Climate-Eval

Sharing good practices on climate change and development evaluation

Guidelines to Climate Mitigation Evaluations

Dr. Christine Wörlen, Arepo Consult

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Climate Change Evaluation Community of Practice
c/o GEF Evaluation Office
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woerlen@arepo-consult.com

Dr. Christine Wörlen, Arepo Consult

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1 Climate mitigation evaluations and persistent measurement issues

The guidelines for climate mitigation evaluations are intended to clarify some of the persistent evaluation and measurement issues associated with climate mitigation interventions. The Climate-Eval Community of Practice is hosted by the Evaluation Office of the Global Environment Facility. The online platform (www.climate-eval.org) houses an electronic library which has a collection of more than 500 evaluations on the project, program, policy and portfolio level. The Community of Practice also conducts online discussions and webinars and is represented at international conferences.

This paper is a contribution towards solving some of the persistent methodological questions by formulating guidelines facing climate change mitigation evaluation. It has a focus on a theory-based approach for evaluating mitigation interventions, but pays heed to a number of these challenges which have been discussed in the online discussion forum of the website of the community. Its foundations have been laid by Zubiri (2012). The paper deals with a number of conceptual and practical challenges that will be discussed in the further sections of this introduction. Section 2 then discusses the various geographic scales of climate mitigation interventions. Section 3 elaborates on different concepts of GHG emissions accounting. In section 4 the application of the OECD DAC criteria on climate change projects is discussed. Section 5 presents a theory of change that has been developed in the context of the Climate-Eval Community of Practice.

1.1 Evaluation purposes in climate mitigation

Evaluation purposes are listed in every evaluation textbook. Firstly, an evaluation should document what has been done and what has been achieved with the activities. Secondly, evaluations should support the accumulation of knowledge and the learning from experience.

Impact evaluation starts with monitoring or reporting: documenting what has been done in the context of the projects, in the form of outputs, outcomes and impacts. For this, indicators that are suited to measure changes in these dimensions need to be formulated. Evaluations seek to measure the impact dimensions before (baseline) and after the intervention with these indicators. Most of the time, indicator values will change over time even without an intervention (a phenomenon that is called baseline shift). In order to understand which dimensions are relevant, i.e. which indicators are expected to change through an intervention, it is necessary to have a theory of change, a conceptual understanding of the system that needs to change in order to achieve climate-compatible development.

Apart from mere documentation of activities and results, accountability also relates to the relationship between the implementer of an intervention and other parties who had stakes in the intervention (for example the target group of the intervention, or donors). In climate change mitigation evaluation, mutual accountability is receiving particular attention (e.g. Bird and Glennie, 2011). One reason for this is Article 4.3 of the Framework Convention that puts special financing obligations on developed country Parties and other developed Parties included in Annex II to the Convention. It implies that in many climate change interventions in “Non-Annex II” countries, a donor-actor relationship will be included and accountability questions will be part of the design, implementation and evaluation of these interventions.

A sense of urgency and high pressure surrounds climate change mitigation, to use resources wisely. The reason for this urgency is the fact that climate mitigation requires a fundamental transformation that needs to take place within a relatively short amount of time. According to the IPCC-reports, avoiding catastrophic climate change requires fast and concerted action. Unlike in other areas where a qualitative change "to the better" might be a distant ideal that helps orientate different actors towards a common goal, climate change poses an immediate threat to many people's existence. We not only have limited time to effect a turnaround but we also know exactly and numerically, how strong this turnaround needs to be. We can measure very well how far away we are from a sustainable path and how little time we have to get on that path. Each intervention can and should also be measured in terms of how much closer it has brought us towards this path. On the other hand, this distance cannot be measured in one single indicator: we are talking about a qualitative change in the way we live. A theory of change can help us to identify which aspects need to be observed in terms of the climate-sustainability of our development. In other words, based on this theory of change climate change interventions can also be evaluated with respect to their contribution towards a (global or national) goal of stabilizing GHG emission reductions, and this leads to new objects (Picciotto 2009) as well as objectives and evaluation questions for CC mitigation evaluations.

This also highlights a new aspect of the „learning" function of evaluations. This learning function traditionally includes the identification of good, better and best practices. In order to be most efficient in becoming more climate-friendly, it is mandatory to stop repeating mistakes and to start learning from experiences. Here, too, experiences can be best analyzed for lessons and lessons can best be applied to future endeavors if they are embedded in a theory of change that helps us understand why initiatives and interventions might work in one context and might not work in others. This is a very strong motivation for these guidelines.

1.2 Theory-based evaluation of climate mitigation efforts

In general, climate mitigation evaluations are approached like all other evaluations. The typical evaluation types and steps can be applied to climate mitigation evaluations. Nevertheless, there are a number of challenges that are specific to climate mitigation evaluations. On the surface, measuring CO_2 benefits is easy and has been done many times. But it does not constitute an evaluation of a climate change intervention. More often than not it is necessary to evaluate socioeconomic and technical systems, like communities, production processes or markets, and their proneness to emitting greenhouse gases, or their changing ability to avoid these emissions. These systems as well as their emissions are highly context-specific. Interventions as well as their results are therefore hard to assess, compare or aggregate in their effectiveness without a common theory of change that goes beyond the linear project logic of single components. A concept is needed that reflects the elements and relationships within the systems.

The challenge lies firstly in defining the system to be evaluated. More often than not, the scope of the evaluation should go beyond the direct outputs of an intervention, as most interventions strive for impacts that are several causal steps removed from the outputs. Also, these desired outcomes and impacts require a number of other preconditions to be in place. This is where a theory of change can provide guidance and help in formulating pertinent evaluation questions. On this basis, the depth of the evaluation and the evaluation methods can be defined.

In addition, the theory of change is necessary to determine baseline development. Many aspects of a system including those that are not directly changed by the intervention, will incur some development over the time period that is subject to the evaluation. A theory-based evaluation needs to rely on a description of what would have happened without the intervention. This can be formulated with the help of the theory of change.

Last but not least, a persistent challenge for climate mitigation evaluations is the question of attribution and causality. In its core it is the question whether or not and to what degree a change to a more climate friendly way of doing business has been triggered or influenced by the intervention to be evaluated. For the Clean Development Mechanism (CDM) this question has generally been discussed in conjunction with the question of additionality, and in relation to the financial viability of an investment with and without the support of carbon finance. This is possible when looking at very well defined investment-specific intervention. However, this approach is not so easy to apply in most other types of interventions. In these, a theory-based understanding helps, to identify what aspects of a given situation need to change in order to transform the system towards climate compatibility and then evaluate these specifically. With a well-defined theory of change, the attribution of observed changes to changes in causal factors can be better founded.

1.3 Systems boundaries

The boundaries of the project system have dimensions in space and time. Evaluation needs to pay heed to the boundaries. The focus on the evaluation normally is the project system inside of the project boundaries: this is the system that is expected to change its behavior as a consequence of the intervention that is to be evaluated. Most of the time, this system is also influenced by circumstances and impulses from outside of the project boundaries. External influences can support or destroy the intervention and its impacts. Therefore, external influences should be noted and discussed in evaluations. In addition, some interventions have ulterior objectives that intend to affect situations outside of their narrow project domain. The evaluator needs to define to what degree these can and should be part of the evaluation.

Boundaries play an important role in climate change mitigation evaluations. Firstly, climate mitigation interventions can take place on various scales (cf. part I). The systems that are defined by the boundaries of the intervention can have very different qualities. Just looking at projects on a local level, the project's system can consist of any of the following exclusively: a technical installation, a community, an enterprise, a geographic area, an ecosystem, a piece of infrastructure (like a waste water system) or a municipal administration. Describing the boundaries sharply is very important for the actual quantification of impact, and its attribution to the project activities. In addition, it is a necessary foundation for defining baselines against which project results are compared.[1]

Depending on the system ("domain") in which the intervention takes place, different descriptions of boundaries are appropriate. Generally, the boundaries of a project need to be defined in terms of the stakeholders, the GHG emissions affected, the spatial realm of the project and the timeframe over which the project is implemented. The CDM glossary (UNFCCC, 2012) defines the project boundary in the CDM/CPoA-(but non-A/R)-context as the „anthropogenic GHG emissions by sources under the

[1] More on baselines in section 1.3

control of the project participant that are reasonably attributable to the CDM project activity“.[2] In the A/R-context, the project boundaries are defined geographically. The boundary of a REDD project in accordance with the CIFOR guidelines can be a 50 hectare forest[3] with a crediting period (temporal boundary) between 20 to 100 years (CIFOR, 2011).

Generally, the project is considered responsible for the changes triggered by project activities within the systems boundaries. These are direct impacts, or immediate outcomes or outputs of the intervention. These guidelines will introduce the concept of the "accountability ceiling" for this boundary of the project. A project can also be responsible for impacts and outcomes beyond its accountability ceiling, but will not be accountable for them. Therefore, assessing and evaluating them will be more difficult for these indirect impacts than for the direct outcomes. On the most superficial level, the reason for this is that in the context of their monitoring plans, projects will routinely collect data for inputs, activities, outputs and results that are observable within their boundaries. Their attention is less directed towards the situations outside of their boundaries, and thus, these areas are less well documented. Secondly, the project is able to control some aspects within their boundaries, so that changes there are easily attributable to project activities. This is not as easily the case for changes outside of project boundaries. These are most of the time subject to a larger set of other influences, which are not controlled by the project. Aspects outside of the boundaries are typically placed on more remote links of the logical chain, and thus the causal link to project activities is not as strong. In addition these impacts are more indirect. They might appear with considerable time lag, and thus might be observable only long after the project's evaluation is finished.

1.4 Leakage

A project can also be responsible for unintended impacts. These are generally called "leakage". Leakage can be negative or positive. Positive leakage is rare and mostly unaccounted for in evaluations. Negative leakage needs to be included into the net impacts of the intervention irrespective of where it takes place. The IPCC refers to (carbon) leakage as "the unanticipated decrease or increase in GHG benefit outside the project's accounting boundary as a result of project activities" (IPCC, 2000), but leakage can also occur in other dimensions (e.g. economic, social). Leakage can occur whenever the spatial scale of the intervention is inferior to the full scale of the targeted problem (Wunder, 2008; in: Climate Action Reserve, 2011).

Leakage is of particular importance in REDD projects, for example, when the protection of one forest area leads to deforestation in other areas. The second most common leakage observed is the negative effect of bio-fuel production increasing agricultural area. The CDM glossary defines leakage as „the increase in GHG emissions by sources or decrease in carbon stock in carbon pools which occurs outside the boundary of an A/R or SSC A/R CDM project activity or PoA (A/R), as applicable, which is measurable and attributable to the A/R or SSC A/R CDM project activity or PoA (A/R), as applicable“(UNFCCC, 2012: 11). Figure 1 visualizes leakage that occurs when biofuel production displaces food production in an agricultural area and the food is then produced on former forest sites. In fossil-fuel mitigation interventions, leakage can result for example from displacement of industrial facilities from countries with strict GHG emission policies to areas with laxer regulations.

[2] Glossary of CDM terms, p:14, http://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf (UNFCCC, 2012)
[3] A forest, as defined by e.g. the FAO, is only eligible if it had to be considered a forest 10 years prior to the project's start.

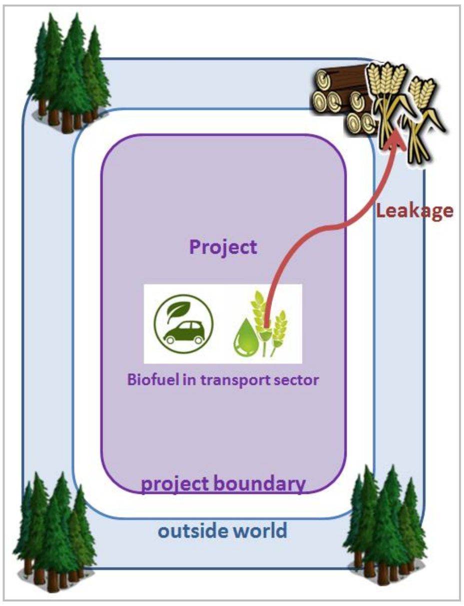

Figure 1 Leakage through forest degradation in other sites caused by conversion of agricultural food production into biofuel production

1.5 Baselines and additionality

In general, the term "reference scenario" is used to describe an alternative future without the intervention. On a national level, in particular, medium- and long-term scenarios are an important tool for creating and evaluating policies. National scenarios for the development of a whole sector (e.g. energy sector, land use) necessarily rely on a large number of assumptions. For example, in the energy field, assumptions on socio-demographic and economic growth projections, energy price trajectories, projections for technological changes, energy efficiency growth and other parameters are necessary. The utility of these types of scenarios for ex-post impact evaluation purposes is limited as most of these parameters will have developed differently in hindsight. However, it is important to know which of the scenarios have been used as the basis for intervention design to answer certain evaluation questions.

Climate mitigation interventions are expected to trigger changes in GHG emission patterns. This implies that its impacts and outcomes need to be compared to the situation that would exist without the climate mitigation intervention. In climate intervention this counterfactual scenario is called the baseline or reference scenario. In most mitigation efforts, a number of people within the project realm would adopt the behavior that is promoted in a project anyway, i.e. even without a project. The baseline describes how emission levels would change without the project – that means that these people and their behavior are already "part of the baseline". According to the principle of additionality, the intervention's impact is the difference of the observed behavior and the (assumed) baseline behavior.[4] This is illustrated in Figure 2**Fehler! Verweisquelle konnte nicht gefunden werden.**.

[4] Additionality is the effect of the project activity to reduce anthropogenic GHG emissions or increase actual net GHG removals below the level that would have occurred in the absence of the project (CDM Glossary).

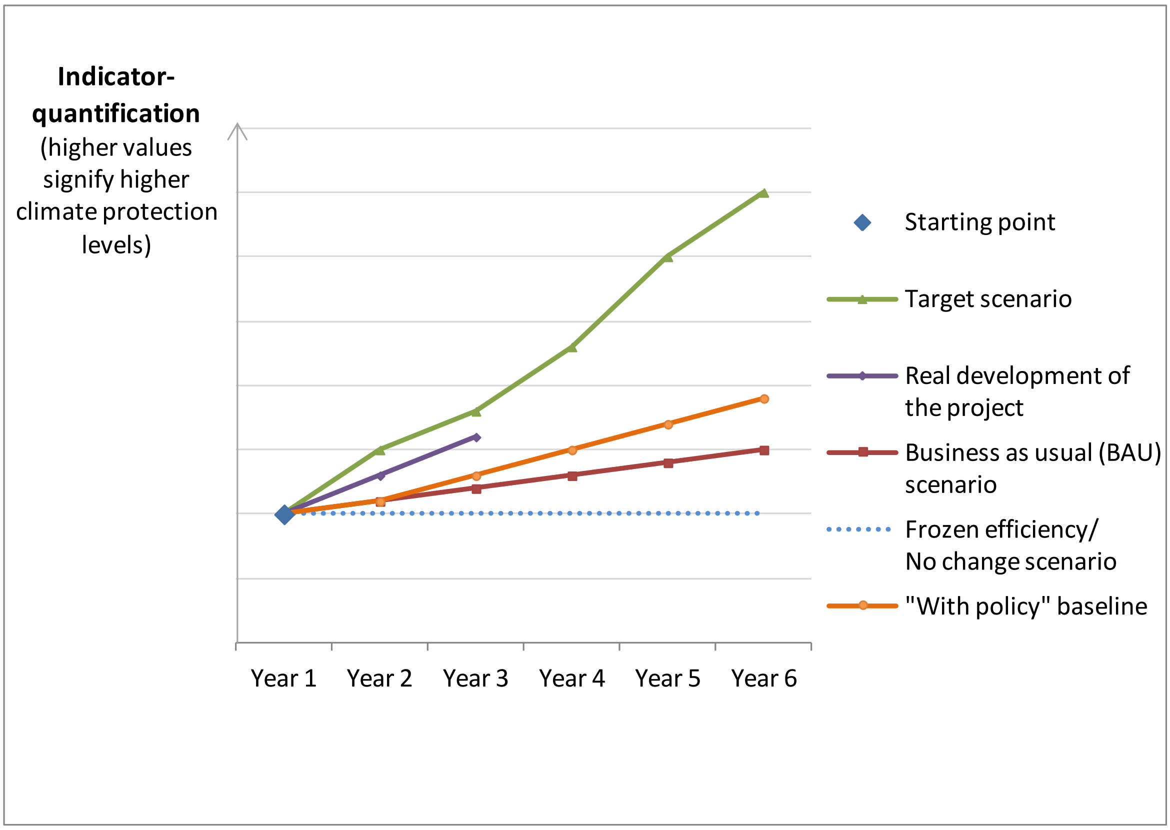

Figure 2 Actual project impact, intended project impact and baseline

Unfortunately, the “undisturbed” development can normally not be observed. If it would be possible to find for example two villages with similar socio-economic and geographic preconditions, it would be possible to identify the baseline or reference scenario on an empirical basis for an intervention on a village level. In these cases rigorous evaluation can be applied and the differences can be analyzed with statistical and other rigorous quantitative approaches. Most of the time, however, the evaluator will be limited to hypothetical baselines, just like in most other evaluation areas.

In the absence of baseline measurements there are three different ways to construct scenarios for the baseline: business as usual, no change (“frozen efficiency”, static), and “with policy” scenarios.

