

Meta-Evaluation of
Climate Mitigation Evaluations
Case Study
Poland's Heating Sector

Climate Change Evaluation Community of Practice
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1 Introduction and Research Question

In the Meta-Evaluation of Climate Change Mitigations a Barrier Framework was developed that helps analyze climate mitigation projects for issues like effectiveness and their contribution to market transformation. In particular, the model holds the promise that a unified set of outcome indicators for climate mitigation could be identified which would work on different intervention levels – policy, programs and policies – and that it identifies or even predicts the long-term impact of an intervention.

A number of case studies are necessary to test the developed framework model for its empirical basis and consistency with intervention approaches. The barrier model has been developed and first tested on the basis of market transformation interventions for energy efficient products in Thailand. In order to expand the model's usability to projects that do not follow a market transformation logic in the strict sense of the concept, but also attempt to achieve longer-lasting and replication impacts the model is tested on another set of projects in this case study. For this second case study, energy efficiency projects in the heating sector in Poland were selected for the analysis.

Some hypotheses that go into the selection of the projects and analysis shall be tested in the end:

1. Some climate mitigation projects are dealing with single investments rather than system wide market transformation. The project approaches in district heating, for example, are typically quite different from those used in the retail market transformation projects: They often target only one specific installation and work in a geographically confined area, mostly a single municipality. In doing that they usually do not work with policy makers or the supply chain to improve the overall investment climate in other locations.
2. Nevertheless, the barriers to project success that they encounter are similar to the barriers encountered in market transformation interventions, so that as a first approximation the same barrier framework can be used.
3. The reason for this is that the outcomes that are to be achieved in these projects are similar to the outcomes that are targeted in market transformation projects. These outcomes are displayed for example in the evaluation framework depicted in Tokle and Uitto (2009).
4. If interventions do not follow that logic, in particular if they ignore existing barriers, they are bound to have less expansive impact than they could have otherwise.

In order to find empirical evidence attesting to these hypotheses, we will analyze the following projects on the basis of their evaluations:

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

2 Case studies

In the following section, a number of energy efficiency projects in Eastern Europe are described, most of them in the heating sector. This discussion is based almost exclusively on evaluations, in some cases also on the project documents. After a description of the project, the barriers in the respective situations are discussed, the barrier removal activities and their success described and conclusions with respect to the Theory of No Change are drawn.

2.1 EBRD Energy Efficiency Portfolio Evaluation

15 sample projects from EBRD's energy efficiency portfolio have been evaluated in a special study (EBRD 2002). EBRD's activities are focused on extending credit or guarantees to private sector entities, among them Energy Service Companies (ESCOs), power plants, district heating system owners, power transmission companies, large industrial consumers, mining companies, and municipal utilities. EBRD participates in energy policy dialogue with the governments in its regions, including through direct high level meetings, frequent joint meetings together with projects sponsors and local financial intermediaries as well as EU and donor organizations. Technical assistance activities in the stricter sense are not mentioned in this evaluation. One of the three objectives of the study was "to assess the institutional, financial, market, technological, and social barriers and opportunities in increasing the number and volume of energy saving projects."

Unfortunately the summary does not provide detailed descriptions what barriers have been found in the 15 evaluated projects. Nevertheless, the lessons formulated in the portfolio evaluation characterize the nature of the challenges posed by non-financial barriers, and implying that these barriers have played some role in the projects of EBRD¹:

1. Lack of awareness with the users / consumers: "Energy saving investments often create a "win-win" scenario, with higher profit margins to the client and better debt service ratio to the Bank. However, the management of the local sponsor, accustomed to low priced energy, often does not recognize the benefits of Energy Audits and energy efficiency investments."

For this barrier, the EBRD evaluation recommends a number of strategies: 1. Developing a marketing package including information brochures but also standard formats for energy audits, as well as a "packaged offer" of energy audits together with a proposal for financing, and 2. Marketing this to existing clients is easier than to new clients. 3. Leverage funding from EU grant programs for energy efficiency studies. 4. Integrate energy efficiency concerns into Environmental Impact Analyses and industrial management tools.

2. Lack of cost effectiveness for the user / owner: "The client's financing could be compensated, if the proposed energy saving investments are implemented."
3. Lack of awareness with policy makers: "The evaluation of energy efficiency of the Bank projects has shown that there is a need to regional energy sector studies to prepare baseline for future energy supply investments, including Demand Side Management opportunities."

¹ As EBRD has not found a specific term for the respective barriers, the terminology of the Theory of No Change has been used.

4. Lack of interest / motivation with the policy maker “It is important to continue policy dialogue with the Governments, aiming at demonopolising and reforming the energy sector, and support such projects, which will increase competition in such sectors that are suffering from a stiff and non-transparent monopoly, as for example in the gas sector in Russia.” “It is important to ensure that the independence of the regulator is enshrined in law.”
5. Lack of expertise with users and financiers: is not formulated as a specific barrier, but it is suggested that benchmarking against the Best Available Technology can help provide decision-relevant information.

This collection of quotes represents only a small selection of the overall recommendations of the evaluation, most of which are targeted towards the question how EBRD and project sponsors can find more opportunities for projects. This emphasis, and the strong reliance on user-awareness and information tools could be interpreted as a sign that “open eyes” and money is all that it takes to actually leverage energy efficiency in the energy supply sector. This might be an underestimation of actual barriers and the level of influence that a regional development bank like EBRD can exert.

2.2 Conversion of coal fired residential heating to gas-fired heating systems in the 1990s

Heating systems in Poland after the opening to the West were typically old and inefficient. After the end of the cold war, Poland was in the focus of engagement of a number of the largest donors, in particular the World Bank and USAID. Therefore, a large number of stakeholders, experts and agencies have worked on the heating sector, which bore considerable responsibility for the bad air quality in some inner cities of the country, due to the inefficient burning coal and pre-modern state of the infrastructure in terms of leakage and lack of controllability. Therefore, a number of projects with final evaluations are included in the climate-eval library. These evaluations and the project documents describe the general situation of the heating sector as follows:

- The government had adopted a National Environmental Policy in 1991, which was reviewed in 1995. It endorsed the UNFCCC as well as the Kyoto Protocol and the Agenda 21 of the Rio Conference UNCED. (WB 2004)
- In 1991 the ownership and responsibility for the district heating systems was transferred from the Government to the local governments (gminas). These then suffered from a lack of funds to effectively operate, maintain and renew their infrastructure (WB 2000).
- The major DH technical problems were: (a) poor physical condition caused by poor water quality and inadequate treatment, leaking networks and lack of insulation;(b) inadequate operating system, using constant flow/variable temperature operation instead of the variable flow/variable temperature operation;(c) lack of sectioning and control capabilities to facilitate repair and maintenance, and (d) excessive use of small coal-fired HOBs resulting in significant environmental pollution. One district heating company writes:”In the late eighties, Warsaw district heating system was on the verge of technical disaster. District heating network pipelines were corroding at a dangerously high rate. There were periods when losses of treated hot water exceeded 2000 tons per hour (which was over 4.5% of the

flow rate) and the number of network failures exceeded 4000 a year. It caused certain problems to the city and its inhabitants.”

- Heat tariffs were regulated by the government, so that boiler owners typically could not recover investments through price increases (WB 2004, p. 28)
- There was not enough investment capital available in Poland in the early 1990s.

In addition to the evaluated interventions discussed below, a significant number of non-evaluated interventions and activities have taken place, for example,

- Already before 1994, the Bank of Poznan provided a credit line of USD 70 million for the conversion of small boilers in 45 district heating enterprises and industrial conglomerates. (WB 1994)
- In 1997, the Government passed the Polish Energy Act in view of EU Accession. It was amended in 2000, when the GoP also passed “Guidelines on Poland’s Energy Policy Through 2020”. (WB 2004)

2.2.1 WB loan “Heat Supply Restructuring Conservation Project”

The USD 202 million “Heat Supply Restructuring and Conservation Project” consisted of a total of six loans to different entities: one to the Republic of Poland, four loans to different district heating enterprises, and one to a financial intermediary (World Bank 2000). Some of the parts were canceled during project implementation. In parallel, another project extended a loan to the district heating company PEC Katowice, the successor of one of the initial project participants.

“The project's objectives were to: (a) support implementation of comprehensive energy sector restructuring, commercialization and privatization of restructured enterprises, introduction of a consistent regulatory framework between network subsectors, and achieve significant additional improvement in energy pricing policies; (b) extend the life of existing district heating assets through rehabilitation and introduction of modern technologies and materials; (c) enhance energy conservation in the district heating sector by financing appropriate investments; and (d) reduce environmental pollution through investments in energy-efficient equipment and systems as well as by supporting programs to replace small coal-fired boilers by gas-fired boilers.” Environmental concerns and energy conservation feature strongly in this listing, but the project has been designed without any reference to the UNFCCC or GEF financing, as it was developed as early as 1991, i.e. in the GEF pilot phase and before the Rio Conference where the UNFCCC convention was signed.

From the description of objectives, it is unclear whether or not the project intended to facilitate investments beyond the immediate engagements of the project, i.e. whether or not the intended outcomes also included barrier removal for further investments. However, the project is very ambitious and large and works with a large number of important owners of district heating systems. Potentially, with this structure it would have been possible, and it was probably part of the ambition, to have a lasting and fundamental impact on the district heating systems in Poland beyond the actual project participants. This is even more likely as at the point of appraisal, the country was in a general transition and almost all framework conditions and

markets were changing rapidly. Thus, even though the investment projects are specified in great detail, some larger market transformation idea is likely to have been part of the concept.

The projects components were defined as follows: “(a) a sector policy component (SECAL; US\$75 million) to the Republic of Poland; and (b) an investment and technical assistance component (US\$210 million) consisting of loan funds channeled directly to four appraised DHEs and through a credit line for similar investments in other DHEs. The borrowers for the investment and technical assistance component were: (i) the DHEs in Gdansk (Loan 3378-POL; US\$40 mln), Gdynia (Loan 3379-POL; US\$25 mln), Krakow (Loan 3381-POL; US\$25 mln) and Warsaw (Loan 3382-POL; US\$100 mln), covering together about 20% of the Polish district heating market; and (ii) the Bank of Poznan (Wielkopolski Bank Kredytowie SA (WBK)) for the credit line (IBRD Loan 3383-POL of US\$20 mln).” (World Bank 2000). Table 1 demonstrates how to conclude from the project activities to barriers in the context of the framework and evaluates the strength of the intervention.

