evaluation for accountability purposes.
## 4f OVERVIEW

<table>
<thead>
<tr>
<th>Visioning/backcasting methodology</th>
<th>(Multi-) actor analysis</th>
<th>Multi-level Perspective (ML) and Strategic Niche Management (SNM)</th>
<th>TIS - technological innovation system - analysis</th>
<th>Monitoring and Evaluation (Reflexive monitoring)</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is it</td>
<td>Process tool for sustainability visioning. The tool is available in different variations.</td>
<td>Analytical tool to identify relevant actors for your innovation. Multi-actor analyses are available in different forms and levels or depths of analysis.</td>
<td>A theoretical model of innovation to describe, to analyse and to understand the diffusion of (a) particular technology (technologies) or products. The model has been translated into an analytical methodology by, amongst others, Anna Wieczorek, Marco Hekkert, Simona Negro (University Utrecht).</td>
<td>A theoretical perspective on monitoring and evaluation of sustainability transitions, such as low-carbon innovations. The perspective has consequences for monitoring and evaluation practices of low-carbon initiatives. Ideas of reflexive monitoring have been developed by among others the University of Amsterdam (John Grin), TNO (Rob Weterings) and Drift (Matthijs Taanman).</td>
</tr>
<tr>
<td>Why important?</td>
<td>Because for a low-carbon society we cannot just rely on incremental innovation and ‘business as usual’. Visioning and backcasting open up new, guiding futures (‘Leitbilder’).</td>
<td>Because a low-carbon innovation involves many more actors than technical innovators and government. The actor analysis serves to identify relevant actors and to give insight into what they might mean for the intended innovation.</td>
<td>The effects of your local low-carbon initiatives in terms of a contribution to a low-carbon society depend on its direct ‘regime’ context and more global developments (landscape developments in MLP jargon). MLP makes you aware of that. An important focus of the SNM approach is on the expectations of important stakeholders, on (collective) learning and on shielding and nurturing of your low-carbon project. Having two perspectives help to identify hindrances and potential for the low-carbon innovation in a broader societal perspective.</td>
<td>Traditional monitoring and evaluation neglect the dynamics, uncertainties and long-term perspective that come with the goal of a low-carbon society. Reflexive monitoring is (much more) directed to learning and adapting, to enhance the system innovation potential of your low-carbon initiative. In that sense it is a useful and relevant Monitoring and Evaluation approach for low-carbon initiatives.</td>
</tr>
<tr>
<td><strong>Visioning/backcasting methodology</strong></td>
<td><strong>(Multi-) actor analysis</strong></td>
<td><strong>Multi-level Perspective (ML) and Strategic Niche Management (SNM)</strong></td>
<td><strong>TIS - technological innovation system - analysis</strong></td>
<td><strong>Monitoring and Evaluation (Reflexive monitoring)</strong></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>When should it be used?</strong></td>
<td>When starting an innovation project or programme and possibly during the project programme to see whether the vision is still relevant and inspiring</td>
<td>When you have initial ideas for low-carbon innovation and during your innovation, since your actor environment will be dynamic (some actors may become more important, others less)</td>
<td>At the start and during an innovation project for a low-carbon society</td>
<td>Reflexive monitoring is an ongoing activity.</td>
</tr>
<tr>
<td><strong>For whom?</strong></td>
<td>For project leaders (those involved in innovation projects or transition experiments) and programme leaders of low-carbon initiatives</td>
<td>For project leaders (those involved in innovation projects or transition experiments) and programme leaders of low-carbon initiatives</td>
<td>For project leaders (those involved in innovation projects or transition experiments) and programme leaders of low-carbon initiatives</td>
<td>Especially programme leaders</td>
</tr>
<tr>
<td><strong>Other comments</strong></td>
<td>The SNM perspective is not confined to sustainability innovation; therefore, additional visioning and environmental analysis are recommended.</td>
<td>The TIS approach is not confined to sustainability innovation; therefore, additional visioning and environmental analysis are recommended. It is, furthermore, recommended to connect a TIS analysis with a multi-level analysis.</td>
<td></td>
<td>Both for project leaders and for programme leaders</td>
</tr>
</tbody>
</table>
4. PRACTICAL ‘UMBRELLA’ APPROACHES

4a TRANSITION MANAGEMENT

Transition management (TM) is a normative and practical approach to sustainability innovation that has integrated knowledge from different disciplines and from experiences of practice. The very idea behind Transition management is to create a societal movement through new coalitions, partnerships and networks, around arenas that allow for building up continuous pressure on the political and market arena. This is in order to safeguard the long-term orientation and goals of the transition process.

Use the Transition Management approach when there are regional ambitions for sustainability/low-carbon innovation; and especially at the start of regional initiatives or to give an impetus to existing, but separate, local initiatives. Transition management especially may help you with developing an inspiring and legitimising narrative. It, furthermore, couples long-term visions to a programme of coherent transition projects. Transition management also offers guidelines for actor coalition formation that is needed for progress. Thus, Transition Management is especially helpful to start or strengthen regional low-carbon programmes/initiatives.

