# Meta-Evaluation of climate mitigation evaluations

Climate Change Evaluation Community of Practice
c/o GEF Evaluation Office
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# 0 Summary

In the evaluation of climate change mitigation interventions a lot of questions revolve around the GHG mitigation impact. Did the intervention actually produce GHG emission reductions? Who can claim credit for that? The direct source of most GHG emissions in the energy sector are fossil fuel combustion processes, mostly by replacing the GHG-emitting energy conversion technology through a renewable energy technology, or one that uses less energy. For example in the simple case of replacing incandescent light bulbs with compact fluorescent light bulbs there is a technical switch from one technology to another. It is easy to assign the resulting GHG emissions to the actual physical process of exchanging that light bulb or switching from a diesel generator to a micro-hydro power plant. This is the logic of Certified Emission Reductions in the context of the CDM or in voluntary carbon markets.

However, very few development-oriented activities beyond these two types focus only on that physical switch, and many to also not provide investment capital. And in fact, there is no doubt that a number of preconditions need to be in place for that physical switch to be possible: The technology needs to be available, local users need to be aware of it, and create demand, they need to be accompanied by local entrepreneurs in getting used to the new technology or getting maintenance services. Financing might be necessary. In other cases, policy frameworks might be necessary to level the playing field between new and traditional technologies. Typically, interventions in the form of projects, programs or policies focus on these preconditions rather than the physical switch. However, assessing the relative contribution of each of these aspects requires a clear understanding of the reasons why and in what situation more sustainable technologies become used, and what was excluding the technologies from being used before the intervention.

In this study, a program theory for climate mitigation intervention has been developed that does not rely on output-based positive contributions to poorly designed intermediate project objectives, but on an assessment of the situation in which a market for sustainable energy products or services can develop. It has been developed on the basis of three sources: The online-library of mitigation evaluations of the Climate Change Evaluation Community of Practice, the Evaluation Framework of Tokle and Uitto (2009) and the concept of market transformation for energy efficient consumer goods. A case study with 10 evaluations on energy efficiency in Thailand was used to test whether four groups of stakeholder and a total of 20 barriers are able to reflect the situation in the market. A second case study with a large number of district heating investment projects in Poland was used to test if the model can also be applied to larger and lumpy investment projects. By testing the model on real life cases, a reduction of the model to 17 barriers is proposed.

In order to get an overview of the barrier situation at a glance, an Excel-tool has been programmed that can display the barriers in one circle using a traffic-light color scheme. With this tool, the degree to which a certain barrier hampers market development can be identified at first glance. In addition to the barrier tool, an intervention mapping diagram has been programmed that helps get a quick impression if the project addresses those barriers that are really active in the respective markets. This tool has broad applicability in ex-post evaluation as well as in monitoring for results and even in project design.

Further research is needed in testing the Theory of No Change on other project approaches beyond the area of energy efficiency, e.g. in the area of renewable energy so that a Generalized Program Theory for Climate Change Mitigation can arise. On the basis of the analysis so far, guidelines for the definition of

the can lead to a broader applicability and ultimately a more standardized framework for evaluating mitigation interventions. It is also recommended to explore the expansion into other areas of policy making and change management.  The development of standardized outcome indicators and optimum barrier-strategy pairs on the basis of the Theory of No Change could guide project evaluation, monitoring and development. For this, a calibration of the intensity of barrier removal activities would need to be developed, and in parallel, a calibration of the intensity of barriers. But even without these, the framework offers significant potential for further analysis, evaluation, monitoring and design of climate mitigation interventions.

# 1 Introduction

The Climate Change Evaluators Community of Practice that is hosted by the Evaluation Office of the Global Environment Facility has collected a library of almost 500 evaluations on the project, program, policy and portfolio level. After a number of summaries on a more formal level (e.g. Matambo and Griebenow 2010) the community felt the need to submit this collection to an in-depth meta-evaluation that should start solving the persistent methodological questions surrounding the evaluation of climate mitigation interventions. A number of these challenges have been discussed in the online discussion forum of the website of the community. The study presented here takes a first step at one fundamental challenge of mitigation evaluations which is the quest for a common program logic of climate mitigation interventions that could serve as an evaluation framework and identify a solution to attributing causality as well as results indicators for enabling environments.

## 1.1 What is a meta-evaluation?

In the evaluation literature, meta-evaluations are generally perceived as evaluations of evaluations, mostly in regard to the quality of the evaluation study and the research methods used. To quote Cooksy and Caracelli (2005): “Metaevaluations are systematic reviews of evaluations to determine the quality of their processes and findings. The knowledge about evaluation quality that results from metaevaluation of multiple evaluations can be used to inform researchers’ decisions about which studies to include in evaluation syntheses. Metaevaluations of multiple studies are also used to identify strengths and weaknesses in evaluation practice in order to develop evaluation capacity.” Stufflebeam (2001) defines: “Metaevaluation is the process of delineating, obtaining, and applying descriptive information and judgmental information about an evaluation’s utility, feasibility, propriety, and accuracy and its systematic nature, competence, integrity/honesty, respectfulness, and social responsibility to guide the evaluation and publicly report its strengths and weaknesses.” In meta-evaluation, a strong emphasis is typically put on research and evaluation methodology, in order to identify how well founded the basis of the findings and conclusions is, and what could have been improved in order to enhance evaluability of the project and the clarity of the evaluation itself. In this sense, Stufflebeam (2001) continues: “Metaevaluations are in public, professional, and institutional interests to assure that evaluations provide sound findings and conclusions; that evaluation practices continue to improve; and that institutions administer efficient, effective evaluation systems.”

Meta-evaluations on climate mitigation interventions in the development arena have been done by a number of development agencies, multilateral ones as well as bilateral ones. Among the multilateral ones, most research was done within the GEF system, in particular by the GEF Evaluation Office. Here, meta-evaluation is already part of a number of standard activities. The most obvious among these is the Terminal Evaluation Review process which systematically scans the terminal evaluations of GEF projects for quality and compliance with the GEF evaluation criteria. Increasingly, the most important agencies also evaluate their evaluations and evaluation practices in order to enhance the quality of their evaluations and their evaluative capacity.

In addition, a significant share of the GEF’s Implementing Agencies‘ efforts on meta-analyzing evaluated projects intend to capture successful projects and describe lessons learned. Typically, these portfolio analyses are concerned only with studies of the respective agency, pursuing one or two of the following objectives: for once they intend to showcase the agency's work, e.g. to the GEF Council, donors in general or other audiences. The second objective relates to knowledge management and learning. In particular, a number of sector specific learning documents have been created after significant experience had been gained with GEF interventions, i.e. in the second decade of the GEF. Noteworthy examples for such attempts to enhance the common knowledge base come in particular from the two large agencies UNDP and the World Bank. Example products are the UNDP/GEF publication on rural electrification with solar energy (Krause and Nordström 2004), the sectoral review of biomass projects (Ballard-Tremer 2007) and a series of post-implementation impact analyses for energy efficiency projects (e.g. World Bank 2006).

In developed countries, too, the tradition of analyzing evaluations in the mitigation area is dominated by best practice distillation for interventions, e.g. for energy efficiency standards for appliances. By systematically analyzing a large number of evaluation reports of interventions of a specific type, the collective experience can lead to a common sense on the best way for implementing them. Good examples for this type of meta-analysis and the ensuing knowledge products are provided by the International Energy Agency (IEA) or by the California Public Utility Commission and Californian Utility PG&E[1]. On their website, best practice recommendations for a large number of project approaches and incentive types and tools like checklists for self-rating, have been developed and demonstrate to a potential designer of an intervention, what components of her own project she should strengthen in order to implement a best practice project based on the experiences made in other projects and programs. In addition, a number of efforts have been directed at improving monitoring and evaluation methodologies. The Department of Energy's Office of Energy Efficiency and Renewable Energy for example has published a number of studies that elaborate on impact evaluation methodologies.[2]

In Europe a number of tools for impact measurement have been developed, that were in turn based on evaluating a large number of project, program and policy evaluations. Here, the focus is more on methodological best practices in monitoring and evaluating the project than in prescribing project approaches and best practices. An example is the EMEES project[3] which provides a number of evaluation tools for national energy efficiency policies and programs. On the other hand, the evaluation tradition of national projects is not as well developed as in the US or in other nationals systems.

Building on the experiences of these attempts to learn from experience and to summarize lessons learned, it becomes clear that a number of methodological challenges regarding the nature of climate change mitigation projects and their evaluability persists. These questions do not only relate to evaluation methodology, but require a thorough understanding of the nature of climate mitigation projects, the relevant evaluation experiences and the lessons learned in evaluation studies. In this study, the meta-evaluation will therefore be defined somewhat differently way. We will put more emphasis on the persistent evaluation challenges for interventions that attempt to transform the energy sector towards climate compatibility.

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[1] www.eebestpractices.com

[2] http://www1.eere.energy.gov/ba/pba/program_evaluation/evaluation_documents.html

[3] http://www.evaluate-energy-savings.eu/emeees/en/home/index.php

## 1.2 Persistent climate mitigation evaluation questions

A superficial glance through the library of climate mitigation evaluation can already lead to three observations:

1. There is hardly a mitigation intervention that works on a clean slate, or in a *ceteris paribus* environment. The context in which an intervention takes place is highly relevant for its success. However, contexts are hardly ever acknowledged or analyzed in climate mitigations project interventions. A theory of change that accounts for the context of a project is the necessary basis for assessing its results. This theory of change needs to go beyond the linear project logic of any single component.
2. As almost no intervention takes place in isolation, it is important to have a model for aggregating the impact of different activities that might take place at the same time. These can generate synergies, or can counteract each other. They might take place with completely different stakeholder groups, interventions instruments, and on different time scales, so that typically, in evaluations, they are hard to bring into relation to each other.
3. The ultimate objective of mitigation interventions is to avoid GHG emissions. Few interventions achieve this in a direct way. Most interventions conduct or support activities that cause changes in the behavior of target groups. These target groups might not even be part of the intervention. The measurement of results needs development of outcome indicators that relate to these behavioral changes which needs a conceptual model of the relationship between outputs and outcomes and outcomes and objectives. While this is a well-researched challenge in results-based evaluations, the logical chain between the project interventions and the ultimate objective of climate preservation is particularly long and weakly formulated in mitigation projects.

Together with a more thorough review of the evaluation studies and some of the portfolio and program evaluations, these observations illustrate the persistent issues with climate mitigation evaluations:

- There is a persistent tension – perceived or real – between GHG-related and developmental objectives. Sometimes it is also described as a tension between global and local benefits. For evaluation purposes, this translates into the question of choosing and weighting criteria. All mitigation projects in the development realm have to take a stance on this question. However, it is obvious that without economic benefits, greenhouse gas emissions would not grow. Mitigation would be easy if the intervention would come along with a reduction of greenhouse gases. Government (or ODA) interventions are only necessary and justified if they lead to economic growth with reduced growth in greenhouse gas emissions. Therefore, ODA projects in climate mitigation always need to have both – economic development and emission criteria.
- Most of the time the scale of the intervention is not commensurate with the scale that would be required for an actual impact on greenhouse gas emissions. Many mitigation projects in the development field are focusing on applying new technologies. These projects are always faced with financial scarcity as well as a lack of local technical readiness. The tendency is strong, therefore, to reduce the intervention to a small pilot or demonstration project when envisioning a large scale roll-out leading to incremental betterment of living conditions for many people would be in many ways preferable, including for environmental reasons. For evaluators, this situation is always unsatisfying and poses a number of questions relating overall goal setting, cost effectiveness indicators and the

search for good practice models that describe under which conditions large impacts can be achieved with limited interventions.