Table 1 Project activities and barriers addressed in the WB loan “Heat Supply Restructuring Conservation Project”

Project activity	Barrier	Intensity
Lending to government	lack of affordability of policy framework for policy makers	Very high (5)
Lending to district heating entities	Lack of affordability of investment with district heating entities / users and consumers	Very high (5)
Credit line with local financial institution	Lack of affordability of investment for district heating entities, Lack of business model with local financiers	High (4), supplemented by EBRD, resulting in very high intensity overall
Technical training, consulting services	Lack of expertise	Very high (5)

rating of “highly likely” but by the time of the ICR, the project had been under implementation for a long time, and consumer prices for heat had increased to multiples of its original heights.

Most of the investment projects were completed successfully. But the financial intermediary WBK did not avail of sufficient capacity to administer the financing facility, deal with the necessary fiduciary standards required to work with the World Bank or EBRD, or have the necessary capacity to evaluate proposal. This project component was therefore canceled rather in the WB project after three years. The EBRD-part of that component was canceled before the scheduled end. Disbursement until then had only been USD 1.3 million of a scheduled total of USD 50 million.

An interesting and unintended effect is noted by the ICR regarding the local supply industry. Manufacturing and installing modern district heating equipment developed during the last decade of the 20th century into a significant sector in Poland, for example through international equipment suppliers who established manufacturing capacities in Poland, and several international joint ventures. Here, the WB ICR formulates an outcome indicator for the enhancement of the local technical capabilities: “The share of locally produced goods and installation services, financed by the World Bank and procured under international competitive bidding procedure, increased from about 3% of the total value of goods, installation works and consultant services during 1992-94 to 50% during 1998-2000”. As the supply sector is an important part of the Theory of No Change, in other words, as there is no change without a developed supply sector, this should be kept in mind for the search for unified outcome indicators for the Theory of No Change. The ICR estimates that the domestic industry at the point of writing of the ICR is able to supply the annual USD 350 million capital investment needs of the Polish DH market and also competitive in other markets.

Table 2 Barriers before and after the WB Heat Supply Restructuring Conservation Project in Poland

Stakeholder Group	Barrier	Barrier level before intervention		Barrier level after intervention (2004)	
		Rating	Remark	Rating	remark
Users					
	Ignorance	Green		Green	
	Lack of expertise	Yellow	Master plans existed, "technically well qualified", but unfamiliar with new technologies	Yellow	One DHE expresses in comment to ICR that more training would have served well
	Lack of access to technology	Orange		Yellow	Procurement through project established relationships with service providers
	Lack of cost effectiveness	Orange	Investment might not be recoverable through higher use tariffs	Orange	Insufficient change in the cost effectiveness due to non-cost-recovering rates
	Lack of motivation / interest	Orange	demand was overstated in the proposal	Green	Market orientation
	Lack of affordability	Red	Transformation processes hampered project preparation	Yellow	unclear
Supply Chain					
	Ignorance	Yellow		Green	
	Lack of expertise	Yellow		Green	
	Lack of access to technology	Yellow		Green	
	Lack of cost effectiveness	Yellow		Green	
	Lack of business model	Yellow		Green	
	Lack of affordability	Yellow		Green	
Financiers					
	Ignorance	Yellow		Yellow	
	Lack of expertise	Red	Banking sector underdeveloped	Yellow	
	Lack of cost effectiveness	red	General financial crisis	Red	If tariffs are not increased to cost recovering levels, no willingness to finance

Stakeholder Group	Barrier	Barrier level before intervention		Barrier level after intervention (2004)	
		Rating	Remark	Rating	remark
	Lack of business model	Red	No financing available	Red	Credit lines were canceled due to lack of demand
Policy Makers					
	Ignorance	Green	Energy sector reform agenda	Green	
	Lack of expertise	Yellow		Yellow	
	Lack of motivation / interest	Yellow		Orange	Insufficient political will for further tariff increases
	Lack of affordability	orange		Yellow	

Summarizing, the project led to a number of successful replacement investments in the four district heating entities that received direct loans. However, even as it accompanied the largest players with a large sum of money it did not result in a self-sustaining market transformation to environmentally and economically sustainable operation and investment in district heating systems in Poland. The most important reason for that were aspects on the financial viability and sustainability side, including a sector reform that allowed for financial sustainability of government-independent heating entities. Follow-up projects to this project were necessary to keep financing district heating enterprises. Not all barriers have been removed. Even the ICR states that future performance is still threatened by potentially insufficient tariff increases.

Interesting lessons are formulated in the ICR with respect to some of the non-financial barriers:

1. Lack of expertise with users: Management and technicians of district heating systems tend to underestimate the level of losses in the system without accurate measurement equipment.
2. Lack of cost effectiveness with financial intermediaries: “When providing a line of credit in partnership with other international financial institutions (IFIs), it is essential to provide for a blending of funds for all sub-loans if there is a difference in the terms under which the funds are provided. In addition, the Bank and the other IFIS should agree on common appraisal and procurement requirements which can be administered at a reasonable cost by the intermediary.” In the project, both the World Bank and EBRD had provided separate lines of credit through the same financial intermediary at differing terms. EBRD terms were more concessional which resulted in the two lines of credit outcompeting each other to the detriment of the World Bank line.

2.2.2 WB Katowice Heat Supply Project 1993

One of the district heating entities that were supposed to take part in the World Bank “Heat Supply Restructuring Conservation Project” was WPEC Katowice. During project appraisal for the large project, it was in the process of reorganization and could not participate in the large project. It was split out in a separate project that started three years later but closed only four months after the large project. Including its ICR (World Bank 2001) in this meta-analysis provides insights into how single investment projects cannot ignore but have to include barrier removal aspects.

For the Katowice project, all components and objectives were “investment-oriented”, but still included 230 staff weeks of consulting services to prepare the master plan, develop the management information system and initiate a quality assurance control system, deliver training on investment planning, economic evaluation and other business management skills. “As a result, PEC Katowice has developed in-house expertise for investment optimization and planning, execution and management of the network operation, and preventive maintenance. The success of the training and technical assistance programs was a key factor in achieving substantial improvements in the company’s physical operation” (World Bank 2001).

The World Bank documents do not discuss the barriers sufficiently for drawing the barrier circles. Nevertheless, some barriers feature prominently. For example, the financial performance of the loan was threatened, as the new national regulator URE focused their activities on the licensing of heat companies rather than on tariff regulation. Therefore, tariffs were not adjusted for over two years. In these two years inflation and a drastic reduction of heat demand led to a loss of revenue for the refurbished heating company. When URE started to regulate tariffs the tariff proposals were long and complex by design, involving calculating more than 60 different tariff categories, and expertise on both sides, with URE as well as with the PEC was lacking. In fact, the ICR itself rated the institutional development impact of the project as “negligible” and much lower than for the other four heating entities of the large program. The ICR reasons that “one reason for this is that the other DHEs were granted two year loan extensions but also because PEC Katowice’s senior management did not follow up their initial intentions with regard to institutional development”.³ The Management Information System remained limited in scope, and the Quality Assurance System was initiated but later stopped. No ISO 14000 Certification process was ever initiated.

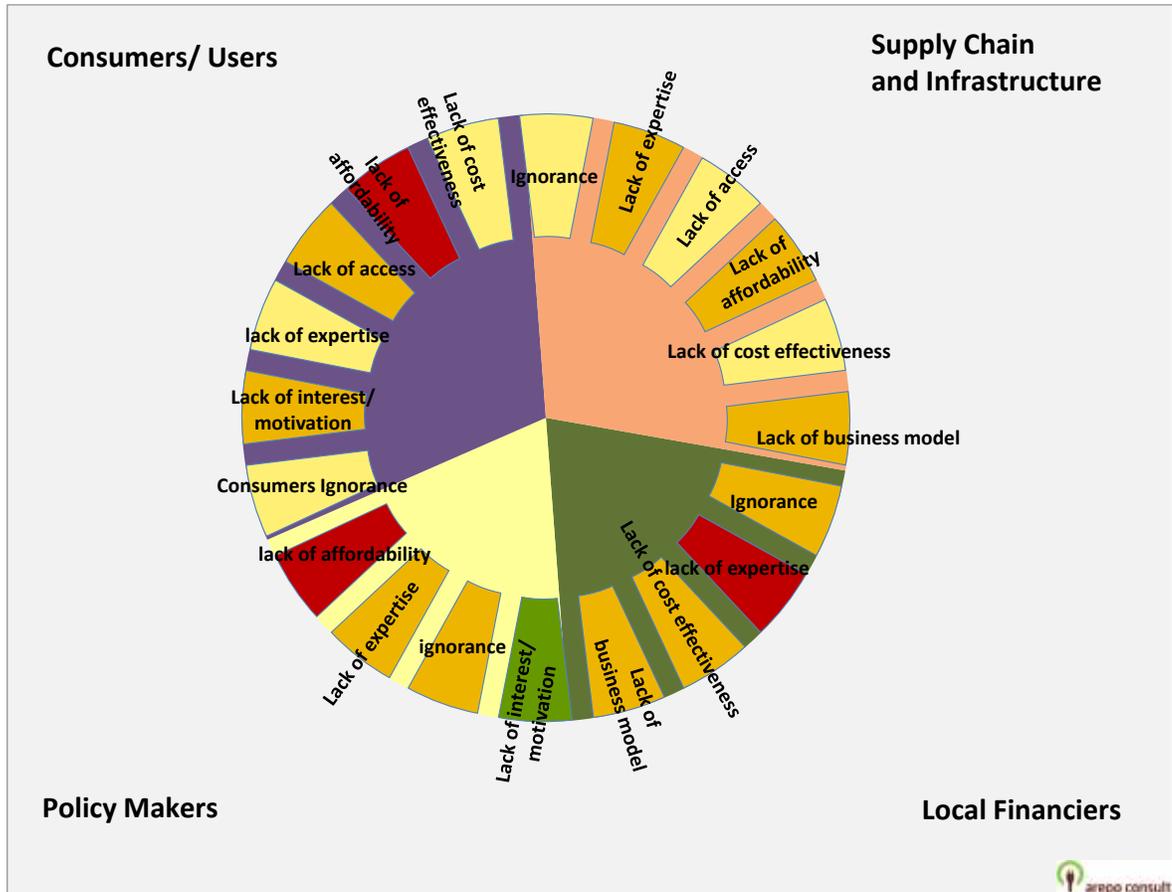
Overall, a number of the challenges that the project faced, and in particular those that related to the financial viability of the district heating enterprise, point to the fact that more significant capacity building with the district heating enterprise as well as potentially with local financiers and the regulator could have helped improve project performance. The mere lending approach seems to have had shortcomings and hit some market transformation barriers.