Theoretical notions

The core idea of transition management theory, which refers among others to complexity theory and to ecosystem studies, is that sustainability involves fundamental or system changes that are dependent on many actors. A low-carbon society, the realization of which is thought to take at least one or two generations, is perceived of as a new and potential state of equilibrium in our society, like different states of equilibrium that are known in ecosystems. This notion, in transition management, is combined with multi-actor network ideas and with the Multi-Level Perspective.

Transition management distinguishes between stages in the transition: a take-off phase, an acceleration phase and a phase of stabilization (the new equilibrium) – see figure 18 next page.

An important issue in transition management research has been how the present unsustainable society could be ‘turned’ into a more sustainable one. A second issue is how one could measure the progress of the transition. The answer to the first question, (the second will be dealt with in section 4f on monitoring and evaluating), has been found in a special way of governing, which is geared to:

- the actors involved being made aware of the impact of their actions, in the developments on different levels of societies;
- their actions being better aligned, structured and directed towards achieving a specific desired transition.
Based on theoretical explorations and practical experience over the last decade, four different types of governance activities are distinguished when observing actor behaviour in the context of societal transitions:

- **Strategic**: activities at the level of a societal system that take into account a long time perspective; that relate to structuring a complex societal problem and creating alternative futures;
- **Tactical**: activities at the level of sub-systems that relate to build-up and break-down of system structures (institutions, regulation, physical infrastructures, financial infrastructures and so on);
- **Operational**: activities that relate to short-term and everyday decisions and action. At this level actors either recreate system structures or they choose to restructure or change them;
- **Reflexive**: activities that relate to evaluation of the existing situation at the various levels and their correlation or misfit. Through debate, structured evaluation, assessment and research, social issues are continuously structured, reframed and dealt with.

The abstract governance strategies have been translated into the following elements of transition management and actions (see also figure 19, next page).

- **Problem structuring/envisioning in specially formed transition arenas**, followed by identifying the first outlines of transition pathways via backcasting
- **Developing transition coalitions - involving new actors - to come to transition agendas**: ideas on pathways and experiments, that can be worked on
- **Implementing transition experiments and actions**
- **Monitoring and evaluating** transition progress and adapting the vision, agenda and experiments if necessary.
Box 9: Examples of the Transition Management approach

Examples of the transition management approach in practice can be found on [www.transitionsinpractice.nl](http://www.transitionsinpractice.nl), under the title Energy Transition. Or read ‘Loorbach, Derk and Jan Rotmans (2010). The practice of transition management: examples and lessons from four distinct cases. Futures, Vol. 42, pp.237-246 (Selected reading). The article can be made available by the regional PIP managers.

The approach has been made even more practical in the testing ground (see also text box 9 above). Table 11 below shows how the different elements have been translated into key activities.

Table 11: Elements of Transition management and key activities

<table>
<thead>
<tr>
<th>Element</th>
<th>Key activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation and exploration</td>
<td>Formation of a transition team&lt;br&gt;Process design&lt;br&gt;System analysis&lt;br&gt;Actor analysis&lt;br&gt;Set-up of monitoring framework</td>
</tr>
<tr>
<td>Problem structuring and visioning</td>
<td>Transition arena formation&lt;br&gt;Participatory problem structuring and visioning&lt;br&gt;Selection of key priorities</td>
</tr>
<tr>
<td>Backcasting, pathways and agenda building</td>
<td>Participatory backcasting and definition of transition paths</td>
</tr>
<tr>
<td>Experimenting and implementing</td>
<td>Dissemination of vision, pathways and agenda (transition narrative)&lt;br&gt;Coalition formation and broadening of the network&lt;br&gt;Conduct transition experiments and implementation in regular policy and projects</td>
</tr>
<tr>
<td>Monitoring and evaluation</td>
<td>Participatory evaluation of method and content (process)&lt;br&gt;Reflection on vision &amp; strategy&lt;br&gt;Monitoring interviews</td>
</tr>
</tbody>
</table>
Application of the Transition Management approach

Below is an assignment to make you familiar with the Transition Management approach for policy analysis for sustainability. The assignment is to develop a transition narrative through problem structuring/visioning. This is followed by backcasting: reasoning back in time from the desired future situation to the present situation, and identifying what is needed to reach the future sustainable situation. The last part of the assignment is about who should be involved in case you should want to form a transition arena.

Not included here is the transition management aspect of monitoring and evaluation. For that you are referred to section 3e.


A. Defining the system

Step 1: Define the scope or ‘system’
You should define the focus of your sustainability ambitions and identify what is at stake.

For defining the focus or system, you might think of:
- a geographical entity like your region, municipality, district
- a sector or societal function like building, transport or housing
- a production/consumption chain
- or a combination thereof

Note that you may also use the system analysed with MLP and SNM assignments.

Then, continue as follows:
- Try to define the basic characteristics and qualitative properties of the system in terms of socio-cultural, economic, ecological, institutional and/or technological domains (e.g. size, population, education levels, labour market, infrastructure, ecological quality and so on);
- Put the current situation into a historical perspective (how did this emerge?), and identify the dominant regime: patterns of behaviour, cultural aspects including values and certain mental models, and structure aspects such as, relevant (formal) rules and procedures, or the physical infrastructure involved;
- Identify major landscape pressures (demographic, economic, political, societal);
- Identify emerging alternatives (niches).