In most cases, a **business as usual (BAU) scenario** is used as the baseline (cf.Figure 2). A BAU scenario describes an alternative future in which past behaviors and policies are continued or kept in place unaltered. Past trends e.g. in terms of deforestation or power plant investments are extrapolated into the future. This could mean an increasing demand for fossil fuels.

Sometimes, if strong climate mitigation regimes are in place already or if bodies outside of the project system are dictating changes towards more climate mitigation efforts, it is necessary to include policy changes in the direction of more mitigation into the baseline. For example, in the case of the EU Member States the EU has mandated states to follow rather strict paths in terms of deploying more renewable energy or saving energy through energy efficiency measures. These mandates come in the form of EU directives which Member States are obliged to put into national laws. Even if a project starts before such a directive is put into national law, it will be clear that it will not be implemented on top of a “business as usual” baseline, but rather on top of a “**with policy” baseline**.

In some cases, static scenarios with “frozen efficiency” are applied. In these cases, evaluations compare intervention results to the initial starting point of a project. It can generally not be recommended to use such a **“no-change”** or **“status quo”** scenario, as it is not very realistic to expect the future to be unaltered from the past. Using a static baseline also exposes the evaluation to the accusation that it might be biased to make project results look more impressive, in particular in mitigation projects in the energy sector. In other sectors, in particular in the natural resources area, there might be projects where the baseline does not change in the dimension of the project objective. For example, if the project’s aim is the re-introduction of predators to reduce forest damage by deer: In the baseline scenario no predators inhabit the area and the deer and predator populations would remain stable (“frozen”). However, In most cases there will be other dimensions in which the system will change during the project’s implementation period without a project.

Frozen baselines are rare, even if only one dimension is observed. The standard case is energy efficiency. Most technical systems have a finite lifetime. If and when they are replaced, they will be replaced by new systems with higher efficiency. This leads to a continuous improvement of energy efficiency even without an external intervention, and associated distributional effects.[5] Frozen baselines therefore are hardly ever useful when looking for realistic models.

Non-static baselines will lead to the effect that climate mitigation activities that looked innovative and non-standard at the outset of the project, will be much more common at the end of the project, even without the project taking place. If project activities stay on the same level of ambition, their marginal contribution will be much smaller over the years. The impacts can only be measured including this “baseline shift”.

Vine (1999) assumes that incentives to “cheat” on the baselines are high as an overstated expectation of emissions in the baseline makes projects impacts look better. Vine therefore calls for basing the baseline on at least a year of measurements before project implementation, and for consistent monitoring of the baseline during project implementation.

Baseline shift can severely reduce project impacts. The EU Directorate-General for the Budget (2004) defines deadweight effects as „effects which would have arisen even if the intervention had not taken place. Deadweight effects can also occur when individuals and groups who are not in the target population end up as recipients of benefits produced by the intervention.“[6] The deadweight effect adds to the costs of the project, as for example in the case of an investment subsidy most of the time there is no way to distinguish between those who would have bought a specific system even without the subsidy and those that were only swayed by the subsidy. As the “free riders” still benefit from the subsidy, they cost of their subsidy is included in the cost of the overall intervention, but it does not add to the benefits of the intervention, so that the intervention’s cost effectiveness is reduced.

Additionality, thus, poses a number of challenges. Gillenwater (2012) summarizes that the comparison to an unobserved scenario almost always needs to be based on asymmetric information and provides misaligned incentives. The actual behavior of actors is almost always influenced by multiple factors, and

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[5] Through rebound effects, it might still not lead to lower energy consumption levels, but to shifting wealth effects..

[6] DG Budget’s July 2004 document (p. 103), Evaluating EU Activities. http://ec.europa.eu/agriculture/eval/guide/eval_activities_en.pdf

the combination of these aspects leads almost always to a level of subjectivity in the assessment of the additionality.

It is best practice to document the baseline when developing the project. Post-project reconstructions of the baselines can look very different from the assumed development at the project design stage. Typically, ex-post baselines are characterized by much better knowledge about the issue in general than the initial projects. In these cases, it is important to look at the perspective of the evaluator, in the form of the evaluation questions, in order to decide whether it is more appropriate to use the former or later. For example, for analyzing project design, it might probably be appropriate to use the ex-ante baseline, for analyzing project impacts, it might be more appropriate to use the ex-post baseline. But this depends on the purpose of the evaluation and the underlying evaluation questions.

The Clean Development Mechanism (CDM) is the project modality that has most of these issues rather strictly defined as every ton of carbon emission reduction is monetized. In the CDM, a baseline scenario is defined as a scenario “that reasonably represents the anthropogenic emissions by sources of GHG that would occur in the absence of the proposed CDM project activity” (EB 66, 2012). It is therefore one alternative future and should “reasonably represent the sum of the changes in carbon stocks in the carbon pools within the project boundary”. The CDM development has drawn up a large body of work in project baseline methodologies, e.g. for “grid-connected electricity generation from renewable sources” or many other types of project-based climate mitigation interventions.

1.6 Co-financing and other forms of joint influencing

Very few climate mitigation projects are financed by only one source of financing. The UNFCCC obliges Annex-II-Parties to make financing available for the “full incremental costs” of mitigation activities, i.e. the cost that mitigation projects have that exceed the costs of comparable activities in the baseline. This requires that the non-incremental costs for the corresponding baseline activities and the incremental climate financing coincide to finance a climate friendly investment. The line between baseline costs and incremental costs is subject to the same challenges as the baseline setting process. Therefore, it cannot be drawn with any scientific certainty. In practice, it is often a result of a negotiation process. In addition, many projects source the financing from more than one source. When these projects are evaluated, project impacts can thus be attributed to various partners, they should share the credit.

In addition project success can be contingent on a number of different preconditions. If these are not there, sometimes the intervention will be designed such that it creates or co-creates these preconditions. In consequence, there is no standardized project scope to lead to a predefined impact. For example, for installing wind turbines in Country A it might be sufficient to procure and build the turbines, while in Country B additional activities in the regulatory realm need to be designed and implemented. Both projects – when successful – will lead to the same impacts in terms of GHG benefit, but require very different effort levels and implementation time scales.

While co-financing and cooperation within projects have significant advantages in some respects (e.g. project robustness) some evaluation challenges arise. When attempting to aggregate over a larger portfolio or a number of donors, attributing the full impacts to each donor will lead to double counting. Double counting can also arise when the GHG emission reduction is attributed to each activity that contributed to the overall context of the climate mitigation effort. For example, in the case above, another project might be working with the policy makers in Country A in order to provide the regulatory framework without which the wind turbines might not have been installed. Can this project also claim the same level of benefit?

Some of these challenges need to be solved for each project. But in order to approach a solution, it might be advisable to moderate the prevailing focus on GHG reductions within the projects, and acknowledge more systematically that interim outcomes in terms of capacity building, policy frameworks, knowledge generation and other soft factors are also very important for the overall objective of global climate change mitigation. The Theory of No Change offers a framework for describing the respective roles of these barrier removal activities that can serve as an orientation for evaluating their contributions.

2 Evaluations in climate mitigation – a classification

Climate change is a global challenge – not only because it has impacts on temperatures everywhere in the world. Rather, the challenge of the greenhouse effect questions the production and consumption patterns that serve as a development ideal for many people everywhere on the planet. The transformation of our systems of production and consumption that is climate change mitigation affects most people and the way they live. To achieve the global objective of climate stabilization, interventions are necessary on every scale: global, regional, national, subnational / sectoral as well as local. This also requires evaluations on every level.

It is important to emphasize that climate mitigation interventions should align themselves with our other development objectives. For each geographic scale, the interventions have different expressions for these co-benefits – they can be called "sustainable development", "green growth", "sectoral transformation" or "local income generating opportunities", to give some examples.[7] For the theory of change aspect of evaluations this means that theories from many fields of intervention (health, community building, education, economic development) can be applied and need to be applied when looking at intervention details. If that avenue is taken, it is useful to keep in mind the climate mitigation specific indicators and aspects that will be dwelled upon in the second part of these guidelines.

Independent of this need to mainstream climate change (mitigation as well as adaptation) into most policy fields, there are different genres of climate mitigation interventions. Very linear and simple projects can take place on the local level. In these, a project can be expressed almost completely in inputs and outputs, although it will hopefully also be possible to define higher level results most of the time. The less local the focus of the intervention is, the more indirect become the program logics, and more "theory" is needed to identify the causal chain that leads from the intervention's inputs and outputs to the actual GHG mitigation results. On the global level, approaches become again rather simple as very few actual approaches exist on the global level. The approaches on the intermediate levels are not only the ones with the shortest traditions but also the ones with the most potential for catalyzing transformations and the ones with the most convoluted program theories. They will be given significant space in this discussion.

2.1 Local projects

Local projects include the simplest form of a climate mitigation intervention: the investment in a specific piece of energy efficient equipment or a renewable energy facility.[8] These projects have a long tradition in climate mitigation, including domestically in Annex-I-Countries, but also donor-funded investment projects. The classical CDM projects are local and very well monitored in terms of impacts: produce Certified Emission Reductions and are strongly monitored and validated.

Another example on the local level are community-based projects. In the mitigation area, these are prevalent where energy projects are integrated into local development projects, e.g. for bioenergy, but

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[7] For a description of co-benefits of mitigation in the energy sector, refer to UNDP (2009).

[8] This type of project includes also simple changes of energy consumption behavior like turning off the lights when leaving a room.

even more so for projects in the realm of forest management. Here community-based projects play an important role. Another example would be micro-finance institutions that lend for solar-home-systems (e.g. Grameen Shakti in Bangladesh). Their evaluations can be extremely helpful in identifying the decisive aspects for climate mitigation. Their theories of change and evaluation questions, however, do not need to be developed separately from more established fields of evaluation. For these projects, the theory of change can and should be taken from the rural development field. It is important, however, that the lessons feed back into the general climate change debate as many fundamental issues need to be addressed on this level and thus, these lessons help guide climate mitigation policy on any higher level.

The typical program theory is not very convoluted. In particular, little impact beyond the local limits of the project are typically intended. Figure 3 demonstrates an example of an investment project, like a local hydropower facility in a village. The direct accountability of the project stops after the construction of the facility. The impacts beyond the accountability ceiling are (hopefully) commensurate with the scale of the project: "local" in that sense is relative to the size of the project. For example, if you think of the Panama Canal in terms of Figure 3**Fehler! Verweisquelle konnte nicht gefunden werden.**; the GHG impacts of ship transportation are noticeable from Shanghai to Amsterdam. But, as projects of this size are the exception rather than the rule, the GHG impacts of most impacts will be hardly noticeable on the global level, and might often be eaten up by rebound effects quickly. Purely local and stand-alone interventions that strictly follow the logic from Figure 3 will hardly ever have transformative impact. Nevertheless, they form important building blocks for the more intervention on larger geographic levels.

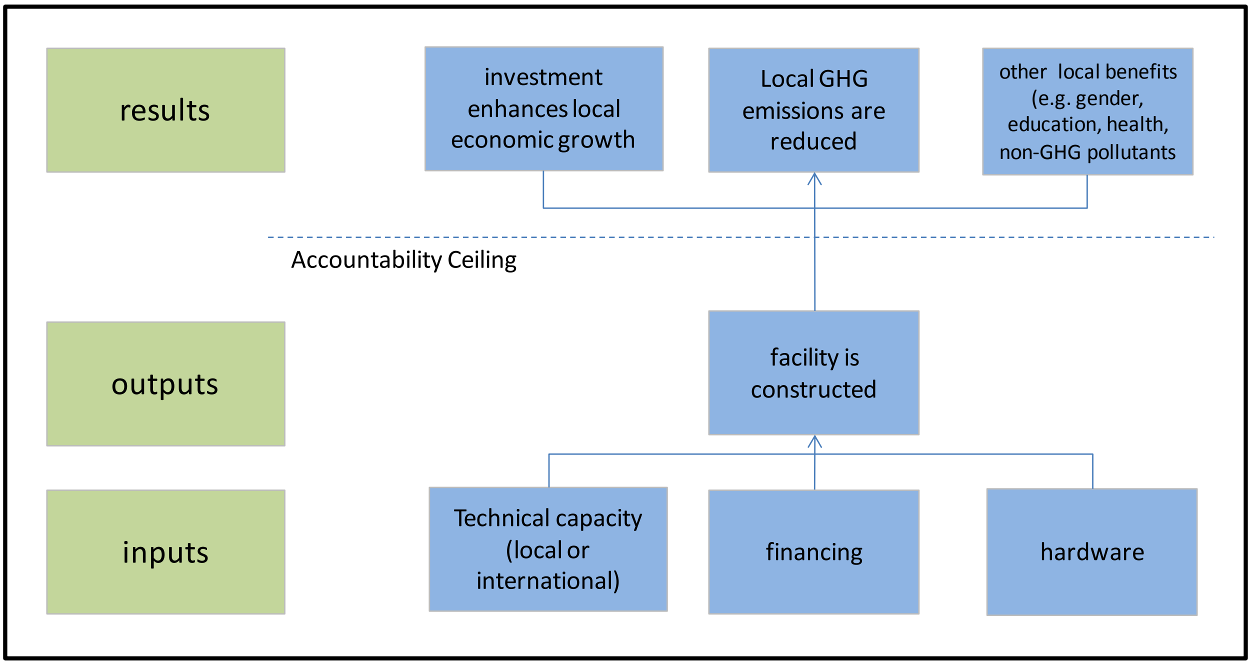


Figure 3 Typical program logic of a local project

2.2 Sub-national

A significant share of climate interventions take place on the subnational level, i.e. have a scope beyond a single investment and look at a sector, or a region. Most of the time these interventions focus on sectoral or regional capacity building.[9] Depending on the nature of the donor or agent of the intervention, they might strengthen awareness, R&D, changes in policy, education and training, technology transfer or financing. Evaluations of these interventions often start out with a similar logic as in Figure 3, just with different quality outcomes (Figure 4), implying a narrow focus on the actual inputs, outputs and outcomes of the intervention.

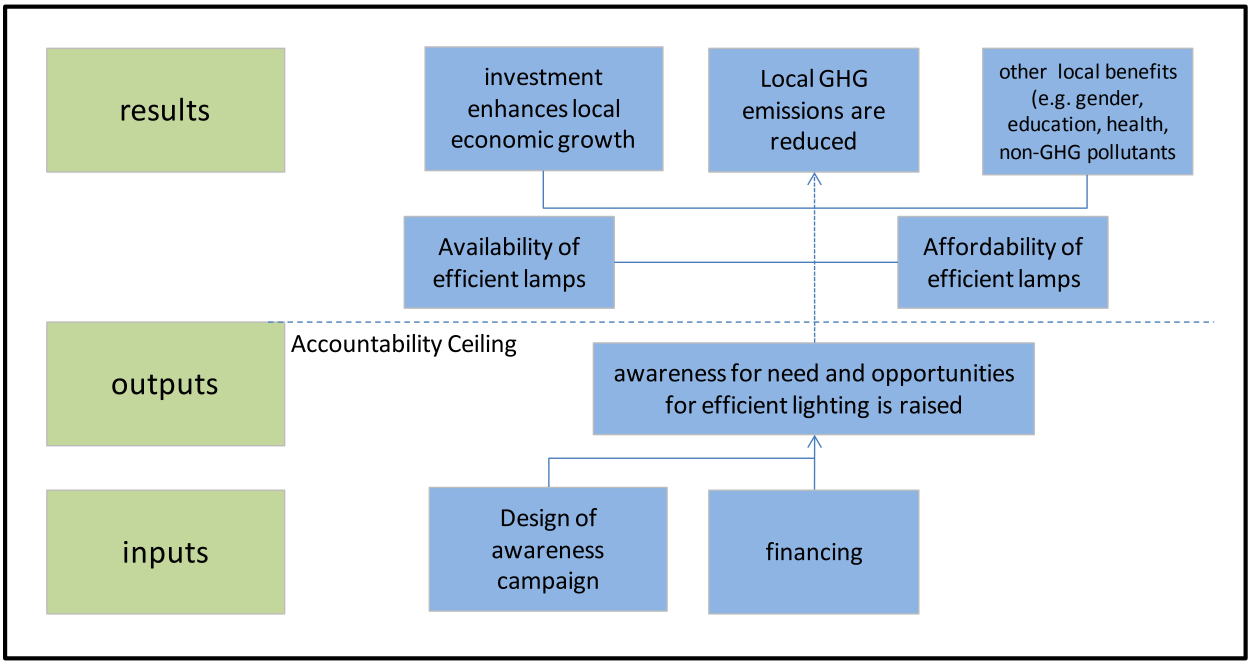


Figure 4: Linear program logic for a sectoral awareness program, e.g. for efficient lighting

Most of the time, however, these interventions need to be enhanced in its impact by preconditions that are not part of the focus of the original project plan and sit outside the "accountability ceiling". In these cases, it would be necessary to include these framework conditions in the evaluations, and discuss their impact on the intervention. If the scope of the evaluations is limited, it might not be possible to systematically analyze the overall system in an evaluation of a single sectoral intervention. This typically results in incomplete and ad-hoc analyses with less than satisfactory explanatory value and little learning potential only. Attribution of GHG or other impacts to any one of the parallel interventions is difficult without acknowledging possible overlap and synergies. For this, a more holistic theory of change for a whole sector is necessary. Such a theory of change is explained in the next section of these guidelines.