³ If this might seem inconsistent with the previous comments on the technical assistance components, one might consider the fact that ICRs are not external and independent reviews but rather team reports for accountability purposes within the project and the World Bank.

2.2.3 WB/GEF grant “Coal to Gas Conversion” of 1994

Associated with the WB HSR project, the World Bank also administered a GEF grant of USD 25 million to the Ministry of Environmental Protection, Natural Resources and Forestry of Poland. It was designed to be cofinanced by a grant of USD 1 million from the Norwegian Government for GEF projects, and local investments of USD 24 million and implemented through the Bank Ochrony Srodowiska SA (BOS; “Bank of Environmental Protection”) as a manager of funds.

Figure 2 Barrier circle for coal-to-gas conversion in Poland in 1992



The project objectives were

- “(a) to demonstrate interfuel substitution and technological innovation, combined with opportunities to improve overall energy efficiency throughout the heat supply chain including the heat transfer systems and the end-user habits of consumers, as a means of reducing carbon dioxide emissions;
- “(b) to build up the institutional capability in making judgements about and capturing global externalities, such as CO2 emission abatement, in project analysis; and
- “(c) to establish the organizational structure for implementing already selected pilot projects and replicating the GEF concept to other investment projects yet to be identified nationwide.” (World Bank 1994)

- The GEF funds were expected to “quickly and strongly influence future investments to the benefit of global environmental objectives through end-user efficiency improvements (..) This would significantly reduce CO2 emission (sic!) from the residential/household sector in Poland”. These formulations indicate that the objective of the project reaches much further than only those installations and investments that are directly part of the projects outputs. This project wants to go beyond and remove at least some of the barriers for more energy efficient investments that exist in Poland. In fact, it had been conceived originally as a model program in which a large number of individual projects could have been implemented with assistance from the Joint Implementation mechanism⁴, which was also the motivation of the Norwegian Government to cofinance this program.
- In the Investment component of US\$ 48.6 million, initially, two coal fired boilers in Krakow should be converted and serve as demonstration projects for natural gas based facility heating. In the context of the “Replicability Framework” of the project, about 51 coal-fired boilers of a variety of scales should be converted to firing gas, out of a total of many thousands of similar boilers in all of Poland that are the overall market to be transformed.
- In the Technical Assistance Component (USD 1.4 million) “local institutional capability to support a broader dissemination and replicability of the present GEF project concept, using the pilot projects in Krakow as a model for replicability” should be built up, a marketing plan for nationwide dissemination of the GEF project concept and rules and procedures for future individual applications under the replication component. As this is an early GEF project, the Project Identification Document (1994) does not go into any further detail of the rationale of the project, the implementation arrangements, contractual relationships or actual outcome or impact indicators.

On this basis, the project’s activities have been assessed as displayed in Table 3. This table associates the activities with the barriers as developed on the basis of the Thai case study for the Theory of No Change.

Table 3 Project activities and barriers addressed in the WB/GEF coal-to-gas grant

Project activity	Barrier	Intensity of barrier removal activity
Building local institutional capacity	Lack of expertise with BOS / local financiers	4
Nationwide dissemination	Lack of awareness with users	4
Demonstration investments	Lack of awareness with users, suppliers, financiers and policy makers	2

⁴ No reference to this can be found in the GEF Grant Agreement, but it is mentioned in the ICR, which quotes a number of media reports. NB: At the time of Grant Agreement signature, the Kyoto Protocol had not been decided upon yet.

Replication facility, incl. funds and rules and regulations	Lack of cost effectiveness for financiers and users	5
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The ICR assesses project procedures as “complex. For example, the individual projects in the *Coal to Gas Conversion Subcomponent* had to follow 19 steps of mandatory actions from the design to the completion stage. and occasionally they were difficult to handle by the beneficiaries, their representative and the Implementing Agency.”

Translating this project into the barrier framework is not trivial because the beneficiaries are a very heterogeneous group, containing residential home owners, facility managers and heating boiler operators as well as housing developers. They will be called the users / consumers. Their level of competence was very mixed initially, but even high expertise did not necessarily lead to investment success (as described in the case of the University demonstration project). The evaluation also mentions a “Boiler Owner Representative”, a private company that seems to have been responsible for collective negotiations with the Implementing Agency / Bank.

The financial sector is also the implementing agency which puts this bank into an awkward position. The GEF office within the BOS remained rather isolated from normal banking operations and even though they acquired specific skills and expertise throughout this project, they did not remain at the bank after the project so that no sustainable learning effect of this bank for gas boilers was gained from the project.

Policy makers and the supply chain for efficient gas boilers were not significantly involved in the project. In particular the Ministry of Environment suffered from fast staff turnover. Other policy makers, in particular those responsible for the energy sector, were busy regulating the overall sector.

In 2004, the World Bank evaluated the project in an Implementation Completion Report (World Bank 2004) which analyzes successes and failures of the project with candid frankness. It describes that the project’s objective “was a challenge because of institutional conditions in Poland at the time of project inception.” The ICR attests to a lack of government coordination and inexperience with institutional processes, as well as “inability to follow project operational requirements”. This could be called “lack of expertise with policy makers” in terms of the Theory of No Change, but on the other hand it might just be a lack of expertise in administering WB projects rather than policy making for the heating market.

In the Implementation completion report, the World Bank does voice some ideas and expectations regarding non-financial barriers: “the introduction of improved technologies would facilitate the Government’s efforts to pursue aggressively its environmental priorities and standards (..) with largely decontrolled coal prices, proper gas pricing policy, and rising labor costs, coal-to-gas conversion would become a financially attractive and self-supporting option. The GEF activity could be made more self-sustaining through the support of an independent power market based on small gas-fired cogeneration systems and the development of a market for advanced energy efficiency housing equipment – insulation, glazing, lighting, and appliances – that are both widely available internationally and only a short distance away in Western Europe.” Put into the context of the Theory of No Change the project design thus recognizes the existence of other barriers – the lack of an independent power market, the lack of access to more advanced housing technologies – but leaves them to other interventions or the natural

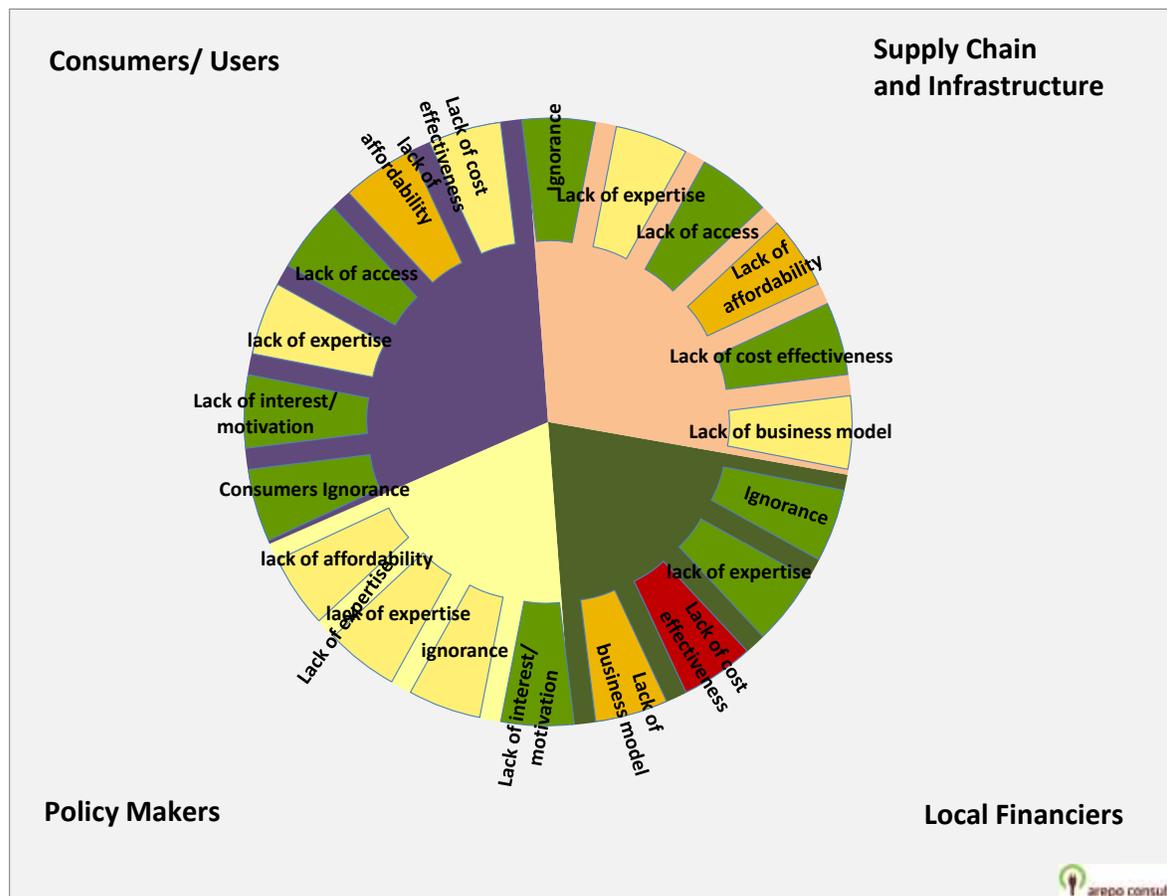
analytical base for the project design, the model for incremental analysis and grounds how to choose the technology.” This means that while it was unable to complete its original mission and remove the awareness barrier with the majority of the stakeholders, unintentionally it did help to remove some of the technical expertise barriers with the implementing agency / the financiers.