- Related to this is the question of sustainability of the intervention and exit strategies of executing agencies after the intervention. In the best of worlds, mitigation projects using cost-effective mitigation approaches lead to a mainstreaming of these approaches so that no further intervention is necessary after the project. In reality, however, development and change overall are slow, and most of the time sustained interventions are required. While this question is not exclusive to climate mitigation interventions, it is particularly pronounced here due to the lack of role models for really sustainable development. Evaluators could provide an important service by identifying functioning approaches and finding a way to link short-term project results to long-term strategies.
- Another issue that is particularly pronounced in climate mitigation projects is their dependency on local capacities, capabilities and preconditions in a number of dimensions, e.g. technical, financial and policy-related. The lack of capacity and the difficulty in quantitatively describing capacity building impacts both compound the problems of data availability and data quality. Here, a number of solutions are required, including an agreement on what exactly is the right mix of preconditions for an intended intervention, with what indicators and on which levels can they be measured, some form of data standardization, a catalogue of standard data sources, and some agreement on data quality requirements.
- Another persistent question of climate mitigation projects relates to the baseline, i.e. emission and investment activities without a climate change intervention. Here a wide range of counterfactuals can be assumed in theory, and it is an open question whether rules need to be standardized among different types of mitigation projects and programs or not. Nevertheless, the number of options is limited and can be clearly structured. Evaluators would benefit from a clear discussion of the types of baselines that can be used, and some guidelines on their use, which could be provided through this or similar studies.
- Related to this question is the question of attributability and causality. If a project is cofinanced between the local government and ODA and maybe also the private sector, who gets to claim the credit? If different projects use different intervention types that jointly lead to GHG emission reductions, is this reduction always attributable to the investment, or also to the policy framework or the capacity building programs? Again, a set of agreed-upon best practice guidelines would create significant benefits for evaluators and policy makers in terms of accountability and ultimately the justification of future allocation decisions.
- In aggregating several projects, e.g. for program evaluation or national stocktaking, this lack of clear rules for attribution lead to significant issues of double counting. Therefore, methodological questions on the aggregation of impacts from different projects are particularly pronounced in the area of program and policy evaluations.
- Last but not least, a number of interventions, in particular those that work on improving the framework conditions for sustainable energy, will only result in reduced carbon emissions a long time after the project has ended and is evaluated.  Evaluating these projects will need to look at intermediary outcomes only and draw conclusions about the ultimate objectives from these. Necessarily, their evaluations will have preliminary character with respect to the ultimate impact on greenhouse gases, and the finding will remain clouded with some uncertainty. Improving the underlying theory that links the intermediary outcomes with the ultimate objectives reduces this uncertainty significantly.

This study attempts a first step in coming closer towards the goal of solving some of these persistent challenges.

## 1.3 Objective and methodology of this meta-evaluation

This discussion demonstrates that a large number of challenges persist in climate mitigation evaluations until today. One reason is that there is no agreed-upon program theory of change how unsustainable use of energy can be transformed into more sustainable use of energy, e.g. by substituting renewable energy for fossil energy, or more energy-efficient equipment instead of less energy-efficient or more polluting equipment. Having such clear conceptualization of what is required so that change in behavior takes place would address a significant number of the above-mentioned challenges: It would help clarify the role that non-investment related activities play in avoiding greenhouse gas emissions and and how different interventions interact with each other, so that the attribution issue would become more tangible. It can be the basis for the formulation of systematic outcome indicators that reflect the full set of necessary enabling conditions, and help identify the full scope of evaluations that look for reasons for failure and success of projects not only in the projects proper but also in their context. If such a concept is developed, it would not only be able to help evaluate projects, programs, and polices, it would also have some predictive power and be able to support project design and monitoring.

The direct source of most GHG emissions in the energy sector are fossil fuel combustion processes. The process of avoiding these is typically closely linked to the GHG-emitting energy technology used. GHG-reducing interventions attempt to substitute them with a technology or fuel that emits less $CO_2$. For example in the simple case of replacing incandescent light bulbs with compact fluorescent light bulbs there is a technical switch from one technology to another. It is easy to assign the resulting GHG emissions to the actual physical process of exchanging that light bulb or switching from a diesel generator to a micro-hydro power plant. This is the logic of paying for Certified Emission Reductions in the context of the CDM or in voluntary carbon market.

However, few development-oriented activities help to do that switch physically, and if they do, the result rarely is a self-sustaining sustainable energy situation. In most cases, donor-funded climate mitigation interventions if anything supply the financing for making that switch. More typically, and almost always in energy efficiency interventions, non-CDM mitigation interventions help build parts of the supply chain, of the policy framework, of the demand, or other types of local capacity. In these cases, can the climate mitigation intervention actually claim any part of the credit for the GHG reduction? If it cannot prove that it is causal for at least some part of the emissions reduction, the rationale for these funds becomes rather weak and might get called into question.

And in fact, there is no doubt that a number of preconditions need to be in place for the physical switch to be possible: The technology needs to be available, local users need to be aware of it, and create demand, they need to be accompanied by local entrepreneurs in getting used to the new technology or getting maintenance services. If we talk about larger investments – and in some development contexts an energy-efficient cook stove for a few dollars might already constitute a pretty large investment - financing sources might be necessary that allow the users to swing this investment even if it might be cost-effective in the long run. In these cases, the users will be able to pay back the loans. It might also not be cost-effective in terms of pure financial costs, but still have significant development and climate benefits. In these cases grant financing might help to improve the cost effectiveness of the single investments. In some other cases, policy frameworks might be necessary to level the playing field between new and traditional technologies.

This illustrates that a number of different stakeholders need to be included in many mitigation interventions. This paper starts with the assumption that for sustainable market development four main groups of stakeholders play a role: users of the technology, the supply chain (i.e. shops and maintenance technicians), policy makers and, in many cases, local banks. Each of these groups of stakeholders typically encounters a number of barriers that keep them from using or supporting the sustainable energy technology. This paper attempts to catalogue all the barriers for the relevant stakeholder groups, and put them together in a “Theory of No Change”, which helps identify why a desired change is not happening. If all the barriers are analyzed using this theory, it can serve to design activities for removing the barriers to change.

For testing the Theory of No Change, two case studies were undertaken on the basis of evaluations from the climate-eval library. The case study for Thailand selected projects that come from the traditional realm of market transformation approaches, and tried to analyze whether or not the Theory of No Change can completely represent the market barriers and their relationship with the ultimate objectives. The second case study for Poland worked on a classical investment sector – district heating and boiler replacement – and analyzed to what degree the market transformation concept and the barrier-oriented Theory of No Change help understand processes in the transformation of larger bulky investment. These case studies help to extend the versatility of the concept and to formulate recommendations for evaluative practice as well as future research needs in the end of this study.

# 2 Program Logic for climate change mitigation: The Theory of No Change

Cliamte  change mitigation interventions in developing countries always have a dual objective: interventions ultimately want to achieve the reduction of greenhouse gases while supporting economic development. However, this ultimate objective is rather general and far away from the activities and direct results of the interventions. Typical climate mitigation interventions on the project or project component levels are public awareness campaigns, capacity building for technicians, advisory services for policy makers, provision of information resources e.g. on global availability of technologies or local renewable energy resources, demonstration projects and so on. This listing indicates that very few climate change mitigation interventions address the actual greenhouse gas emissions on a measurable scale. Many more are targeted towards providing an enabling environment for the deployment of energy efficient technologies or renewable energy use. This means that the theory of change for these interventions is necessarily somewhat indirect and hard to express in strong causalities or even quantitative indicators.[4]

## 2.1 Requirements for a program logic for climate mitigation

As we have seen, it would be useful to have a formulated program logic for climate mitigation approaches, in particular in those cases where the emphasis of the intervention does not lie on investing in sustainable energy technologies but in changing users' behavior or in providing enabling framework conditions for a more encompassing roll-out of these technologies.

Such a program logic could resolve or contribute to a solution of a number of important challenges for climate mitigation projects and interventions, in particular the attribution challenge: It is important for intervention evaluations to demonstrate that the intervention was actually causing the change. If this cannot be shown in an evaluation, the rationale for the intervention can be contented. In order to demonstrate that an intervention was actually necessary to effect the use of sustainable energy and in turn avoid GHG emissions, it is necessary to have a clear logic for the attribution of the effect to the intervention. Typically, this will require evaluating not only the process and output of the intervention itself, or the outcome in terms of changed behavior but also the other conditions in the market, including the situation of the other stakeholders and their readiness for a given new product.

Requirements for such a program logic this would be that it reflects a „complete" theory of change: it goes beyond single groups of stakeholder, beyond singular capacities and encompasses all factors and aspect that are important for the sectoral move towards the use of a particular sustainable energy technology. While reflecting the complete sectoral context, it should still do so in a lean manner – the new paradigm entails automatically that more indicators need to be observed or evaluated than before, so that higher data collection effort is required. In this situation, parsimony is necessary.

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[4] The notable exception to this are the project-based Kyoto-mechanisms like CDM, where each CDM-supported project needs to prove direct GHG-emission reductions. They, too rely to a significant degree on other interventions for project identification and development.

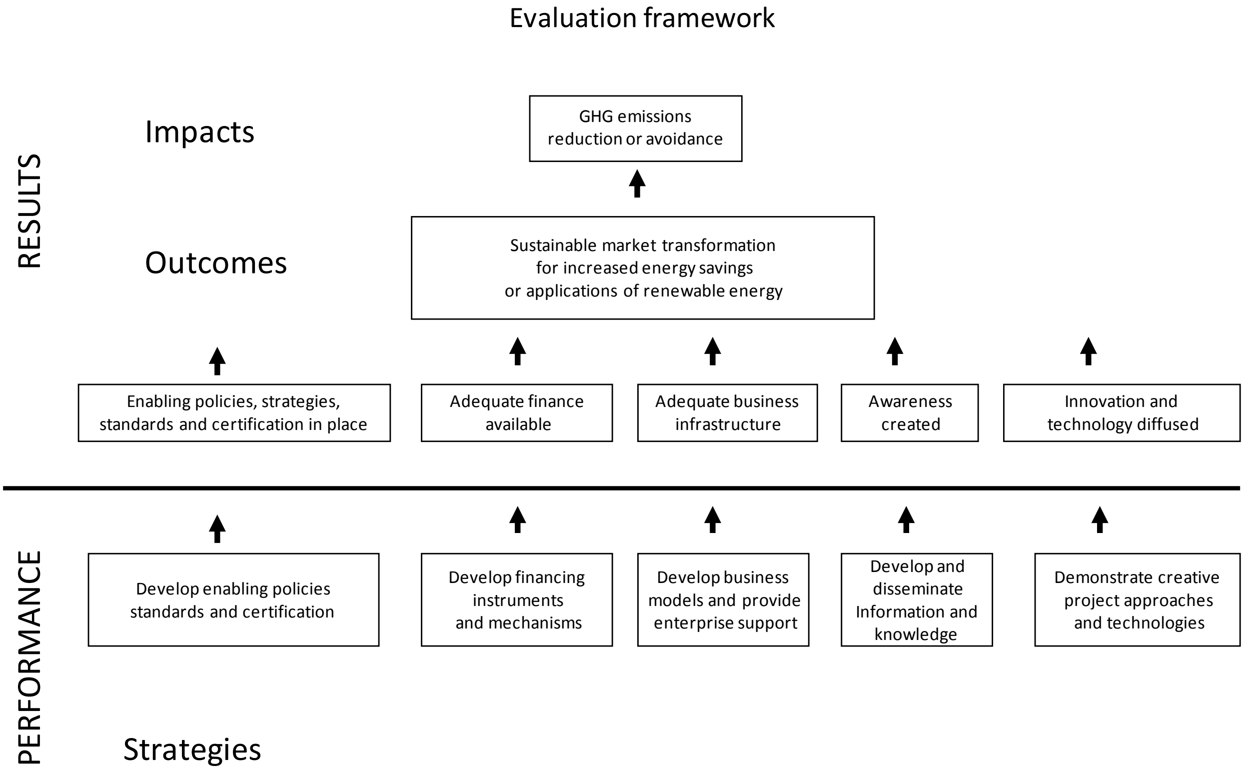
Further, as the new program logic reflects more components and factors, it is all the more important to do so in a discriminating fashion, and to reflect the relative importance of the impeding and supportive factors for the intermediate objective. In fact, weighing more and less important aspect in and of itself can already be an important guiding light for project, program, policy or sectoral evaluation.

Such a program logic should be flexible and comprehensive at the same time so that its explanatory power is optimized. High explanatory value (tested on a significant number of case studies) enhances predictive value for project, program and policy design. This means that such a program logic could be used for interventions on all levels: from project components to larger ranging programs all the way up to sectoral policies. In addition, such a program logic could be the basis for evaluation, but also for project design as well as monitoring.

## 2.2 The Evaluation Framework of Tokle and Uitto (2009)

The challenge is to come up with a strong description of the logic that leads from enabling environments to greenhouse gas reductions. Tokle & Uitto (2009) create an evaluation framework that illustrates a possible program logic for such market transformation intervention (Figure 1). It shows that an enabling environment consists of five different capacities that need to be in existence locally: The capacity with policy makers to create and sustain conducive and supportive policy frameworks, the capacities with the supply chain to provide and maintain the technology. Local market participants need to avail of the relevant business skills and models as well as financing, and the end-users as well as other players need to be aware and well informed of the relevant technical options. Tokle and Uitto (2009) emphasize that “normally all these capacities must be in place in order to provide the enabling environment for sustainable development and growth of a market, with supply and demand infrastructure for renewable energy technologies. Market development and removal of barriers to adoption of climate friendly technologies are a continuous process.” When these capacities are in place, they describe the intermediate outcome of a climate mitigation intervention as “Sustainable market transformation for increased energy savings or applications or renewable energy”.