Like in the case of local interventions, climate change mitigation concerns can and should be integrated into other sectoral policies. An example for the integration of climate change concerns into other policy areas (in this case planning) is given in the evaluation framework of Balaban (2012). In this paper, the author first clearly defines, what climate change aspects have a relationship with aspects of urban

[9] Non-sector-specific interventions on the subnational level mostly target capacity building for institutions and organizations (authorities, NGOs, banking sector). They follow very similar logics as sector specific capacity building projects.

regeneration processes, why it is relevant to include climate concerns (mitigation as well as adaptation) in the urban regeneration process and how this can be done. While the framework's indicators can be used for evaluation and monitoring purposes, the abstract formulation of the relationship between the two areas leads to an appropriate theory of change for the system "inner city that is to be regenerated under the paradigms of climate change mitigation and adaptation". This theory of change can then lead to an appropriate theory of action for the specific local situation but the indicators can be used to measure progress for any such case. The theory of change as well as the indicators proposed in his study come from the academic disciplines of urban planning.

2.3 National level

States are the Parties to the UN Framework Convention on Climate Change. As such, they play a central part in formulating climate change objectives and translating them into national realities, as well as steering the national portfolio of climate mitigation interventions – none of the international funding for climate change is expected to go to the country without the active support of the national government. The role of national governments also includes the monitoring and reporting on GHG emissions, the creation of policy frameworks and the planning and implementation of national growth strategies, including transformations towards carbon-reduced development. There is a lengthy tradition in this field in Annex-I as well as Non-Annex-I countries, starting with the National Communications and gradually moving towards integrating GHG avoidance into national development policies. In the last years, a significant number of countries have developed Low Emission (or Low Carbon) Development Strategies or Green Growth Strategies. They are an important step to the general mainstreaming of the climate concern into national policies and national growth. They are accompanied by significant technical assistance and conceptual support through international organizations (e.g. UNDP 2011, CDKN 2011, World Bank 2012)

Looking at these strategies, however, it becomes clear that they consist of compilations of sectoral strategies (cf. Figure 5). Each mitigation-relevant sector is discussed separately, interventions and funding flows are specifically designed for each sector or stakeholder, and impacts are envisioned sector by sector or even project by project. At very few points, so it seems, can the "general green concern" be leveraged for significant synergies across sectors or fundamental transformation or even a new growth paradigm. This is particularly surprising as many of the interventions that are modern standards of climate policy in the public and private realm are non-sector specific: The Clean Development Mechanism as well as Emissions Trading or Corporate Responsible Procurement / Corporate Social Responsibility are specifically designed to leverage the most cost-effective mitigation potentials across sectors. Nevertheless, the evaluations of these interventions lack conceptual models that are able to evaluate effects beyond the direct impacts (e.g. for an emissions trading system: evaluating innovation effects, structural transformation, industrial process efficiency, instead of mere accounting of emission allowances and maybe trade flows).

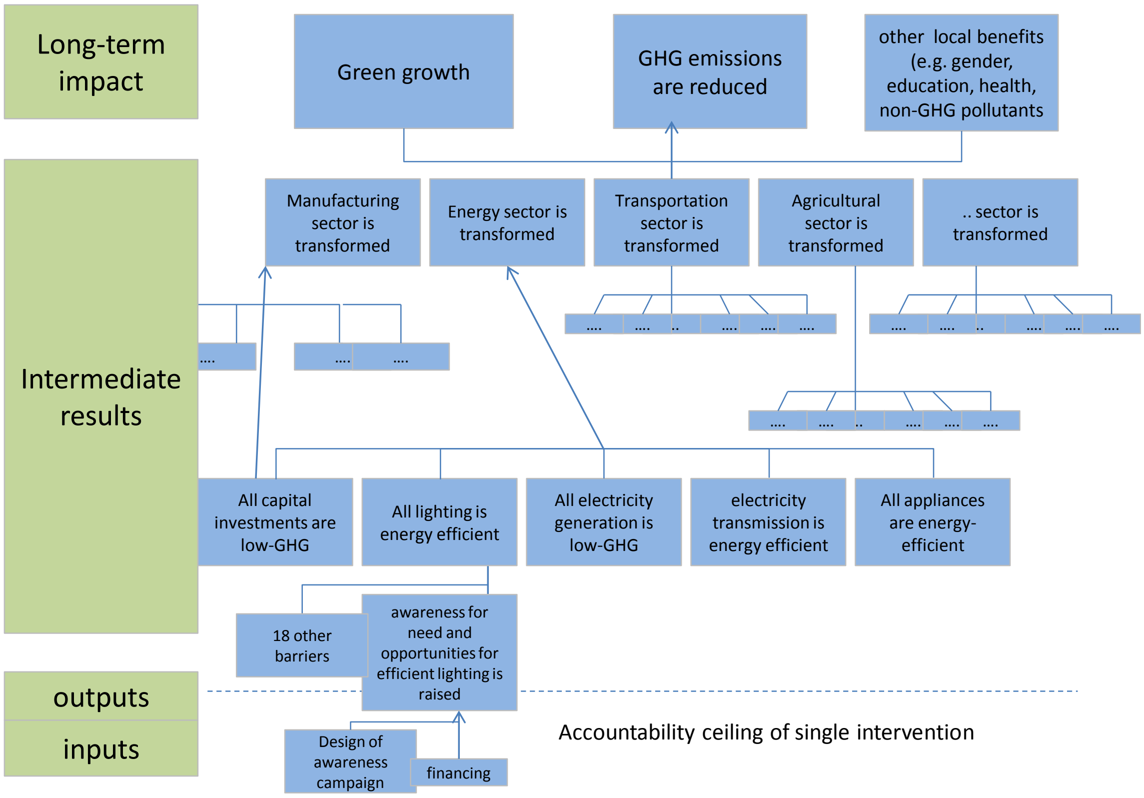


Figure 5 Economy-wide transformation is composed of sectoral transformation

2.4 Global level

Similarly, on the global level, evaluations are restricted to accounting: On a regular basis, IPCC evaluates the current emission trends, and evaluates them in terms of how far away they are from a sustainable global trend. However, here, too, any deeper analysis is a bottom-up compilation from the national level. For a number of specific technologies, IEA and REN21 publish regular report on the deployment trends of these technologies. In some of these, particular the IEA Energy Technology Perspectives Report, more substantive analyses of innovation and diffusion processes are conducted that help understand processes, draw lessons and allow for benchmarking (aid) efficiency. However, mostly, interventions on the national, regional and global levels are planned and evaluated as the sum of greenhouse gas emitting sectors rather than systems in their own right.

2.5 Synopsis

Table 1 illustrates the hierarchy of intervention levels with some examples of climate mitigation evaluations on various geographic scales and with different evaluation objects.

Table 1 Climate mitigation evaluations on different geographic scales

Geographic scale	evaluation object	example for intervention	typical theories of change if any	typical evaluation question	typical evaluation type	cobenefit	example for evaluation
global / regional	commitments	Kyoto-Protocol; GCF commitment	static accounting, no theory of change	Have commitments been acted upon? To what effect? What other benefits have accrued? Are objectives attainable?	ongoing evaluation, formative evaluation	economic growth, enhanced energy independence, health benefits, jobs	climate finance mapping paper (UNEP / KfW)
	achievements						
	cooperation mechanisms	CDM	mostly static accounting, but could be e.g. diffusion of innovation (E. Rogers)	How many emissions have been avoided? Has this avoidance been additional and cost-effective? What were the sustainable development benefits? How high were the funding streams? Which partners were particularly active and why? Recommendations for the future of the mechanisms?	impact evaluation	sustainable development	
	technology transfer		diffusion of innovation	How wide spread is a mitigation technology? Who adopted it? Why? What capacities have been built? What were the factors that favored its dissemination? How can this experience be replicated / how can costly errors be avoided in the future?	impact evaluation, process evaluation	innovation, technological development	REN21 Global Status Report; IEA Energy Technology Report
regional	country policies / comparison		static accounting, no theory of change	Whose policy works better? Why? Which lessons can be extracted and transfered?	impact evaluation		IEA 25 Energy efficiency evaluation
national	green economy / low carbon development strategy	National Development Plan	composite of sectoral models	how far have we come? (outcomes, impacts)	formative evaluation, impact evaluation, developmental evaluation	sustainable development	IEA WEO
				where will we get if we continue on this track?	ex-ante		IPCC SRES
	poverty reduction strategy	Development Assistance Framework	composite of sectoral models	how far have we come? (outcomes, impacts)	Results-based Monitoring		
	elements of national green growth strategy	budgetary support for national cc program; national CDM program	input-output / linear logic / WYSIWYG	How much funding has been delivered? Is the funding used for the purposes agreed? What impact is it having on climate adaptation and mitigation outcomes?	formative evaluation, impact evaluation, developmental evaluation		Nepal Climate Public Expenditure and Institutional Review (CPEIR)

Geographic scale	evaluation object	example for intervention	typical theories of change if any	typical evaluation question	typical evaluation type	cobenefit	example for evaluation
sectoral	sectoral transformation program		barrier model / Theory of No Change	Have the barriers to market development been removed?	formative evaluation, impact evaluation, developmental evaluation	economic growth, enhanced energy independence, health benefits, jobs	
	technology transfer	technology center	diffusion of innovation	How wide spread is a mitigation technology? Who adopted it? Why?	Results-based Monitoring	jobs	
	capacity building project	teaching and training program	organizations / knowledge management	Has the local capacity (to solve CC challenges, to make good policies, to use mitigation technologies, etc) improved?	Results-based Monitoring	jobs	
	policy change	renewable energy feed-in tariff; energy efficiency standard	economic policy	What policies were implemented? What impacts resulted from the policy change? What stakeholders took part in the change? Will the change have lasting impact?	impact evaluation	economic growth, enhanced energy independence	
	R&D funding	international research collaboration		Were new technologies developed that help mitigate climate change? Was research capacity enhanced?	Results-based Monitoring	capacity building	
	advocacy	national awareness campaign	advocacy evaluation	did the advocacy effort change mindsets and awareness for CC issues?	impact evaluation, developmental evaluation		
local	single investment project	CDM-Project	input-output / linear logic / WYSIWYG	was the investment implemented as envisioned?	summative evaluation / survey	demonstration effect, capacity building	
	community based project		development sociology	was the investment implemented as envisioned? What were the benefits for the local community?	impact evaluation	income generating opportunity	

Summing up this discussion the most interesting level for evaluating climate mitigation to date is the sectoral level. The reason for this is clear: single investments or single communities cannot suffice for large-scale savings in greenhouse gas emissions. Their main contribution to the global problem of climate change lies in being demonstrations and role models for multiple replications on a sectoral level. With this, they can partially remove some barriers to the necessary path of development which goes significantly beyond any single investment: It is the whole greenhouse-gas-emitting sector that needs to be transformed. Good (local) practices as implemented by pioneering communities or investors can contribute by showing the way and demonstrating what are the preconditions under which the large-scale replication and sustainable sectoral development can be achieved. They might serve as benchmarks or help assess the inputs needed for achieving sectoral transformation. But the main impact will only be achieved through action on a sectoral level.

But is it not more desirable to leverage transformation on the national or international level? Yes, and it is decisive for effective climate mitigation. National reporting and international aggregation of data on greenhouse gas emissions is the most important indicator for international and regional obligations and the central objective of the climate convention. However, nation-wide climate mitigation strategies so far are composed of sectoral components by simple addition.

Most of the time, the IPCC mitigation sectors are used as a unit of analysis. These are: energy supply, transportation, residential and commercial buildings, industry, agriculture, forestry, and waste and wastewater (Barker et al 2007). It is possible to choose other categories, or look at single product markets in particular.

3 Measuring GHG emission reductions – concepts and methods

Climate change mitigation projects are conducted with the objective of reducing carbon or greenhouse gases (GHG). Nevertheless, a large number of projects do not include the actual reduction of emissions in their outputs, but focus on capacity building, attitude changes, scientific studies or policy development in their respective project domains. These projects will lead to emission reductions only outside of their project boundary. In monitoring and evaluation, it is normally not possible to assess emissions inside and outside of the project boundaries with the same degree of certainty. On the other hand, the ultimate objective of any climate mitigation project by definition is to limit the rise of atmospheric GHG concentrations, so that all evaluations will require some discussion of climate mitigation impacts, no matter whether or not they take place within or outside of the boundaries of the project. In order to strengthen the case for relevance of these projects, donors often require quantification of the GHG impacts.

3.1 Terminology

Depending on the project boundaries, the nature of the system in which the project takes place, and the nature of the project, different types of GHG emission reductions need to be distinguished. We will distinguish three different accounting concepts ("real" emission reductions, carbon footprint reductions, and conceptualized emission reductions); two levels of immediacy ("primary" and "secondary") and three levels of attributability ("direct", "indirect" and "post-project").

We propose to distinguish between the two levels of immediacy with which project activities lead to GHG emission reductions: primary reductions happen because the project affects energy consumption or sinks directly, through investment measures. On the other hand, secondary emission reductions take place as a consequence of a project's catalytic or barrier removal impact. For example in energy efficiency projects, primary emission reductions are associated with incentives for changes in energy consumption behavior or investments, secondary emission reductions result from capacity building or policy-oriented projects.

Many interventions strive for replication after the project. These replications will then have to happen without inputs from the intervention, based on other resources. The attributability of these replications is not as strong as for the impacts that happen directly under the project. We will call them "indirect" GHG savings. There is an intermediate level of attributability where the intervention puts in place facilities or organizations, that keep leading directly to impacts even after the end of the intervention. An example for that are revolving funds for investments in energy efficiency or renewable energy that can keep operating and lending money for further investments after the project's termination. We will call these "post-project GHG emission reductions".

GHG mitigation opportunities occur in many shapes. The obvious savings are caused by the direct reduction of energy consumptions or organic matter mineralization rates. However, mitigation can also take place through the reduction of "embedded energy" (and consequently "embedded emissions). This type of reduction can be measured with a different carbon accounting concept. Most of the time the concept of the *carbon footprint* is used for that. *Carbon Footprint Reductions* happen because the project changes consumption patterns of energy-intensive products, or other forms of embedded emissions.

Lastly, a large number of climate mitigation interventions are conducting studies and analyses of energy savings potentials, or renewable energy deployment, or they design schemes for energy efficient buildings or renovation. In these, carbon emission reductions are often quantified, but not implemented. We will call these "*conceptualized GHG emission reductions*" – obviously the weakest concept, as they are contingent on further implementation action in order to reduce GHG impacts. It is important to note that GHG emission reductions that have been determined with different accounting concepts cannot be added to one another, and comparisons are taken with caution.

All these have been the objective of climate mitigation interventions and subject to evaluations. They can be determined with different levels of certainty. To help categorize the different emissions and gain more analytical depth, we have illustrated the definitions in Figure 6. These different distinctions can be combined – a carbon footprint reduction can be indirect and secondary. Table 2 gives some examples for a number of such cross-sections. As this table shows, not all accounting concepts can (or need to) be matched with all of the attributability levels.

Table 2 GHG accounting concepts relative to project domains and some project examples that lead to the respective reductions

	Primary emission reductions	**Secondary emission reductions**	**Carbon footprint reductions**
Direct emission reductions in the project domain	Substituting renewable fuels for fossil fuels	Building bicycle lanes	
Off-site / indirect emission reductions (outside of the project domain)	Implementation of electricity saving measures	certification of technicians	Saving water
Post-project emission reductions	Solar water heaters continue to avoid GHG emissions after the project	Replication investment, capacity building	Long-lasting improvements of water infrastructure

Figure 6 illustrates the relationship of primary and secondary reduction impacts and their correspondence with direct and indirect emission reductions.

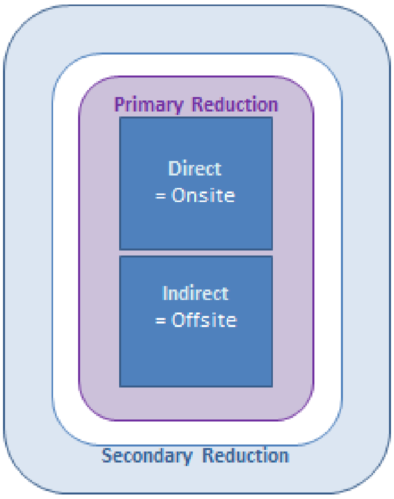


Figure 6 Illustration of the different emission reduction types

While this is an attempt to harmonize and clarify some of the concepts, it is necessary to acknowledge that many organizations that evaluate climate mitigation projects have already developed terminologies and methods for distinguishing between these types of GHG impacts. The reader is reminded that there is no standard terminology and different authors might use the terminology differently (in particular the term “indirect”).

In the following, we will first discuss in more detail the evaluation of primary emission reductions, and distinguish between direct, indirect and post-project reductions for this example. In section 3.3 we will discuss the secondary impacts, in section 3.4 the application of the carbon footprint accounting concept, and in section 3.5 we will briefly go into the conceptualized emission reductions.

3.2 Primary Emission Reductions

Primary emissions reductions are those emission reductions that are the direct consequence of the change in the behavior of the target group of the intervention. For example, projects that include the installation of a new energy technology as part of their outputs, i.e. “under” their accountability ceiling result in primary emission reductions. Within the framework of what we define as primary reduction, direct, indirect and post project emission reductions can be distinguished.

3.2.1 Direct Emission Reductions

Direct emissions are the emissions caused in the domain that is changed by the intervention. E.g. in the case of a bus rapid transit system investment, the emissions of the transport system are directly reduced within the project domain and during the project’s lifetime.