B. Problem structuring/visioning

Step 2: Define the persistent sustainability problems, including the structural roots
Now that you have gathered basic information concerning your system, you should be able to name the transition challenge and the underlying structural or regime aspects. You will be answering the question, ‘is there a need for transition and can a transition towards sustainability be expected?’ Identify, to this end, the systemic problems (the systemic aspects that make the sustainability problems persistent), and from there, the associated transitional challenge.

**Step 3: Define guiding sustainability principles for your system**

Based on the definition of the persistent problem and unsustainability of the system, formulate the basic sustainability principles that could guide a transitions towards 2040 (e.g. energy self-sufficiency, closed material cycles, social equity and participation, institutional flexibility etc.).

It is not unusual in the process of visioning/problem structuring to go forwards and backwards from one to the other. This is not surprising since in fact the problem and the vision are two sides of the same coin.

**Step 4: Identify transition themes and develop future images**

Based on these principles and the current situation: what are key transition themes and what would the sustainability principles imply in terms of desired future images for these themes? Note: try to think out-of-the-box and avoid being locked-in into present day paradigms and realities, for example current boundaries between, for instance disciplines or policy domains or current regulations or infrastructure. See for an example of out-of-the-box thinking box 10.

**Box 10: Items of a TM analysis. The example of river water management in the Netherlands**

Sustainability problem (theme): Increasing Dutch river water discharges due to climate change. Further raising of the dykes would bring with it higher risks that they would break. The challenge is, therefore, to enhance safety in a more sustainable way.

Guiding sustainability principle/future image: more ‘Room for the river’; to lower river water levels. To implement the vision, however, the underlying structural and cultural problems also need to be addressed.

Structural and cultural (systemic) aspects for example have been:
- the dominant culture of ‘fighting the water’ and keeping it out;
- the engineering culture of water management, directed to building dykes, dams etcetera;
- the separation between ‘land’ and water management: taking into account water aspects when deciding about area development was uncommon;
- the existing knowledge basis;
- lack of interaction between water managers and spatial planners.

**C. Backcasting**

**Step 5: Sketch pathways and experiments**

Take one or two future images and identify which pathway(s) might be leading to these images. Intermediate steps need to be taken i.e. which broader societal changes might help or hamper this pathway. An example is given in text box 11.

If possible try to do so for different time periods (e.g. 2025, 2020, 2015). Include some short-term experiments and actions that you think should be taken to explore this transition. Think about how
your own activities and/or projects should be reframed to contribute as well as possible to the transition.

**Box 11: Transition pathway examples**

Examples of pathways from the Dutch Energy transition programme are, for example: biomass and green electricity-chain efficiency. In the Birmingham Retrofit Programme (example section 2) pathways were about the social, financial, economic and environmental dimensions.

D. Making up an arena

**Step 6: Compose a transition arena**

Identify which frontrunners you could involve in a transition arena.

- To that end, first identify relevant actor/stakeholders for the sustainable solutions that you have in mind, think of: government, the business sector, consultancy and banking, civil-service organisations and the scientific community. Remember that these stakeholders not only bring their knowledge but also might give access to diverse and relevant networks;
- Identify frontrunners. You need in the arena a mix of pioneers with experience in innovation and decision-makers in the established regime;
- Identify roles/competences in terms of vision creation, communication and networking.

Then:

- Make sure that there are enough people in your group with social status and networks, since they will be able to give the innovative vision a more prominent place on the public agenda;
- And check, if you have time left, whether the individual members:
  - have a *commitment* to sustainability
  - are willing to work together and share their ideas
  - understand complex problems at a reasonably high level of abstraction
  - are capable of seeing beyond the boundaries of their own area of expertise and background
  - are not dogmatic when it comes to defining problems and solutions
  - are willing to invest time in exploring problems and formulating a vision and to commit to it.
4b Transitioning approach

Introduction

‘Transitioning’ is an approach of analysing and adapting existing innovation projects (or a set of actions) based on a transition perspective, leading to a higher potential to contribute to a transition or system innovation. The methodology is based on e.g. Strategic Niche Management and has been used several times in special project transitioning sessions. Starting point of the methodology are the ideal process and content of a transition or system innovation project.

Theoretical notions

A low-carbon economy is dependent on radical changes in the present systems of mobility, energy supplies, building and housing, spatial planning etcetera: system innovation. However, many low-carbon innovation projects are not designed and directed from the perspective of system innovation. They are ‘classical’ innovation projects rather than transition projects, having different characteristics (see Table 2 section 3c) shows. Consequently they are not optimized for system innovation.

Application of the transitioning approach

On the next pages are two tables that can be used for the ‘transitioning’ of these projects. Table 13 shows issues related to the management of the project (process issues); in table 14 you find issues related to the content of the project.

