

Meta-Evaluation of Climate Mitigation Evaluations

Case Study:

Transforming Markets for Energy Efficient Products in Thailand

Climate Change Evaluation Community of Practice
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1 Purpose and basis of this study

In the meta-evaluation, a logic model for market transformation in the energy efficiency and renewable energy field is developed. Market transformation is the process of introducing more efficient products and services into targeted markets, typically by a strategic intervention that brings the existing market towards a state where the more efficient product is the “natural” equilibrium choice.¹ The overall study elaborates on the concept of market transformation by formalizing it into a Theory of No Change. The objective of the overall study is to expand that elaborated concept into a larger number of areas around climate change mitigation, including more fundamental energy efficiency investments, changes of practices and the field of renewable energy generation and other substitution processes.

The case studies help to develop the logic model and to ground it in empirical evidence. The first case study is a longitudinal study on energy efficiency in Thailand. It looks at the following interventions for which a large number of evaluations are contained in the Climate-Eval Community of Practice Library:

- EGAT Demand Side Management Program, financed by WB GEF, 1993 – 2000:
 - o WB Implementation Completion Report, 2000 (quoted as World Bank 2000);
 - o WB/UNDP ESMAP Technical Paper, October 2000 (Singh and Mulholland 1999);
 - o Sulyma et al: Taking the Pulse of Thailand’s DSM Market Transformation Programs. 2000 (Sulyma et al, 2000);
 - o Na Phuket, C. Priyanonda: HOW ENERGY LABELLING AFFECTED PRODUCTION DECISIONS OF APPLIANCE MANUFACTURERS IN THAILAND; 2000 (Na Phuket 2000)
 - o WB/GEF Post-Implementation Impact Assessment: Thailand Promotion of Electrical Energy Efficiency Project. 2005 (World Bank 2005)
 - o Energy Policy and Consumer Reality: The Role of Energy in the Purchase of Household Appliances in the U.S. and Thailand. (du Pont 1998);
- GTZ Energy Efficiency Promotion Project (ENEP), three phases, 1993 – 2002
 - o Meyer et al: Ex-post Evaluation 2007 (Meyer et al 2007)
- IFCT Building Chiller Replacement Program, 2001 – 2005, financed by WB GEF
 - o WB ICR (World Bank 2006)

On the basis of these evaluations we will use the barrier circle to illustrate and define reasons for successes and failure of these projects and help support the barrier circle as a fundamental logic model for market transformation.²

¹ For a discussion of the various definitions for market transformation refer for example to York (1999). The term market transformation has since developed and narrowed in meaning, to relate in one school of thinking to interventions through standardization and labeling / customer information only, in the second school of thinking to a utility activity. This is not taken up in the following, where market transformation continues to refer to the process of changing the products in the market rather than a single policy instrument.

² For a general description of the barrier circle please refer to the Meta-Evaluation of Climate Mitigation Evaluations.