Unfortunately in the literature the concept of direct emission reductions is also applied to emissions reduced in other places than the immediate project site but within the project boundary. An example would be a power saver project for households that reduces the emissions of power plants. This definition of “direct emission reduction” is established for example with GEF and GIZ. Others, like the California Registry, refer to it these as “indirect emission reductions”, because they occur offsite, outside of the project’s physical boundaries. GEF and GIZ on the other hand use “indirect emission reductions” to describe among other things replications of projects.

Figure 7 illustrates the difference in understanding.

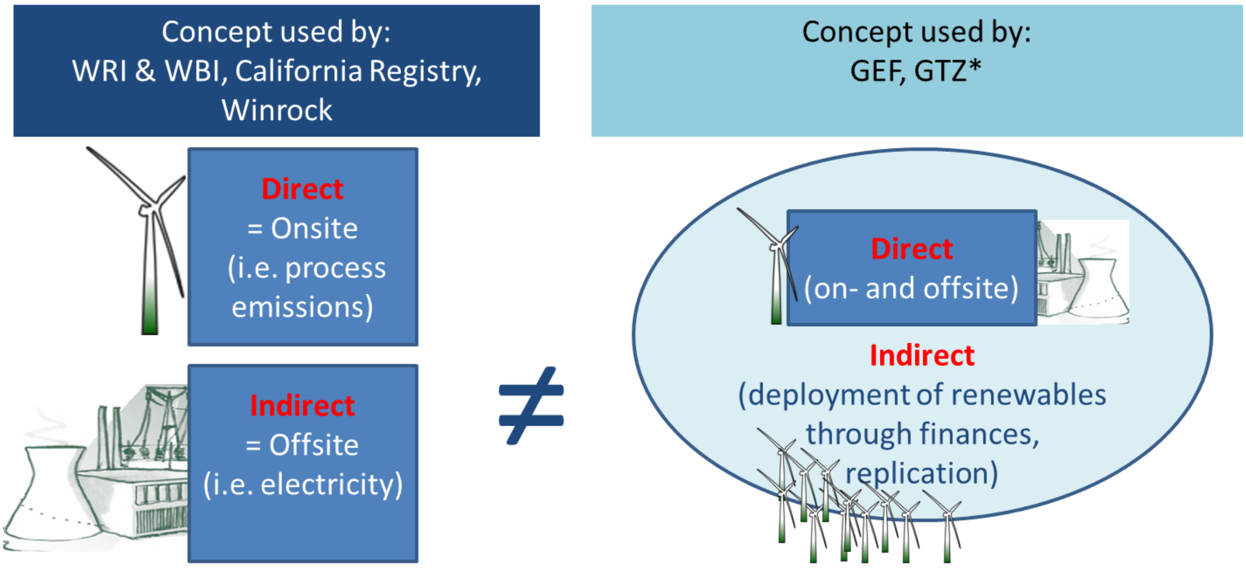


Figure 7 Competing concepts of indirect and direct emission reductions

Net direct emission reductions are for example caused by substitution of a GHG source with a less-emitting technology that can be measured in a specific plant or the creation or sustaining of GHG sinks. The reduction needs to be calculated in comparison to a hypothetical counterfactual (the baseline) of "what would have happened if this project would not have happened". Examples for such reductions are the construction of renewable energy plants e.g. a micro hydro power plant, or CDM projects. In the case of a micro hydro power plant the calculation could be as follows:

The capacity of the micro hydro power plant times the number of power plants installed in a given year times hours per day that the alternative plant runs – in this case the baseline is a diesel generator times 365 days per year times the emission factor of the diesel generator (GTZ, 2008).

CO_2 saving/yr = 26.5 kW x 20 nos. x 4 h/d x 365 d/yr x 1.3 kg CO_2/kWh = 1006 tCO_2/yr

Direct and primary emission reductions are the basis for the CDM methodology and payments (see box).

Example: CDM Project Activity "Hunan Chenzhou Xiangdian Luhejin 48MW Wind Power Project" in the People's Republic of China

In the baseline scenario emissions from power generation of Central China Power Grid are estimated.

Baseline emissions/year = Electricity supplied by the project activity to the grid in year *y* (MWh) *Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using "Tool to calculate the emission factor for an electricity system" (Version 02.2.1)

BEy = EGfacility,y · EFgrid,CM,y = 90,074 MWh * 0.87705 tCO2e/MWh = 78,999 tCO2 e

Leakage is ignored in this project as the methodology ACM0002 / Version 13.0.0 states „the main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected.“ There is no use of fossil fuel for the Wind project, so as the project is a green field wind power project, thus project emission is zero.

The total emission reductions from the project are estimated to be 552,993 t of CO2e over a seven years crediting period, averaging 78,999 t of CO2e annually.

Baseline emissions/year	- project emission/year	= emission reduction/year
78,999	- 0	= 78,999tCO2e

http://cdm.unfccc.int/filestorage/x/g/W15JE0QNKOTZCD7UXRHYILFBP9SM68.pdf/PDD_Luhejin.pdf?t=aE58bWM1MnA5fDDvWalK2947bPqpXmX7lnUH

3.2.2 Indirect emission reductions (Off-site)

Indirect emissions occur when the emission reductions happen off-site, outside of the project domain. The simplest example is the reduction of electricity that produce emissions in coal power plants in other sites. The reduction does not occur at the project site or under the direct control of project stakeholders but at the fossil fuel power plant. They are a primary reduction because the reducing measure occurs within the project boundary.

Indirect emission reductions most of the time require the use of approximations and conversions. To monitor the indirect reduction effect of a project the GIZ[10] is applying the AURA impact monitoring concept[11] and is thereby ideally trying to establish a relationship between the project activity and its impact (GTZ, 2008).

GTZ Project: Micro-hydro power Plant Project in Peru

In the case of the micro-hydro power plant project mentioned above, the indirect project impact could [12]be an additional 20 power projects to be constructed after the initial demonstration project proved to be successful. The indirect emission reduction is the result of the capacity of the additional micro hydro power plant times the number of power plants installed in a given year times hours per day that the alternative plant runs – in this case the baseline is a diesel generator times 365 days per year times the emission factor of the diesel generator (GTZ, 2008).

Indirect emission reduction in tCO_2/a = 35 kW x 20 nos. x 6 h/d x 365 d/yr x 1.3 kg CO_2/kWh

GEF estimates the indirect effect of a project by a bottom-up approach by multiplying the measured project impacts with an expert estimate on its likely replication. The bottom-up approach can be

[10] GIZ (Gesellschaft für Internationale Zusammenarbeit) is the successor organization of GTZ (Gesellschaft für Technische Zusammenarbeit)

[11] The GTZ introduced the contracting procedure under the „Development Policy Framework for Contracts and Cooperation“ (AURA =„Entwicklungspolitischer Auftragsrahmen“) in 2002 with a view to strengthen its results orientation (e.g. Wagner, 2008)

[12] In the terminology utilized by the GIZ these reductions are called „indirect impact“

complemented by a top-down approach that estimates what share of the national deployment potential of that technology will be tapped as consequence of the intervention over the 10 years after a project's finalization. Since secondary and indirect effects have very high levels of uncertainty and a severe causality problem, GEF uses a causality factor, e.g. 80% to attribute changes to a GEF project. Due to the different certainties attached to these reductions GEF is not recommending to add direct and indirect reduction figures into one sum (GEF, 2008).

UNDP/GEF Project: Improving the energy efficiency of lighting and other building appliances

"The cumulative **direct GHG reduction** benefits of the project have been estimated at **0.95 Mt of CO_2eq** resulting from the agreed financial support schemes for EE lighting and calculated over the expected lifetime of the appliances sold under these schemes. The project may also result in direct post-project GHG reduction benefits, but given the nature of the financial support mechanisms agreed so far, they cannot yet be accurately predicted or quantified. The cumulative indirect GHG reduction benefits of the project to 2025 have been estimated at the **upper end to be 176 Mt of CO_2eq** and at the lower end to be roughly half of this – i.e. 88 Mt of CO2eq. This is calculated from the estimated incremental increase in energy efficiency and associated reduction of unit. With a **causality factor of 60%,** the cumulative indirect GHG savings until 2025 for the lower-end scenario can be **estimated at 53 Mt of CO_2eq**, which has been considered as the expected minimum indirect cumulative impact of the successful project implementation over the period 2011-2025 i.e. from the project start until ten years after its expected closure. (…)The combined direct and indirect global benefits of the project resulting from the new regulations and foreseen investment support schemes implemented by the project have been assessed to be **between 54 and 107 million tonnes of CO_2** compared to the baseline."

3.3 Secondary greenhouse gas reductions

Technical and financial development projects that have mitigation impacts often work through activities in the field of policy-advisory, training and capacity building measures as well as the development of financial mechanisms, facilitating future market development or removing barriers. To quantify the GHG impact of these projects we refer to these as "secondary reductions", signifying that these impacts will not be part of the project's outputs but result from changed attitudes, knowledge levels or infrastructure and regulatory frameworks provided through the project. The improvement of these framework conditions can lead to positive climate protection effects but more conditions are involved, and thus these reductions are not the primary consequences of the intervention's activities.

To give an example the improvement of infrastructure such as bicycle lanes combined with a cycling promotion campaign, shall enable people to travel more by bike. The direct GHG emission effects of such a project are actually increasing emissions through construction and campaigning activities. The actual emission reduction riding ones bike instead of using a car is an indirect and secondary reduction. The project removed barriers to cycling and thus led indirectly to net emission reductions. If the project is replicated, e.g. another city is using the same strategy and material, this duplication of the project counts also as a secondary reduction, because it occurs outside the set boundary. Since the second city might count the achieved reductions as their own, the risk of double counting occurs and the secondary reduction can be reported, but cannot be used to acquire e.g. emission certificates.

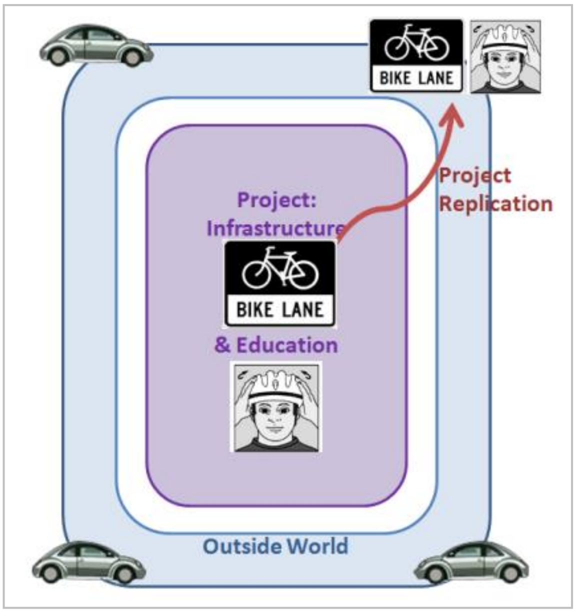


Figure 8 Example of secondary and secondary indirect emission reduction effect

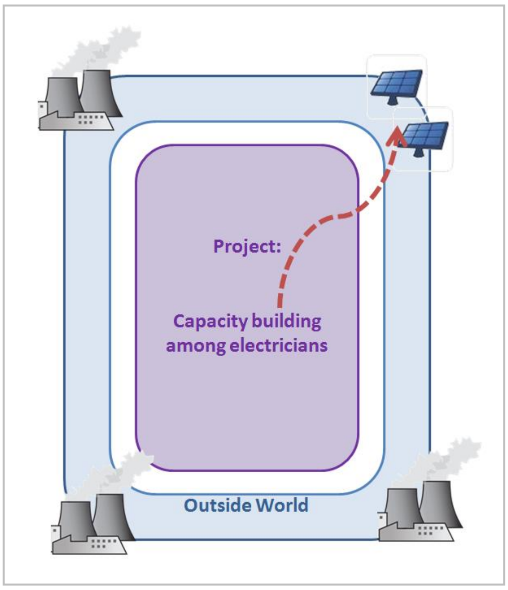
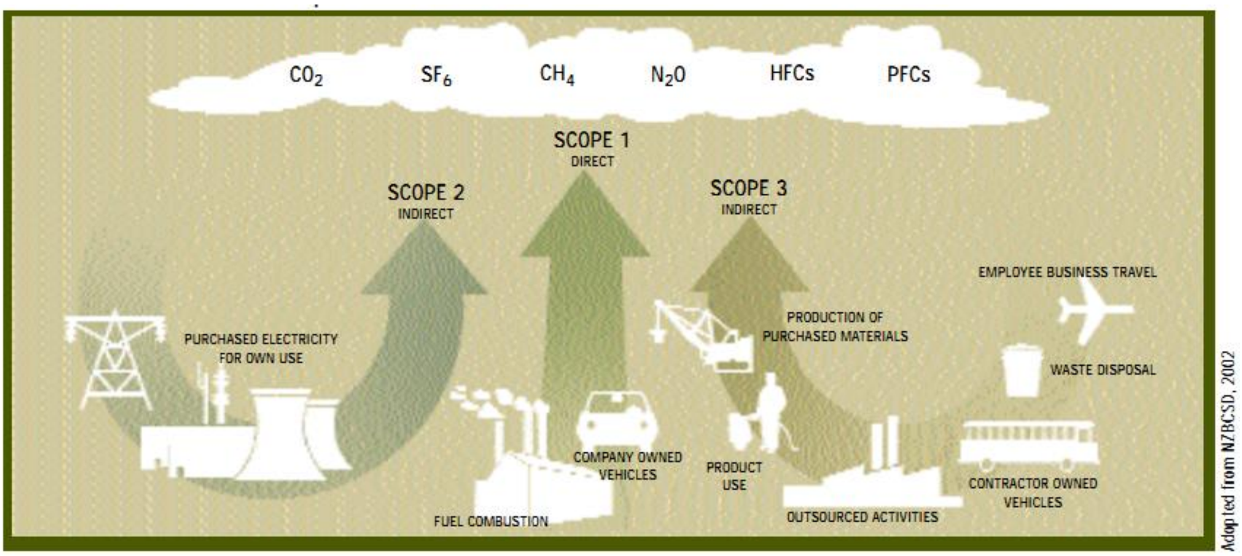


Figure 9 Example of secondary emission reduction effect

Vine (1999, p.17) gives a number of examples where the change in behavior is replicated as a consequence of the project but not as part of the project: “Spillover effects can occur through a variety of channels including: (1) an individual hearing about a project measure from a participant and deciding to pursue it on his or her own (“free drivers”); (2) project participants that undertake additional, but unaided, energy- efficiency actions based on positive experience with the project; (3) manufacturers changing the efficiency of their products, or retailers and wholesalers changing the composition of their inventories to reflect the demand for more efficient goods created through the project; (4) governments adopting new building codes or appliance standards because of improvements to appliances resulting from one or more energy efficiency projects; or, (5) technology transfer efforts by project participants which help reduce market barriers throughout a region or country.”

3.4 Carbon Footprint Concept

The ‘carbon footprint’ of a product or an activity is the sum of all GHG emissions that were emitted for the inputs of a good or service, during its use or consumption (direct emissions) and after the use, e.g. recycling or destruction. Figure 10 depicts which emissions are included in the concept.



Source: WRI &WBC 2004
Figure 10 Emission accounting in the carbon footprint concept

Scope 1 refers to direct emissions of the activity (e.g. driving a car). Scope 2 and 3 include indirect emissions. They are utilized in the carbon foot print debate in a different way than in project impact assessments. WRI & WBC (2004) understand indirect GHG emissions as emissions “that are a consequence of the activities of the company but occur at sources owned or controlled by another company”. The difference is one of control rather than space or time. Indirect GHG emissions are divided into Scope 2, which are emissions from purchased heat and electricity (e.g. in the car example: the fuel), and Scope 3 emissions from the supply chain, e.g. from the extraction of materials, business travel or wastes (e.g. in the car example: the emissions from producing the car). Instead of the term “scope 3 emissions”, other organizations prefer the use of upstream-, embedded- or embodied emissions. Figure 11 sorts the scopes in space and time dimensions to clarify, that this concept’s main purpose is to clarify responsibilities. Indirect emissions according to Scope 3 take place along the time axis before (upstream) and after the activity or consumption (downstream). All three types of Scopes can be found in different geographical locations.