Figure 1 Evaluation Framework of Tokle & Uitto (2009)




For the first time, this evaluation framework illustrates a number of important aspects:

- Sustainable energy projects typically need to address more than one capacity and knowledge gap at once.
- Sustainable energy projects typically need to provide for knowledge, financing and access to hardware at the same time.
- Sustainable energy projects typically need to work with more than one group of stakeholders at once or in a harmonized fashion.

These statements also mean that an intervention that addresses only one of these aspects, e.g. works only with policy makers or only with financiers or only with the training of technicians, will only contribute to one aspect of the overall sectoral development. Without overall sectoral development, the ultimate objective of sustainable GHG emission reduction will not be achievable. If an intervention chooses to focus on only one small part of the necessary capacities but still intends to achieve significant GHG impacts, it needs to make sure that the other capacities are either already in existence or addressed through other interventions.

It is also a significant contribution of Tokle and Uitto (2009) that they define the necessary intervention results that are the precondition for market transformation:

- Enabling policies, strategies, standards and certification in place
- Adequate financing available
- Adequate business infrastructure
- Awareness created
- Innovation and technology diffused.

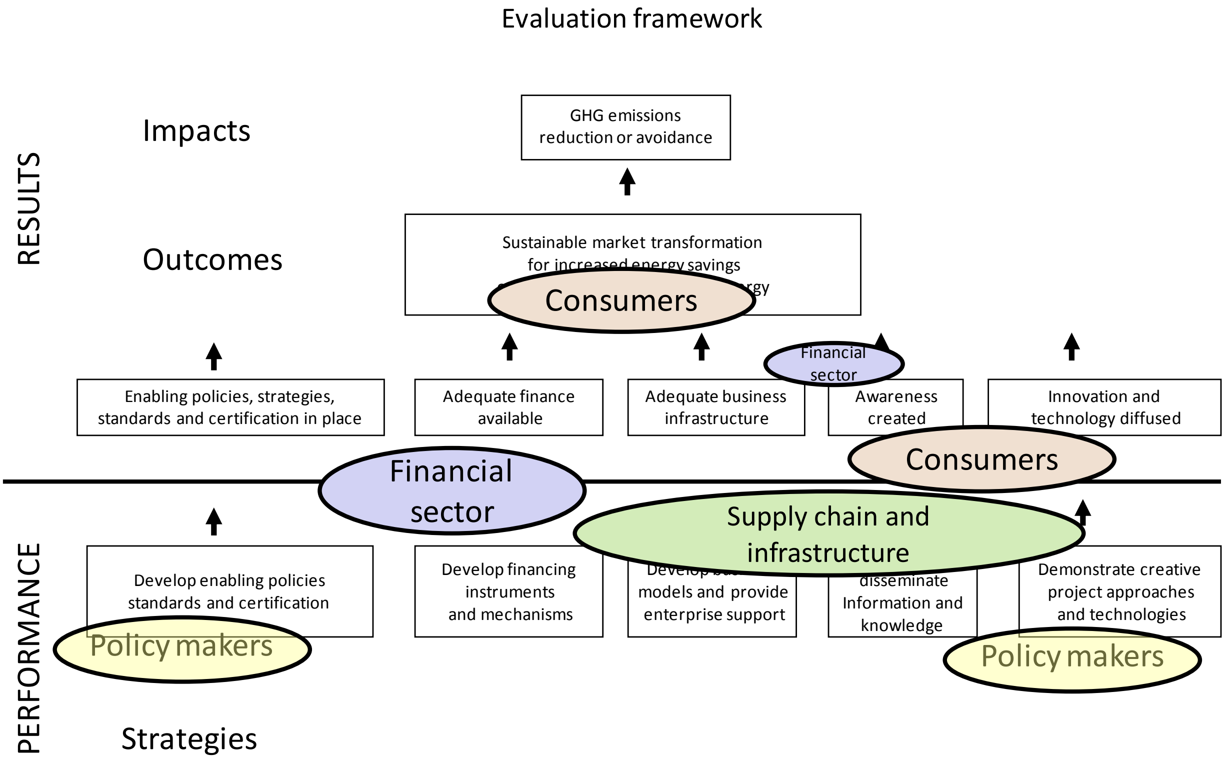
A drawback of formulating results in this positive way is that they will be hard to put into generalizable indicators, as they will always have to be measured in their respective context and relative to the specific sub-goal of the intervention. Thus, they will remain intervention specific and not solve too many of the above-mentioned attribution and aggregation challenges. A general baseline definition does not seem to be required when applying Tokle and Uitto's framework. This paper therefore inverts this framework, from a focus on enabling capacities into a focus on hampering barriers: The absence of each of these enabling capacities poses a barrier to market development that can be measured in a more generalizable and standardizable way for a larger number and scale of interventions.

Looking at Figure 1, the intermediate outcome of market transformation is seemingly directly related to the intermediate results in terms of access to technology, financing, supportive policy frameworks, information and technical capacities. An important dimension for further development would be to define outcome indicators for these capacities that could then serve in the aggregation process across different interventions, as well as for weighing the relative contributions of multiple interventions to a common objective.

Tokle and Uitto acknowledge in their framework implicitly, that a multitude of stakeholders are involved in market transformation. In order to enhance the framework, it is serves well to take a closer look at the mechanics of market transformation, as each actor who defines and conducts an intervention starts with his or her own perspective. This perspective typically relates to different target groups. For example, consumers, businesses, financial intermediaries, policy makers, all can constitute target groups relevant for climate mitigation. The perspective typically also relates to different approaches and activities. For example, awareness campaigns, technical training, policy formulation assistance or development of energy efficiency standards can all constitute legitimate activities in climate mitigation projects. All of these can constitute strategies that claim to be leading towards measurable impact in terms of reduced GHG emissions and enhanced economic growth.

Policy makers are responsible for providing the necessary policy framework, banks and financiers need to be available for financing the energy transformation, service providers and technology companies need to install, sell, operate and / or maintain the new energy equipment, and all of them need to be well informed and aware of the new technologies and opportunities. In fact, the level of necessary capabilities across all relevant stakeholder groups is much more refined and wide ranging, but needs to be defined for generating attributability and aggregability across several projects and interventions in the same sector. On the other hand, from the perspective of the evaluator it becomes clear at this point that one of these aspects alone, e.g. enhanced awareness for climate-relevant behavior is not enough to ultimately also achieve the goal. In many cases and mostly without central coordination, activities of different actors come together in independent projects to jointly achieve a change in behavior. For example, a consumer might feel that his utility bill is too high and is therefore predisposed to making an investment into a more efficient heating system in order to save electricity. Public awareness campaigns might have told him that this opportunity exists. His electrician might just have gone through a training at his business association and be very well informed about the options. In addition, his wholesaler might just have added importing a more energy efficient heater model to his product line. The utility or government might incidentally offer subsidies to defray the (potentially higher) initial investment cost of the more efficient heater. All of these situations might collude to actually result in less energy consumption on the side of the consumer. While this example might sound artificial in terms of the emphasis on serendipity and coincidence of so many actors playing together in an uncoordinated manner into the same direction, it illustrates very well how many preconditions need to be in place for one single decision to happen in a manner that contributes to the amenable to climate mitigation.

Figure 2 Evaluation Framework of Tokle and Uitto (2009) with stakeholder groups




In the following Tokle and Uitto's evaluation framework will form the basis for the development of a more refined and generalizable theory of change that is able to capture different project approaches and illustrate their interdependence and context. The only empirically-founded way to achieve these objectives is to analyze a significant number of project, program and policy interventions and their evaluations in order to find common patterns. In order to facilitate this search for a pattern, this study chooses to add some theoretical considerations regarding the concept of market transformation first, and then test the theory-derived model with selected clusters of evaluations in order to refine it further.

First, stakeholders will be associated with the required capacities ( Figure 2). Important agents in terms of sustainable energy use are 1. the users of energy, 2. the supply chain of sustainable energy technologies, fuels, and maintenance services, 3. The financiers for both supply chain enterprises and users of energy technologies, and 4. Policy makers in the widest sense of the word, who need to provide conducive framework conditions for the deployment of sustainable energy technologies and services. For each group of agents, it is important to identify the reasons why he or she does not yet behave in an climate-friendly manner, i.e. does not yet use the sustainable energy technology in question, does not yet foster it with supportive policy schemes, does not yet finance investments into this technology or is not yet selling or servicing that technology. These reasons can be understood as the barriers to climate-friendly behavior and sustainable energy systems.

# 3 The concept of market transformation

The concept of market transformation for energy efficient products has originally been developed in the energy efficient consumer goods markets. The market for a well-established but rather inefficient electrical appliance or product, e.g. the incandescent light bulb, can be transformed into a market for an efficient appliance that serves the same purpose, e.g. the compact fluorescent bulb. The lack of market transparency is defined as the main barrier to energy-efficient behavior in the pure concept of market transformation – users are simply not fully in the know about the comparable costs and benefits of the energy efficient option and therefore keep using the energy inefficient option. These markets need to be transformed. The tool box for market transformation consists in certifying and labeling the energy efficient product and in promoting the label and the energy efficient type of appliance with consumers with the ultimate objective of gaining a significant market share for the new product and decreasing sales for the old, inefficient product. Market transformation approaches were (and still are) seen as an alternative to regulatory and more command-and-control-type government interventions. In the recent past market transformation concepts have been applied to consumer products and energy efficient buildings.

Nevertheless, the market transformation concept has some severe drawbacks in terms of its usability for evaluating climate mitigation projects. In particular, market transformation literature takes on specific perspectives, e.g. only the viewpoint of the policy maker, or only the viewpoint of the consumer or only the viewpoint of the providers of energy efficient equipment or services. However, as discussed above, the actual success of climate mitigation interventions can only be assessed by taking on several perspectives at once. Secondly, as the formulation of barriers changes with the perspectives there is also no agreed upon set of barriers. This is not a major challenge for the pure application of the market transformation concept as most of the time it is used in a very activity-based manner: Barriers are identified in a heuristic way, and immediately translated in activities to be taken, and evaluated in outputs. However, a coherent and complete definition of all barriers would make it possible to create a much better assessment of immediate and higher-level results and allow for the design of better and more targeted interventions.

The concept of market transformation starts with the consumers or users of the product. In fact this is the most relevant point in the decision chain for climate mitigation: It is consumers of energy services, and users of energy-using equipment who are responsible for emitting greenhouse gases. Consumers/users are in control of what products and technologies they are using, and they are the ones who should be replacing their current inefficient product, service or way of doing things with the energy-efficient or non-emitting product or manner. The Theory of No Change has this process at its core, but turns it around: Why would a user NOT use the new, more efficient or more modern product, what are the barriers to the consumer or market exhibiting the “better” behavior.

A number of barriers can be identified that lie in consumer preferences or characteristics. In order to remove these, the only relevant stakeholder is the consumer. However, there are a number of other aspects that consumers cannot solve by themselves but “help” from other stakeholder groups is necessary. In the following, a complete set of barriers for the consumers will be discussed, and where barriers are encountered that cannot be solved by changing only consumer behavior, the model will be expanded by the respective stakeholder group. In turn, that stakeholder group might also encounter barriers to “good” behavior which will then also be discussed so that ultimately a complete and closed set of barriers will be defined. Each of these barriers can be removed with a barrier-specific strategy. An appropriate intervention for market change can ultimately be composed by pooling the barrier-specific strategies after the identification of the barriers relevant in the current market situation.

For this analysis we will look at a total of four stakeholder groups: Users, the providers of the hardware, technology or know-how that makes users' behavior less emission-intensive, the policy-makers who are often called upon for the creation of better policy frameworks, and the financiers, who need to provide liquidity to either users or to the supply chain if they need to make investments in order to change their behavior. They relate to Figure 1 as indicated in Figure 2. The barrier synopsis that follows in the next sections is a cross-section of the barriers that are mentioned in the literature for various energy efficient products and services.

## 3.1 Barriers for the demand for sustainable energy technology or services

"Consumers" or "users" as the central group of agents in this model are the operators of the equipment that uses or converts energy. This is the act that ultimately causes the GHG emissions. Climate mitigation means that they change their behavior and use energy more efficiently or convert to non-greenhouse-gas emitting fuels. Consumers and users of energy typically encounter several barriers to behaving more climate-friendly:

- They do not know that they are causing GHG emissions, or if they know they do not know an alternative to their behavior (ignorance).
- They do not mind that they emit GHG, or the sustainable alternative is unattractive for another reason, e.g. perceived as too risky, or not comfortable in operation or just not fashionable (lack of interest/motivation).
- They know the alternative but they cannot operate it (lack of expertise).
- The technological alternative might not be available to them (lack of access).
- The alternative behavior would be more expensive than the emitting behavior so that a change of behavior would not be cost-effective (lack of cost-effectiveness).
- Or it might be cost-effective in the long run but the users might actually not have the financial means to afford the initial investment (lack of affordability).