As stated in the ICR, the project did not have defined intermediate outcome indicators. Still, the ICR attests to achievements in terms of “Change in thinking about saving energy (firstly from the economic and secondly from the environmental point of view)”, i.e. a change in the barrier of “lack of motivation with consumers / users”. Unfortunately, the ICR does not formulate quantitative or SMART indicators for this dimension, but remains rather qualitative when it states: “Today, housing developers and individual home and apartment owners are more eager to install energy saving technologies (...). (Interestingly, people of higher education display a greater willingness to pay for energy efficient equipment above the currently binding ecological standards). GEF contributed to this trend locally as the housing communities continued to develop their pro-ecological thinking and activities, which constitutes institutional change. The project assisted in the process of technological switch albeit it was not a cause of it.” Potentially, this statement is made on the basis of a public opinion survey but the research methods are not clarified in the ICR. Some of the change in attitude is attributed to the project, although no quantification is undertaken. As the ICR findings point to the outputs of demonstration installations as the main results of the projects, the impact on public motivation is likely to be rather weak, in particular if one keeps in mind that the ICR was written 10 years after the grant agreement was signed, and that in these 10 years Poland prepared its accession to the European Union with its much stronger policies and much higher general awareness for energy conservation and exposure to other demonstration objects.

The project was also able to make the cost-effectiveness of energy savings measures relevant to the consumers and users: “inhabitants of energy-efficient housing must continue to implement energy saving techniques, which is likely because they have already been exposed to energy-saving measures and have felt the economic benefit of the switch to the new technology” (WB 2004). However, for the boilers the project was not able to sustainably ensure cost effectiveness for consumers, as gas prices rose during project implementation to the degree that at the end of the project, a new coal boiler would have been more cost effective than a new gas boiler. Thus, “conversions on mass scale are not likely in the near future because the cost of such undertaking (...) remains high from the Polish investor perspective” (WB 2004).

The ICR finds further that while a the envisioned number of boilers were converted and a large number of dwellings were equipped with energy-conserving equipment, there were many boiler owners who were not able to convert even with the grant due to a lack of “counterpart funding”, i.e. equity or loans at acceptable rates. This is a typical affordability barrier with consumers / users that the project was unable to remove. It is not a cost-effectiveness barrier, as the grants were calculated so generously that they would have led to an internal rate of return of 25%.

Figure 4 Barrier circle for coal to gas conversion in Poland in 2004



All World Bank ICRs need to discuss “Institutional Development Impact”, which in the Theory of No Change could be interpreted as enhancing the expertise of financiers of policy makers for playing their roles in the new markets. In this project, a special project component was tasked with increasing BOS’s capabilities for assessing lending opportunities in the energy efficient heating realm. The assessment of the ICR goes beyond this narrow definition and assesses the impact on the institutional development of consumers as well as policy makers in addition to BOS. While the authors state that “the overall institutional development of the country as a result of the project is assessed as modest because the multiple extensions decreased the impact of the project on the issues in question” they also find that some solutions to specific issues that have been found in the project for all three stakeholder groups, have been resolved in a project with significant impact. It is natural for the evaluation through an ICR to also value highly the increased capacity of participating agencies to deal with international project implementation rules, however, for the market transformation process and thus also for the Theory of No Change this is irrelevant and will not be discussed further here.

Table 4 Barriers before and after the GEF Coal to Gas Conversion Program in Poland

Stakeholder Group	Barrier	Barrier level before intervention		Barrier level after intervention (2004)	
		Rating	Remark	Rating	Remark

Stakeholder Group	Barrier	Barrier level before intervention		Barrier level after intervention (2004)	
		Rating	Remark	Rating	Remark
Users					
	Ignorance	Yellow		Green	Cost effectiveness was proven
	Lack of expertise	Yellow		Yellow	
	Lack of access to technology	Orange	Market underdeveloped	Green	Project did not change situation directly
	Lack of cost effectiveness	Yellow	Cost-effective if affordable	Red	Changed fuel prices
	Lack of motivation / interest	Orange	No general concern for energy consumption	Green	ICR is very upbeat on this, 777 households who have benefitted from energy savings are highly motivated; but just through this project?
	Lack of affordability	Red	No funds	Orange	More capital available
Supply Chain					
	Ignorance	Yellow	No domestic industry	green	Government policy creates interest; but not through this program
	Lack of expertise	Orange	No domestic industry	Yellow	Not through this program
	Lack of access to technology	Yellow	No domestic industry	green	Some market has been created, but not through this program
	Lack of cost effectiveness	Yellow		Green	Some market has been created, but not through this program
	Lack of business model	Orange		Yellow	
	Lack of affordability	Orange	Generally little capital available	Green	
Local Financiers					
	Ignorance	Orange		Green	Banks know opportunities
	Lack of expertise	Red		Green	Banks knew well how to evaluate projects through demonstration projects' model solutions
	Lack of cost effectiveness	Orange		Red	Gas prices had risen, leading to lack of cost effectiveness
	Lack of business model	Orange		Orange	After the grant disappeared

Stakeholder Group	Barrier	Barrier level before intervention		Barrier level after intervention (2004)	
		Rating	Remark	Rating	Remark
Policy makers					
	Ignorance	orange	Lack of studies, data, and scenarios	Yellow	Insights have been created
	Lack of expertise	Orange		Yellow	Insights, policies, projects have been created, but not all through this program
	Lack of motivation / interest	Green		Green	
	Lack of affordability	Red		Yellow	Grants were cut, but policy makers had access to new financing sources

In conclusion, the ICR finds that the market has not been sustainably transformed: “To achieve the coal to gas conversion on a truly national scale, additional funding is required to support the process, which began with this project and continued with other unrelated and unconnected projects. Various programs aiming to reduce carbon dioxide emissions that exist today would need to be more visible and coordinated to facilitate the conversions. Similarly, coordination is needed between various ministries to propose a coherent set of energy efficiency programs and related subsidies. Most importantly, the *Guidelines on Poland's Energy Policy Through 2020* and their assessment need to be implemented without further delay.”

Relevant lessons learned *from* this project are formulated in the ICR as follows:

“The success of a project targeting the environment could be better assured if Government had an integrated policy on financial and substance aid management. An *isolated* project such as this GEF undertaking would have stronger effects if it had been coordinated with other sources of funding.

“A local office of a reputable international company does not necessarily have the needed skill. The experience with the first BOR⁵ shows that although the selected company was respected in the country of its origin, its representative was not able to provide desired support. Local accredited firms should be a first choice when designing and implementing a project.”

In the “Theory of No Change”, these barriers would be identified as “lack of awareness” with users, “lack of expertise” with policy makers and “lack of expertise” with the supply chain. Actually, the lessons quoted above is the only time in the ICR where issues with the supply chain are discussed at all, indicating how hard it is to discuss all relevant issues of project success and failure without a coherent framework of analysis like the Theory of No Change.

⁵ Boiler Owner Representative, an intermediary between the project and the boiler owner

2.3 Geothermal district heating interventions

In the late 1990s and early 2000s, the World Bank in particular undertook a number of attempts to introduce geothermal heat sources into a number of Polish heat sources. In Poland, the geothermal resource is significant, and its analysis and documentation dates back to the 1970s, when wider interest in this energy sources arose. As Oniszk (2006) describes, the first Geothermal Research Institute of the Polish Academy of Science was installed in Podhale in 1992, and by 1999 three geothermal heating plants were operating.

The best documented is the project in Zakopane / Podhale. An experimental plant had been built in the years 1989 – 1993. As it proved able to supply heat to a small number of households in the proximity of the well, scientific assessments predicted that a significant share of the inhabitants in the Podhale Valley could be connected to a heating network and be supplied from the thermal waters in the warm aquifers (Kepinska 2003). The technical proof of concept led to an investment proposal of over 50 million USD (Kepinska 2003), around which a WB loan with GEF grant as well as a carbon finance intervention have been developed since 1995.

For the WB/GEF project a final evaluation is available (World Bank 2005). Zakopane has also been used as a study case for the UNU Geothermal Training program (Kepinska 2003), which mentions that the overall development was accompanied by an extensive information and education campaign, in particular in the form of town hall meetings, with the objective of convincing consumers to trust in the reliability of the geothermal source. The case of Zakopane is also documented in a case study that was conducted under an EU-funded research program that analyzed the experiences with creating acceptance for renewable energy and energy efficiency initiatives (Oniszk 2006). In this, a market survey among potential heat customers conducted in 2002 is documented, and an in-depth stakeholder analysis is undertaken.

The project was implemented by PEC Geotermia Podhalanska SA, which was the result of a merger between the geothermal company Geotermia Podhalanska and the Tarty district heating company which operated the Zakopane district heating system. The company was co-owned by the Municipality of Zakopane, the National Fund for Environment Protection and Water Management NFEPMW, and Hydrotrest. While many of these are public actors, the setup was giving the company as much freedom as a private company would have. The local policy makers “highly appreciated” the idea of utilizing geothermal energy, for its modern technology, for its reduced environmental impact, for the appeal for tourists, enhanced safety features, energy security aspect and local ownership. The plant operator Geotermia had sufficient competence and worked actively in outreach and the promotion of geothermal district heating.

Ultimately, the project failed to deliver on its business plan. The reason for that was that much less load could be attracted. Kepinska (2003) mentions that the price for geothermal heat was initially negotiated in such a manner that it was comparable to coal-based heat and cheaper than gas-based heat. Therefore, using geothermal heat would have been cost-effective for consumers. Oniszk (2006) divides the users into four major groups: around 4200 individual households, larger loads, the boiler houses formerly operated by Tarty and the boiler houses formerly owned by Nowy Targ. He does not mention resistance against being connected to the cleaning heating network. But probably many of these potential loads were not in need of a new heating system at this point in time. The project lost profitability when the residential town of

Nowy Targ lost interest in the concept and dropped out. In the main area, lower than expected heat load could be found and connected to the project. Oniszk (2006) writes:

“Representatives of Nowy Targ (another big city which was supposed to receive a large part of the heat produced) knew that without the participation of their town there was practically no chance for the quick payback for the geothermal investment. The town was a good partner for ‘PEC Geotermia Podhalańska’ - with 20 thousand inhabitants, its buildings close to each other and its modern heating network easily adaptable. The authorities of Nowy Targ were well aware of the value of this potential market. Relations of the authorities of Nowy Targ with the company were described as difficult but based on partnership.”