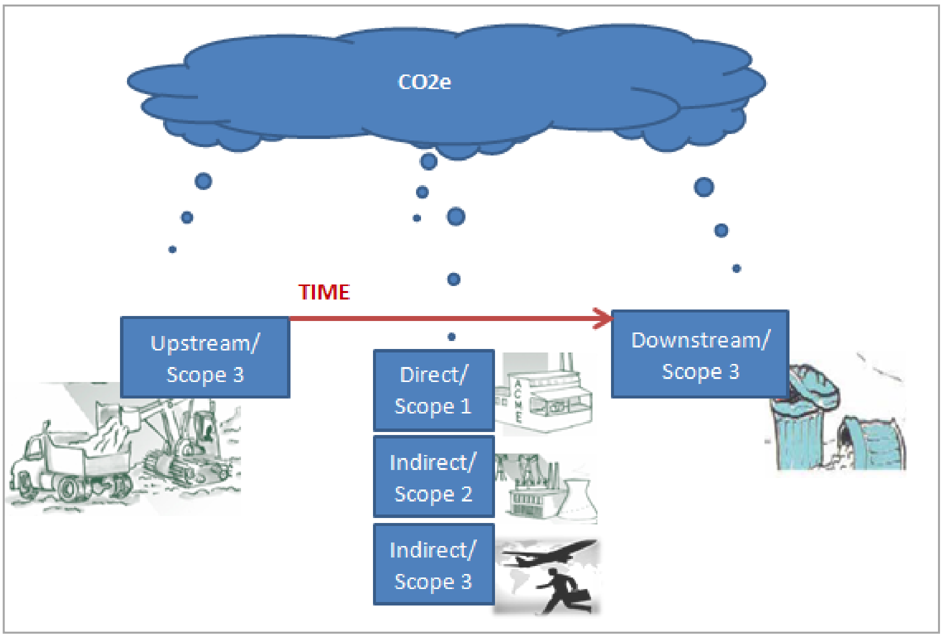


Figure 11 Visualization of the Carbon Footprint Concept in space and time dimension

Carbon footprint is the emission type to use when evaluating the impacts of changing consumption patterns or lifestyles / ways of doing business. It is an all-encompassing method and of particular importance if an activity takes place in an area where direct emissions do not play the biggest role, e.g. in the comparison of meat-eating and vegetarian lifestyles.

3.5 Conceptualized Emission Reductions

Many climate change mitigation interventions take the form of concepts, e.g. plans for market development, blueprints for hydro- or wind power plants, schedules for completion of housing renovations. These often also quantify the emission reductions that would result if the blueprint would be realized. However, just by completing these projects, i.e. writing up the concept, no single kg of GHG emissions has been saved. We call these “conceptualized emission reductions”. Conceptualized reductions are the result of projects that help plan climate mitigation interventions, for example analyses of energy saving potentials of a specific technology or policy in a given geographic and economic context. They are highly contingent on assumptions that are made for their calculation and can only lead to climate protection when follow-up projects lead to an implementation of the measures that have been conceptualized, e.g. energy savings. They are sometimes a very important part of the logic chain that leads to more climate-friendly behavior, for example in those cases where the project consist in finding a cost effective way to replace inefficient lighting, and the only thing that is needed is more information on how much energy (costs and emissions) would be saved. If such interventions are evaluated, e.g. in the context of a program evaluation, it is tempting to add up the calculated emission reductions in each “concept” in order to demonstrate the achievements and importance of this program. A practical use for this concept was for example the evaluation of the German National Climate Initiative in the funding of climate change concepts for local communities. The concepts financed by the federal government identified the emission reduction potential in a community. This potential included for example more efficient lighting of streets, other reductions of electricity consumption and the insulation of public buildings to reduce heat demand. The sum of the potential activities was calculated and forms the “conceptualized” emission reduction.

However, if these concepts do not lead to installations and real-life actions, these emission reductions are hypothetical only. If the implementation of these blueprints is not part of the project, these reductions cannot be monitored within a direct post-project evaluation and therefore not verified. Conceptualized emission reductions are the reductions that would occur if a project, a facility, a way of living that has been developed as a blueprint during the course of a project, would be put in place. Since the reductions presented in the concepts all lie in the future they cannot be measured within the evaluation time frame. The actual reduction could be measured if measures are implemented and evaluated at a later point in time. On the other hand, frequently it will be difficult to establish a causal relationship between the concept and this realization of the ideas. Conceptualized emission reductions have to be handled with an increased caution and cannot be added to direct emission reductions. If projects and concepts are developed in the same program, for example, both types of reductions need to be calculated and presented separately due to the different levels of realism and verifiability.

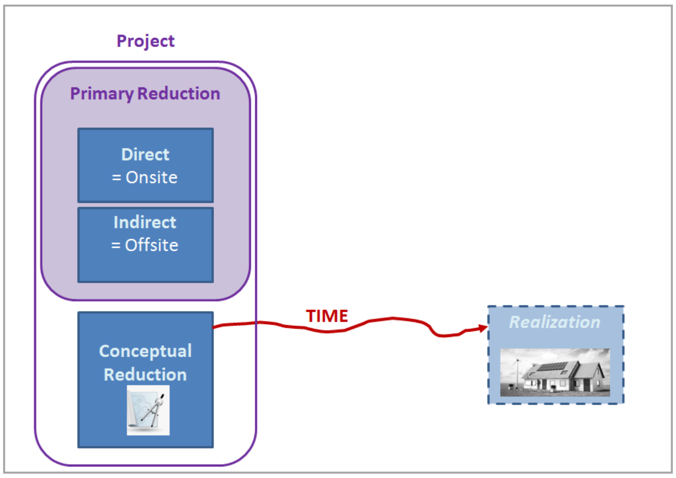


Figure 12 Illustration of the concept of conceptualized emission reductions

4 OECD-DAC-Indicators

Many climate mitigation projects take place in the context of Official Development Assistance (ODA). The Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD) has agreed on five major indicators for ODA interventions:

- Relevance
- Aid effectiveness
- Efficiency
- Impacts / results and
- Sustainability.

These five indicators represent good practice for the evaluation of (development) projects in general, including climate mitigation projects. For the climate mitigation evaluation context, it is - in some respects possible to formulate them slightly more specifically than in the general definitions of the OECD-DAC. The founding document of the OECD DAC criteria is “Principles for Evaluation of Development Assistance” (1991), but the formulations chosen in the following are taken from the OECD (2010).

4.1 Relevance

The OECD DAC evaluation criterion of “relevance” is rephrased in OECD (2010) as follows:

> *“The extent to which the aid activity is suited to the priorities and policies of the target group, recipient and donor. In evaluating the relevance of a programme or a project, it is useful to consider the following questions:*

- *To what extent are the objectives of the program still valid?*
- *Are the activities and outputs of the program consistent with the overall goal and the attainment of its objectives?*
- *Are the activities and outputs of the program consistent with the intended impacts and effects?”*

This criterion reflects the alignment of the project with the priorities of the intervention’s stakeholders, be they the beneficiaries, the recipients or the donors. This question can be expressed in a number of other dimensions, e.g. through country drivenness or country ownership. In this sense, one could adjust the questions for climate changes into:

- To what extent is the climate mitigation objective aligned well with other development objectives?
- What other development benefits have been achieved through the climate mitigation intervention?
- Did the intervention strengthen the local commitment to climate mitigation?

Often this alignment is evaluated by looking at national planning documents and identifying the degree to which climate mitigation concerns are incorporated. A number of different documents can be used for this, and they express the general local commitment to climate mitigation to different degrees. For example, climate change will be always mentioned in the National Communications to the UN Framework Convention on Climate Change. It might be mentioned in the National development cooperation coordination documents and country assistance framework agreements. Country ownership is stronger when it is also endorsed by or mentioned in the documents of Ministries that are not necessarily part of the climate finance project cycle but responsible for the GHG emitting sectors, like the energy plan, or the rural development strategy.

In most donor funded initiatives the government will complement the project with in-country funds or in-kind contribution. Sometimes, thus, the criterion is measured in terms of the willingness to co-finance a project. If this willingness is high with a specific stakeholder, it is an indication that the project is aligned with the priorities of the stakeholder and therefore that the project is very relevant to the priorities of that stakeholder.

Looking at it through a different lens, one stakeholder of climate mitigation is the global community. It would be possible to apply the "relevance" criterion such as to evaluate whether the project is able to contribute significant amounts toward that objective of stabilizing the global atmosphere. However, the challenge of stabilizing GHG levels in the atmosphere has been acknowledged to be so big that very few projects could claim to be absolutely decisive for the stabilization. The challenge is too large for any single effort in terms of scale, scope and time horizons. A policy of small steps is generally accepted as the necessary and logical result of this consideration. This begs the question whether any endeavor can be too small to be relevant.

A third interpretation of the OECD-DAC Criterion of Relevance is to test, whether it is actually a climate change mitigation project by using the OECD Rio Marker approach. OECD tracks climate funding by evaluating whether a project has climate change mitigation or adaptation as a "significant" or "principal" objective. The difference between "principal" and "significant" in this context is that in the former case, the project would not have been undertaken without the climate-related objective, while projects with "significant" climate relevance would have been undertaken even without including climate in its objectives.

4.2 Aid effectiveness

OECD (2010) gives the following longer formulation of the criterion of aid effectiveness:

> *"A measure of the extent to which an aid activity attains its objectives. In evaluating the effectiveness of a programme or a project, it is useful to consider the following questions:*
>
> *• To what extent were the objectives achieved / are likely to be achieved?*
> *• What were the major factors influencing the achievement or non-achievement of the objectives?"*

These lead questions can be used directly for evaluating climate change mitigation interventions.

In addition, this criterion has been expanded by a defining international discussion process on the basis of the Paris Declaration on Aid Effectiveness. This declaration was followed by the Ghana and Busan processes. At the 4th High Level Forum on Aid Effectiveness 2011 in Busan, the Busan Partnership for Effective Development Cooperation was agreed upon. In the Busan process, the aid effectiveness criterion was applied to a number of thematic contexts and a number of preconditions were distilled from the collective knowledge of the participants in this process. The emerging lessons on climate finance were formulated in a "Building Block" of itself.

It was stated there that the effectiveness of climate finance can be enhanced by strengthening linkages between climate change finance and countries' planning, budgeting and public financial management systems – similar to the definition of relevance discussed above. Climate finance is made more effective through promoting lesson-learning across countries and policy area as well as between the various international negotiation processes. Climate finance should be delivered equitably and needs to be predictable. Last but not least, public climate finance needs to catalyze private finance. On this basis it is possible to not only assess whether objectives were achieved or not, but also whether or not they followed the guidance from the Busan Building Block on Climate Finance which can also serve as the basis for formulating evaluation questions or criteria.

4.3 Efficiency

According to OECD (2010) efficiency

> *"measures the outputs – qualitative and quantitative – in relation to the inputs. It is an economic term which is used to assess the extent to which aid uses the least costly resources possible in order to achieve the desired results. This generally requires comparing alternative approaches to achieving the same outputs, to see whether the most efficient process has been adopted.*
> *When evaluating the efficiency of a program or a project, it is useful to consider the following questions:*

- *Were activities cost-efficient?*
- *Were objectives achieved on time?*
- *Was the program or project implemented in the most efficient way compared to alternatives?"*

Efficiency is normally defined as the most economical way to achieve a certain desired outcome. Palenberg (2011) investigates a large number of methodologies for measuring aid efficiency, drawing on concepts from various sub disciplines of economics. He points out that sometimes data do not allow to find a strong definition for aid efficiency. In these cases it is possible that different evaluators would come to different conclusions and potentially inconsistent recommendations. In addition to the data limitations, it is most of the time very hard to identify which way would be the most economical way to achieve a specific outcome.

For climate mitigation projects, the OECD questions can be applied directly. However, sometimes this efficiency criterion is defined as "are GHG benefits maximized for the given project amount". This leads into a number of traps, which we will call the Benefits Trap, the Cost Trap, and the Merit Order Trap.

The Benefits Trap: The benefits of climate change mitigation are sometimes reduced to "tons of GHG emissions saved." This excludes any external (environmental) benefits that result as a consequence of saved GHG emissions, e.g. reduced risk of climate change or reduced emissions of other pollutions. In addition, it also excludes all local co-benefits of the intervention, e.g. in the form of capacity build-up, technology transfer or local economic benefit. The only alternative to collapsing the impact dimensions into GHG savings would be to operate on multiple efficiency dimensions at the same time, e.g. including “total emission reductions per dollar spent”, “annual emission reductions per dollar spent”, “number of stakeholders reached per dollar spent”, “number of trees saved per dollar spent”, “tons of soil carbon not mineralized per dollars spent” and so on. Obviously this does not make the issues more manageable or allow for more evaluation insights on the matter of efficiency.

The second big issue with this indicator is the Cost Trap. If the parameter is to be used for project evaluation, often the project costs will be used for assessing the parameter. Project costs will most likely include costs for capacity building, project management, analyses and studies as well as advisory service. They might also include fuel and technology investment costs. An overview is given in Vreuls et al (2005, p. 39ff). However, projects are not standardized to the degree that they all include the same types of costs. That means that this measure for cost effectiveness can only be used as a benchmark for a project with the exact same set of activities. This will be a very exceptional case. In addition, the question how much these activities will cost is highly context specific. For example the remoteness of project locations will add significantly to project costs. For practicability reasons this indicator is sometimes reduced to the weaker criterion of cost-effectiveness. An activity is cost-effective when the benefits are greater than the costs. But that does not alleviate the conceptual challenge: This criterion then requires that the benefits are also expressed in dollar values. As long as the ratio of the project’s cost to the project’s monetized benefits is smaller than 1, the project is cost effective, i.e. it was overall beneficial.

To compound the challenge, there are at least two other standard indicators in the climate mitigation arena that are also measured in money per ton of GHG emission savings. These are in particular the prices of Certified Emission Reductions as well as the prices of tradable certificates in emission trading systems, like for example the EU ETS. These prices fluctuate significantly over time and reflect the most cost effective option on the market for saving the “next” (or “marginal”) ton of CO_2 among all participants in those markets. This is a very different price indicator from the evaluated cost-benefit ratio of climate mitigation projects.

A third indicator that is measured in the same dimension is the marginal abatement cost. It is displayed for example in the so-called “McKinsey-curves” and used to compare different GHG-mitigation opportunities with each other on the level of their cost-effectiveness. Again, the comparison with the cost-effectiveness of a multifaceted climate mitigation project, e.g. in the area of technical cooperation or even climate financing is normally not possible. Marginal abatement curves are a tool for selecting the most “cost-effective opportunity for GHG savings”. However, they do not reflect the degree of barrier removal work that is required to actually unlock that potential as they do not include any analysis or estimate of the barriers that keep an energy savings potential from being tapped into.

This illustrates the third trap, the Merit Order Trap. Comparing “cost effectiveness” of climate change interventions with each other will always lead to a ranking in which some interventions are “cheaper” (more “cost effective”) than others. As discussed earlier, this is a trap because these neither the interventions nor their benefits are actually comparable. If they were, they would lead to a prioritization of climate mitigation interventions. From the viewpoint of the global climate this would not be a desired outcome. The main problem that exists with global warming is that there is a very short window for action and that we will need to work at the same time on low-cost options (like energy efficiency) and on high-cost options (like new technologies) in order to limit warming to the 2°C-target that the UNFCCC agreed on in Copenhagen. To reflect this in easily computable cost effectiveness curves is not possible.

4.4 Impact / Results

Following OECD (2010), impact measures

> *"the positive and negative changes produced by a development intervention, directly or indirectly, intended or unintended. This involves the main impacts and effects resulting from the activity on the local social, economic, environmental and other development indicators. The examination should be concerned with both intended and unintended results and must also include the positive and negative impact of external factors, such as changes in terms of trade and financial conditions. When evaluating the impact of a programme or a project, it is useful to consider the following questions:*
>
> - *"What has happened as a result of the program or project and why?*
> - *What real difference has the activity made to the beneficiaries?"*

Rephrased for climate change mitigation interventions, these questions could read:

- What climate emission reductions have been achieved as a result of the programme or project and why?
- What carbon leakage has occurred?
- What has happened in terms of
    - Local economic growth
    - Jobs
    - Productivity, knowledge, capacity
    - Health
    - Education
    - Natural ressource protection, pollution abatement…
    - …other dimensions?

The development objectives vary greatly between project approaches, project domains, and even project sizes. They can be economic in nature– where projects lead to investment in energy infrastructure and technologies, to job creation, or to economic benefits through reduced energy expense. Other benefits can be i.e. social development, and improved local environmental impacts. Local economic benefits in particular can help stabilize GHG mitigation outcomes, e.g. if achieved in a carbon-neutral way. For example, if a village learns how to use local renewable energy for income generating purposes local economic growth is enhanced while demonstrating climate compatible development. Economic impacts are often measured in terms of investment triggered, with larger projects also in terms of national economic growth impacts and job creation effects. The latter two typically require a computable general equilibrium model for the project area which requires economic tools and parameters that are non-standard in most impact evaluations.

There can also be negative impacts – in the economic dimension, for example the loss of jobs that would harm forests. If these are likely in a project, negative consequences should be mitigated from the start. Important negative impacts could also consist in carbon leakage. An evaluation could assess the mitigation systems for negative impacts as well as the ability of the project to maximize benefits on other levels.

4.5 Sustainability

According to the definition of OECD (2010),

> *"sustainability is concerned with measuring whether the benefits of an activity are likely to continue after donor funding has been withdrawn. Projects need to be environmentally as well as financially sustainable. When evaluating the sustainability of a programme or a project, it is useful to consider the following questions:*

- *To what extent did the benefits of a programme or project continue after donor funding ceased?*
- *What were the major factors which influenced the achievement or non-achievement of sustainability of the program or project?"*

Obviously, this criterion does not measure the sustainable development in the sense of the WSSD process but a more process-oriented version that measures to what degree the project was able to trigger a lasting change. In effect, it measures the quality of that change: will the impact last or will everything revert back to the initial state of things?

It is important to note that the sustainability consideration should involve the financing component: If any of the projects' outputs are repeatedly required to ensure the middle- to longer-term impact of the project, the intervention should work towards ensuring that these requirements are satisfied and the necessary resources are available even after the project. Of particular importance are questions of organizational setup and governance arrangements in this respect.