"Consumers" or "Users" can be part of any of the major energy consuming groups: households, industry, commerce, public institutions, transportation services. All these groups have different decision parameters: For businesses who consume a lot of energy, minimizing the cost of energy might be a high priority. This will most likely not be the case for consumers or businesses with low energy consumption. Public institutions might have administrative limitations to the choices that they can make in practice. Transportation service providers might value fuel availability and the service and maintenance infrastructure along their main routes higher than the environmental impacts that their fuel consumption causes. In the case of renewable energy technology deployment, the "Users" are mostly specialized owner-operators, ranging from utilities to Independent Power Producers or owners of single family homes with grid connected solar roofs or grid-independent solar home systems. This listing just names a number of decision making parameters and has never been fully formulated.

Even if this list is long and complicated, the barriers and decision making parameters can be categorized in a number of groups that make them more tangible. As the products are new, obviously, the first barrier is that the user is <u>unaware</u> of the product, has no idea what to do with it or how to use it. We will call this the ignorance barrier. It includes misconceptions about the product's technical performance and safety as well as usability.

Some technologies require that users or consumers have some level of technical expertise to own or operate the equipment. In these cases, lack of expertise can require a barrier to market change towards more sustainable energy use.

Even if the consumers might know about a product and how to use it, they might still not want to use it because the product lacks attractiveness. For example, many people find that the light of energy savings bulbs is flickering or of unpleasant color. This barrier can be very powerful: its expressions range from simply not being used to changing anything in one's consumption patterns, to not liking the new product because of matters of taste and style, all the way to cultural and religious reasons why a new way of doing things might be not appropriate. This barrier can be associated with a lack of interest in or motivation for using the energy-saving alternative.

The third barrier is often the price of the new product, appliance or service. In many cases, the new and efficient product has higher investment costs than a comparable inefficient product. This can result in two different situations: either the energy efficient product or service really comes at an additional cost over the existing solution. In that case, the new product would not be competitive with the old one. This is a cost-effectiveness barrier.

In many cases, particularly in the field of energy efficiency, however, the long-term total cost of ownership of a product or utilization of a service is lower for the energy efficient product than for the conventional alternative, for example because of lower energy costs. In that case it would be cost effective to use the energy efficient service, however, it might still not be affordable, for example because the cash flow structure might require higher upfront investments. In this case, we are encountering an affordability barrier, or a lack of a business model.

A good reason for a consumer not to use a product is because the product might not be marketed to him. He might not be able to buy it, and has no access to the technology.

The user can control only very few of these barriers. This means that the consumer alone can never constitute a market that can be transformed: a market consists of demand and supply. The market transformation model therefore needs to also account for the supply chain for the product or service.

## 3.2 Barriers for supplying sustainable energy technology or services

The supply chain consists of all the organizations that provide the hardware and the services for operation and maintenance of the sustainable energy technology. The supply chain is typically a multilayered structure, and can go all the way upstream to the manufacturers for the energy efficient equipment. In all cases it includes at least the distributors and installers or retailers of a technology and mostly also a service or operation and maintenance structure.

If there is sufficiently large demand from consumers / users of a technology or service, service and hardware providers will typically try to build up a supply chain that provides this (sustainable) technology or service. The lack of interest is hardly a barrier as supply chain members are standing in competition with each other and most of the time look for new business opportunities. Thus, if one offers itself and provides an avenue for earning more money, they will react. However, even if the supply chain would "like" to serve a particular demand, it might encounter its own set of barriers:

- They do not know the alternative, might underestimate the market or the technology (ignorance).
- They know the alternative but they cannot handle it (lack of expertise).
- It might not be available to them, for example because it has to be imported (lack of access).
- They might not have sufficient working capital to add another line of business (lack of affordability).
- They might not be able to expand their business to the sustainable energy application, because they have sufficient more profitable other products on which they focus their attention (lack of cost-effectiveness).
- There might not be a market for this product yet (lack of demand).

If market development is not driven by demand, but by another force (e.g. policy), most of these barriers will still apply for the supply chain. Obviously, if none of the barriers apply to the supply chain it will develop into an active driver for market transformation.

## 3.3 Barriers for financing sustainable energy technology or services

Both, supply and demand need to put financial resources into the development of a market for a new product or service. In those cases where they cannot use their own resources for this – either because they do not have enough financial means or because it would not be cost effective for them to use these – they will need to rely on financial intermediaries for loans. If financial intermediaries do not understand the income generating opportunity that is provided by the sustainable energy investment, they might not be willing to lend money for such an investment, or might only do so at very high interest rates. Therefore, well informed financial intermediaries are generally important for smooth market development.

Reasons why financiers would not support sustainable energy are for example[5]

- Lack of information and misconceptions about the technical risks and financial benefits of energy conservation. (ignorance )
- More attractive lending opportunities in conventional alternatives.
- Lack of financial and technical expertise for appraisal and risk assessment (lack of expertise)
- Additional transaction costs as compared to standard lending products, e.g. in appraisal/consideration and monitoring (lack of cost-effectiveness).
- Lending terms that they would be able to give (e.g. in terms of tenors) would not be appropriate for cash flow structure of sustainable energy technology (lack of business model).

There will be a number of mitigation options where no financing is involved and thus financial intermediaries are not needed. The case studies will be analyzed under these aspects. However, there are two levels of financing that might be necessary: one is the financing for the users in order to invest in the change of equipment, for example from kerosene lamps to an electric lighting system based on

[5] EBRD: Operation Performance Evaluation Review of Energy Efficiency and Renewable Energy Credit line (EERECL) and Residential Energy Efficiency Credit Line (REECL) in Bulgaria, A technical Cooperation Operation (April 2008)

solar electricity, or of a district heating company to a more efficient combined heat and power generation. On the other hand, some of the smaller items might not need financing. For example, while compact fluorescent light bulbs ("energy savings lamps") are more expensive per piece, there are still many places in developing countries where users can afford them without applying for a bank loan. The second level for which financing might be necessary is the level of the supply chain. In the case studies, these two are sometimes not too easy to set apart.

## 3.4 Barriers for making supportive policies for sustainable energy technology or services

Policies and programs are in many cases important instruments for facilitating market transformation. As indicated in Figure 2, policy makers need to be capable of putting in place enabling policies, including market introduction and technology transfer strategies, standards and certification as well as quality control options. This means they find themselves in the first, fourth and last of the immediate results of Figure 1. As market change is not a one-off activity but an ongoing process, policies are necessary to maintain the momentum of change. In addition, sometimes there are policies that impede the transformation of markets towards higher energy efficiency. Therefore, policy makers are an important stakeholder group for a barrier model of market transformation.

Policy makers, too, encounter a number of barriers when trying to enhance the policy frameworks:

- They have insufficient knowledge about GHG emissions, that they are causing climate change, where they come from and how to avoid them, or they do not care (lack of motivation).
- They do not trust the alternatives in terms of technical performance, local availability of (fuel) resources, scale, costs or other aspects (ignorance / lack of proper information).
- They do not know what policies would work or they know the alternative but they cannot design it (lack of expertise).
- The policies would be fiscally unaffordable e.g. in the case of large-scale subsidy programs (lack of affordability).

# 4 A first cut at the Theory of No Change

As shown in the discussion so far, evaluating sustainable energy projects quickly leads into an analysis of the local barriers to market development and market change. Classical market transformation concepts are activity-based and formulated from the viewpoint of just one stakeholder. Inverting and generalizing implies that removing barriers to market development facilitates quasi-automatic market development. Putting all the barriers to market development together in one multi-stakeholder multi-barrier model leads to four groups of stakeholders as discussed - users of the energy technology, suppliers of the technology, financiers of the technology and policy makers - and seven types of barriers, which do not apply to every group of stakeholders in the same way. On this basis, the Theory of No Change formulates a framework describing the whole set of conditions that might be barriers to more efficient behavior for all relevant stakeholders.

## 4.1 An abstract description of the potential-barrier types

There are some barriers which are almost exactly the same between different groups of actors, for example when policy makers and financiers do not trust the technologies in terms of their technical performance. Here, the same barrier removal strategy, and sometimes even the same activity can be used for removing both barriers.

Thus, in the context of this study, it is assumed that a total of 7 types of barriers exist, not all affecting all stakeholder groups equally:

- <u>Ignorance</u>: as described in the previous sections, a large number of stakeholders might not know that the technological alternative exists. This is a particularly obvious barrier for consumers and users: if they do not know that an alternative to their current unsustainable behavior exists, how can they be expected to behave more sustainably! However, all the other market stakeholders also need to be aware of the more sustainable alternative in order to provide their respective part in the market model. Speaking in terms of Figure 1, awareness needs to be created throughout the market that is to be changed.

- <u>Lack of expertise</u>: Even if people know about the technologies, actually using, marketing or servicing them might require specific technical knowledge or skills. In this analysis, expertise is defined for each stakeholder group in terms of the specific skills that are used for participating in the transformed market. Training of technicians is particularly important for the supply chain, and many technology programs in developing countries or even technology suppliers provide it. In addition, there are specific skills that policy makers need in order to provide the optimum policy framework, and financiers need to have the skills to evaluate a new technology in its context.

- <u>Lack of access to technology</u>: Even if sufficient people are trained in using the technology, the technology might not be available in the local market. That might be an expression of insufficient capacity along the supply chain which might or might not be caused by a lack of financing or one of the other barriers to building up a sustainable supply chain. However, in many cases it is related to policies in unrelated domains, e.g. terms of trade, taxes, tariffs, administrative procedures and other policy areas.

- Lack of cost effectiveness: Most of the time, the more sustainable energy service or technology is not used because it is more expensive than a fossil fuel alternative. This can be due to a number of factors, including fossil fuel subsidies. In some cases, technology cost will be brought down in the course of market transformation: as the technology is spread more widely, economies of scale in production, distribution and service delivery can be leveraged, competitive pressure on the market drives down prices, and risk premia are reduced.
- Lack of motivation: Even if the technology is accessible, people are aware of it and know how to use it, and it might even be cheaper to use than the conventional alternative, people might still not be interested in using, supplying, financing, or supporting it. Reasons for this might lie in the realm of status or image connected with the old technology, but also in the realm of prejudices or perceived risks associated with the new technology. A lack of motivation might also be associated with an overall resilience to change – which in fact might be very justified, e.g. if the new product requires a major change in routines that have become associated with other co-advantages. This lack of motivation can plague various stakeholder groups. On the other hand, in (admittedly few) cases, people might be so motivated to use a new technology that they do not insist on cost effectiveness.
- Lack of business model: while the product might be cost effective, it might not be affordable at the current cash flow and liquidity models, but a different way of loans or rental schemes might make it affordable. This is particularly an issue with weak banking systems, or in situations where sophisticated financing tools are not available. However, beyond financing there might be regulatory or administrative issues that require new business models like Energy Service Companies (ESCOs), leasing, or exclusive-use contracts to be developed so that stakeholders in a specific market can utilize the more efficient technology.
- Lack of affordability: a specific technology might simply be too expensive for people to afford it. This is easily possible in those places where a new technology does not replace an old inefficient technology but introduces a completely new form of consumption into a market. In some cases, the inefficient technology, e.g. burning of fuel wood in open fireplaces has not been associated with any monetary costs. When a new technology, e.g. kerosene stoves, replace these, the new technology costs money that the users of the old technology did not have. In other cases, even if a business model would be available that would structure financial flows in an optimal manner and even if the technology would be cost effective it could still be unaffordable, e.g. due to a lack of investment capital, equity, or loans.

With the exception of the last barrier, these barriers have been discussed in the order of their typical removal in practical market transformation, i.e. if one barrier is removed, the next might become visible and require a new project for its removal. Some of them are worse for stakeholders on the supply side, others for stakeholders on the demand side. This is a complication particularly for the stakeholder group "Supply Chain": as the name indicates, there are a number of chain members who constitute both supply and demand for the technology and/or its components, so that these are often faced with barriers on the supply and demand side.

## 4.2 The stakeholder-barrier matrix

If every barrier would be encountered by every stakeholder group, a matrix with 28 barriers would result. However, not all barriers are relevant for all stakeholders. In order to reduce the number of barriers that are necessary to draw the full picture of market barriers, the following discussion discusses some reasons for eliminating some of the barriers. This is possible without empirical basis as some of these barriers contradict the internal decision-making logic of the stakeholder.