However, political support for the geothermal project waned when Nowy Targ had to make concessions on pricing, including giving up sovereignty on pricing policy (Oniszk 2006). In this respect, two different traditions had existed in Zakopane and Nowy Targ, where the price of heat was kept subsidized. Accordingly, the government representatives in the survey answered that they considered the high expenditures and energy costs, unstable gas prices and other obstacles threats to the economic viability of the plant. In Zakopane, the project had been able to replace 28 inefficient coal-fired boiler houses with geothermal heat and provide some hotels with emission-free energy. This led in particular to a reduction of coal-caused air pollution. The ICR states on the aspect of the business case for this geothermal district heating system:

“The single most significant failure of PEC/GP has been the inability to accurately characterize the potential heat market or the approaches needed to achieve any predictable penetration of the market. Seriously outdated data continued to be used; market penetration models that clearly revealed strong sensitivity to heat prices were never adjusted when tariffs were substantially redesigned; and no efforts were made to recalibrate the models to early experience. As a result, no early changes were made to the Project design; no significant revisions were made to the marketing approach or tariff designs; possible EcoFund funding to stimulate new connections was never obtained, and financial projections could not be reliably revised. During supervision the World Bank team repeatedly proposed an updated market-study and intensified marketing activities. PEC/GP suggested that these could be undertaken by local personnel or consultants rather than drawing on international expertise. Local expertise would have been helpful in better understanding local decision-making, but international consulting support may have carried more weight and led to more decisive responses. Networking with marketing experts from other successful district heating companies could also have strengthened the marketing effort.”

The project was terminated in 2004 without having achieved its full objectives. The targets for GHG reduction of the projects had to be corrected downward significantly. Geotermia Podhalanska was not able to serve the World Bank loan anymore as revenues were short of the business plan while costs were in line with the business plan. Its majority owner, the National Fund for Environmental Protection and Water Management, had to invest more equity to cover the World Bank loan. The ICR (World Bank 2005) analyzes whether or not it would make sense for the National Fund to continue operating the plant, or shut it down, concluding that a deficit-stricken operation would still be more beneficial economically than shutting it down.

Table 5 Barriers to geothermal district heating in Zakopane

Stakeholder Group	Barrier	Barrier level before intervention (1995)		Barrier level after intervention (2006)	
		Rating	Remark	Rating	Remark
Users					
	Ignorance	Yellow		Orange	Offers of Geotermia were often not understood
	Lack of expertise	Yellow		yellow	
	Lack of access to technology	Red	Option was not offered	Green	Access was available
	Lack of cost effectiveness	green	Geothermal was competitive with gas	orange	Rates had to include taxes
	Lack of motivation / interest	Orange	Consumers did not trust in the reliability of the heat source	Orange	ICR finds that marketing to households was not effective
	Lack of affordability	Yellow		Yellow	
Supply Chain					
	Ignorance	orange	“the single most significant failure of PEC/GP has been the inability to accurately characterize the potential heat market”.	green	Learning by doing, change of management; new ideas including JI
	Lack of expertise	green	Local geothermal research center	green	
	Lack of access to technology	Yellow	No domestic industry, but local geothermal center	green	
	Lack of cost effectiveness	Green	Due to tariff regulation, project should have been cost effective	red	Insufficient number of connections made; unexpected excise tax
	Lack of business model	Red	Business plan was unrealistic; management capacity insufficient	orange	Equity injection and management change still failed to make the project viable
	Lack of affordability	Orange	Initially insufficient capital	Yellow	Local equity injection was possible, but still unsatisfactory
Local Financiers					

Stakeholder Group	Barrier	Barrier level before intervention (1995)		Barrier level after intervention (2006)	
		Rating	Remark	Rating	Remark
	Ignorance	Yellow		Yellow	
	Lack of expertise	Red		Yellow	
	Lack of cost effectiveness	Orange		Red	As project has failed to deliver enough connections, the FIRR was too low for bank engagement
	Lack of business model	Orange		red	National fund as majority stakeholder would not borrow from commercial banks
Policy makers: municipal governments and other public bodies					
	Ignorance	Yellow	Impact on rates was unclear	green	Insights have been created
	Lack of expertise	red		Green	Institutional development impact rated as substantial in the ICR
	Lack of motivation / interest	Green	Mostly supportive	Green	
	Lack of affordability	Green	Was initially not considered a barrier	Red	Fear of rate hikes led to drop-out from project; no tax-financed subsidy possible

Interestingly, the largest financing share for the Zakopane project did not come from the World Bank, but from the EU PHARE program (cf. Table 6).

The management response from PEC/GP interestingly pointed out similar issues from the perspective of an aid recipient. In the response, the then current management blames the previous management for bad business and technical practices. However, it also complains that the World Bank was not able to make up for this with technical assistance, e.g. in terms of writing business plans. They also correctly point out that some of the financial difficulties have been caused by unstable national government taxation policies which in turn affected local government taxation. These factors were included in the government negotiations during project preparation insufficiently mitigated during project implementation. No sustainable commitment of the government had been produced during project preparation.

Table 6 Podhale geothermal project capital expenditures 1995 – 2002 (Kepinska 2003, quoting Dlugosz 2003)

Source of finance	Million Euro	(%)
Share capital	9,900	18.8
Grants	26,175	49.7
PHARE	17,700	
NFEPWM	2,650	
Ekofund	1,050	
GEF	2,500	
USAID	1,750	
DEPA	525	
Credits	16,625	31.5
World Bank	10,525	
Bank PKO	6,100	
TOTAL	52,700	100.0

1 PLN = about 0.25 USD

PHARE – Poland Hungary Aid for Reconstruction;

NFEPWM – National Fund for Environmental Protection and Water Management;

GEF – Global Environmental Fund;

USAID – United States Agency for International Development;

DEPA – Danish Environmental Protection Agency

Even though this project was not removing all barriers even for its own sustainability – after the World Bank/GEF intervention, the financial situation of the investment was not stable –; or rather in spite of its difficulties, the ICR suggests that the project is triggering significant interest and follow-up investments in geothermal heating systems in Poland and the region. Later, Geotermia Podhalanska and the municipality of Zakopane looked for other means to expand its network and connections, including carbon finance. It was able to attract a Danish project partner in the Joint Implementation scheme (AAN 2006), and connect some more residential consumers as well as two swimming resorts.⁶ In addition, a number of other cities in Poland started developing geothermal resources for heating purposes. As Zakopane is the largest geothermal project and the seat of the local center of expertise, all of these projects have benefitted from the experiences made here.

2.4 Biomass-based district heating

Another attempt to replace coal boilers and the associated pollution was undertaken by the UNDP/GEF Medium Sized Project ‘Integrated Approach to Wood Waste Combustion for Heat Production in Poland’. The final evaluation, the mid-term review (Ballard-Tremeer 2004) and a specially managed project review are part of the climate-eval library. According to the Mid-Term Evaluation (Ballard-Tremeer 2004), the project “originally aimed to reduce barriers to the

⁶ Unfortunately, no evaluation for this ongoing project could be found. This claim is based on the JI document (AAN 2004) and an internet research that found that the Aquapark Zakopane features geothermal heat today.

creation of a biomass market in Poland.” In order to analyze the project in terms of the barrier framework developed for the meta-evaluation, the market would be the market for biomass-based fuel. In this market, the district heating companies would be the users, and the supply chain relates to the suppliers of the biomass-based fuel. Financiers would provide financing for both types of economic activities, and policy makers would regulate the supply of biomass-based fuels, as well as the conditions for the production and the provision of heat.

According to the Midterm-Review, the following barriers had been identified in the project document:

- Heating companies were supply-oriented, i.e. they were programmed to maximize sales and heat consumption rather than supplying the correct amount of heat that satisfies the need. This was limiting the emission reduction potential of substituting coal with biomass. In terms of the barrier terminology developed here, this barrier can be related to a lack of the motivation of the user.
- Municipalities were in charge of the wood resources. In order to use wood waste efficiently, cooperation between different municipalities would be necessary. This had not been done before, so that here a “lack of business model” could be identified.
- Oil and gas were marketed aggressively as a substitute for coal heating to the municipalities. Comparable capacity for the promotion of biomass was not existing. This translates into a “lack of awareness” and potentially even a “lack of access to the technology” for the biomass-using municipalities⁷.
- The Mid-term-Evaluation further states that initially, a “difficulty to finance biomass projects” was defined due to a lack of knowledge with “investors and developer” of biomass projects. This does not clarify whether this relates to users (i.e. district heating systems) or suppliers of biomass systems, and whether investors include the financial sector or is limited to the owner-operators of the biomass-systems.

However, the midterm review proved insufficient to assess all aspects of the project design. Going back to the project document (UNDP 1999) does not bring clarity on this issue either. On the other hand, the project document contains a number of intelligent results and outcome indicators that could serve as a starting point for the next step in the development of the Theory of No Change.

While this project is explicitly structured around a barrier framework, it is not refined enough to be unequivocally translated into the scheme used in this paper. On the other hand, all of the mentioned barriers are covered by the barrier framework developed here.

The mid-term analysis then lists the key stakeholders.

- Local authorities (responsible for delivery of heat and other services to consumers)
- Government ministries, in particular
 - o Ministry of Environment (responsible for Renewable Energy Policy)
 - o Ministry of Economy (responsible for Energy Policy)
 - o Office for Housing and Urban Development,

⁷ The mid-term evaluation is somewhat murky at this point, whether the lack of access relates to technology or to biomass fuel.

- Ministry of Agriculture and Rural Development (responsible for Forestry Policy)
- Energy companies (power sector in generation, transmission, and distribution; and heat supply and distribution)
- Oil, Coal and Gas industries (competitors)
- Wood / biomass industries (using wood resources and producing and using wood-waste)
- EcoFund (GEF Operational Focal Point), established by the Ministry of Finance to manage the Polish debt for environment swap
- The National Fund for Environmental Protection and Water Management
- The Voivodship Funds
- Civil society and NGOs
- Corporate sector (equipment suppliers, services providers)
- Heat and power consumers

Not all of these play a role in the barrier circle framework. There are at least three funding organizations (EcoFund, National Fund for Environment Protection and Water Management, Voivodship Fund), which are not really parts of the barrier framework as they are not participating the market itself. The role of a number of stakeholders in the project, e.g. the oil and gas industry, or the civil society is not necessarily following the project logic. However, the list also allows an interesting analysis of the supply chain coverage of the barrier framework: Compared to the definition developed above – focusing on the wood-based fuel market, for which supply is constituted by the wood product supply, and demand is constituted by the heating companies -, the supply chain in the stakeholder list is longer on both ends: on the demand side, the project’s stakeholder list also includes the heat and power consumers. On the supply side, the project’s stakeholder list also includes the suppliers of hardware to both, the heating companies as well as the wood-fuel producers. Last but not least, the local governments are part of three aspects of the barrier framework: They are the owners of the wood as a fuel, they are (in some cases) the owners of the heating companies (who have made it to the list in their extra-bullet) and they are also setting some of the rules, and thus also play a role as policy makers. The project MTE also identifies them as the “most important direct beneficiary”.