Here is a suggestion how to work with the tables:
1. Read (quickly) through the tables.
2. Ask individual people involved in the project to score all items, in terms of a -, 0 or +. Collect the scores in an overview. And alternative is to do the initial assessment collectively. Then, use colours to score the items: green for a positive score, orange for reasonable and red for something that is missing.
3. Nominate what already scored positively: well done!
4. You could then have a discussion on those items that score negatively, or red: which do you think are most important and why? Which items can be adapted/enhanced?
5. Develop interventions for the improvements.
Table 13: Management framework for transition projects: process

<table>
<thead>
<tr>
<th>Project characteristics</th>
<th>Steering/guiding dimensions</th>
<th>Deepening</th>
<th>Broadening</th>
<th>Scaling up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Activities aimed at learning as much as possible from the transition project in the specific context</td>
<td>Activities aimed at repeating the transition project in other contexts and/or connecting them to other functions or domains</td>
<td>Activities aimed at anchoring or embedding the project in dominant ways of thinking, doing, organising and/or infrastructure</td>
</tr>
<tr>
<td>Process</td>
<td></td>
<td>The project’s process design allows for reflection and for adapting the vision and the learning goals</td>
<td>In the project’s process design is enough room for joint reflection with potential partners on the connection of the project to the broader context</td>
<td>The project’s process design includes strategic reflection on hindrances and opportunities in dominant ways of doing, thinking, organisation and infrastructure (the regime)</td>
</tr>
<tr>
<td>Room in process</td>
<td></td>
<td>The project’s budget and planning account for money, time and expertise for a learning processes of consortium partners</td>
<td>The project’s budget and planning account for interaction with relevant other projects and partners in other domains</td>
<td>Resources are allocated for the transfer of results to actors who operate on strategic level (actors who have the power, influence and willingness for longer-term regime change)</td>
</tr>
<tr>
<td>Budget and planning</td>
<td></td>
<td>The project design includes a broad and reflexive social learning process (reflexive on starting points, regime, project goals etcetera)</td>
<td>The learning process includes the identification of other related, relevant projects and how they could reinforce each other</td>
<td>The learning also focuses on the way in which experiences could be anchored into dominant ways of doing, thinking, organisation and infrastructure (the regime)</td>
</tr>
<tr>
<td>Quality of learning process</td>
<td></td>
<td>Accounting mechanisms have been developed to enhancing the quality of the learning processes</td>
<td>Justification /accounting mechanisms have been developed, which stimulate learning from and cooperation with other projects</td>
<td>Justification /accounting mechanisms have been developed to encourage the transfer of the project results to a strategic level (regime players in the society who are able and have the power to incite longer-term structural change)</td>
</tr>
<tr>
<td>Mechanisms of justification and accounting</td>
<td></td>
<td>Accounting mechanisms have been developed to enhancing the quality of the learning processes</td>
<td>Justification /accounting mechanisms have been developed, which stimulate learning from and cooperation with other projects</td>
<td>Justification /accounting mechanisms have been developed to encourage the transfer of the project results to a strategic level (regime players in the society who are able and have the power to incite longer-term structural change)</td>
</tr>
<tr>
<td>Consortium/competencies</td>
<td>When composing the project consortium not only expertise, but also open mindedness of participants were taken into account</td>
<td>The consortium participants are open to experiences of others, and able to look beyond their own field of expertise</td>
<td>The management has safeguarded the transfer of results to the strategic level and does have the competences to anchor results in key players</td>
<td>The management has safeguarded the transfer of results to the strategic level and does have the competences to anchor results in key players</td>
</tr>
<tr>
<td>Management</td>
<td>The management has guaranteed the connection between project results and the social challenge</td>
<td>Supportive incentives/accounting mechanisms have been defined that stimulate interaction with other with other domains and partners</td>
<td>Supportive incentives/management mechanisms have been developed, which simulate feeding back results to key actors at a strategic level</td>
<td>Supportive incentives/management mechanisms have been developed, which simulate feeding back results to key actors at a strategic level</td>
</tr>
<tr>
<td>Steering/guiding dimensions</td>
<td>Deepening</td>
<td>Broadening</td>
<td>Scaling up</td>
<td></td>
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</tr>
<tr>
<td><strong>Project characteristics</strong></td>
<td><strong>Activities aimed at learning as much as possible from the transition project in the specific context</strong></td>
<td><strong>Activities aimed at repeating the transition project in other contexts and/or connecting them to other functions or domains</strong></td>
<td><strong>Activities aimed at anchoring or embedding the project in dominant ways of thinking, doing, organising and/or infrastructure</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Substance</strong></td>
<td><strong>The project goals are linked to societal challenges (transition goals) that are made explicit</strong></td>
<td><strong>The system innovation project is tuned to relevant related innovative projects and these are linked to each other by a (common) societal challenge that is made explicit</strong></td>
<td><strong>The project is adapted to and - whenever possible - takes advantage of societal trends and other new developments</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Social challenge</strong></td>
<td><strong>Project participants have shared their perspective on dominant ways of thinking, doing, organising and infrastructure in the sector (from which the project deviates)</strong></td>
<td><strong>Project participants have identified similar and related innovative projects and potential new partners, application domains and functions</strong></td>
<td><strong>Key persons are identified with the power and willingness to influence dominant ways of thinking, doing, organising and infrastructure and who thus could help establishing new regime(s)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>System analysis</strong></td>
<td><strong>Participants in the project are sharing a long-term sustainability vision</strong></td>
<td><strong>An overarching sustainability vision has been developed to align the project with related (system) innovative projects, in order to work in a common direction</strong></td>
<td><strong>The overarching vision is brought to the attention of the strategic level (management and Board level and other external regime players in society who are important for longer-term structural change)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Vision/ ‘Leitbild’</strong></td>
<td><strong>Explicit learning goals are defined with regard to the desired (interrelated) changes in dominant ways of thinking, doing, organising and infrastructure</strong></td>
<td><strong>It has been explored between concerned participants if and how the system innovation project could be done in another context</strong></td>
<td><strong>Learning about opportunities and barriers in ways of thinking, doing, organising and infrastructure is part of the learning goals</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Learning objectives /intended innovation</strong></td>
<td><strong>A distinction is made between results that are context generic and context specific</strong></td>
<td><strong>Project results, including those of learning results, have been shared with participants of similar projects</strong></td>
<td><strong>Results, including relevant results from the reflection process, have been communicated to the strategic level and are leading to structural support and resources</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Intended results</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The website www.transitionsinpractice.nl has been created by the Dutch Competence Centre for Transitions and the Knowledge Network on System Innovations and Transitions as a tool for anyone involved in efforts to make the transition to sustainable development.