For example, most consumers do not rely on business models for their energy- related decisions. Only few users, e.g. large industrial or commercial users, will invest in energy technologies outside of the natural reinvestment circles, which would provoke need to for a business case. This barrier will be disregarded for now. Another barrier that will be disregarded the next stages of this discussion is the potential lack of interest and motivation with the supply chain - here we shall assume that the supply chain consists mostly of organizations that strife to increase their business, and will not need extra motivation if they see a new business opportunity or can expand their product offerings. Similarly, for the financiers we shall assume that they will always be motivated to engage in new lending opportunities as long as they understand the risks associated with them, and can demonstrate cost effectiveness to their clients. We also assume that they will be able to afford lending to these cases most of the time. We will see that in times of financial crises. Lack of liquidity with financiers constitutes the same barrier to engagement of financiers as lack of cost effectiveness. In fact, in practical terms they are indistinguishable, as they both result in higher cost of capital. Thus we will subsume both cases into one for the financiers.

A couple of barriers are simply irrelevant. For example, for financiers as well as policy makers, it makes no difference whether or not they have access to the technology. In addition, policy makers will never worry about the business model. Also, while cost benefit analysis, i.e. the classical method to measure cost effectiveness, is a standard tool for policy decision making, it normally is not the same definition of cost effectiveness as the one that we use here, which relates to cost effectiveness on the level of the technology. Cost benefit analysis is better expressed in the barriers discussed here by “lack of motivation” on one side, and lack of affordability on the other. These dimensions are closer to the actual practice of policy making and suffer less from uncertainties related to external costs as are introduced into cost-benefit-analysis as a policy decision tool.

Excluding these irrelevant barriers allows us to draw a reduced stakeholder-barrier matrix, which is displayed in Table 1.

Table 1: Stakeholder groups and potential barriers

| Agent group | barrier |
|---|---|
| **consumer/user** | ignorance<br>lack of expertise<br>lack of access<br>lack of affordability<br>lack of interest / motivation<br>lack of cost-effectiveness |
| **supply chain** | ignorance<br>lack of expertise<br>lack of access<br>lack of affordability<br>lack of cost effectiveness<br>lack of business model / no demand |

| | |
|---|---|
| **policy maker** | lack of motivation<br>Ignorance / misinformation wrt abatement options<br>lack of expertise<br>lack of (fiscal) affordability |
| **financier** | ignorance<br>lack of expertise<br>lack of cost-effectiveness<br>lack of business model |

A number of barriers might apply only to specific subgroups of the stakeholder groups or specific product markets. For example in market transformation from incandescent light bulbs to compact fluorescent light bulbs, users do not need any additional expertise in using the light bulbs as their functionality is exactly the same for both products.

# 5 The market transformation circle tool

The underlying assumption of the barrier discussion for market transformation is that all relevant barriers need to be removed in order for market transformation to take place. This can be solved with a checklist. In this study a visualization tool is developed that allows illustrating the intensity of the barriers with a traffic light symbolism. In order to visualize the barrier situation of a market, a tool on the basis of pie and donut diagrams has been developed (Figure 3). It can be combined with a visualization of the project intervention so that the line-up of the intervention with the barriers can be assessed at one glance. The tool can thus be used for evaluation, but also for project design and even monitoring.

The tool is programmed in MS Excel. It has been made available on the Community's website for perusal, testing, and further development.

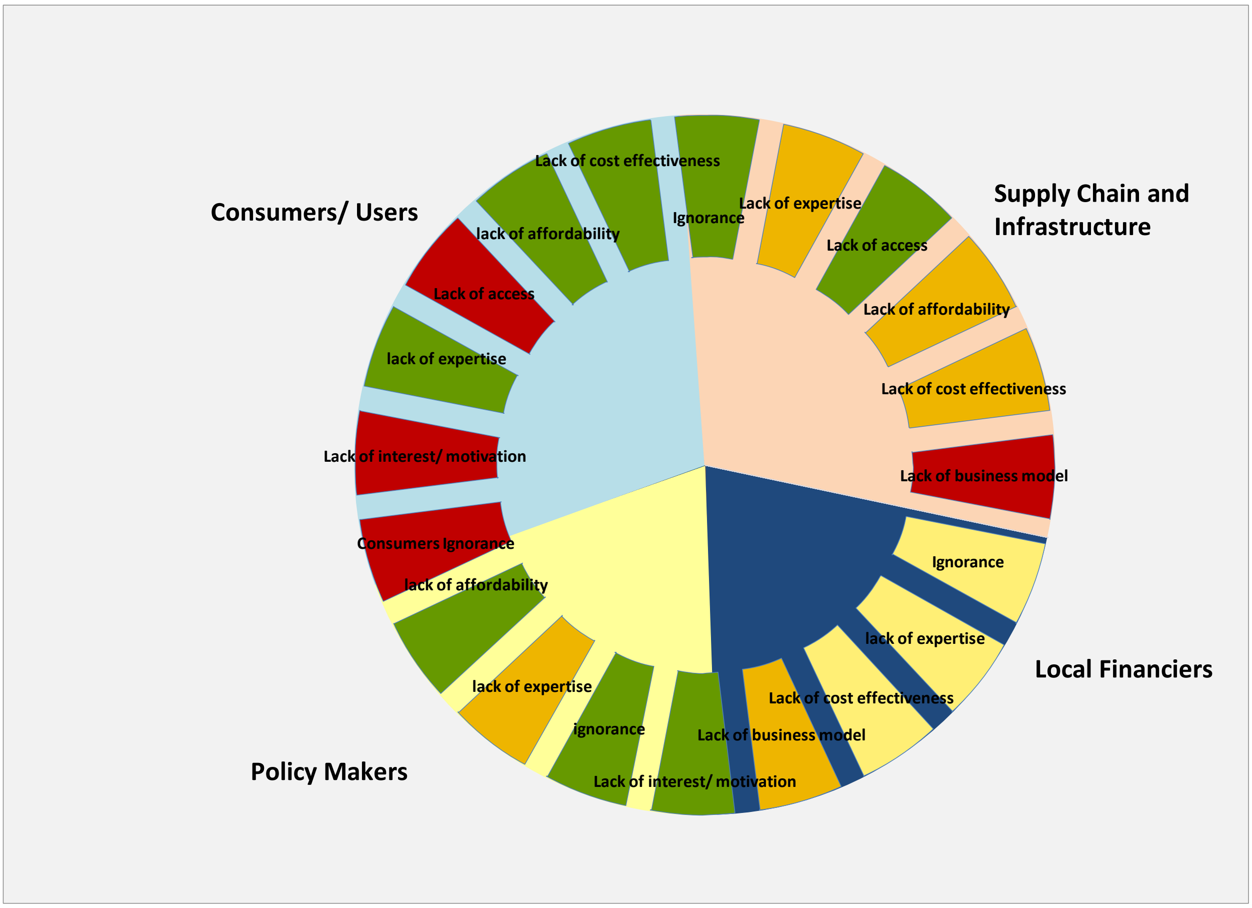
## 5.1 The barrier circle

The market for the new product or new way of doing things is symbolized by the circle that lies in the background of the diagram. Each group of market participants has a role to play which relates to a piece of the pie that is associated with the respective stakeholder group: Consumers and Users play a big role. The second biggest role is played by the supply chain and infrastructure. Smaller but crucial parts of the circle are associated with policy makers and local financers respectively.

Each barrier is symbolized by a small element which is labeled with the name of the barrier as described in the stakeholder-barrier matrix. It is colored according to the strength of the barrier. This color code follows the globally accepted color scheme of a traffic light, but with two intermediate steps (yellow and orange) instead of only one. Green is a situation that is favorable to market change. Yellow is a situation that is not necessarily favorable but also no significant barrier. Orange and red barriers are impeding market change. Orange is the color for a situation that slows down market change significantly. Red is the color for a show-stopping barrier. As long as there is a red barrier the market will not change in any meaningful way.

The traffic light symbolism is helpful as one important function of the tool consists in the visualization of the relative weight of the barriers. During the testing of the tool, it has been demonstrated that three levels of barrier depth are not sufficient to reflect the degrees to which barriers might or might not be responsible for the failure of a market to develop, in particular, if more important and less important barriers are illustrated in the same tool.

Figure 3 Barrier circle diagram




The example in Figure 3 relates to a market where the financiers' activities, attitudes and awareness levels do not fully stop but slow down the change in the market. This is symbolized by the yellow and orange ring segments in the financiers' part of the circle in the lower right part. Policy makers – the lower left part of the circle -, know of the opportunity (as indicated by the green color of the "Ignorance" barrier), are motivated to put in place the right policies and frameworks (as indicated by the green color of the "lack of interest / motivation" ring segment) and have the fiscal means to do so – indicated by the green color of the "lack of affordability" ring segment. However, they do not know which would be the right policies and how to implement them, which is coded in orange, i.e. it constitutes a significant barrier to market change. None of these barriers would necessarily be a "show-stopper" to market change without an intervention. However, the consumers' ignorance and the lack of cost effectiveness of an engagement of the supply chain in the market are coded in red in Figure 3, indicating that they are absolute barriers on market development which need to be removed before the market can change into a functioning market for energy efficient products.

## 5.2 The Intervention Circle

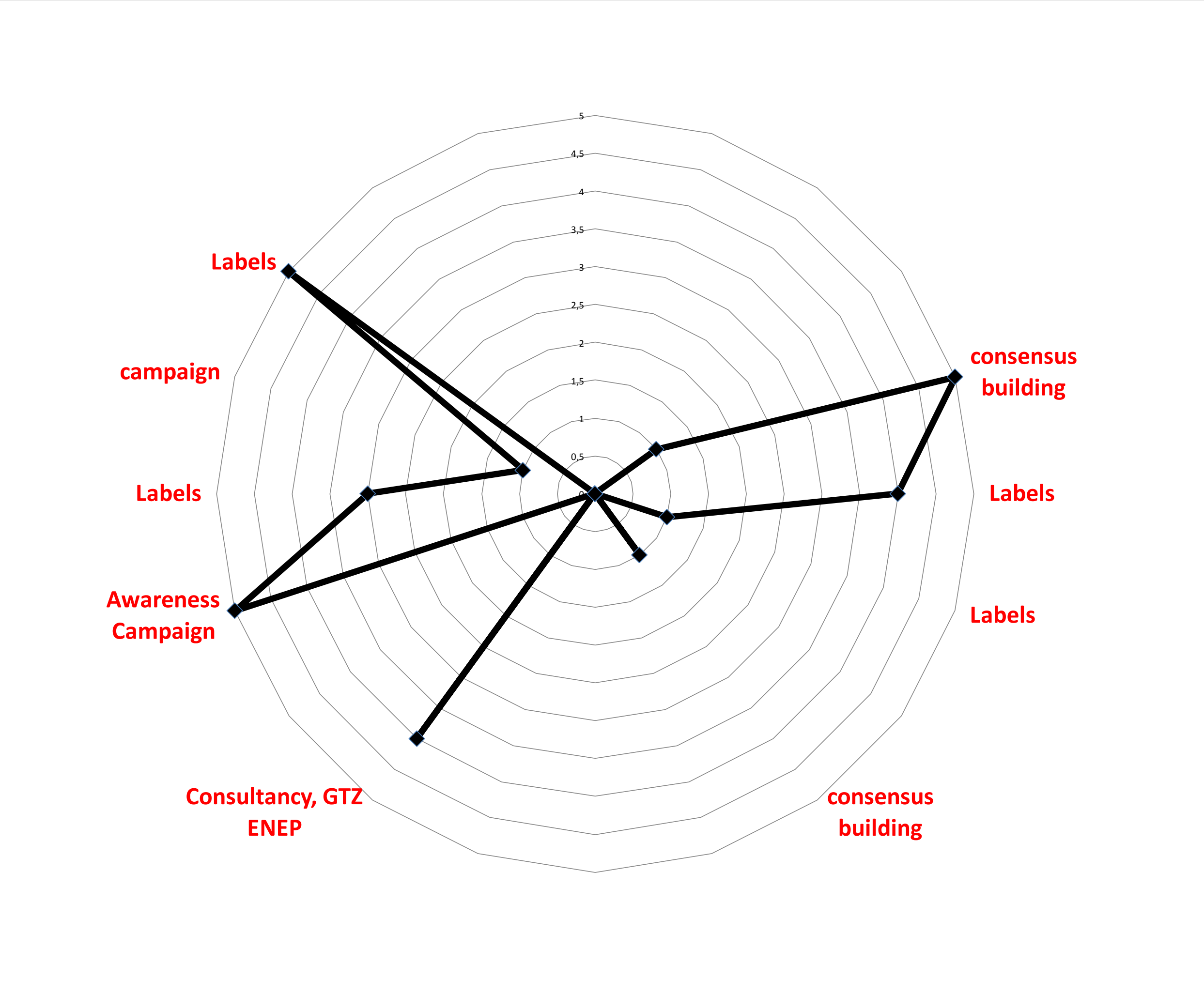
As discussed above, the interventions in climate change mitigation interventions, including such that are explicitly called market transformation programs, but also others, should be targeted towards the actual barriers to market development so as to illustrate whether or not the intervention is on target of contributing to the immediate market development as well as to the overarching dual objectives or whether the intervention addresses issues that are not in fact hampering the use of more sustainable energy use. When we are able to visualize this in the barrier diagram (Figure 3), this project visualization can help to identify whether the project is "doing the right thing".