Table 7 Barriers affecting the development of a biomass-for-heat market in Poland

Stakeholder Group	Barrier	Barrier level before intervention, 1999		Barrier level at MTE/SMPR (2002)	
		Rating	Remark	Rating	remark
Users					
	Ignorance	Orange	No awareness	Green	High awareness
	Lack of expertise	orange	Insufficient expertise for bankable business proposal	Yellow	No info
	Lack of access to technology	Orange		green	
	Lack of cost effectiveness	Orange	No supply chain	Orange	Building new DH grids is not cost effective

Stakeholder Group	Barrier	Barrier level before intervention, 1999		Barrier level at MTE/SMPR (2002)	
		Rating	Remark	Rating	remark
	Lack of motivation / interest	Orange	Incentives are to maximize sales	Green	Market orientation
	Lack of affordability	orange	No explicit info, but "financing" is identified as a general barrier	Yellow	Financing situation has improved for communities but demo project still has financially non-viable parts
Supply Chain					
	Ignorance	Yellow		Green	
	Lack of expertise	Orange	No experience	Green	
	Lack of access to technology	Yellow		Green	
	Lack of cost effectiveness	Yellow		green	
	Lack of business model	Orange	Inter-municipal marketing is necessary to attain viable market size	Green	
	Lack of affordability	green	EcoFund	Green	Ecofund is not giving funds anymore
Financiers					
	Ignorance	orange			
	Lack of expertise	orange	No experience with evaluating proposals		
	Lack of cost effectiveness	Yellow	Insufficient description	Yellow	
	Lack of business model	yellow	Insufficient description	yellow	
Policy Makers					
	Ignorance	Yellow		Green	
	Lack of expertise	Yellow		yellow	
	Lack of motivation / interest	orange	No explicit policy targets	Green	Renewables obligation
	Lack of affordability	green	EcoFund and National Fund	Green	No additional cost to government

The Mid-term evaluation and the SMPR converge in their opinion that despite the slow start of the project, by the time of the midterm review a number of barriers had already been reduced or removed. In particular:

- The government had put in place a renewables obligation, so that the political motivation and also the motivation of the district heating companies became clearer and more definitive.
- Rising fuel prices have made the search for energy savings and substitutions solutions more attractive for end users and district heating companies.
- Independent of the project, municipalities had easier access to financing by the time of the mid-term review, including through own resources, access to credit and third party financing.
- Pellet production had become so profitable as a business that the EcoFund and the National Fund for Environmental Protection and Water Management have stopped giving grants for this purpose.
- A Polish Biomass Chamber of Commerce was established in 2004 with 170 co-founders. This implies that the supply chain for biomass-producing and –consuming equipment has been well established by then.
- Interviewees of the midterm review attested that there had been an “explosion in demand for biomass fuel” – independent of the project.

In general, the mid-term review confirms the validity of the barrier framework as discussed here, and can be interpreted to the effect that the actual market barriers were already removed before the project even started to show impacts. Partially, this can be linked to the delays in project start including in the approval but also in the start-up process.

On the other hand the project is still credited with demonstrating that significant and large-scale challenges can be overcome, including the implementation of a complex public-private partnership and the new construction of a whole district heating system and heat distribution network. In addition, during implementation the project’s management framework was adjusted to reflect some of the new developments, by including activities that would for example stabilize the development of the wood-waste market by assigning a storage area or analyzing possible sources for wood waste in Poland. Obviously, these affect different barriers and are not anymore characterized with the help of an abstract barrier removal framework but more by ad-hoc abatement of identified bottlenecks.

In the end, the project was implemented for 6 years – an extraordinary amount of time for a medium-sized project. Nevertheless, the project failed to build the new district heating network but managed to develop a pipeline of five biomass boilers for larger single facilities (e.g. schools, nursing homes) in the region around Krakow. Nevertheless it seems that the second part of the project did not become much more effective than the first but was equally bogged down by institutional issues.

In terms of lessons, the final evaluation, too, points to the long time span between project development and implementation (4 years) in which many of the project’s initial assumptions have become obsolete. The final evaluation spends a number of pages on the analysis of a project design document that was already outdated when the project was started and then changed a number of times, such that the reader needs to ask herself why the evaluators take that route. On the other hand, the final evaluation took place 1.5 years after the conclusion of the project, so that very few project participants could still be interviewed for the evaluation. The field visit reports attached to the final evaluation do contain some interesting pointers towards the market transformation impact or lack thereof. For example, “because the nursing

home arranged the biomass boiler they could get funding from the municipality for two coal boilers.” Actually, the base load is provided by the coal boilers, as coal is still cheaper than pellets in Poland, so that the biomass boiler is only used when the coal boilers are insufficient to cover the heat requirements of the nursing home. This happens only very few hours per year as the standardized energy audit parameters lead to oversizing the boilers. The documentation of some of the discussions with the project manager points to a “parachuting approach” that led to insufficient ownership by the municipalities and significant local political issues. These quotes point to incomplete barrier removal and no lasting impact on the market. This is not surprising when looking at the dilution effect that set in through the long delays during the project.

2.5 Debt-for-environment swap EcoFund

At the end of the cold war, the USA, France, Switzerland, Norway, Italy and Finland agreed with the Polish government to forgive 50% of the Polish debt if the government would pay 10% of the debt into an environment fund that would cofinance environmental activities and investments in Poland. This Fund, the EkoFundusz or EcoFund, was in operation between 1992 and 2010 and was evaluated by Ernst and Young in 2010 (Ernst&Young 2010). According to this analysis, the fund had supported 1402 projects with 1.800 million PLN or 588 million USD throughout five environmental sectors (air pollution, water protection, climate protection, biodiversity protection and waste management). Ernst and Young assess that a total of 6.2 Million tons of CO₂ emissions or 1.6% of Poland’s emissions were avoided through the 579 climate change projects with support from the EcoFund, and the scope of renewable energy use was broadened significantly, including in the heating system sector. The Fund leveraged a total investment volume of 4.5 for each PLN spent from the fund.

The EcoFund was set up like a private foundation but the governing council consisted of government representatives from Poland and the donor countries. The support consisted in non-returnable grant financing. EcoFund projects, according to the program evaluation, also worked on a number of other barriers beyond the unavailability of investment finance: Investment projects were asked to conduct significant outreach activities, e.g. at conferences and be receptive to visitors in order to fulfill their function as a demonstration project. In this, they removed some of the awareness barriers with users, the supply chain and the policy makers. The fund solicited project proposals actively and appraised them with the help of international experts, which probably addressed some of the barriers with users as well as financiers in terms of awareness, expertise and motivation. Through making its decisions and processes as transparent as possible and through posting ethical standards on its website, the fund also shaped “a specific behavior, based on high standards”, according to the evaluation another way in which its influence reached beyond just financing. Another point of influencing beyond the financial means is expressed in the quote of the Deputy President of the Foundation that is documented in the evaluation: “we tried to avoid single projects which did not bring wider results and were only fragmentary in their contributions” – indicating that the internal coherence of the fund and the continuity of the funding priorities over 17 years might lead to more changes in behavior beyond the pure investment. For some regions and / or some pollutants, the fund also set for itself objectives of 100% market transformation, e.g. replacing all coal-fired boilers in Krakow by the year 2000, and was able to achieve it in cooperation with local players and other interventions.

Unfortunately, the evaluation does not measure these non-financial impacts in any outcome indicators. In addition, and typical for this type of program evaluation, the evaluation focuses to a significant degree on the questions of administration of the program. In the impact evaluation section, the attribution of causality to the EcoFund is close to 100% as if all projects that were funded by the EcoFund were also purely caused by the Fund. Only one outcome is defined as innovation, which was one of the funding criteria. The EcoFund administrators had defined it as “applying of a new technology for the first time in Poland or create a favorable environment for the introducing of such a technology onto the Polish market. The EcoFund’s task in this case is to promote and popularize the tried and proven solutions that have not yet been applied in our country. However, such solutions must not be prototype solutions not used before on the production basis, and having never been implemented elsewhere.” Such projects were eligible for higher subsidies. The evaluation goes on to discuss four processes for which the EcoFund is considered instrumental for their market introduction in Poland (desulphurization, biomass for energy, combination solutions for thermal modernization of buildings, switch to natural gas). For all of these, the Fund supported some projects, and in other locations the same technologies were then installed without support by the fund. The evaluators emphasize that “due to the large professional knowledge of (..) salaried staff of the Foundation (...) it could avoid spectacular failures in the form of a wrong choice of technologies.” On the other hand, all of these technologies were also supported by other projects discussed in this case study. Nevertheless, the authors of the evaluation find the promotion of these technologies through the EcoFund significant. While the projects were systematically accompanied by the same staff member from approval to closure, there is no indication in the evaluation that the fund provided other barrier removal activities than funding. How much and for which barriers cannot be deducted from the evaluation. The projects and objectives were too diverse and the non-funding activities too unsystematic for that. And non-financial aspects were too far outside of the focus of the discussion.

2.6 JICA Energy Conservation Technology Centre Project

The government of Poland was committed to further improving the state of technology and energy efficiency. After a JICA-implemented “Study on master plan for energy conservation” following the Energy Law 1997, a Poland-Japan Energy Conservation Technology Centre (ECTC) was established at the Polish Agency for Energy Conservation (KAPE S.A.) to train engineers and to raise awareness for energy conservation and energy efficiency (JICA 2008). The Polish government requested JICA support for this Centre and from 2004 to 2008 a technical cooperation project was implemented.