Sustainability is also closely linked with the question of relevance. In general, the sustainability of an activity will be greatest if it matches with the local development situation – in terms of human and economic development as well as in terms of natural resource development or development of the energy generation and consumption sectors. Its strategies need to be aligned with the countries overall development strategies and with its national priorities.

Last but not least, sustainability is hard to assess ex ante, during the project, or even immediately after the project. Long after the project, when lasting impacts of the project will have proven their sustainability, they might not be attributed to the project anymore. The aspect that can be included in an evaluation, however, is whether and to what effect the project has used sustainability strategies like exit strategies for the financial components, establishment of longer lasting institutions and governance arrangements for continued project activities, or an institutionalized and well educated stakeholder group that will keep pushing the project's objectives without being dependent on external inputs.

4.6 Summary: OECD DAC criteria as a basis for evaluating climate mitigation interventions

The discussion of the OECD-DAC criteria in the context of climate mitigation evaluation has demonstrated mixed suitability. Some of the criteria – in particular "results" and "cost effectiveness / aid efficiency" have a long history in this as in other domains. Impacts can be identified and measured, costs and cost effectiveness will be assessed, and two very important criteria – relevance and sustainability – measure the match with local priorities, and detect whether there has been a qualitative change for the better to some degree. Others are hard to apply or operationalize. Interestingly, any ambitious evaluation will go deeper into the analysis than required by the OECD criteria. A number of interesting climate mitigation evaluation challenges are not fully addressed by the OECD-DAC criteria. In particular, the question of the interaction and relative weights of environmental and economic impacts (i.e. the prioritization of multiple objectives) as well as the challenges of baseline shift are not addressed even as they are not unique to climate change mitigation project. In addition, the OECD DAC criteria are distinctly suited for project and program evaluation. They can neither account well for contextual changes nor for sectoral changes. But the main purposes of a standard evaluation – and in particular those that are important from the viewpoint of the OECD-DAC can be satisfied using these criteria.

An important difference in the nature of the OECD DAC criteria and the other criteria mentioned in this part of the guidelines is that the OECD DAC criteria are absolute descriptions of a project. The measure characteristics of a project or a project approach, and can therefore be evaluated best against general benchmarks, e.g. in the form of other climate mitigation interventions. Most of the other indicators discussed in this text measure the “state of the world” before and after the project. The project is thus described by the difference in this “state of the world”, at least the part of the difference for which the project is in fact responsible.

5 The Theory of No Change

An analysis of a large number of climate mitigation evaluations (Wörlen 2011a) has resulted in the formulation of a theory of change for sectoral climate mitigation interventions that basically consist of a checklist of preconditions that need to be given in order to achieve transformation. In the absence of these preconditions, there will be no transformation. If any of these preconditions are absent this constitutes a barrier to the transformation. This model has been named the “Theory of No Change” (TONC).

The model builds on Tokle and Uitto (2009) for identifying a full set of barriers to be included. For testing this framework, two case studies were undertaken on the basis of evaluations from the climate-eval library (Wörlen 2011b, 2011c). These observed long-term market transformation in the energy efficiency sector of Thailand and the geothermal energy and district heating sector of Poland. Minor adjustments were useful to achieve indicator parsimony but the overall concept and framework proved appropriate and adaptable for both cases.

5.1 The Concept of “No Change”

The underlying assumption of the Theory of No Change for climate change mitigation is that climate-friendly behavior is required to make our societies more climate-friendly. The model is derived from markets for energy efficient goods but the model is applicable outside the energy efficiency and renewable energy sectors as well. Taking a stakeholder-oriented approach it is analyzed why stakeholders do not behave in the “climate-friendly” way – why do they not use energy-efficient refrigerators, why do they drive inefficient cars instead of clean vehicles, why do they cut down forests instead of using them in a sustainable manner. In general, climate-friendly behavior comes in two expressions: in one-off allocation decisions (e.g. investments), and in daily routines.

Both decisions are made by individuals ("consumers") or individual businesses and have direct impact on their CO_2-"footprints". A number of preconditions need to be in place for consumers to make climate-compatible decisions, and if they are not in place, they can constitute barriers that prevent climate-friendly behavior. For example, they need to know about the alternative behavioral options, they need to have access to the technologies, they need to be able to afford these alternative technologies, and they need to be motivated to use them. Several of these preconditions must or can be provided through other stakeholders.[13] These stakeholders are:

- the supply chain – as the developers, manufacturers and distributors of the technical precondition (and technology) for climate friendly behavior -,
- the financiers – as the providers for the financial preconditions for climate-friendly behavior – and
- the policy makers – as the providers of the legal environment for climate-friendly behavior.

If these stakeholders do not provide the opportunities for climate-friendly behavior on the side of the consumers, the consumers cannot behave climate-friendly. But these non-consumer stakeholders also encounter barriers for their respective roles. These barriers then become barriers for climate mitigation as they prohibit significant change in existing behavioral patterns of the consumers. The Theory of No Change analyzes the types and strengths of these barriers.

In many climate mitigation areas, it is mandatory to analyze barriers to climate mitigation from a multitude of perspectives, and this approach is gaining increasing traction. For example, Balaban (2012) in his discussion of indicators for urban redevelopment and climate change, focuses significantly on policy frameworks and political decisions in the process of urban renewal. However, many of the examples used make clear that even if you supply public transit options and a network of sidewalks through policy and supply side decisions the users still might not do it, for example because they might not be motivated to do so (in this case by the lack of attractiveness of the shopping district). In fact, his analysis concludes that the views of and barriers for other stakeholders were insufficiently incorporated in his case studies.

Taking on a system's perspective even for interventions that are focused on very specific and narrow aspects of climate-friendly behavior has also been recommended in other sectors. Last but not least it is the simplest way to ensure and reflect upon the synergies between climate mitigation and development efforts.

5.1.1 The Stakeholder-Barrier Matrix

The groups of stakeholders mentioned in the last section typically encounter a number of barriers that keep them from using or supporting the sustainable energy technology. Interestingly, similar barriers can impede more than one stakeholder groups. A set of six stereotypical potential barriers has been the starting point of the barrier matrix. They are displayed in Table 3.

[13] Often, they are provided through markets. Even if they are not provided through markets, markets are a useful and well researched paradigm for the analysis of this interaction which is why we will keep the term market in this study also for non-exchanged based structures.

Table 3 Full set of barriers

Potential Barrier	Explanation of the barrier
ignorance	not knowing what causes and does not cause GHG emissions, not aware of how to reduce them
lack of motivation / interest	not minding, not interested in reducing emissions or providing the supporting service even if other benefits would accrue (e.g. saving money, leveraging growth opportunities)
lack of expertise	not being knowledgeable enough for implementing the reduction
lack of access to the mitigation option	the technology is not physically available, e.g. because the next sales point is too far away, no maintenance service is provided …
lack of affordability	the funds for the investment are not available even if the implementation would save money and be overall cost effective
lack of cost effectiveness	the mitigation option is not cost effective, i.e. would be more expensive than the status quo

While these stereotypical barriers can affect more than one stakeholder group, some of them are irrelevant for some stakeholders. For example, the "lack of interest" barrier will not affect financiers or the supply chain, if all other barriers are removed: if they are "aware" of a "cost-effective" business model, they will find a way how to make money off financing or selling that new technology, and thus will also be interested / motivated to leverage this opportunity. 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 lack motivation for change. This means that the matrix of stakeholders and barriers does not have all cells filled with relevant barriers. The current framework contains 19 types of barriers (Table 4).

Table 4 Barriers for each group of stakeholders

Potential Barrier	Users / Consumers	Supply chain	policy makers	local financiers
ignorance	users might not know what causes and does not cause GHG emissions, might not be aware of how to reduce them	suppliers might not knowing if their products cause GHG emissions, and might not be aware of how to reduce them	policy makers might not know which options cause more GHG emissions, and how they can be reduced	financiers might not know which options cause more GHG emissions, and if they can trust the technical solutions
lack of motivation / interest	users might not be aware or not interested in reducing emissions even if they could save money	Not applicable (if all the other aspects are given, the supply chain will be interested in additional business)	not interested in reducing emissions even if other benefits would accrue (e.g. saving money, leveraging growth opportunities)	Not applicable (if all the other aspects are given, banks will be interested in additional business)
lack of expertise	users might not know how to implement the GHG-reducing measures	users might not know how to install or maintain the GHG-reducing measures	not being knowledgable enough for making smart policy / lack of policy capacity	not applicable (banks should have sufficient banking knowledge)
lack of access to the mitigation option	the technology is not physically available, e.g. because the next sales point is too far away, no maintenance service is provide or the like	the technology is not physically available, e.g. because no local production or importation exists	Not applicable	Not applicable (banks do not neet to access the technology)
lack of affordability	the funds for the investment are not available even if the implementation would save money and be overall cost effective	the funds for the expansion of the business are not available even if the change would provide growth opportunities	the funds for political support are not available	even if liquidity is available, banks might not be able to lend more as they might be overexposed
lack of cost effectiveness	the mitigation option is not cost effective, i.e. would be more expensive than the status quo, even if the savings are fully factored in	no business can be established, e.g. because of a lack of demand	the mitigation option is not cost effective on an economy-wide level as measured in an economy-wide costs benefit analysis	no business model can be established, e.g. because of small market size

Grey: not relevant

5.1.2 The barrier circle

In order to visualize the barrier situation of a market that should be transformed, a tool on the basis of pie and donut diagrams has been developed (Figure 13). 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. It has four segments representing the four stakeholder groups (users / consumers, supply chain, local financiers and policy makers). The barriers are represented by small elements labeled with the name of the barrier. Each element can be colored according to the strength of the barrier in a specific market situation. 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 there is no significant barrier. Orange and red are barriers to impeding market change. Orange is the color for a situation that significantly slows down market change. Red is the color for a show-stopping barrier. As long as there is a red barrier for any single factor, the market will not change in any meaningful way. Each group of market participants has a role to play which relates to the wedge that is associated with the respective stakeholder group: Consumers / Users are the decisive agents for the emission reduction impact: if all the others fulfill their roles without being impeded by barriers, but the consumers do not adopt the climate-friendly behavior then the whole objective cannot be reached. The second highest number of potential barriers affect the supply chain and infrastructure. Smaller but important parts of the circle are associated with policy makers and local financers respectively.

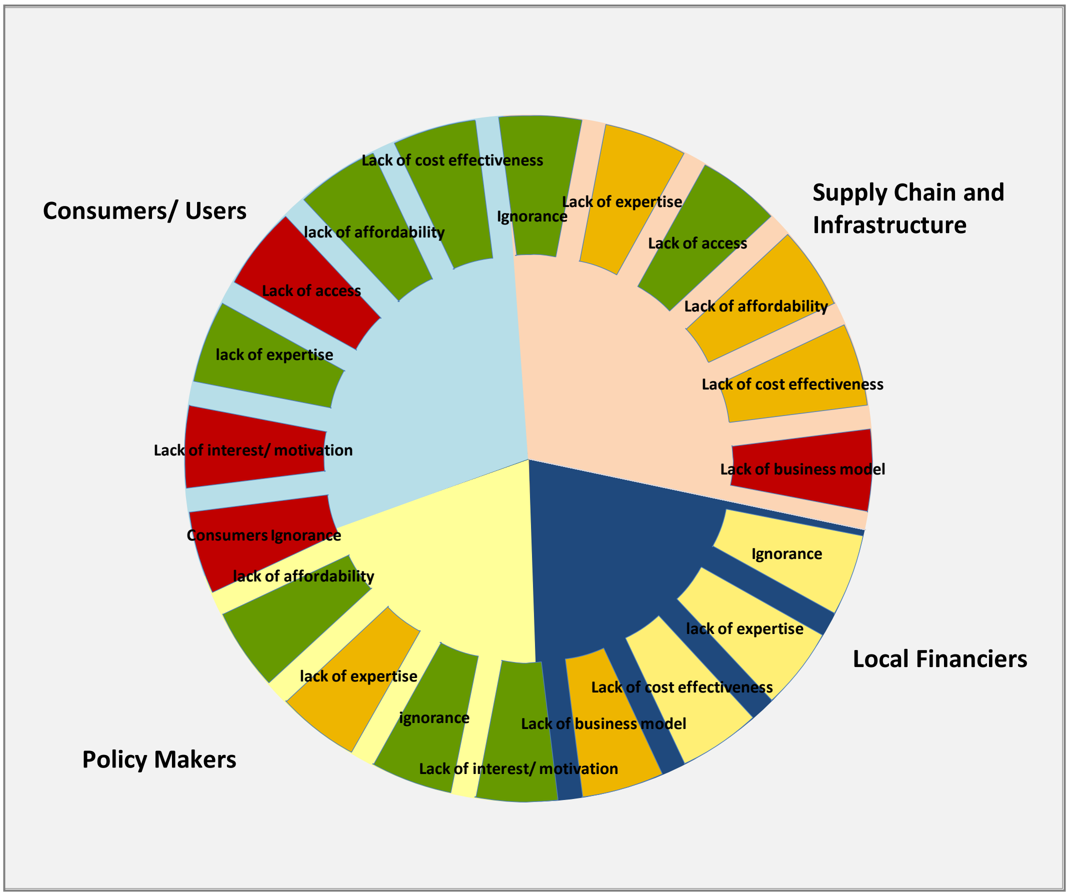


Figure 13 Barrier circle diagram

The example is taken from the case studies and relates to a market where the financiers' activities, attitudes and awareness levels do not fully stop but slow down the change in the market, particularly due to a "lack of business model." 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. But, they do not know which would be the right policies and how to implement them. Thus, "lack of expertise" is coded in orange, i.e. it constitutes a significant barrier to market change. None of these barriers would necessarily be an absolute bar 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 13**Fehler! Verweisquelle konnte nicht gefunden werden.**, 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.

5.1.3 From the Theory of No Change to a Theory of Action

The Theory of No Change identifies what is preventing consumers from "doing the right thing". Climate mitigation interventions should help consumers– the ultimate producers of greenhouse gas emissions, either through their direct consumption or through consuming goods whose provision has caused emissions. Therefore, the Theory of No Change can serve as the basis for developing a Theory of Action[14] for climate mitigation interventions (Funnell and Rogers 2011). Well-designed mitigation interventions should try to match their activities with the barriers in order to allocate their resources efficiently. The barrier circle can help guide the interventions: they should be matched with the barriers identified by the barrier circle analysis. This can be used for project planning as well as evaluation.

It is very illustrative to represent the intervention as a spider web diagram. Figure 14 presents this representation. The elements of the intervention are "arms" of the spider. The directions of the arms on the spider web diagram conform to the barrier they are designed to address respectively. The larger out the points lie on the spider web, the "longer the arm", the more intense is the project's focus on these activities. The level of the intensity was chosen to lie between 0 and 5, in relative weights. In the example presented in Figure 14, 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 consensus on the labeling system among manufacturers of these systems, which created a business case for the suppliers to produce and distribute more efficient appliances.

[14] For the relationship between Theory of Change and Theory of Action, refer to e.g. Funnell and Rogers (2011).

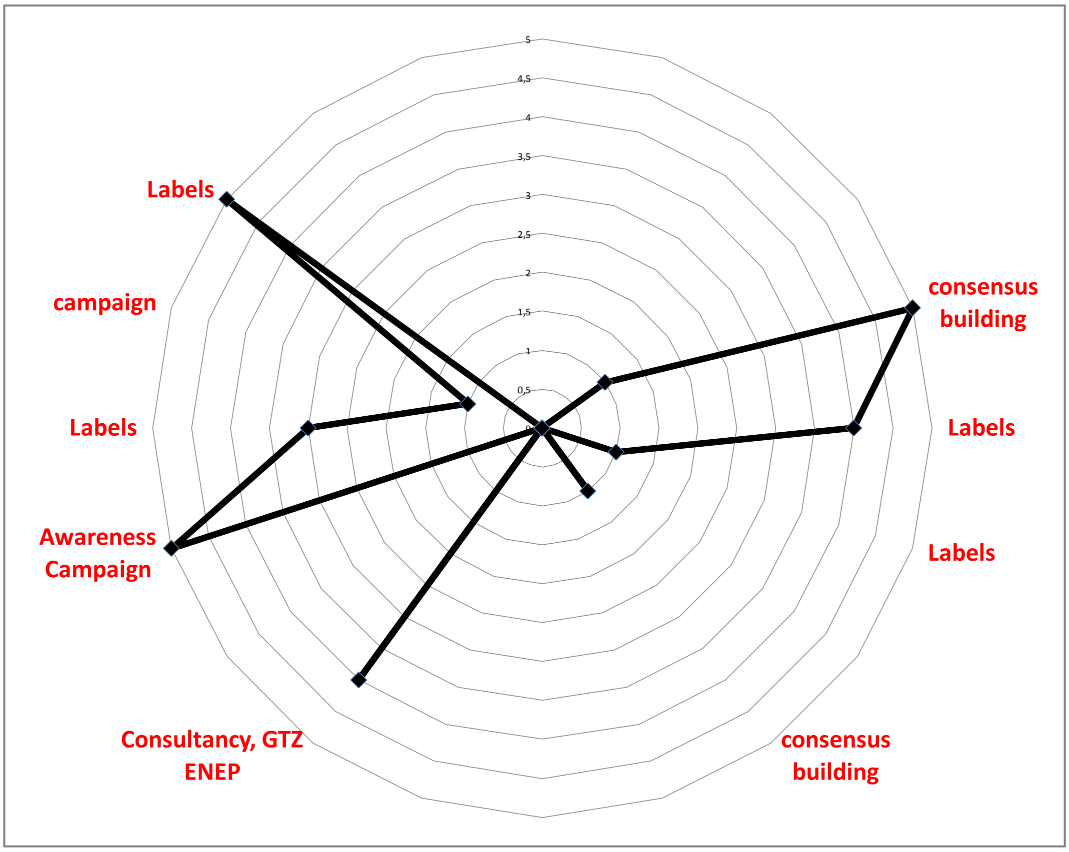


Figure 14 The intervention circle

With the help of the Intervention Circle, each project can receive a 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 circle 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. The intervention circle of Figure 14 does not distinguish between interventions carried out by different actors, stakeholder groups or agencies. The main objective is to aggregate across several projects and interventions, and all of these can be mapped onto the same spider web diagram.