Figure 4 presents the intervention circle using an exemplary intervention. The basis of the intervention circle is a spider web diagram. The axis signifies the intensity of the intervention: The larger out the points lie on the spider web the more intense is the project's focus on these activities. The direction in which the spikes point on the spider web are the same as the directions of the barrier they designed to address.

The intensity of the barrier removal activities is ranked on a scale from 0 to 5. So far no absolute scale has been developed in order to rate the intervention activity, e.g. relative to the depth of the barrier. Currently there is no methodology that could serve to calibrate the intensity of the barrier removal activity as compared to the intensity of the barrier. Therefore, for now, the calibration happens only within the project. Typically, interventions consist of more than one activity, directed at more than one barrier. Nevertheless, the main emphasis and motivation of an intervention will lie in one or very few barrier / strategy couples. These were given the highest ranking of 5. Other, less important parts of the intervention received lower rankings, in relation to their relative importance within the intervention.

In the example presented in Figure 4, the activities consist of a consultancy to help policy makers develop expertise on smart policies, in this case a labeling policy for energy efficient appliances. An awareness campaign helped consumers understand the energy efficient product and the energy efficiency labeling policy. A side aspect of the awareness campaign worked on the motivational barrier, by making it "the cool thing" to buy the appliance with the energy efficiency label. The project built a consensus on the labeling system among manufacturers of these systems, so that a joint move toward more market transparency through the labels created a business case for the suppliers to produce and distribute more efficient appliances. Side effects of these activities were that the financiers also started to understand the market for energy efficient appliances (through the labels), and that they accepted this as a cost effective market opportunity (through the consensus building exercise whose primary target group were the manufacturers).

Figure 4 The intervention circle



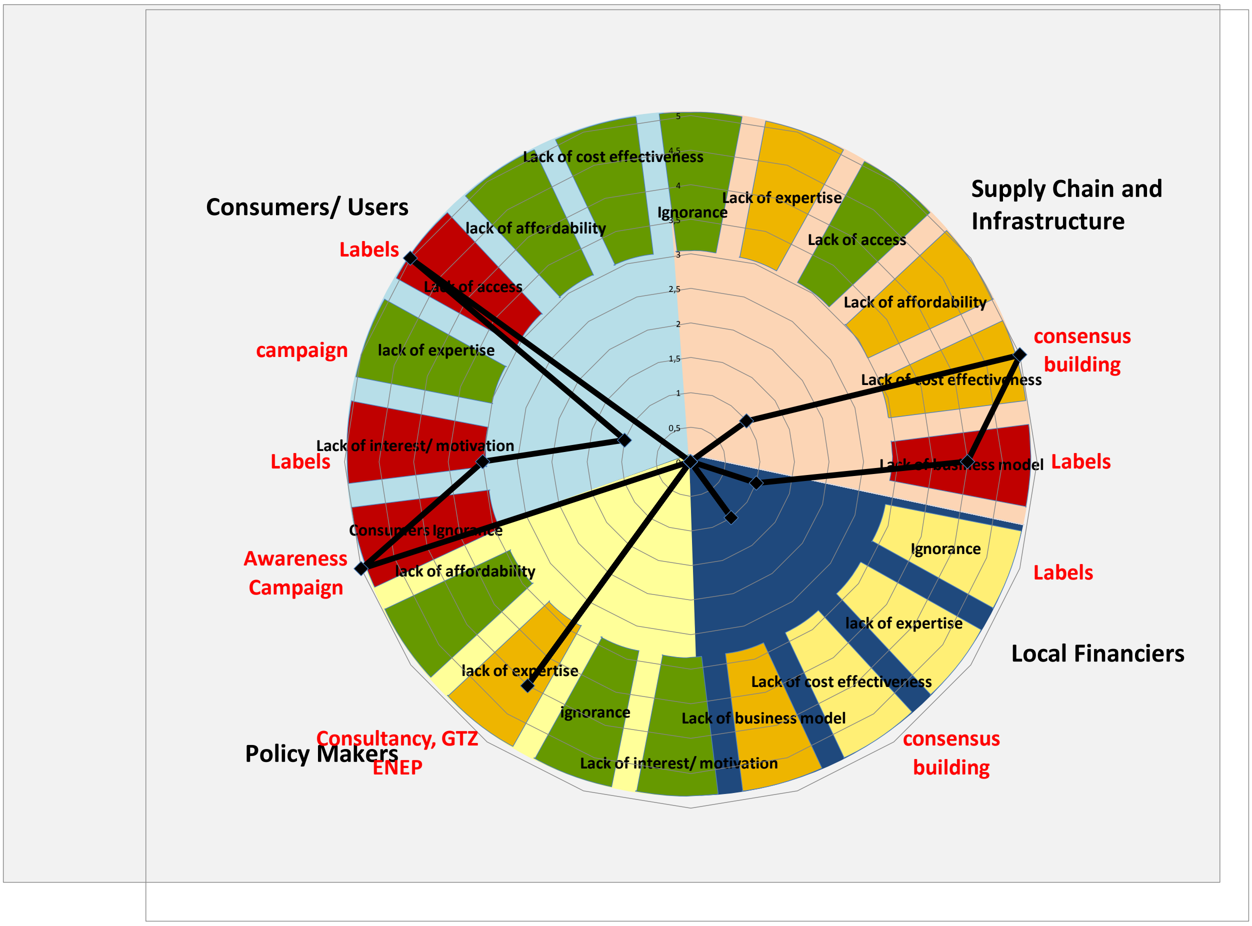

With the help of the Intervention Circle, each project can receive a characteristic fingerprint of barrier removal activities. If interventions or intervention components cannot be mapped on this circle, their contribution to market development should be justified separately, as the Theory of No Change strives to represent all relevant barriers. As the Intervention Cycle is a reflection of barriers to investment activity, rather than investment activity itself, investment components are not displayed as barrier removal activities in this circle.

On the other hand, the Intervention Circle does not distinguish between projects carried out by different actors, stakeholder groups or agency. As one of the main objectives is to aggregate across several projects and interventions, all of these can be mapped onto the same spider web diagram.

## 5.3 Putting the two together

Figure 5 illustrates how the two tools can be combined to illustrate an intervention's match with the existing barriers in a market. A simple overlay of the two diagrams illustrates whether or not the activities align with the barriers. In the example presented here, the consensus achieved with the supply chain and the ensuing labeling addressed directly the lack of a market for this not-yet-cost-effective product and created a new business model, consisting in selling energy efficient appliances in addition to the original appliances. By doing so, it also provided access for consumers to the energy efficient appliance. The awareness campaign informed consumers and users about the energy efficient option. In addition, the labels were expected to motivate consumers to buy the more energy efficient appliance. Another project component assisted policy makers in becoming smarter about energy efficiency labeling policies, their development and their enforcement. The overlay of the diagrams shows that a number of yellow and orange barriers were not addressed by project activities. It can be suspected that these barriers were not removed successfully through the intervention.

Figure 5 Barrier Circle and Intervention Circle diagram




This example illustrates how the Barrier Circle and the Intervention Circle together can already give an indication for the likelihood of the success of an intervention at the outset, i.e. in the design stage of a project. When used in evaluation, the direction of the intervention's lines will be aligned with those barriers that they actually addressed. This is not necessarily the barrier that they are designed to address. If the activities address a different barrier from the one they are designed to address this can be an indication of a misunderstanding in the quality of the barriers (or intervention). However, it can also be an indication of a severe misinterpretation of the actual barrier situation in the local market. In any case it should raise a warning sign.

If a project component was attempting to remove a specific barrier but the barrier persists after the project, it was not successful, and the tool will show this very clearly in red or orange. However, if a barrier is being removed, it will become yellow or green in the updated barrier circle. In these cases, the remaining red or orange ring segment will constitute the next barrier for continued development of the market.

Thus the tool is able to illustrate the sector in a holistic manner and reflect that barriers are sometimes not independent. It also reflects the barriers in their relative importance: If an intervention is designed on the basis of a sound barrier analysis, it will typically attempt to remove the red barriers. If the red barriers are removed the market might grow to some degree but market transformation most likely will be slowed down by the remaining orange barriers. As markets develop, new barriers that used to be orange will then come up and become “red lights”. New barriers can also be created by external factors like changes in government, financial crises, failure of technical infrastructures, or new technological developments. The traffic light system will reliably indicate these barriers in updated analyses.

# 6 Case Studies

## 6.1 The Thai case study

In the course of this analysis, a case study on energy efficiency programs with household appliances and commercial building chillers has been undertaken and published in a separate paper. In the 1980s and 1990s, Thailand had experienced distinct growth in energy consumption resulting from an ongoing economic boom. The national utility EGAT and the national government were increasingly concerned that they might not be able to provide sufficient energy for the continuation of that economic boom if the use of energy would not become more efficient. Therefore, they embarked on prominent energy efficiency and market transformation program.

The case study (Wörlen 2011) applies the barrier framework to a number of different programs and interventions:

- Replacing T12 lighting tubes through more efficient T8 lighting tubes ("thin tubes")
- Replacing incandescent light bulbs by compact fluorescent light bulbs
- Developing energy efficiency labels for refrigerators
- Developing energy efficiency labels for household AC units
- Replacing old, inefficient building chillers in commercial buildings by more modern, CFC-free and energy efficient ones.

On some of these markets, more than one project was active. For these interventions, a total of 10 evaluations can be found in the climate-eval library. Thailand thus offers an interesting case for studying the long- and short-term impacts of energy efficiency efforts. Overall, and in the long-term perspective, the markets that these projects were attempting to change were ultimately successfully transformed to markets for energy efficient equipment. However, these interventions themselves were not all equally successful. The barrier framework was able to demonstrate for the timescale of the intervention that typically those projects that accounted for all relevant barriers were more successful than others. For the less successful projects the model was able to illustrate where this was due to project design issues or due to failure of some project components or due to external disruption.

This is noteworthy as only the first four interventions actually followed the market transformation paradigm closely. The projects in the building chiller market in the years after 2000 were focusing their activities almost exclusively on financing. However, this market had been prepared in some senses through some of the earlier interventions so that many of the classical barriers, in particular in the information realm, had been resolved already.

This demonstrates how the barrier tool and the analysis of snapshots of the markets in time can help identify factors for success and failure and contribute to solving the attribution issue. For the building chiller market, due to a dense sequence of evaluation studies, the barrier situation could be mapped almost yearly so that almost a "movie" of the barrier removal process could be developed. When the database is so good, the effects of single interventions can be identified pretty well even if all evaluations focus on the impact of just one project and do not contain sufficient information on the overall development of the enabling framework in the market.

Such a sequence could best be created, if the tool would already be used in monitoring intervention. As it focuses on outcomes and impacts rather than on outputs it can have particular applications in result-based monitoring. By focusing on the intermediate impacts of barrier removal activities, it can help identify gaps and holes in the project strategy during implementations and thus help project implementing agencies to step back and look at their project's impacts in a more holistic manner than output-based monitoring. In the Thai case study it was particularly striking how the Asian financial crisis impacted sectoral development and thus project success, and how the barrier framework would have been able to serve as a warning sign for such external influences.[6]

In addition, the Theory of No Change provided a conceptual and practical model for putting together and jointly analyzing different projects and interventions that were conducted by different agents and agencies, but worked on transforming the same markets. In the Thailand project, in some instances, three different agencies were at work. This is not an unusual situation in real life, but always poses major challenges for evaluation studies that look at only part of the picture of use only partial program logics.

This discussion also illustrates that the Theory of No Change is applicable for evaluation and monitoring on the project, program and policy level: as the outcomes translate into preconditions for a sustainable market development, and the barrier framework captures all relevant outcomes, it does not matter whether the intervention that is evaluated works on only some aspects of the barrier framework – as is usually the case with projects – or a larger set of barriers, as is usually the case with policies and programs. As the Theory of No Change looks at the context of the whole sector or market, it can be used on all intervention levels.