The evaluation uses the OECD DAC criteria as guiding poles. The project is evaluated to be highly relevant at the start and still at the end of implementation, as energy prices and awareness for energy efficiency are rising. Training to engineers and managers is an important skill that needs further development until today. The project is also assessed to be effective, as the training delivered has been receiving good reviews among trainees. The evaluation of “aid efficiency” is difficult as usual, and efficiency is measured in number of full-time staff and a “cost-benefit-factor” which was “positive” due to significant own contributions from Poland. The impact of the project is measured by the ability of KAPE to deliver technical assistance to the rest of the region and by the adoption of role models from Japan. The sustainability is unclear due to

threatened financial support and an unclear definition of KAPE's roles and responsibilities in the future. Most of the lessons and conclusions are very specific to the case or to JICA's internal processes (e.g. on procurement). One lesson that can be generalized is that such a project should not formulate its impact goal as a national reduction in energy intensity as this is not appropriate for the scale of the intervention and also hard to measure within four years simply because national statistics usually take around 1-2 years for publishing.

As this project is not targeting the same sector as the other projects – the other projects were targeting the heating sector, this project is targeting industrial energy efficiency – the barrier circle would need to be drawn fresh for this savings potential. However, even without this, the message of the Theory of No Change would be that in this case, significant awareness and expertise with the supply chain and the users of energy efficient technology has been built. Nevertheless, the sustainability and ultimately the impact of the intervention depends on 2 factors external to the project itself:

1. the definition of roles and responsibilities of KAPE is crucial for its institutional sustainability. It depends on the “current intensive discussions within the Polish government on the draft energy efficiency law”. Here, the policy makers come into play as an important group not only for the overall achievement of energy efficiency but also for keeping up the momentum of capacity building as a precondition for continued efforts with the consumers. Their awareness and expertise needs to be developed sufficiently to provide support for this momentum.
2. The sustainability of consumers' efforts around energy conservation will depend on the further development of the energy prices. In terms of the barrier model, it is the cost effectiveness that needs to be proliferated for the desired behavior to remain attractive.

Therefore, again it becomes clear that a well designed intervention hardly can limit itself to a small part of the barrier circle if it wants to achieve lasting impact. In fact, the evaluation states that “future technical cooperation projects in energy efficiency and conservation (EE&C), therefore, are required to assess the current legal framework supporting EE&C.” Again, this is probably a lesson worth applying to most interventions in the field, simply because capacity building in climate mitigation is not an end in itself but one step in a long way of transforming the way we consume energy.

3 Summary: Is the Theory of No Change useful for the analysis of large investment projects?

3.1 Did the barriers limit market development?

Overall in Poland in the early 1990s a very inefficient heating sector was characterized by enormous investment needs as well as a need to catch up in terms of hardware supply, technical capacity and smart policy making for more energy efficiency. A dire need for change in the way energy was provided and consumed was felt because of pressing factors like environmental pollution and deteriorating public health, the fact that Poland was one of the largest sources of CO₂ emissions at the time, and last but not least the feeling that with the opening to the West

this all could be changed in record time. Very large flows of funds in the energy sector and very large scale interventions were planned that still worked on a relatively large number of relatively detailed technical issues like leakage in district heating systems or single facility boilers.

The local economic structure was not necessarily optimally suited for supporting the endeavor. The mindsets of technicians and managers changed slowly towards more market orientation. The banking system needed time for its establishment and was not in a position to extend financing appropriate for the revamping of the heating sector. Thus, the situation was blocked from market transformation towards energy efficient district heating and heating systems by a large number of barriers for all stakeholder groups on multiple levels.

The first activities were focused on filling the most urgent gaps: Fighting corrosion and leaks in the transmission systems for heat, installing metering equipment, introducing cost oriented management and building cost control systems. Typical objectives of this first wave of projects were nevertheless investment oriented and included “Extending the life of existing district heating assets through rehabilitation and introduction of modern technologies and materials”. But still, the size of single interventions was rather large at the time, even if a large number of coordinated small technical changes were required to implement them. All such project were extended in their implementation duration as the barriers were to be found on levels other than just large amounts of financing.

In addition, this meta-analysis also looks at a number of investment-focused projects for larger investments. It is interesting to note that all of these investment-focused projects, including the non-GEF projects, mention barrier removal for further energy savings activities at some stage as an objective or at least as a co-benefit of their project; and that all of them also mention the removal of barriers as a precondition for the investment success, meaning that they were relying on other (donor- or Polish-funded) activities to provide the grounds for their investments and remove those other barriers. Thus, investments and barrier removal activities are intrinsically linked. A major transformation of the way of providing and using energy as required by climate mitigation cannot rely on investments or investment-oriented project based mechanisms (like CDM) alone but needs to be accompanied by and seen in concert with a transformation in capacities, capabilities, motivations and financial attractiveness.

For evaluation approaches this means that we did find barriers in almost all projects that were not reflected in the project plans but are part of the barrier framework. It is hardly ever possible to ignore the role of barriers when analyzing GHG emission reductions. It is dangerous to not acknowledge that barrier removal is a necessary precondition for GHG-reducing investment. Barrier removal and capacity building should receive sufficient credit when evaluating their contribution to climate mitigation, or when attributing GHG emission reductions to project interventions. It will be up to further studies to develop the Theory of No Change further and to the degree where it can help create fair attribution rules.

3.2 Were the stakeholder groups relevant?

There is little doubt about the assignment of the roles of policy makers and financiers to stakeholders in practice. However, in district heating systems there are a couple of interesting cross-overs as we were able to show: For example, in the Coal-to-Gas conversion project, the

implementing agency was a bank. This led to a number of practical complications in administrative processes, and to a project that was not really addressing the relevant barriers, but focusing on financial aspects. The project failed to reach its objective due to these two reasons.

Another area of “cross-over” is the role of municipalities, who are often owners or shareholders of district heating systems, rather than policy makers. In fact, in the case of district heating, the municipalities rarely function as regulators or political framework-setters, but rather as the subjects or objects of regulation, and thus as economic market participants. The most prominent example for this is the case of Nowy Targ in the case of Zakopane.

Consequently, for heating systems, the consumers / users of energy are almost consistently defined as the boiler owners, be they district heating companies or single family home owners. For the case of the coal-to-gas-conversion for example, this did not lead to an assessment of the barrier structures that was adequate to the thinking within the project: Some of the supply chain issues were in fact limiting for the market but were not affected by the project. Thus, in this case, the barrier analysis shows that barriers were removed during the duration of the project, and that others were coming into existence, but that the project had little or no contribution to barrier removal and also did not protect from the newly arising barriers (like rising gas prices).

In the case of Zakopane, it was tried to assign the role of the user to the actual home connections on the end of the district heating network, and to assign the role of supply chain to the district heating company. In this case, this worked very well, as the company was also the provider of the geothermal knowledge and thus also played the role of supply chain at least in this respect.

In all cases, the projects delivered direct investment and capacity building support to the consumers of energy, i.e. the district heating companies. In a number of cases, policy makers and regulators were also involved, even though the projects for which evaluations were included in this analysis did not have strong policy foci. In one case the project attempted to include the financial sector in the barrier removal activities but as it was not sufficiently developed and liquid yet, this part of the project did not prove to be successful.

Defining the boiler companies as the users, leaves the role of the supply chain to the technical hardware producers and providers of operation and maintenance services. The supply chain for energy efficient turbines, boilers, insulated pipes and other energy efficient equipment is mentioned in most projects only very marginally. Only one project points out that the large energy efficient program has also led to the unintended consequence of developing the domestic supply chain to the degree that it is able to export its equipment and services to other countries. None of the older programs focuses on capacity building or financing for the supply chain but this aspect is left to the overall economic and educational programs and policies. On the other hand, the USAID SEED program supported desulphurization project in Skawinia failed because first a US Contractor provided low quality construction services, and after that, trust in foreign suppliers had deteriorated so badly that the successful finalization of this aid project was impossible. The flue gas desulphurization of this power plant thus was installed only in 2006 rather than in 1994 as envisioned originally. This could be taken as an indication that focusing on

local supply chain capacities might be a faster way to sustainable barrier removal than focusing on financing only.

Overall, in the programs discussed, the stakeholder groups were not typically considered important at project outset but turned out to constitute relevant success factors for the specific project activities and for the larger market development of heat equipment and services in Poland. None of the projects, not even the UNDP biomass project, which was the only one that demonstrated barrier removal thinking in its design, were analyzing the roles of the stakeholders to any consequence.

In some projects, the “general public” is considered a relevant group for outreach activities. The most prominent example in the Polish case study for this is the EcoFund. The general public is not showing up in the barrier circle as a stakeholder group. The reason for that is that so far no example could be found where the general public (in particular with respect to their lack of awareness) has been a barrier to project implementation or sustainability. However, in a number of sustainable energy projects, this might indeed be the case, for example in the area of public resistance in the form of NIMBY attitudes to infrastructure construction or wind turbines. This issue requires some further investigation. It is in the same vein that environmental and other NGOs should be considered as part of the opinion forming process in the general public, not as market participants per se.⁸

Overall, the conclusion of this case study for the barrier removal framework with respect to the stakeholder group is that it can sometimes be hard to assign the correct role to some of the stakeholders. Key here is the question of which market are we looking at – e.g. the market for efficient boilers or the market for competing heat companies. The group that is to be classified as the “users or consumers” is the group that is required to change their behavior in order to reach the primary target of reduced emissions. As the cases show, the projects here focused almost exclusively on the heat companies as the users or consumers. The supply chain is then only a group of enablers – they need to provide what is needed for the users to change their emissions. In some cases, the emitters can only do this, if there is sufficient demand for their less-emission-related product, e.g. geothermal heat instead of coal-based heat. However, in the barrier framework this lack of demand is reflected in the form of a lack of motivation⁹ or cost effectiveness of the users.

3.3 Summary: did all barriers and all stakeholder groups prove limiting for sustained project success?

Climate change mitigation is not a single-project-opportunity but a long-term fundamental transformation process. In order to reach a climate-compatible energy system – and this is true for many other areas as well – we need a close-to-complete transformation of the way we provide and use energy. Therefore, most projects attempt to have some catalytic or transformative impact beyond their actual scope, and most of the project documents formulate

⁸ Ernst & Young (2010), for example, consider the strengthening of NGOs through the EcoFund a result of the program.