**ANNEXES**

**Annex A**  
www.transitionsinpractice.nl

**Set of methods**

Many examples

**Two entries:** Experiment or local innovation project or Programme: a package of interlinked initiatives

**Five clusters with ‘how to’ questions and answers on visioning, action plans, societal anchoring, monitoring and evaluation and competences.**

Transitions: Pioneering and taking a leap.

The website www.transitionsinpractice.nl has been created by the Dutch Competence Centre for Transitions and the Knowledge Network on System Innovations and Transitions as a tool for anyone involved in efforts to make the transition to sustainable development.
Annex B OUTLINE OF THE 2013 MENTORING PROGRAMME

Goal

The goal of the mentoring programme is to enhance the interdisciplinary know-how and managerial capabilities of practitioners involved in low-carbon innovation. The programme is especially aimed at:

- To make pioneers understand the main systemic challenges in the transition to a low-carbon economy;
- To support pioneers in the contextualization of their current projects/every day work and in the identification of (regional) system innovation barriers and opportunities;
- To support pioneers in the development of potential solutions, by suggesting transition strategies
- To make pioneers familiar with strategies that help work in an interdisciplinary setting and using different analytical perspectives.

Outcome

After successful completion of the programme: pioneers should be able to:

(i) analyse systems that provide basic human needs, such as electricity or mobility system;
(ii) situate their own projects in the context of transition to low-carbon society;
(iii) identify ways in which their every-day work can contribute to making a ‘low-carbon transition happen’,
(iv) develop project ideas for societal change; and
(v) be able to deal with varying actors’ perspectives and interests.

File

Each pioneer will have to place information on his or her assignments in a PIP mentoring file. In the end, the file will contain (chronological order):

- first description of own project(s)/every day work
- notes on interviews with some stakeholders
- reflections on their projects (as part of the group assignment during regional placements)
- assignments results from MLP, SNM, TIS and TM perspective assignments
- final transitioning ideas that have come from the individual assignments and from the group assignments

Workshop events

Note:

1) check the dates with your regional PIP manager, because of possible local changes
2) this is an initial programme, and during the year adaptation can be made. In advance of every workshop, you will receive the final programme for that workshop.
15-17 April: 2-day Introductory workshop (two days out of the three indicated days, directly followed by a regional placement in the period of 15 April – 31 May)

- Aim of the first day is to get-to-know each other introduce the overall aims and components of the PiP programme as well as provide an overview of the regional strategies and flagship initiatives relevant in the context of the course. The programme of the first day will be the primary responsibility of the PiP manager and regional coaches.
- The second day will be the responsibility of the Dutch mentor in cooperation with the PiP manager and regional coach and will be focused on discussing the transition thinking/transitioning and in particular on the multitude of actors involved in system change.
- Concrete items:
  - An introduction by the mentor to transition thinking and to the notion of ‘transitioning’ of on-going projects;
  - An introduction by the mentor to actor analysis
  - An introduction to actor interviewing techniques
  - An assignment ‘actor interviews’ during the day
  - An assignment ‘actor interviews’ for the placement period (including an interview with the host).

In principle pioneers should present their projects (every day work) during the two days. It has to be sorted out how this could be done, given restrictions of time. ¹

3-5 June: 1st regional Crucible (two days out of three, following the domestic workshop)
Main subject will be the exchange of placement experiences between pioneers and the discussion of two transition perspectives: MLP and SNM. Concrete programme items:
- Sharing placement and interviewing experiences;
- Introduction to the Multi-Level Perspective and Strategic Niche Management and assignment(s) on MLP/SNM;
- Examples of barriers and solutions (and new business models) are to be included in the presentations and could be discussed. Dutch examples available but input from the regional platforms is very welcome.
- Assignment to apply the SNM/MLP analysis to one’s project/every day work and or (depending on time) to projects that are proposed the regional platforms.