Potential further development needs are to further test the Theory of No Change with regard to whether it is a complete and streamlined representation of the barriers, and whether it is able to capture these aspects also for projects that do not follow the market transformation logic in the proper sense, or how much adjustment is necessary to apply it to markets other than energy-efficient product markets. Financing, for example, had not proven to be a significant barrier for many of the other programs. Changing markets for household goods in particular were not dependent on financing barriers for the actual household goods. They were in fact limited by the willingness to invest (and in extension also lend) for changing production equipment from producing inefficient T12 tubes to producing thin tubes without an external market change influence. This means that future applications of the Theory of No Change might be guided by a more dynamic way of selecting relevant stakeholder groups and their respective barriers. This should be accounted for through more case studies.

In the next step, SMART outcome indicators for the barriers and quantification methods for the intervention depth are required in order to calibrate the strength of the barriers and the intensity of the barrier removal activities. Once they are calibrated against each other the explanatory power can increase greatly.

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[6] In this case, adaptive project management would not have been able to generate higher project success because the barrier in question was extremely severe and structural, but in other cases, projects might be able to react and work against newly arising barriers.

## 6.2 The Poland case study

A second case study investigated the explanatory power for enhanced energy efficiency and fuel switch in district heating and other heating applications in Poland. After the end of the cold war, large investment projects were designed to improve the inefficient and dilapidated infrastructure in this second largest economy in transition which was one of the biggest emitters in Europe. The following projects were included in the case study on the basis of their evaluations:

- WB Heat Supply Restructuring Conservation Project,
- WB Katowice Heat Supply Project,
- WB Coal to Gas Conversion (GEF),
- EBRD: portfolio review,
- UNDP/GEF Biomass project,
- EcoFund Debt-for-Environment Swap,
- Zakopane Geothermal project,
- JICA energy efficiency technology center.

The first of these interventions were focused on filling the most urgent gaps: In the early 1990s, fighting corrosion and leaks in the heat networks, installing metering equipment, introducing cost-oriented management and building cost control systems. The objectives of this first wave of projects were mostly investment-oriented and included "extending the life of existing district heating assets through rehabilitation and introduction of modern technologies and materials". The size of single interventions was large and ambitious. All these projects were extended in their implementation duration - the barriers were not necessary related to financing only. A major transformation of the way of providing and using energy as required by climate mitigation cannot rely on investments or investment-oriented project based mechanisms (like CDM) alone but needs to be accompanied by and planned in conjunction with a development of capacities, capabilities, motivations, business models and financial attractiveness. A major transformation of the way of providing and using energy as required by climate mitigation cannot rely on investments or investment-oriented project based mechanisms (like CDM) alone but needs to be accompanied by and planned in conjunction with a development of capacities, capabilities, motivations, business models and financial attractiveness.

In some evaluations, the "general public" was considered a relevant group for outreach activities. The most prominent example in the Polish case study for this is the EcoFund. The general public is not showing up in the barrier circle as a stakeholder group. The reason for that is that so far no example could be found where the general public (e.g. with respect to their lack of awareness) has been a barrier to project implementation or sustainability. It is conceivable that in sustainable energy projects, this might indeed be the case, for example if a policy attempts a real transformative change of a whole energy system. In these cases this issue requires some further investigation. It is in the same vein that environmental and other NGOs should be considered as part of the opinion forming process in the general public, not as market participants per se.

With respect to the Theory of No Change, it was necessary to clearly define the market that is to be changed for each of the projects. The general switch between the Thailand and the Poland case studies was from a mass / retail market for energy efficient appliances to a market for large and lumpy energy efficient equipment, or (in the case of biomass) to a market for fuel. This in particular requires some clarification of the roles of "users / consumers" and "supply chain". As long as we look at a retail technology which is marketed to households or business owners, the user is naturally the retail customer. However, in many of these cases, the stakeholder that had to invest was the provider of energy services, e.g. the district heating owner. In those cases where such an intervention intends to introduce new technologies that are also relying on a changed fuel, sometimes two markets need to be changed, i.e. the market for the equipment and the market for the fuel. In the cases studied, however, each of the cases dealt with only one market. Even in the (complicated) case of geothermal district heating in Zakopane, the issue was not related to the geothermal resource but to the district heating grid.

Thus, for each market, the supply chain and the users need to be clearly defined. If a market for fuel is changed, the supply chain is providing the fuel, and maybe also the stoves. If a district heating system should be changed, there is a market for the equipment that might need to be changed through intervention but there might also be a bottleneck downstream of the district heating system in the connections with the heat users. The case study never got quite so complicated that this was necessary. In fact, for every project it was possible to clearly describe the market roles in each case. But it should be kept in mind that downstream and upstream markets should not always be separated in these kinds of transformative projects, and if this would be the case the circle would need to be amended.

But as the projects became more complex, the abstraction with the Theory of Change was more difficult due to these added complications. The lumpiness of the projects emphasized to some degree the importance of the stakeholder groups “policy makers” and “financiers”. On the other hand, the local policy makers in the municipalities often were also important as owners of the district heating systems and therefore found themselves in two stakeholder groups. The evaluations did not provide a lot of information from the perspective of the policy makers so that this situation could not be fully described in the case study. In fact, for many of the barriers, information was scarce in the evaluations and often conclusions needed to be drawn from marginal aspects.

## 6.3 Reducing complexity

The Theory of No Change attempts to describe the full market for an energy efficient product, process or service. If the Theory of No Change should be applied in daily tasks like monitoring, 20 barriers are quite a number of parameters to observe. In order to make the Theory more useful in practical applications it is recommended that complexity is reduced. One way to do so is to reduce the number of stakeholder groups to be included.

The general Theory of No Change model has four stakeholder groups. In the Thailand case study we have discussed whether or not the implementing agency should be reflected in the stakeholder groups if it is not an active and permanent participant in the market. This was rejected. In the case of Poland we had to think about the definition of the stakeholder groups for each market. In the case of the biomass fuel market, for example, the operators of biomass boilers were defined as the “users” while in the case of the district heating systems, the boiler operators were defined as the “supply chain”. The rationale behind it was that in the biomass case, the market to be changed was the market for biomass fuel, while in the case of the heating systems, the market to be changed was the market for heat services, i.e. in the biomass case the boiler operators constituted the demand side of the market while in the heat case they constituted the supply side of the market. It is implied by these considerations that some adjustments might be necessary in the specific cases that are to be evaluated in the future.

Obviously, for small retail goods like light bulbs, financing these is easier than for large bulky investments. Therefore a stakeholder group of financiers is less likely to be able to block the market change for light bulbs than for district heating boilers. While the benefit of the TONC lies in its general applicability, the case studies demonstrate that some modifications are still required. One approach would be to better describe the types of markets that could occur in sustainable energy projects and define which stakeholders are relevant in which market. This can be done in a later stage.

However, another such approach at this point would be to make some more general observations as to whether or not the Theory of No Change could be reduced by some of the barriers and thus made less operationally involved. In order to understand which barriers have been proven binding in the cases studied, Table 2 combines all barriers from all the markets in the case study into one table so that it is possible to see which barriers were limiting most often, but also which ones did not really play a role in the markets from the case studies.

Table 2 Barriers in the Thailand and Poland projects

| | Barrier | Thailand | | | | | | | | | | | | | Poland | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T8 light tubes | | CFL | | Refrigerators | | AC units | | Industrial energy efficiency & EGAT | | Energy efficiency plus WB/GEF chiller project | Start EGAT/ ENCON | Building chillers | District heating | | Geothermal | | Coal to Gas | | Biomass | |
| | | 1992 | 2000 after implementation | before intervention | 2000 | 1994 | 1999 | 1994 | 1999 | 1990s | 1999 | 2001 | 2003 | 2005 | prior to project | 2004 | prior to project | 2004 | prior to project | 2004 | prior to project | 2002 |
| Consumers/ Users | Ignorance | ⬇ | ⬆ | ⬇ | ↗ | ⬇ | ⬆ | ⬇ | ⬆ | ⬇ | ↗ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ↗ | ↘ | ↗ | ⬆ | ↘ | ⬆ |
| | Lack of expertise | ⬆ | ⬆ | ⬆ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ⬇ | ↗ | ↗ | ↗ | ⬆ | ↗ | ↗ | ↗ | ↗ | ↗ | | ↘ | ↗ |
| | Lack of access to technology | ⬇ | ⬆ | ⬇ | ⬆ | ↘ | ⬆ | ↘ | ↗ | ↗ | ↗ | ↗ | ⬆ | ⬆ | ↘ | ↗ | ⬇ | ⬆ | ↘ | ⬆ | ↘ | ⬆ |
| | Lack of cost effectiveness | ⬆ | ⬆ | ↘ | ↘ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↘ | | ⬆ | ↘ | ↗ | ↗ | ↘ | ↘ |
| | Lack of motivation / interest | ⬇ | ⬆ | ↗ | ⬇ | ⬆ | ⬆ | ⬆ | ⬆ | ↘ | ↘ | ↘ | ⬆ | ⬆ | ↘ | ⬆ | ↘ | ↘ | ↘ | ⬆ | ↘ | ⬆ |
| | Lack of affordability | ⬆ | ⬆ | ↘ | ↗ | ⬆ | ⬆ | ⬆ | ↗ | ⬆ | ⬇ | ⬇ | ↘ | ⬆ | ⬇ | | ↗ | ↗ | ⬇ | ↘ | ↘ | ↗ |
| Supply Chain and Infrastructure | Ignorance | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↘ | ↗ | ↗ | ↗ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ↘ | ⬆ | ↗ | ⬆ | | ⬆ |
| | Lack of expertise | ↗ | ⬆ | ↘ | ↘ | ↗ | ⬆ | ↘ | ↗ | ↗ | ↗ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↘ | ↗ | ↘ | ⬆ |
| | Lack of access to technology | ⬆ | ⬆ | ↗ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ↗ | ↗ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ↗ | ⬆ | ↗ | ⬆ | | ⬆ |
| | Lack of cost effectiveness | ↘ | ⬆ | ⬇ | ⬇ | ⬇ | ⬆ | ⬇ | ↗ | ↗ | ↗ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬇ | ↗ | ⬆ | | ⬆ |
| | Lack of affordability | ↗ | ⬆ | ↗ | ↗ | | | | | ↗ | ↗ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ↘ | ↗ | ↘ | | ⬆ | ⬆ |
| | lack of demand | ⬇ | ⬆ | ↗ | ⬇ | ↘ | ⬆ | ↘ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬇ | ↘ | ↘ | | ↘ | ⬆ |
| Local Financiers | Ignorance | ↗ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ↗ | | ↗ | ↗ | ↘ | ⬆ | ↘ | |
| | Lack of expertise | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↘ | ↘ | ↗ | ⬆ | ⬇ | | ⬇ | ↗ | ⬇ | ⬆ | ↘ | |
| | Lack of cost effectiveness | ↗ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↘ | ↘ | ↗ | ⬆ | ⬇ | | ↘ | ⬇ | ↘ | ⬇ | ⬇ | |
| | Lack of business model | ↘ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↗ | ⬇ | ⬇ | ↗ | ⬆ | ⬇ | ⬇ | ↘ | ⬇ | ↘ | ↘ | ⬇ | ⬇ |
| Policy Makers | Ignorance | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↗ | ⬆ | ⬆ | | ↗ | ⬆ | ↗ | ↗ | | |
| | Lack of expertise | ↘ | ↘ | ↘ | ↘ | ↘ | ⬆ | ↘ | ⬆ | ↘ | ↗ | ↗ | ⬆ | ⬆ | ↗ | | ⬇ | ⬆ | ↗ | ↗ | ↗ | |
| | Lack of motivation / interest | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↗ | | ⬆ | ⬆ | ⬆ | ⬆ | ↘ | ⬆ |
| | Lack of affordability | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | ↗ | ↗ | ⬆ | ⬆ | ↘ | | ⬆ | ⬇ | ⬇ | ↗ | ⬆ | ⬆ |
| Implementing Agency | Ignorance | | | | | | | | | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | | | | | | | | |
| | Lack of expertise | | | | | | | | | ⬇ | ⬆ | ⬆ | ⬆ | ⬆ | | | | | | | | |
| | Lack of affordability | | | | | | | | | ↗ | ⬇ | ⬇ | ⬇ | ⬆ | | | | | | | | |
| | Lack of cost effectiveness | | | | | | | | | ⬆ | ⬆ | ⬆ | ⬆ | ⬆ | | | | | | | | |
| | Lack of business model | | | | | | | | | ⬇ | ⬇ | ⬇ | ⬆ | ⬆ | | | | | | | | |

If we assume that the case studies reflect a sufficient breadth of climate mitigation interventions, we could simply exclude those barriers that never hindered the development of a market. Across all market situations studied in Thailand and Poland, the only two barriers that have no orange or red fields are “access to technology” for the supply chain and “ignorance” for policy makers. It reflects on good projects that these two barriers were not relevant in the country cases studied, as this means that policy makers mostly are sufficiently included into the programs from international organizations to be aware of the technologies and energy efficient options that are available, and that international technology markets were working to supply the countries with the necessary technologies. For most countries and most energy technologies (except nuclear power) this will be the case so that it might be possible to shorten the concept by these two barriers.