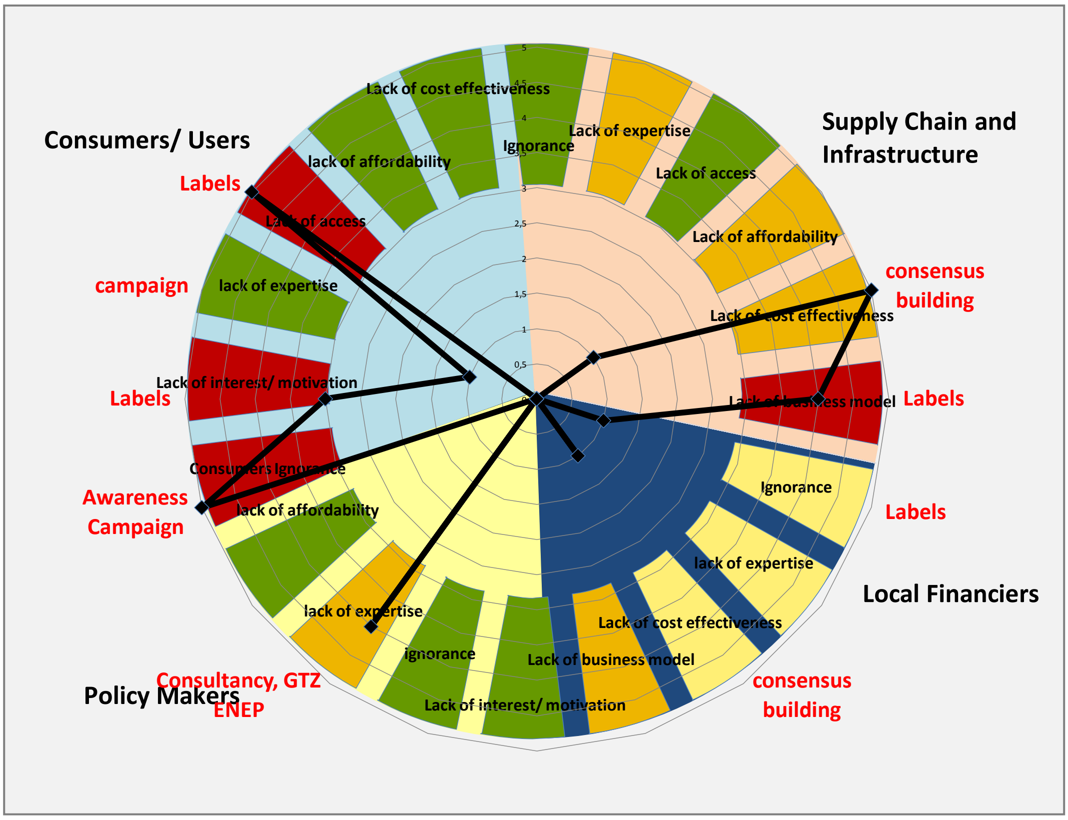


Figure 15 Barrier circle and intervention map

Figure 15 illustrates how the two tools can be combined to illustrate an intervention's match with the existing barriers. 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 non-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. These barriers were not removed successfully through the intervention. However, in order for "our" intervention to be successful for market transformation, these barriers need to be removed, too.

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. In this stage, the interventions should strive to address those barriers that are limiting for market development.

When used in evaluation, the direction of the interventions lines will be aligned with those barriers that they actually have addressed. This is not necessarily the barrier that they are designed to address nor the barrier that is most responsible for a lack of change. If the activities address a different barrier from the one they are designed to address this can be an indication of either 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 barrier circle for that later point in time. In these cases, the next red or orange ring segment will constitute the next barrier for continued development of the market.

The tool is able to illustrate a specific part of a sector, a field of activity and its transformation in a holistic manner. It can also reflect that barriers are sometimes not independent. 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”, i.e. show-stopping challenges. 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.

5.1.4 Practical considerations for the application of the TONC to evaluate interventions

The model was developed on the basis of the classical market transformation concept, originating from the energy efficiency field. It has been amended and expanded on the basis of the meta-evaluations of country studies. For application to other sectors or situations, it can be further modified. This section will explain what modifications will be necessary most of the time.

The first step in using the model is defining the market to be transformed. This is not necessarily trivial. Most of the time, a number of markets can in theory be defined that need transformation. For example, when evaluating an intervention that focuses on facilitating finance from the banking sector for renewable energy, the evaluator might be tempted to define the market for retail loans for solar water heaters as the market that is to be transformed (rather than the market for the solar water heaters). Obviously, the model can be applied to this market, and will be very useful when answering the evaluation questions on how successful this intervention was, how lasting the success might be, and why this intervention might have been successful or not. However, when the evaluation is also looking into the GHG impacts of the intervention, the explanatory value of the model is maximized by focusing on the market of those goods, services or activities that actually reduce the GHG emissions, in this case the installation of solar water heaters. This allows that the evaluation analyzes not only the impact on the financial market but the overall sectoral transformation and the context of the intervention as well as its greenhouse gas related results and the prospects for long-term sustainability and impact. In fact, the provisions of loans for the solar geysers might be perfectly worked out but still no solar water heater might be sold because there might not be any plumbers that can actually install them.

Once the market is defined, the stakeholders are identified: who needs to participate in the market transactions? Who needs to understand this market? Who needs to provide framework conditions or support services so that the technology or behavior can become wider spread? It is important to acknowledge that the same individuals can have more than one role in terms of a stakeholder group – for example, a financier of a technology can also be a user of the same technology in his or her private household, or a supplier can also provide financing. A second complication is that in some markets, some of the stakeholder groups from the standard model need to be split into two groups. For example, in housing weatherization often investment is asked from the owners of houses while the beneficiaries of the weatherization and users of the houses are the tenants (so-called "principal – agent – problem"). In these cases it might be necessary to leave out one group or split the standard group "consumers" into "owners" and "users". Similar modifications might be necessary for the supply chain group.

Obviously, these new groups then need to be included in the evaluation plan. This implies that for practical reasons, modifications of the TONC should always strive to keep the numbers of stakeholders and barriers to be analyzed as small as possible, and to focus on relevant and meaningful aspects only.

The next step in adjusting the model to the local context is to analyze the barrier matrix for each stakeholder group. This is done by starting with the full set of barriers (Table 3) and deleting those barriers that are not relevant for the stakeholder group or the context. For example, there might be situations in which the consumers' engagement in the market might not depend on the availability of loans. In these cases the role of the financiers will be limited to financing working capital for the supply chain. Table 4 can help distinguish between potentially relevant and non-relevant barriers.

In the third step the barrier should be rated in terms of its impact on the respective market: how strong is it hampering market development? Barriers can be so strong that they bring all development to a halt. They can also be strongly limiting the speed of market growth. They can be hardly noticeable, or even non-existent. In the barrier circle tool, the barriers' actual market impact is described qualitatively: no impact, insignificant barrier, significant barrier, show-stopping barrier. This barrier rating results in a description of the "healthiness" of the market and displays quickly which barriers have to be removed in order to develop the market. A comparison between the barrier circle before and after the intervention helps to understand which barriers have changed through the intervention. Thus, interventions' successes can be identified even if the overall behavior of the greenhouse gas emitters does not change due to other barriers. This might be the case if the sum of the interventions did not attack the prevalent barriers or if the intervention that was supposed to attack the barrier failed to accomplish its objective.

5.2 Theory of No Change Outcome Lead Questions and Indicators

For using them in practice, it would be very elegant to have standardized outcome indicators for each of the cells in the stakeholder-barrier-matrix. If they are phrased as outcome indicators for climate change mitigation interventions, they should measure the absence of the barrier, i.e. they should be benchmarked against the level of competence, financing, or technology access that would be desired for optimum deployment of the technology. These indicators are specific for each stakeholder group, even if they measure the absence of the same barrier, simply because the type of knowledge, capacity, service or other resource required is different depending on the stakeholder group. However, so far, it was not possible to find such indicators for all cells. Nevertheless, the barriers can be expressed in lead questions and indicators. In the following, suggestions for such lead questions and some indicators are presented.

5.2.1 Policy makers

The analysis starts with policy makers because policies can create the strongest barriers and therefore are in some sense the most "powerful" stakeholder group: if they constitute a major barrier all other stakeholders are likely to experience difficulties beyond their control and most likely insurmountable by any intervention that does not also include the policy makers.

In a first step, some general considerations are tested to see whether policy frameworks are a barrier or not. Most of the time, there will be some aspects of the policy frameworks that could be improved for faster roll-out of the climate mitigation technology or the climate-friendly behavior. If policy makers are not putting in place these policies, it can be analyzed with the TONC. According to TONC this can result from (1) ignorance, (2) lack of motivation/interest, (3) lack of expertise, (4) lack of access to the mitigation option, (5) lack of business model/ affordability, (6) lack of cost effectiveness, or a combination. Due to the complexity of reality the theory obviously cannot cover all possible factors but tries to cover the most important and frequent ones. Most of the time, thus, the shortcomings in the policy framework can be attributed to these barriers.

Climate mitigation interventions work towards the removal of these barriers. This means that the outcome of climate mitigation interventions can be described as a barrier-free situation. In the following we will be phrasing this barrier-free world and try to formulate indicators that can serve as milestones describing this world.

5.2.1.1 Policy makers: Ignorance

In some cases, policy makers are not aware of the options to reduce greenhouse gas emissions. To gauge whether a general lack of awareness among policy makers and administration might be the barrier to greenhouse gas mitigation, the following lead questions can be applied

- Are training programs and information material available?
- Is sufficient data available, on the project's intended mitigation option, e.g.:
    - renewable energy endowment: wind power potential, biomass availability etc.
    - climate change risks on key economic sectors e.g. agriculture, tourism (e.g. coral reefs) and environmental services (forest, fresh water supply) etc.
    - emission sources: LULUCF, sectoral emissions (transport, energy, industry etc.)
- Is the general awareness of policy makers sufficient?[15]

5.2.1.2 Policy Makers: Lack of Motivation and Interest

The motivation of policy makers is understood as the interest in implementing supportive policy frameworks. A lack of interest and motivation can be due to a variety of reasons, of which only a few will be enumerated here for illustration purposes:

a) a lack of motivation due to a lack of incentives, personal or political;
b) lack of recognition that climate change is a challenge that needs policies;
c) prioritization of issues other than climate policy;
d) political competition about topics, for example between institutions or parties.

Whenever policy makers, institutions etc. are interested and motivated for climate mitigation policies, a general level of activity in climate policy is usually measurable, as expressed for example in the following types of activities:

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[15] Measuring the level of awareness of policy makers is part of this analysis, e.g. by means of analyzing local media or interviews with policy makers. A tested method for the public awareness and opinion among policy makers and influence bearers is the bellwether analysis (Coffman 2009).

- Participation in international negotiations (UNFCCC);
- national and regional initiatives and programmes, policies and directives;
- implementation of international treaties;
- legislative climate activity, e.g. regulations on building codes, feed in tariffs, renewable obligation, minimum standards, emission trading schemes, feed in tariffs, tax abatements for public transport etc.;
- Inter-institutional coordination on climate policy, mainstreaming of climate policy between different resorts and levels

Looking at the general area of climate policy does not allow to fully gauge the motivation for a particular climate mitigation option. Overall, policy makers might be very interested to pursue climate policies but particular interests for specific areas of activities might lack or prevent action. It is not only important to participate in the Climate Change Convention, but also to be motivated for action in the domestic energy and land use sectors. Here, similar indicators can be created but they might not be as robust. Instead, national policies can be analyzed, for example, whether any national strategies, targets or studies on low carbon development, deforestation reduction, renewable energy deployment or energy efficiency programs exist. These might be in fields other than the one that the invention is targeting.

5.2.1.3 Policy Makers: Lack of expertise

It is important to note that the potential barrier "lack of expertise" with policy makers relates to the expertise of making "smart" policies, i.e. policies that induce the desired behavior effectively and cost-effectively. While making smart policies, e.g. for deployment of sustainable energy, requires some knowledge of energy technologies, this is not enough for smart policies. Much more important is an interdisciplinary understanding of the energy sectors, and of how framework conditions can be altered to achieve the change towards a climate compatible energy sector. This applies to all other mitigation sectors. The main indicator that the expertise of policy makers for making smart policies might be limiting climate mitigation activities is a lack of intelligent policies, but then also:

- Insufficiently trained staff: insufficient number of academics (e.g. engineers, economists, lawyers, political scientists etc.) or otherwise trained staff in ministries and administration.
    - Indicator: quality of the national communications to international bodies, stakeholder interviews, number of staff with adequate degrees and qualifications
- Insufficient staff in key areas. If sufficient staff is available is not necessarily easy to assess because particularly if combined with inefficient bureaucratic structures, personnel has to spend a lot of time to carry out certain tasks.

5.2.1.4 Policy Makers: Lack of Affordability

The need for financing and thus also the affordability of policy depends on a number of factors, including the path to competitiveness (in terms of cost effectiveness) of the climate mitigation option, but also other local aspects like other subsidies, the overall level of education and technical competence of the supply chain and other infrastructure characteristics. General rules and benchmarks are hard to define.

There are mitigation options that are not cost effective in the short run but become cost effective after a period of market maturation. These need supportive policies to improve their financial viability until they market mature sufficiently. Typically, these issues are abated by public subsidies and support policies. The policy barrier “lack of affordability” is limiting market growth when no funds are available to finance these subsidies. Therefore, research questions that can be applied are:

- Are local funds available for climate policy?
- Is international funding available for climate policy?

5.2.2 Local Financiers

Local financiers provide capital to all other stakeholders, to carry out mitigation projects or invest in technologies. If they are private institutions such as banks they might even provide capital to the public sector. Financiers include private entities such as businesses and even individual citizens that are willing to invest in climate friendly activities.

In an evaluation, the first test for potential barriers in terms of financing is to identify whether there is a need for (bank or other third party) financing at all. These questions relate to the general availability and accessibility of finance, in particular for the intended group of users and consumers.

A sustainable situation in the stricter sense includes that no project-based international donor financing is necessary to sustain a local market (cf. discussion of OECD-DAC criterion “sustainability”). There are exceptions in the area of climate mitigation, for example in the context of the CDM where inflow of financing is granted over a long period of time. But “standard” donor financing is intermittent and project specific and thus can only trigger market development but not sustain it over a period of more than five years.

Thus, the financing barrier for making climate-friendly behavior possible – if it exists - needs a solution within the local financing structure. On the other hand, there are climate friendly behaviors that do not require financing, and might come at no extra costs, in particular no extra investment costs. In these cases, the financial market will not be part of the stakeholder groups that need to be evaluated.

In fact, the question if local financiers need to get involved is related to the affordability barrier with the other stakeholder groups: if users, the supply chain or policy makers encounter an affordability barrier, financing can become a strong limitation to the climate mitigation option, and then financiers will be an important part of the solution and the market. But even without a constraining affordability barrier with the other groups, a good availability of financing enhances market development.

5.2.2.1 Local Financiers: Ignorance

If a technology option is generally unknown to financiers, it cannot be expected that they lend happily for it. In interviews evaluators can find out to what degree local financiers are aware, that customers might be interested in funding of (investment) projects and know the associated financing products, e.g. solar panel loans. Like the other stakeholders, financiers need to be orientated about the prospective market size. The level to which this barrier is limiting the market can therefore also be indicated by the availability of trade journals, internet sites and market analyses for the respective technology, including but not limited to the financial sector.

5.2.2.2 Local Financiers: Lack of cost effectiveness / business model

A financier will only lend money if and when there is a business model that helps the borrower to generate an internal rate of return that allows to pay back the loan. This is how cost effectiveness would be defined from the viewpoint of the local financiers. In order to mitigate a lack of cost effectiveness business or loan redesign can help generate revenues, reduce the revenue expectations of the financiers (e.g. financing from other sources), or enhance the rates of return through subsidies, other support policies or regulatory requirements (e.g. for energy efficiency).

An indicator for the existence or lack of a barrier through cost effectiveness is therefore the existence or lack of a realistic business model at the prevailing capital market rates.

5.2.2.3 Local Financiers: Lack of affordability

Even if a business model can be demonstrated and financiers are aware of it, there can be cases in which the financial market is not liquid enough to provide the necessary financing. This can be part of a general weakness of the financial sector in a country, or it can be the result of an overexposure in the particular market section. This bottleneck can be measured in finance-market related parameters like millions of potential exposure to a specific risk available. It can mostly be identified through interviews with the financial sector, and can only be mitigated through appropriate measures on the capital markets.