21 October: one-day international PiP workshop in Wroclaw for all pioneers, following the international placements and followed by the Climate-KIC Innovation Festival
The programme will be centered around TIS and international exchange/matchmaking². Concrete programme items:

---

¹ Especially in regions with many (30 or more) pioneers and to avoid long sessions we have to think of creative solutions
² The matchmaking approach has been used in the Netherlands for pairing of frontrunners or innovators from two parties who need each other but would not normally meet or cooperate. The approach/method is about bringing together frontrunners/innovators from parties who need each other’s help for a system innovation by organising an event with a lot of scope for formal and informal meetings. The organizers explore the supply and demand in advance and make lists for the participants. The number of participants at a matchmaking event is
• Morning: introduction to TIS and an assignment: the TIS assignment could be focussed on various European renewable technologies and directed to analyze their system weaknesses. The goal would be to think of European strategies that could help these technologies develop and the regional contributions to this goal and/or implications. To make things connected, this TIS assignment could be used as input to the 2nd crucible (as it is planned for November) in a construction of the regional transition agendas.

• Afternoon: 2 ‘matchmaking’ rounds, starting with a matchmaking ‘table’:
  o First: thematic tables
  o Second: regional tables with regional introductions – this year eg. those of West Midlands and Hessen were very much appreciated. The set-up of these presentations could be used for inspiration.

End of November: 2nd regional 2-day Crucible 2 (exact date to be set per region;; in principle Crucible 2 will be after the international placement).

The programme will be around sharing placement experiences/ideas and Transition Management including visioning and backcasting. Participation of regional platform members in visioning is encouraged. The outcome of the two days would be suggestions – based on systemic analyses - from pioneers for regional initiatives or projects or even transition agendas.

around 100 to 125. The hoped-for result is the creation of at least ten coalitions engaged in follow-up initiatives.
Annex C  THE DUCTH MENTORS

Below are the addresses and information about the professional background of the mentors in the 2013 programme.

<table>
<thead>
<tr>
<th>Address and region</th>
<th>Professional background and experience</th>
</tr>
</thead>
</table>
| Anna Wieczorek/ Lower Silesia  
Email: Anna.Wieczorek@ivm.vu.nl  
Phone: +3120 5989504  
Mobile: + 316 10872215  
Institute for Environmental Studies  
VU University Amsterdam  
De Boelelaan 1087  
1081 HV Amsterdam  
The Netherlands  |
| Anna Wieczorek is an executive officer of the Industrial Transformation Science Project of the International Human Dimension Program on Global Environmental Change at the IVM/VU in Amsterdam. Anna is specialised in TIS (technological innovation system) research and Strategic Niche Management. She is an experienced trainer and has been involved in the Pioneers into Practice mentoring programme from the beginning, as a mentor and co-developer. |
| Simona Negro/ Emilia Bologna  
E-mail: S.Negro@geo.uu.nl  
Phone: + 31 30 2537166 (or 625)  
Utrecht University  
Faculty of Geosciences  
PO 80115  
3508 TC Utrecht  
The Netherlands  |
| Simona Negro will share her mentorship in Emilia Bologna with Suzanne van den Bosch (below). Simona is Assistant Professor in the Innovation Studies Group at Utrecht University and has specialized in the field of dynamics of Technological Innovation Systems and environmental management. Simona is an experienced trainer and has been involved in the Pioneers into Mentoring programme since 2010. |
| Suzanne van den Bosch/Emilia Bologna  
E-mail: suzanne@susi.nl  
Phone: +31 (0) 630499887  
SUSi  
Spieghelstraat 7  
2332 BC Leiden  
The Netherlands  |
| Suzanne van den Bosch shares the mentorship with Simona Negro. She will be the mentor at the Introductory workshop and Low-carbon Crucible I. Suzanne is a freelance consultant in sustainable innovation (SUSI). She has worked for an environmental consultancy in Rotterdam in the areas of sustainable product development and social responsibility and at Drift Erasmus University. She has written a PhD-thesis on transition experiments, which builds upon the Strategic Niche Management (SNM) perspective and Transition Management. Suzanne has recent experience in applying Transition Management in the health care domain. |
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Annex D TRANSITION VOCABULARY

**Anchoring**
The process and activities to stimulate a development from separated and local transition experiments to a societal movement, where new and sustainable practices are becoming ‘business as usual’. Another definition is: setting and maintaining in motion a process of reciprocal strengthening of new, sustainable practices and new regime elements. Important elements of an anchoring process are:

- **deepening** of transition experiments: learning as much as possible about regime or structure elements and perceptions that form barriers for system innovation, in the context of the specific transition experiment;
- **broadening** of transition experiments: linking and repeating experiments in different contexts
- **scaling-up** of transition experiments: embedding the experiment in new, dominant regimes or dominant ways of thinking, doing, organizing, infrastructure

**Competence**
Competences are conceived of here as the combination of explicit and professional knowledge, ‘implicit’ or tacit knowledge, skills and attitude.