Another barrier that might be cut out from the system is the lack of affordability for businesses. It seems that if it is cost effective for a business to invest in supplying a sustainable energy technology, and if there is demand, businesses of the supply chain were always able to afford the investment. In the two cases of orange cells for this barrier (coal to gas and geothermal in Poland) the “lack of business model / demand” barrier was also red or orange and when this was removed, the suppliers were also able to afford embarking on these new lines of business.

If these findings can be generalized, the barrier circle can be shortened by a total of three barriers, from twenty to seventeen.

Some of the other barriers seemed to have been negligible in their impact on the market development. In particular the lack of motivation for policy makers has rarely effectively hampered market development. On the other hand, government support is part of the decision making system of most ODA-bodies, and therefore it is not surprising that all the projects analyzed here were supported by the government. If these were private-sector or civil-society driven market changes, the motivation of governments might indeed be a barrier. Therefore one should be careful to cut this barrier for all types of interventions on the basis of the evidence of ODA-projects that were presented here.

# 7 Summary and outlook

## 7.1 The Theory of No Change

Climate change mitigation is not a one-off switch that can be turned but a long-term fundamental transformation process of almost all energy consuming processes in our societies. In order to reach a climate-compatible energy system – and this is true for many other areas of greenhouse gas emissions as well – we need a close-to-complete transformation of the way we provide and use energy. Project designers are aware that their efforts can only be small steps on this long path. Thus, most projects strive for some catalytic or transformative impact beyond their actual scope, and most of the project documents formulate this explicitly as part of their motivation or even as their objective. Contributing to a changed way we use energy would be their mission and is what they want to be measured against.

However, it is hard to define how such a step should be measured against standardized criteria like effectiveness and efficiency, and how it can prove to be relevant when the larger goal is so many causal links away from whatever a project can achieved. In order to better define the logical linkages between the steps and the goal, a program theory for climate mitigation intervention has been developed that allows determining the contribution to the larger goal. This program logic does not rely on output-based contributions to mostly weakly defined intermediate project objectives, but on an assessment of what would be necessary for enabling change and market entry for more energy-efficient and less carbon-emitting technologies and fuels. It assumes that the low-carbon alternative would be the natural equilibrium towards which the markets would swing if no barriers were keeping them away from it. If such barriers were in place in a strong way, the market would not change from its current state which is why the program theory was named the Theory of No Change.

The generic Theory of No Change (TONC) assumes that a market requires four types of stakeholders: Consumers who constitute the demand, suppliers who satisfy it, financiers who provide the financial liquidity in the market, and policy makers that set the framework conditions. These groups of stakeholders typically encounter a number of barriers that keep them from using or supporting the sustainable energy technology. 7 generic barriers have been identified:

- Ignorance – people might not know that the technological alternative exists.
- Lack of motivation – people might not be interested in using, supplying, financing, or supporting it.
- Lack of expertise – people might not know how to use it, maintain it, valuate its economic promise, or its benefit for energy supply and climate mitigation.
- Lack of access to technology – it might not be available in the respective country due to a lack of licensed production or a presence of prohibitive import tariffs.
- Lack of cost effectiveness – it might be more expensive to use than the existing fossil fuel alternative.

- Lack of business model or demand – currently, nobody would like to buy it, but a different way of loans or rental schemes might make it affordable.
- Lack of affordability – the initial investments might be too high so that it might not be affordable.

Not all of these generic barriers affect all groups of stakeholders. For example, the "lack of interest" barrier will not affect financiers or the supply chain, if all other barriers are removed, i.e. if they are "aware" of a "cost-effective" "business model", i.e. see a way how to make money of financing or selling that new technology. On the other hand, households might not act all that rational and still might not use a technology even if it might be cheaper and better than the old technology, just because they abhor change. The current framework contains 20 types of barriers.

The concept has been developed on the basis of three sources: The online-library of mitigation evaluations of the Climate Change Evaluation Community of Practice, the Evaluation Framework of Tokle and Uitto (2009) and the concept of market transformation for energy efficient consumer goods.

In order to get an overview of the barrier situation at a glance, an Excel-tool has been programmed that can display the barriers in one circle using a traffic-light color scheme. With this tool, the degree to which a certain barrier hampers market development can be identified at first glance. In addition to the barrier tool, an intervention mapping diagram has been programmed that helps get a quick impression if the project addresses those barriers that are really active in the respective markets. This tool has broad applicability in ex-post evaluation as well as in monitoring for results and even in project design.

Two case studies were conducted to test for various aspects of this theory. A case study with 10 evaluations of energy efficient market transformations in Thailand was used to test whether this setup of stakeholder groups and barriers is able to reflect the situation in the market. The model was tested for the number of stakeholder groups to be included: consumers / users of equipment, the supply chain that delivers hardware and maintenance services, the financiers that provide for the necessary financial liquidity and the policy makers who create the enabling policy framework. The stakeholder group for which a reflection did not contribute to higher understanding of the barrier situation was the "Implementing Agencies". The reason for that is obvious: only those barriers are relevant that are part of a functioning market. Implementing Agencies can be found among the four other groups of market participants, and then they might be barred from taking active part in the market through a barrier that affects them in this property. If they are not active in one of the markets in one of the four roles mentioned above, their barrier situation is irrelevant for the actual functioning of the market. Once the market is sustainably operating, there is no need for further activities of the implementing agency, or a role in the barrier circle. Their activity is expressed in the project mapping. Thus, it is not helpful to include them in the stakeholder groups of the Theory of No Change. The case study in Poland used examples from a large number of large investment programs in energy efficient heating and demonstrated that in principle the Theory of No Change can also be applied when the market it of very different character.

By designing a full program theory for market development, the Theory of No Change is able to assess whether or not an intervention has been contributing to a more favorable framework for market development for a sustainable energy technology. As it is able to reflect the context of a project, it can also identify whether or not the barrier that was tackled by a specific intervention was actually limiting or not. This is important in order to assess  whether the contribution was really decisive or whether the project was only having an impact because it took place together with other changes in the market that were similarly or even more decisive for a change in market conditions. In that, it is a step towards solving the attribution question in climate change mitigation which will typically limit the importance that is given to capacity building and policy interventions and attribute most of greenhouse gas benefits to investments.

Further research is needed in testing the Theory of No Change on other project approaches beyond the area of energy efficiency, e.g. in the area of renewable energy so that a Generalized Program Theory for Climate Change Mitigation can arise. It is also recommended to explore the expansion into other areas of policy making and change management.

## 7.2 Further developing the Theory of No Change

The Theory of No Change has demonstrated in the two case studies that is a very helpful tool for organizing the thinking on climate mitigation evaluations for single interventions as well as for larger programs or sectoral policies. Some more testing in particular on the program and policy level will be done in the near future. The TONC can also serve as the basis for project evaluation – by understanding what barriers were impacted by an intervention – as well as for project monitoring – e.g. for watching how new barriers are generated through external influences – as well as for project design – e.g. for analyzing the barrier situation in a market for project preparations of in discussions with stakeholder.

However, the barrier circle currently includes 17 barriers. Their evaluation requires significant effort and potentially high expense. This can potentially be modified by identifying SMART but elegant outcome indicators, but even 17 very accessible outcome indicators require a significant amount of research and data work. Therefore, it is advisable to conduct some further analysis in order to further reduce the number of barriers included in the Theory of No Change.

### 7.2.1 Interdependencies

This analysis was done on the basis of literature research and a collection of projects. Typically, these sources do not discuss market transformation as a multi-stakeholder multi-capacity approach (which it is if we follow the logic of Figure 1). It is more typical to discuss market transformation from the perspective of just one stakeholder. Often the perspective of the policy maker or of the supply chain is chosen. A number of analyses also relate to the perspective of the consumer. The barriers that are identified from the perspective of one of the stakeholders are sometimes not part of the respective stakeholder’s behavior but of other stakeholders’ behavior. They might be “mirror images” of each other, and in many cases they are not independent from each other. For example, if a specific technology is unaffordable to a consumer, it might be due to the ignorance of a financier who is not inclined to make financing available for an investment that he cannot assess in terms of risk. Therefore, in a multi-stakeholder multi-barrier framework, the number of barriers for each stakeholder might be reduced further.

These projects have demonstrated, that all practical barriers are finding a representation in the Theory of No Change, but have not managed to show whether or not barriers are included that are not stand-alone barriers in the sense that they are independent of other barriers currently represented in the barrier circle. When looking at the barrier tool in the Thai case studies, it becomes clear that not all barriers are relevant all the time. In particular, there are some barriers duplicating other parts of the barrier circle. Going back to the theory of market transformation allows us to analyze the barrier model for cross-relationships between barriers and thus eliminate duplication.

The hypotheses are formulated for further empirical confirmation:

- the barrier of access to the technology for the consumer or user depends on the functioning of the supply chain. Therefore, potentially, this barrier does not need a separate evaluation but might be just contingent on the barrier situation in the supply chain.
- Similarly, the affordability of an engagement by the supply chain in supplying a new technology, or by consumers to buy and use a new technology might always be solvable by a functioning financial sector.

If these hypotheses can be proven through case studies, the use of the barrier circle could in theory be simplified. These three barriers would then not have to be evaluated separately but their barrier level could just be defined in dependence of the respective barrier situation in the supply chain or financial sectors.

### 7.2.2 Barrier-strategy pairing

As indicated by the initial ideas of the market transformation approach as well as by Tokle and Uitto (2009), each barrier can be removed by a specific strategy. One of the benefits of the Theory of No Change is that it forces the analyst to distinguish very clearly between barriers that might look very similar in practice. For example, for the use of renewable energy, often the first barrier that is identified is that they are "too expensive". The Theory of No Change requires then further analysis whether "too expensive" in this case means that consumers cannot afford it at their current liquidity level or whether it is not cost competitive compared to other options. The former could be abated by implementing grant programs with public banks that might not even need to be subsidized. The latter, on the other hand, would require ongoing subsidization of the renewable energy source or taxation of the conventional energy source. This argument can also be turned on its head: Often subsidies are called for and implemented, when the only actual barrier that limits the market is an awareness barrier. While incentives are typically very effective in removing barriers, they are typically expensive, hard to exit from, and they might distort the market to the degree that it becomes difficult to intervene at all. It is highly recommended that some more effort goes into the area of exploring the optimal barrier-strategy pairs under aspects of efficiency, effectiveness and sustainability.

### 7.2.3 Outcome indicators

It is an interesting observation in the evaluation studies, that the barriers are hardly ever measured in terms of indicators. Even those projects that have explicitly adopted a barrier removal rationale and a market transformation concept do not quantify the barriers. One reason for this is that such projects typically do not adopt a holistic market view but the perspective of one stakeholder groups, or 2 stakeholder groups max. All the reasons why a market does not change are then phrased in their expression from the perspective of that one stakeholder group. Thus, almost none of these projects that were subject of this meta-evaluation has discussed the full set of barriers completely, but leave out the barriers that do not primarily affect the stakeholder group in question – even if those other barriers might be equally hard to remove and show-stopping.

This leads to the lack of a complete barrier analysis in a consistent manner. Therefore, also, in the literature no satisfying standards for the “full set” of barriers can be found.  The present study attempts to define such a full set of barriers, and has moved the discussion a significant step forward.

However, so far, only one of the analyzed terminal evaluations has used an outcome indicator to measure project success. That was the case of the district heating lending program of the World Bank in Poland between 1991 and 2000. In this case the project’s success related to the local industrial capabilities of the supply chain, which had not even been part of the intended consequences of the project: “The share of locally produced goods and installation services, financed by the World Bank and procured under international competitive bidding procedure, increased from about 3% of the total value of goods, installation works and consultant services during 1992-94 to 50% during 1998-2000.” While this is not an indicator that is specific to a barrier, it is at least an indicator that describes the overall status of one stakeholder group in terms of its market readiness. It is hard to generalize this particular indicator into an overall framework as it is specifically defined with the help of the World Bank procurement rules.  But it can provide an inspiration for the ways in which SMART outcome indicators or proxies can be defined.

The scope of this study could not be extended to the identification of outcome indicators for the actual barriers or their removal. Nevertheless, this is one of the major promises of developing this study further, and should be the next step in developing a general framework for climate change mitigation evaluations.

# 8 References

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