5.2.2.4 Local Financiers: Other barriers

It is not mandatory to test for a lack of expertise on the side of the financiers as one should assume that they would know how to structure financial products. In addition, a lack of motivation will also hardly ever be the case as if there is an opportunity to structure a profitable financial product, and if they have capital available the financiers will be motivated to lend for this opportunity.

5.2.3 Supply Chain

Through the supply chain equipment, services, maintenance, and expertise are provided to install, service and operate the climate-friendly alternatives. In order for new technologies or behaviors to take hold in a market, the supply chain as well as the delivery infrastructure needs to grow in pace with overall market growth. The function of the supply chain is not only to provide hardware but can also be to provide software, capacity building, project development services or access to information and communication. To list a few examples, this group encompasses:

- Retailers and suppliers;
- logistics and transportation providers (incl. public entities);
- energy providers and grid operators;
- professional associations (e.g. for training, networking, standard setting);
- universities/open universities/public schools offering executive and applied education;
- project developers, foresters, architects, engineers;
- technicians.

Normally if a technology, methodology or product is new to a country, the supply chain will be insufficiently developed, which will pose a barrier to market development. Overall, the first step is to understand how big the issue with the supply chain is, for example using questions like these:

- Do users experience a lack of spare parts, equipment, services that are price competitive and deliverable within reasonable time?
- Are users considering products and services to be of satisfactory quality?

Again, the supply chain might have a number of different barriers for engagement.

5.2.3.1 Suppliers: Ignorance

Ignorance is understood as the lack of awareness on part of the suppliers of the impact their products and services have, often suppliers do not know how much energy the products that they are selling consume, or what efficient alternatives might exist.

Interviews with suppliers can be used to identify to what degree this is a barrier for market development. Mostly, some suppliers and some links of the supply chain will be better informed than others. There is reason to hypothesize that the overall awareness of suppliers follows a logistical growth curve. If interviews are undertaken on a statistically representative scale, actual shares of the awareness level can be used for this barrier. Measurement with a four- or five-level Likert scale might already be sufficient (no awareness – some awareness – 50% of potential suppliers are aware – most suppliers are aware).

5.2.3.2 Suppliers: Lack of motivation and interest

In many cases, the existing supply chain will be locked into their established product portfolio. Any modification of their product portfolio brings along transaction costs, learning curves and technical and financial uncertainty. Therefore, lack of motivation and interest to participate in climate friendly market segments might be an important barrier for market change. It will be even worse the less perfect the competition is. Therefore the number of providers providing a product or service is certainly one of the relevant factors that stimulates others' interest.

5.2.3.3 Suppliers: Lack of expertise

In order to provide a novel product and the necessary support services, the suppliers need to enhance their technical expertise, for example in the form of:

- Number of trained staff working in certain key professions, e.g. trained electricians;
- Number of staff in key departments, e.g. number of software experts in electricity distribution companies;
- Number of training opportunities available to suppliers, e.g. professional unions offering training to construction workers on new building materials.

Technical expertise can be demonstrated through certificates and other formal qualification. In some of the thematic areas of climate mitigation (e.g. renewable energy), these types of certifications are provided through the equipment manufacturers or project developers. These sometimes import their expertise from other countries. If training is insufficient, particularly in the renewable energy field, it often leads to malfunctioning equipment. Therefore, in these cases, the number of complaints about badly installed or bad quality products and projects, call for repairs and maintenance, call on warranties, repair turn-around rates, etc. can be used as an indicator for the constraining effect of this barrier. They can be evaluated with the help of industry and observer voices, e.g. trade journals or other industry information. A more broadly applicable approach to identify this barrier in this and other areas are interviews with stakeholders, e.g. costumers about the quality of service provided.

5.2.3.4 Suppliers: Lack of (physical) access to the mitigation option

If a technology cannot be produced in a country and also not imported into the country, market development cannot take place. Indicators to measure it could be the price and lead time for orders of the technology. An interesting aspect in this respect is customs regulations. If a technology is completely unknown in a country, there might not be a customs regulation for its importation. In this case, it might actually be easier to import the technology than at a later stage in market development when sometimes very tough and restrictive customs regulations are designed in order to build up local production capacities.

5.2.3.5 Suppliers: Lack of cost effectiveness

For the supply chain, providing the new technology or catering to the new behavior might not make economic sense as more money might be made in the old ways. This barrier is crucial in preventing change. It can be analyzed by comparing the business cases of the old and new products.

These business cases obviously depend on a number of factors, among them the overall expected market sizes for the old and new products, and the policy frameworks. Subsidies in particular have significant impact on the profitability of business models and adding subsidies for the desired technology / behavior or taking away subsidies for the “old” behavior might be one way how to abate this barrier. It is important to note that we are not looking into one-time costs of setting up a new business, like teaching or training or certification costs, but only at the medium- to long-term profitability. Those barriers are subsumed under the next section, lack of affordability, meaning the opportunity to switch to a different business model. Disregarding the setup and learning costs, suppliers would only switch if and when the new business is at least as profitable as the old business.

5.2.3.6 Suppliers: Lack of affordability

If suppliers lack sufficient funds to expand their business or train their staff, they are not able to enter or develop a market segment even if the new technology would offer a profitable business opportunity. Reasons for such a lack of affordability might be a general scarcity of capital on the capital markets, or a distrust towards the new technologies with the financiers of the supply chain.

This barrier is not too easy to spot or measure with SMART indicators as affordability is not only a matter of degrees but also of subjective preferences. While suppliers might readily volunteer a lack of funds in interviews this might not really be the limiting factor for a possible lack of engagement on their side. Interviews with banks, financiers, venture capitalists as well as typical investment figures in the respective sectors might give a stronger indication for whether capital would be available for business expansion. In general, it is not necessary that all suppliers can afford the new behavior. A small number of pioneers might be enough to deliver the first spark for a new market.

5.2.4 Consumers and Users of the systems

Users and consumers are the stakeholders who are carrying out the activities that have an impact on the climate. They are the ones using or saving energy and producing or avoiding greenhouse gas emissions, e.g. by driving fossil-fuel cars, buying emission-intensive products and goods, and planting or cutting down trees. Like the GHG-saving systems and the GHG-saving behaviors, they are a very diverse group. Users are individuals as well as companies, organizations, institutions and collective groups, such as a village community.

Users and consumers always are a major focus of the program logic of any GHG-reducing intervention as they are the ones who ultimately need to adopt the new practices (technologies, behavior) in order to reduce the demand for energy, change the way energy is provided or reduce harmful impacts on forests. Therefore the classical barrier analysis as well as most classical climate mitigation interventions revolve around them, and measurement indicators for these are rather well developed. Nevertheless, due to the large variability of this group, the definition of universal indicators that fit all groups, all mitigation options and all program approaches is difficult. The attempts in the following sections are therefore even more preliminary than in the preceding chapters.

Users and consumers can be faced with all six types of barriers: they can be unaware of "better" behavior; they might not be motivated; they might lack technical know-how; the GHG savings option might not be cost effective or not affordable for them; they might not have access to the technology. This demonstrates the linkages to the barriers for the other stakeholders: Providing the technology is actually the task of the supply chain but even with a well-developed supply market, there might still be barrier for the users on this level, for example if there is a principal-agent-divergence (e.g. between renters and owners). Similarly, financing might be available generally or for a specific market segment but not in the particular circumstances that the consumer finds herself in. A standalone analysis of the barriers for one stakeholder group might lead to a related barrier in a different stakeholder group, which also needs to be evaluated for obtaining a full picture of the market, success of the intervention or recommendations for future interventions.

5.2.4.1 Users: Ignorance

Very often, users are simply not aware of their impact on the climate. Basic understanding of climate change and energy production is lacking. In these cases, understandably, no climate conscious behavior can result, or if, it will be by coincidence.

Even if they are aware of the larger context of climate change and their own impact on the climate, users and consumers might not be aware of alternatives that cause less greenhouse gas emissions. In these cases they cannot make informed decisions.

Potential indicators to assess users' knowledge and awareness levels are:

- Does the population have a general understanding of climate change? E.g. is it reported in read/consumed media (Number of news reports, curricula)
- Is information available, accessible (e.g. in audio form), understandable (in all languages and simple enough available). Is the information provided sufficiently practical and adequate for the user group? (Number of websites providing information, number of visits, number of distribution points of information, number of teachers/trainers, coverage of target group by trainings/information distribution)
- Do stakeholders, e.g. companies, demonstrate any awareness of climate change and their contribution to it? (company reports, sustainability reports, public statements)
- Are users (individuals, companies) having access to any data regarding their annual consumption of electricity or hot water? (Number of and share in users with access to personalized data, number of companies with energy measurement points, Share of companies who have had energy audits)
- Do stakeholders know options to reduce their carbon footprint? (E.g minimize waste, energy consumption, apply better technology , energy/environmental management systems)
- Do companies publish energy or climate policy, do they offer corporate sustainability reports. (count of key words in company publications, number of cases against companies due to violations of environmental laws)

- Are companies certified? Have they implemented environmental management systems? (Number of certified companies in a sector, number of companies with environmental management systems implemented)

Awareness levels will almost always be unevenly distributed among the population. The actual level of information might vary even between regions within a country. It can only be assessed with any certainty on the basis of representative polls. In particular the latter questions are not necessarily well suited to gauge general information and awareness levels in the population as they are measuring the information offering rather than the actual uptake. They are not outcome indicators but more output oriented.

Awareness levels with companies, for example for energy savings opportunities, have been tested to be generally rather low. This is counterintuitive as energy is a cost factor for companies and the general expectation is that companies minimize costs wherever possible. Nevertheless, companies and private sector decision makers often tend to accept a certain level of energy consumption as "necessary", and a number of organizational barriers prevent that even cost effective energy efficiency options for reducing GHG emissions are fully exploited. Therefore for companies the more adequate parameter might be to what degree companies are actually implementing energy audits, energy management systems, energy control systems or other types of certification tools. On the basis of polls the knowledge levels regarding energy savings in a company will depend strongly on who is being asked. In addition, the knowledge gaps in companies will be ignored even if companies claim to know their energy efficiency (or other GHG savings) potentials very well.

5.2.4.2 Users: Lack of motivation and interest, conflicting priorities

Companies as well as private individuals might know about the "better" choices in terms of climate change mitigation but still have other priorities for allocating their resources in terms of time, attention or money. Lead questions in this respect can be:

- What are citizens' attitudes, values and expressed priorities? Do people perceive energy/forests/fuel as a precious good worth economizing?
- Is climate protection perceived as an important value in the respective society?

The importance of attitudes and priorities cannot be underestimated. When discussing why energy efficiency measures are often not implemented even if they might be more cost effective than other GHG savings options, it is often said that energy efficiency is "not sexy". While this might be a colloquial sloppiness it is obvious that decision makers do not judge always and exclusively on economic terms (or any other objectively verifiable parameter) in which part of their business or private life they put more effort. In some countries, this information can be found in national surveys.

5.2.4.3 Users: Lack of expertise

This barrier applies if users and consumers know about their options to cause less emissions but do not know how to implement option technically. This does not apply to all climate mitigation options to the same degree: substituting a light bulb with a CFL requires less technical understanding and expertise than switching to sustainable forest management. The barrier can be abated through public outreach, individual education and training, or a service industry (part of the supply chain) that is taking over the implementation (e.g. energy contractors, project developers). Policy frameworks can support this effort, e.g. by requiring to acquire expertise by law, e.g. energy management obligations or specific certifications, in particular when the users / consumers are private businesses.

Indicators for the level of expertise are for example:

- Is sufficient trained staff present, e.g. in the industry, to carry out the necessary activities? (Share of companies with energy managers, personal with higher educational degrees in companies)
- Are users sufficiently knowledgeable to apply and maintain techniques and technologies?

5.2.4.4 Users: Access to mitigation option and information / access to decision making

Access to products necessary for implementing the mitigation option should be provided through the supply chain. However, in some cases users and consumers can still not change their behavior even if they were motivated to do so. In some cases there are legal or cultural restrictions that do not allow them to execute these options, for example because of a principal-agent dilemma between individuals or groups or because changes of social norms would be required. Test questions would be:

- Are users empowered to make climate relevant decisions:
  - Are users in control of the emission source, e.g. can they regulate their heating?
  - Can investors benefit from their investment decisions or does the benefit fall to somebody else, e.g. on new housing insulation or windows?
  - Are users socially empowered to make decisions (e.g. women)
- Do users have access to climate friendly services, technology, spare parts, equipment etc. that are price competitive and deliverable within reasonable time?

These barriers typically take the form of „all or nothing“, i.e. a stakeholder either has full access or no access. Therefore, the appropriate metric would be percent of stakeholders whose access to the option is barred either physically or legally / socially. This is applicable for individuals as well as organizations (including companies).

5.2.4.5 Users: Lack of cost effectiveness

As with other stakeholders, the established (climate-damaging) behavior might be more cost effective for the agent than the more climate-friendly behavior. This is one of the most important and often investigated barriers. Normally cost effectiveness is analyzed in the context of a cost-benefit-analysis (CBA) by comparing the net present values (NPV) of the two behavioral options. In some situations, this CBA will have to include non-financial benefits and costs. In addition, the NPV analysis needs to be adapted to the actual circumstances of the decision maker - required pay back periods or internal rates of return will be different for companies and private actors. Even within these groups, these parameters can vary widely.

If not all actors within each of the group face the same investment conditions and the same starting situation in terms of current costs and opportunities, the result of this analysis will take the shape of a reduces market size, i.e. an exclusion of a number of consumers / users for whom the new behavior will not be cost effective. Due to learning and scale effects the costs of the new behavior are likely to go down over time, so that this number will be smaller in the long term.

5.2.4.6 Users: Lack of affordability

Even if a change of behavior is cost effective, it might require initial investments. The need for sufficient funds can create affordability barrier that might be insurmountable by the users and consumers, depending on their financial situation. This situation can be mitigated by the development of business models, including business models for the finance and microfinance sectors. Therefore, when analyzing the situation of users and consumers in terms of investing, it is required to also look at the accessibility of financial products for the target group.

In addition, there might be non-financial affordability aspects that impede changes. Examples can be found in those areas where climate mitigation would require deep changes in lifestyle or living circumstances, including learning or migration periods.

Overall, the following aspects need to be taken into account:

- How large is the investment really, including not only capital investment costs but also transaction and learning costs for the change and lost income of the old behavior?
- Is sufficient capital available for the necessary investments?
- Are financial products accessible to facilitate the investments while not introducing cost effectiveness barriers?

The result of this analysis will take the form of a market share and will be even smaller than the number of users for whom the climate-friendly behavior is cost effective. The barrier mitigation activity should strive to increase that market.

6 Conclusion

Evaluating climate change mitigation interventions is an important effort in order to learn, to account for the use of funds and for impacts and to justify better interventions. All three will help improve climate mitigation, make it less costly, and aid our efforts to stabilize the global climate on a level that can sustain human life. After 20 years of climate mitigation projects, a significant number of evaluations have been compiled, and lessons on how to do these evaluations and the projects, have been accumulated. These guidelines make an attempt at digesting and distilling some of this experience.

Evaluating climate mitigation activities is trivial on the surface: has an intervention avoided greenhouse gases or has it failed to do so? But in quite a number of cases climate mitigation interventions might even have led to higher emissions than the baseline! But climate mitigation is about reducing the emissions of greenhouse gases into the atmosphere. At a time when the challenge was not as well understood as today, and when climate-compatible development was an empty shell that was not filled with a technological vision, it was obvious that all climate mitigation efforts needed to be justified in terms of the result of greenhouse gas emission reductions. However, today, with the wide range of projects and interventions, programs and project-base mechanisms that has been tested, we know that in order to reach sustainable development in a stable atmosphere, we will need investment on a grand scale – that can directly emit less than the baseline investment would emit. But: we also need a significant number of efforts that will not lead to direct emission reductions, but will nevertheless facilitate climate-compatible economies and lifestyles. In fact, evaluating single investments mostly fails to acknowledge the existence of barriers for this transformation. In their evaluations, some of the barriers can be highlighted if they are observable in the given project. However, mostly evaluating them cannot result in a consistent analysis of the context for replicating a specific project. Thus, evaluating one-off projects on their merits alone provides limited pointers in promoting the process of climate mitigation further.

These “softer” efforts and the “harder” efforts are both important. Nevertheless, until today, the paradigm persists that the “value” of a climate mitigation effort is measured in GHG savings. In this paper we have been discussing the various concepts for measuring GHG savings that have been developed over the years and that have been used in evaluations. While this is an interesting exercise in and of itself, it has also demonstrated that this perceived need to evaluate everything in terms of GHG savings is not reducing complexity and comparability but increasing conceptual confusion. The paper’s intention was to add some clarity in this respect.

The search for alternative indicators was continued, and two alternative sets of indicators were discussed: the OECD-DAC criteria and the barrier criteria for the Theory of No Change (part I). While both discussions cannot be fully mature, definitive and simple at this point, the hope would be to contribute to the general acceptance of two thoughts: that the relevance and importance of climate mitigation interventions can also be justified through other developmental benefits (OECD DAC), and that the impact on GHG emissions can also be rather indirect (TONC).

Both indicator systems are not fully matured and finalized yet. The outlook for the future would be to keep developing these two systems to the degree that they would be generally acceptable as related to climate change mitigation, contributing to a safer climate, and gradually replace the perceived pressure to measure results exclusively in terms of something that is not there (greenhouse gas emissions) but rather in terms of positive achievements.

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