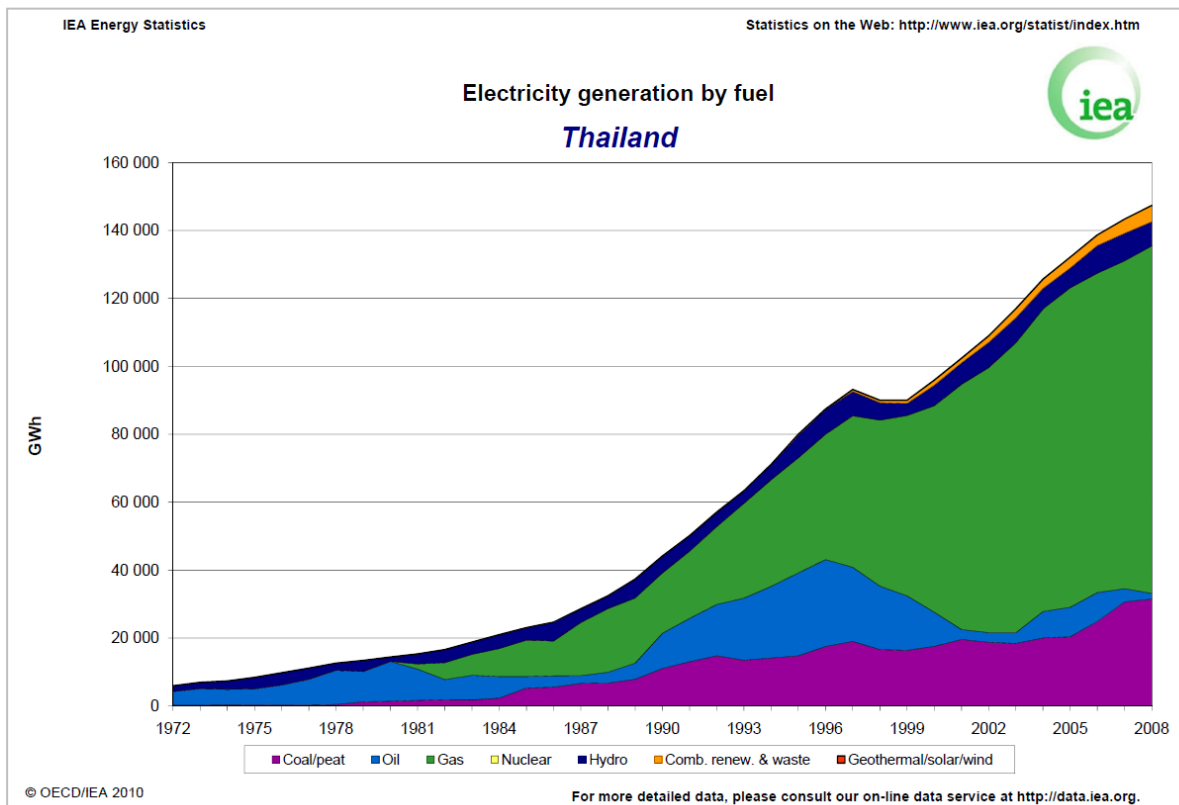
2 Thailand Case Study

2.1 Background

As one of the “Asian Tigers”, Thailand experienced a period of fast industrialization and economic growth in the 1980s and 1990s. Between 1986 and 1996, net average annual economic growth rate was about 10% p.a. (Wangskarn 1997). Fast growth periods like these typically come along with a parallel growth in energy consumption – for once because a higher level of industrial activity requires more energy and secondly because economic growth leads to higher levels of wealth, higher standards of living and more private consumption. Typically, these also come along with higher consumption of energy in terms of electric power in households. This growth trends put a strain on the local energy systems and infrastructures for electricity and fossil fuels which are required to grow in step.

As Figure 1 shows, this was also the situation in Thailand, a country with no domestic oil and little coal. Power generation relied and still relies to date to a significant degree on imported oil and gas as well as coal. Rather early on, the government acknowledged that this could lead to a situation where the lack of reliability in the electricity system could put a brake on national economic development. A variety of actions were taken. For example in 1990, the National Energy Policy Committee NEPC requested the three electric utilities EGAT, MEA and PEA to agree on a master plan for Demand Side Management (Singh and Mulholland 1999) and legislative action ensued.

Figure 1 Electricity generation by fuel in Thailand from 1972 to 2008.



Source: IEA (http://www.iea.org/stats/pdf_graphs/THELEC.pdf, accessed 2 July 2011)

In the Seventh National Economic and Social Development Plan (1992 - 1996) the Royal Thai Government defined short and medium-term targets and strategies for the development of the energy sector. Reducing the annual growth rate of energy consumption from 13% to 10% per year was one of the main objectives. A supporting measure was the Energy Conservation Promotion Act that the

government passed in March 1992. An Energy Conservation Fund (ENCON FUND) was established, and provided financial support to government agencies, state enterprises, non-government organizations, universities, individuals and businesses that wish to follow the Act by implementing compulsory, voluntary or complementary measures to increase efficiency in energy utilization, promoting energy conservation, efficient energy use, sustainable use of natural resources, development and use of renewable energy sources, development of energy conservation technology and environmental protection. The initial start-up capital consisted of a transfer of 37.5 million USD from Thailand's Oil Fund. Other financing sources were a tax on petroleum products, bank interests and other subsidies from governmental and private sources (UNESCAP 2003).

This illustrates that already in the early 1990s, Thailand began with strategic and consistent efforts to enhance energy efficiency. This makes it an ideal case for this meta-study. A large number of Donor-supported interventions have been carried out for which evaluations were available. In the projects, programs and policies that were evaluated over the years, a clear progression of interventions can be identified, and the barrier removal process can be tracked over a number of years. Step by step, policy makers and consumers, as well as utilities and the supply chains were confronted with the idea of Demand Side Management (DSM) and energy efficiency labeling early on. Financiers were alerted to lending opportunities in energy efficiency, not the least through the establishment of the sizable ENCON Fund. In the next sections we will go through a number of interventions targeting energy efficiency on the demand side in more or less chronological order to test the barrier circle model and draw conclusions.