**Culture**
The sum of shared images and values (paradigms) that together constitute the perspective from which actors think and act. Changes in culture comprise shifts in thinking, mental models and perceptions.

**Innovation**
Innovation is the creation of better or more effective products, processes, services, technologies, or ideas that are accepted by markets, governments, and society. Innovation differs from invention in that innovation refers to the use of a new idea or method, whereas invention refers more directly to the creation of the idea or method itself.

**Institution**
Institutions are the rules of the games in society, i.e. regulations, routines that govern the interactions and behaviours of actors and organisations. The term institutions is sometimes also used for major societal realms of, for example state, civil society, market. A distinction can be made between **formal institutions**, such as laws, regulations, public financing schemes and **informal institutions** such as values, beliefs, and principles of actions.

**Landscape**
Term from the Multi-Level-Perspective (MLP). Most often this is understood as the external and social context that enables and constrains the possibility for regime change; the outcome of behaviour/decisions of many people and major changes in society of natural conditions. Examples of landscape developments are: demographic developments, increasing encroachment and interference of state, onset of climate change or fluctuating oil prices. Also major crises are considered to be elements of the landscape.

**Learning**
An (inter)active process of obtaining and developing new knowledge, competences or norms and values. Literature on transitions to sustainability emphasizes the importance of **social learning** - a process in which multiple actors interact and develop different perspectives on reality. In transition processes an important aspect of social learning is second-order learning: reconsidering or changing
the ‘frame of reference’ and perspective of actors involved. First-order learning involves learning about the problem, analysis or solution of a problem, but with preservation of the initial theoretical insights or deeper beliefs or values.

**Multi-level perspective**
The Multi-Level Perspective (MLP) or Multi-Level-Model is a prominent framework that has been developed to understand and analyse transitions. The MLP distinguishes between the meso-level of ‘socio-technical regimes’, the micro-level of ‘niches’ and the macro-level of ‘landscape trends and developments’. Within this model, transitions are conceptualized as the result of different dynamics and interactions between these levels.

**Niche**
A new and relatively unstable set of rules and institutions for innovative practices. More abstractly: a ‘space’ or ‘location’ that is protected from the dominant regime and which enables actors to develop and apply an innovation without immediate or direct pressure from existing regimes.

**Persistent problems**
- are complex and involve uncertainties because of many causes and consequences;
- are embedded in the dominant regime/institutions;
- have the involvement of many and various actors who have to work together for a solution but most often have varied goals or agendas.

For these reasons persistent problems are difficult to solve and often recur notwithstanding various efforts to overcome them.

**Regime**
Coherent and dominant rules and institutions that guide actors (e.g. firms, users, policy actors, scientists) in a specific direction, by enabling and constraining their choices. A distinction can be made between:
- Regulative rules or institutions: formal rules, laws, sanctions, incentive structures, reward and cost structures, governance systems, power systems, protocols, standards, procedures
- Normative rules or institutions: values, norms, role expectations, authority systems, duty, codes of conduct
- Cognitive rules or institutions: priorities, problem agendas, beliefs, bodies of knowledge (paradigms), models of reality, categories, classifications, and jargon/language.

**Reflexive monitoring**
- a participatory process of gaining insight into how a transition project or programme progresses and into its effects,
- in relation to, and in interaction with, the context
- followed by reflection on this, and on the initial starting points for the project or programme and on initial, more deep beliefs which probably are questioned
- and the adaptation of the project or programme on the basis of the conclusions of the collective reflection in order to sustain the ambition of system innovation

**Societal challenge**
An issue related to a persistent societal problem, which guides the search and learning process in a transition experiment. An example of societal challenges is how to realize a sustainable, i.e. clean, reliable and affordable energy supply system. Another example is how one can deal with the ageing of the population and rising costs in health care, and still provide for good health care.
System
Systems here are defined as the social networks and institutions that are formed around novel technologies.

Structure
The institutions and physical infrastructure.  

Strategic niche management
Strategic Niche Management (SNM) is an analytical framework for understanding and governing - then the model is used in a prescriptive way - system innovation. SNM has a strong focus on technological innovation (niches-projects) and on the role of mobilizing support through the articulation of expectations, on the construction of social networks, and on learning dynamics. An important claim in SNM is that ‘clever experimentation’ in innovation projects is a critical part of niche and transition management.

Transitions or system innovations
Transitions or system innovations are major shifts in the way systems of provision, such as housing, electricity supply, food provision etc., are organised. Historical analysis of past transitions shows that transitions: 1) are long-term processes (up to 50 years); 2) involve both technological and social innovations; 3) involve many different actors; 4) include changes at many different levels in society.