⁹ If the user is a profit-oriented company, a lack of motivation is equal to the lack of a business case. Whenever a business case exists, a profit-oriented organization should be motivated to exploit it.

this explicitly as part of their motivation or even as their objective. The tenet of this study is that this can only be achieved through barrier removal, or rather, it cannot be achieved if barriers obstruct it. The case studies have qualitatively confirmed this assessment. Table 8 displays which barriers have been observed in the projects and their evaluations.

Table 8 Which barriers have proven limiting in the cases discussed?

	Barrier	District heating		Geothermal		Coal to Gas		Biomass	
		prior to project	2004	prior to project	2004	prior to project	2004	prior to project	2002
Users	Ignorance	↑	↑	↔	↓	↔	↑	↓	↑
	Lack of expertise	↔	↔	↔	↔	↔		↓	↔
	Lack of access to technology	↓	↔	↓	↑	↓	↑	↓	↑
	Lack of cost effectiveness	↓		↑	↓	↔	↔	↓	↓
	Lack of motivation / interest	↓	↑	↓	↓	↓	↑	↓	↑
	Lack of affordability	↓		↔	↔	↓	↓	↓	↔
Supply Chain	Ignorance	↑	↑	↓	↑	↔	↑		↑
	Lack of expertise	↑	↑	↑	↑	↓	↔	↓	↑
	Lack of access to technology	↑	↑	↔	↑	↔	↑		↑
	Lack of cost effectiveness	↑	↑	↑	↓	↔	↑		↑
	Lack of business model	↑	↑	↓	↓	↓		↓	↑
	Lack of affordability	↑	↑	↓	↔	↓		↑	↑
Local Financiers	Ignorance	↔		↔	↔	↓	↑	↓	
	Lack of expertise	↓		↓	↔	↓	↑	↓	
	Lack of cost effectiveness	↓		↓	↓	↓	↓	↓	
	Lack of business model	↓	↓	↓	↓	↓	↓	↓	↓
Policy Makers	Ignorance	↑		↔	↑	↔	↔		
	Lack of expertise	↔		↓	↑	↔	↔	↔	
	Lack of motivation / interest	↔		↑	↑	↑	↑	↓	↑
	Lack of affordability	↓		↑	↓	↓	↔	↑	↑

As Table 8 demonstrates, there are very few barrier of our barrier framework that have not been identified as limiting or show-stopping for market development, indicated by orange or red color respectively. The “lack of access to the technology” for the supply chain is the only barrier that received only green and yellow rankings. In fact, in a country that has WTO-compatible

regulations for foreign trade, this barrier is hard to imagine. On the other hand, even countries like China and India might choose to reduce the importation of specific hardware components, for example in order to not expose their domestic industry to international competition. This might lead to a lack of access to certain technologies for the supply chain. The second-least limiting barriers are “ignorance” for the supply chain and “lack of motivation / interest” for policy makers. “Ignorance with the supply chain” is rather unlikely in times of the internet and globalization. A trader or handiman has ways and means of hearing of new technologies. Thus, the barrier framework could be shortened by this barrier to make it easier to handle. A “lack of motivation with policy makers” is more realistic, but in almost all development projects, governments need to support the project at least at its inception. Once political interest gets lost during project, though, or if the government loses consensus on its motivation, this can cause new barriers to market development. Therefore it is recommended to keep this barrier under observation and included in the barrier framework.

4 Lessons

4.1 Poland

Poland has benefitted from exceptional commitment of donors in the area of energy efficiency improvements after the end of the Cold War. The World Bank states in its overall analysis and report “Transition to a Low Emissions Economy in Poland”: “Poland has made considerable advances in energy efficiency in the past 20 years; yet further efforts are required to bring it to Western European standards. Per unit of GDP, Poland’s economy is still more than twice as energy intensive as the EU average. (...) Energy sector emissions have fallen by one-third since 1988, although the sector still produces near half of the country’s greenhouse gases.” Table 9 demonstrates indicatively another use in this context: by compiling the barrier analyses in chronological order from left to right, the reduction of barriers can be illustrated. This is particularly useful for sectoral or country analyses.

This table is not fully calibrated as it is not yet supported with quantitative outcome indicators. But already it shows that even if large amounts of money have been spent, the work is not over. Still, in 2007 through 2013 the largest share of the EU Cohesion funds that go to Poland are devoted to the Infrastructure and Environment Sector (Cichowska 2010). In addition, the World Bank CIF has approved an investment program of more than a billion US Dollars to be spent within a short time span. This demonstrates mainly the magnitude of the task of converting an inefficient coal-based energy and heating system to one that complies with modern standards of efficiency and comfort and climate-compatibility. Huge steps have been taken already but more effort is required still. Further investigations should be undertaken that draw conclusions from the present set of projects and the experiences analyzed here for future large-scale efforts. Potentially, an integrated approach taking into account whole markets rather than specific barriers or small groups or specific stakeholders can deal with this task more efficiently.

Table 9 Chronological order of barrier analyses (indicative)

DH	G	Cto	B	DH	G	Cto	B
prior to project	prior to project	prior to project	prior to project	2004	2004	2004	2002
↑	↗	↗	↘	↑	↘	↑	↑
↗	↗	↗	↘	↗	↗		↗
↘	↓	↘	↘	↗	↑	↑	↑
↘	↑	↗	↘		↘	↗	↘
↘	↘	↘	↘	↑	↘	↑	↑
↓	↗	↓	↘		↗	↘	↗
↑	↘	↗		↑	↑	↑	↑
↑	↑	↘	↘	↑	↑	↗	↑
↑	↗	↗		↑	↑	↑	↑
↑	↑	↗		↑	↓	↑	↑
↑	↓	↘	↘	↑	↘		↑
↑	↘	↘	↑	↑	↗		↑
↗	↗	↘	↘		↗	↑	
↓	↓	↓	↘		↗	↑	
↓	↘	↘	↓		↓	↓	
↓	↘	↘	↓	↓	↓	↘	↓
↑	↗	↗			↑	↗	
↗	↓	↗	↗		↑	↗	
↗	↑	↑	↘		↑	↑	↑
↘	↑	↓	↑		↓	↗	↑

4.2 Interesting mix of evaluations

This meta-evaluation contains a significant number of different evaluation approaches:

- WB Implementation Completion report

- Bilateral intervention completion evaluation
- Process and impact evaluation of an institution
- Survey and stakeholder assessment evaluation
- MFI portfolio evaluation

In this mix it becomes clear that most of the project or portfolio evaluations tend to focus on procedural aspects. They tend to focus on the project's activities and neglect the intervention's context. Sometimes they do this to the degree that they fail to explain project successes and failures or extract lessons from experiences.

Typically, these evaluations follow one of two methods for identifying evaluation criteria: Project evaluations focus on the project's defined output or outcome indicators. Often, and in particular in the GEF context, GHG emission reductions are part of this predefined set of indicators. This allows us to identify and use intervention-specific criteria and indicators, which are suited for climate change projects. They can potentially be aggregated over a sub-portfolio if sufficient standardization takes place.

Alternatively, they focus to a significant degree on the OECD-DAC criteria. Mostly this happens when the interventions had no predefined indicators framework, or when a portfolio is being evaluated with interventions in different domains, e.g. thematic areas (like in the case of the EcoFund). These evaluations often come up with evaluation-specific definitions for the OECD-DAC criteria. They tend to focus on processes rather than outcomes.

Overall, it is hard to understand the "full story" around a project only from the evaluations that were part of the library. In most cases, additional supporting documents had to be found. This is even true for the rather comprehensive discussions that take place in World Bank ICRs, or in some of the case studies, even if they might have more than 20 pages of text.

For the evaluations of GEF projects, a clear improvement in the M&E practice, in particular in terms of logframe and indicator discipline can be seen from the early years to the second half of the first decade of this millennium.

4.3 Intended and unintended barrier removal, attribution of impacts to interventions

The discussion clearly shows that in many cases barriers exist before an intervention, and are removed during an intervention, but not by the intervention. In these cases, an independent evaluation should be able to identify whether or not a specific impact is actually due to a specific intervention or not.

It becomes more complicated when more than one interventions are active. In these cases, the barrier circle and project mapping tool is able to distinguish the interventions according to their barrier removal impact and "give credit where credit is due" – at least qualitatively, in the sense that irrelevant interventions can be identified and not be given any credit. Expressing this credit quantitatively, e.g. in GHG emission reductions will still remain difficult.

However, there might also be cases where an intervention targets one specific barrier, e.g. lack of expertise with policy makers, and is successful so that suddenly other barriers are also

removed, e.g. lack of business model for local financiers. In these cases it is important to go back to the origin of the barrier model as a program logic model that brings these barriers into causal relationships with each other as well as with the overall objective. The Theory of No Change in these cases can be formulated more explicitly to identify whether this unintended barrier removal is due to a particularly elegant cascading effect (e.g. local bankers find the investment attractive because of strong and consistent policy support that was initiated because policy makers learned to make better policies) or due to badly formulated project documents, impact evaluations, or even due to adaptive project management.

A number of typical project approaches have been used repeatedly in this and other portfolios and demonstrate rather limited barrier removal impact. The weakest such approach is the demonstration project. In a relatively large country like Poland, demonstrating a gas boiler will always have only very limited impact and remove no barriers, and lead to no glimpse of a sustainable market development.

The analysis shows further that the bulky nature of the investment into district heating does not make projects easier through economies of scope, but potentially even more difficult due to the complicated barrier structure. This means that barrier removal is an exercise that requires a long breath – in Poland around 20 years and counting. On the other hand, kairos can also be at play: When a project hits the right nerve at the right time, like the biomass project, the barriers might be removed faster than expected (on the other hand, if the project delays for too long, it will be successful but superfluous).

4.4 Outcome indicators

The World Bank projects in the early 1990s did not necessarily specify a hierarchy of results and a parallel hierarchy of SMART indicators for outputs, immediate outcomes, and higher-level outcomes. Therefore, the documents do not consistently contain indicators that relate to these levels. However, the authors of the ICRs strive to retrofit such hierarchical results indicators. A number of such indicators have been mentioned throughout the text. As Table 9 shows, defining SMART results indicators for all barriers would allow for intelligent mapping of the state of markets. That would allow to measure progress e.g. in the form of an index that is calculated on the basis of these indicators. This should be one of the next steps in this research.

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