2.2 Demand Side Management Programs

In 1993, a demand side management program of 9 million USD was financed by the World Bank and GEF to support the national electricity utility EGAT in implementing DSM plans. EGAT created a separate internal department to manage the grant and implement the initiatives. This department was referred to as the Demand Side Management Office DSMO. According to the Grant Agreement between the World Bank and the Thai Government (World Bank 1993), the objective of the project was to “assist the Recipient to (i) build sufficient institutional capacity in its electric power sector, and energy-related private sector, so as to deliver cost-effective energy services throughout its economy, and (ii) pursue policies and implement actions which would lead to the development, manufacture and adoption of energy efficient equipment and processes within its territory.” Thus, the creation of a market for energy efficient equipment and processes with domestic supply and demand were part of the objectives of the project. The activities of the project were planned based on successful attempts of energy consumption reduction in the US, which resulted in a “four-pronged approach: (a) to provide user and manufacturer incentives and consumer education to influence practices and attitudes towards energy-efficient technologies; (b) to develop efficiency standards and testing capabilities to exercise control and monitor efficiency improvements; (c) to develop and promulgate building and appliance codes in order to enforce minimum efficiency standards; and (d) to continue pursuing technological improvements and their adaptation to Thai conditions” (World Bank 2000). According to the project's ICR, the line-up of activities as well as the distribution of responsibilities within the project were changed during implementation when the DSMO “became aware that the Western strategies for DSM had to be appropriately modified to better suit Thai conditions” (World Bank 2000). The ICR states further that “after initial modifications in the strategic approach, EGAT has developed a strong and significant portfolio of 19 DSM programs.”

EGAT at the design stage of this program was a classical vertically integrated utility that generated and transmitted electricity to the two distribution utilities (MEA and PEA) who in turn delivered the electricity to the consumers. In the 1980s, demand side management had been developed as a business for utilities, which allowed them to defer building new generation capacity. However, today's consensus is that market transformation is not necessarily a core activity typical for utilities, particularly if they

move from a public service entity to a private business identity in the course of liberalization. EGAT built up significant expertise on energy conservation and market transformation programs in its DSMO³

The following household product markets were targeted for market transformation in the project:

- T12 light tubes to be replaced by T8 light tubes,
- establishment of compact fluorescent lights (CFLs) instead of incandescent light bulbs as quasi-market standard,
- increase in market share of very efficient (“level 5”) single-door refrigerators through labeling,
- increasing the market share of “level 5” air conditioners,
- 59 brands of brown jasmine rice⁴ on the market.

When trying to analyze the DSM programs using the barrier circle method, the first observation is that every product requires a separate analysis. Even T8 lamps and CFLs are impeded in their market penetration by different sets of barriers. Therefore, it is not possible to draw the same barrier circle for both. Instead, for each energy efficient product a separate barrier circle needs to be drawn and discussed. In fact, the same experience was made by the DSMO: each market has to be transformed by itself, sometimes with rather little synergies. The two markets for lighting are not always so dissimilar. But in Thailand, they were characterized by a very different composition of local actors, which was ultimately the reason why these two markets were approached with radically different strategies. In the following sections the barrier circle analysis is conducted for each of the four energy-related markets.