Technological Innovation System
The Technological Innovation System Analysis (TIS analysis) is a framework to analyse, monitor and evaluate emerging technological systems. The Technological Innovation System Analysis used in this course entails seven functions:
- entrepreneurial activities,
- knowledge development,
- knowledge diffusion,
- guidance of the search,
- market formation,
- resource mobilization,
- dealing with resistance/creation of legitimacy

Transition Management
Transition Management (TM) is a participatory governance instrument that starts from the idea of transition arenas where ‘frontrunners’ from business, policy and society develop attractive visions about the future and derive strategies to realise them including developing transition pathways, experimentation in niches and monitoring and evaluation.

Transition experiment
A transition experiment is a (small-scale) innovation project with a societal challenge as a starting point for learning aimed at contributing to a transition (system innovation); a practical experiment with both a high uncertainty and a high potential to contribute to a transition process. Transition experiments are aimed at deviating from the regime or dominant structure and practices.

Vision

3 Note: according to this definition ‘culture’ is part of the institutions. Some transition scholars however – among them from Drift, the Rotterdam University - distinguish between the two.
A guiding image (‘Leitbild’ in German), or a picture of an attainable future that provides orientation to people’s actions.
Annex D. WEBSITES AND SELECTED READING

Websites

www.transitionsinpractice.nl, is the English section of the Dutch website for practitioners www.transitiepraktijk.nl that was developed by KSI and the Dutch Competence Centre of Transitions. Here you will find questions and answers on relevant aspects of transition work, examples of transition work in practice, references to tools that could probably be of use to you during your innovation trajectory, literature suggestions and information on competences.

At www.sustainabilitytransitions.com, a site for scientists and practitioners, you will find videos, and blogs on sustainability transitions. The site is aimed at continuing the discussion on topics addressed in the scientific Routledge Sustainability Transitions book series, a product of the KSI research programme on system innovation.

www.transitionsnetwork.org is the website of the international Sustainability Transitions Research Network (STRN) in which many former KSI researchers participate. STRN works to improve scientific understanding of sustainability transitions through a program of networking, research coordination and synthesis activities organized around eight research themes (see the network’s Research Agenda). The site provides information about researchers from various countries who are working in, or familiar with, transition thinking, projects, upcoming events and output of the network.

Top 4 Practical reading

Roorda, C., et al. (2012). Transition Management In Urban Context - guidance manual, collaborative evaluation version. Drift, Erasmus University Rotterdam, Rotterdam. This report is aimed at inspiring and guiding city officers who work on creating a sustainable future of their city. It introduces Transition Management, a governance approach that aims at influencing the pace and direction of societal change dynamics. It illustrates the approach by experiences from five European cities.


Van den Bosch, S. and J. Rotmans (2008). Deepening, Broadening and Scaling up. A Framework for Steering Transition Experiments. Knowledge Centre for Sustainable System. Innovations and Transitions (KCT), publication no 2. The publication introduces system innovation concepts and is a 'toolkit' essay oriented towards practitioners and focused on concrete projects 'experiments'. The publication can be downloaded from www.transitionsinpractice.nl or http://repub.eur.nl/res/pub/15812/

‘Ten tips for clever change’ is meant to help realising the change processes sustainable development asks for. Point of departure of this booklet is: see the system as a collection of processes, look at relations, see the whole picture starting with the various parts of it, change by connecting, learning by doing, doing by learning and keeping an eye on realising positive feedback loops.

The booklet can be downloaded from: [http://transitionsinpractice.nl](http://transitionsinpractice.nl)

Van Mierlo, B. et al. (2010) Reflexive monitoring in action. A guide for monitoring system innovation projects. Wageningen UR: Wageningen; Athena Institute, VU: Amsterdam. This is a guide about (and for) monitoring projects that aim to contribute to the sustainable development of a sector or region by working on system innovation. In addition to considering the characteristics and the value of this type of monitoring, the book offers practical guidelines.

The manual can be downloaded from [www.transitionsinpractice.nl](http://www.transitionsinpractice.nl) or [http://www.knowledgebrokersforum.org/wiki/item/reflexive-monitoring-in-action](http://www.knowledgebrokersforum.org/wiki/item/reflexive-monitoring-in-action)

**Top 4 Academic reading**


This article is somewhere between practice and academic and focuses on providing practical examples in which transition management has been applied.

Markard, J., Raven, R., Truffer, B. (2012) "Sustainability transitions: an emerging field of research and its prospects", Research Policy, 41(6), 955-967. This is a more academic article, providing an overview of 'the state of the art' in transition research and its different 'schools'. It among other addresses how the different perspectives relate to each other’ and how they relate to other fields. In case you would like to have one of these academic articles, please ask the regional co-mentor or mail to pip.mentoring@kpnmail.nl.

Anna Wieczorek and Marko Hekkert (2012). Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. Science and Public Policy, Vol.39, pp. 74-87. The paper is about two approaches to studying Technological Innovation Systems (TISs): the structural and the functional analyses. It proposes (i) how to use the potential of both analyses to identify the problems that hinder the system and (ii) how based on this analysis to deploy the most efficient policy tools. It ends with a consistent systemic policy framework. In case you would like to have one of these academic articles, please ask the regional co-mentor or mail to pip.mentoring@kpnmail.nl.