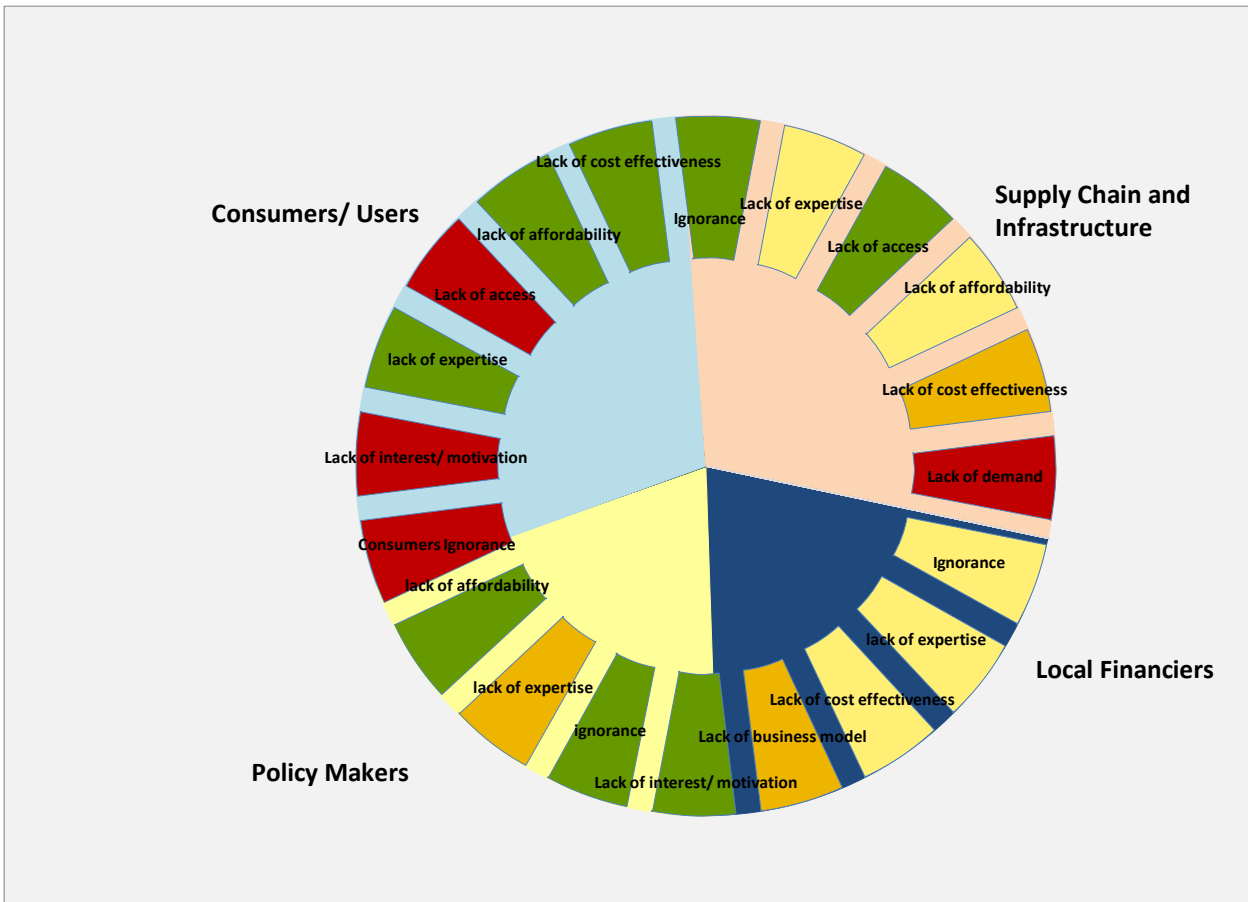
2.2.1 Efficient lighting tubes

The T-12 market in Thailand, i.e. the market for the less efficient lighting tubes that were to be replaced by the more efficient T-8 models, was characterized by significant lock-in effects, which posed a number of barriers to the introduction of the more efficient T-8 tubes (Figure 2). Consumers mostly did not even know about the possibility to simply replace their T-12 tubes with so-called “thin tubes” as they were not easily available on the Thai market (lack of access). Users were also not motivated to use them as thick tubes were falsely expected to emit more light than the more efficient thin tubes. In the barrier circle diagram this leads to three red (show-stopping) wedges for these three distinct barriers. The rationale behind that is that each of these barriers needs to be removed step by step – simply offering on the Thai market does not mean that people become knowledgeable about them or are interested in using them. For this, at least some kind of marketing campaign or other motivational measure would be necessary.

³ Nevertheless, the role of either the utility or an Implementing Agency is disregarded in the barrier circle. The reason for this is that it is necessarily a non-sustainable situation if the market needs continued interventions. If the market reaches a sustainably transformed situation in which no continued intervention is necessary, there is no more need for an implementing agency in the market or its representation in the form of the barrier circle.

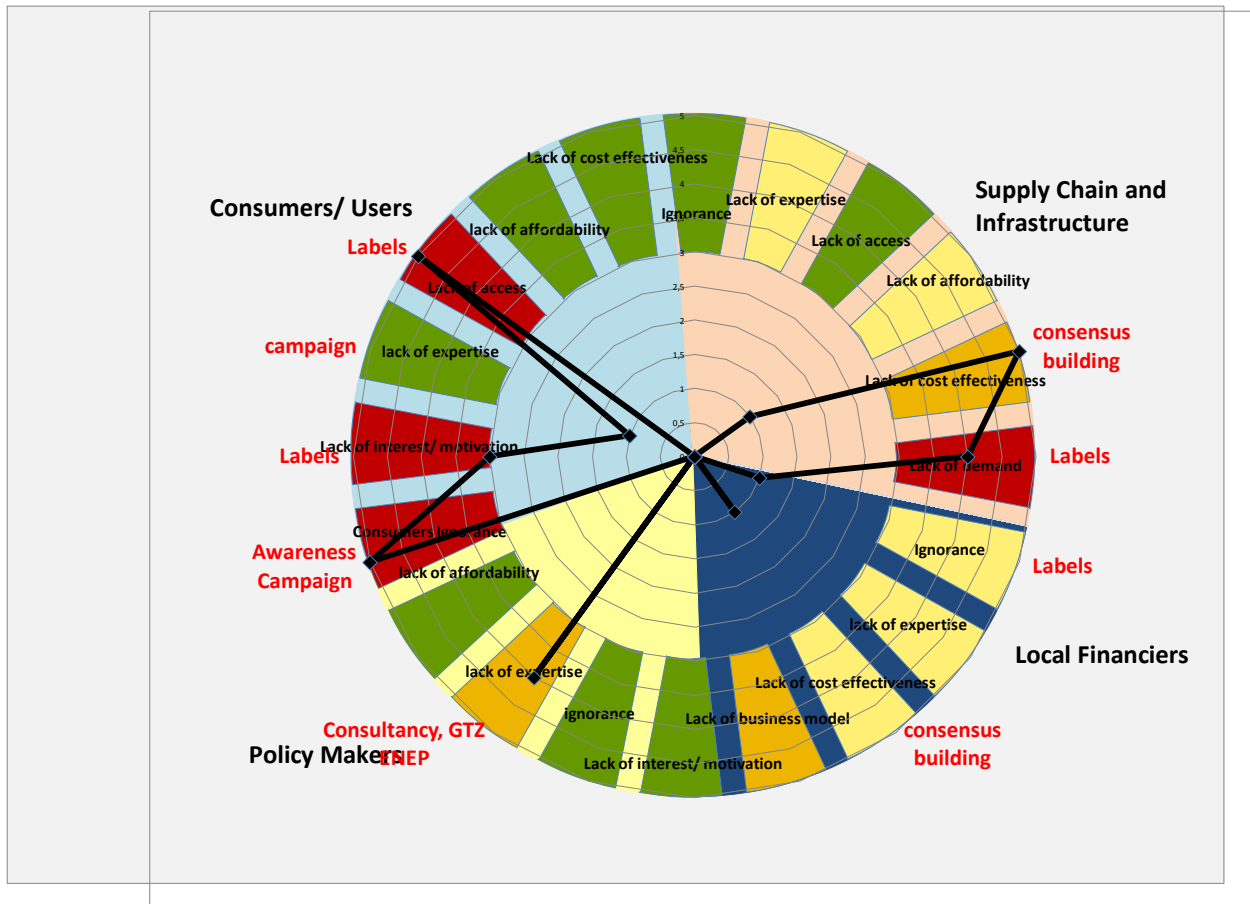
⁴ Requires less energy to process than white rice

Figure 2 Barrier circle for T8 light tubes in 1992



On the other side of the market (and of the barrier circle) there was little to no interest on the side of the suppliers to supply thin tubes. Their production and marketing processes were fully geared towards producing and selling thick tubes. Changing production processes would have required additional investments and was therefore not considered cost-effective. As long as the other manufacturers would not invest to the same degree the first mover would have had a competitive disadvantage which meant that there was also no business case for the move to thin tubes. This would at least be the case for as long as there was no demand for T8 light tubes which is why there is a red barrier for the supply chain and infrastructure in the “lack of demand”. This led to the absence of financing and therefore a skeptical stance of the financiers which is expressed by yellow and orange barrier wedges in Figure 2. As there is no financing available, the supply chain also could not afford to put in new equipment for the manufacturing of thin tubes.

Figure 3 Barrier circle for T8 light tubes in Thailand in 1992 and project interventions

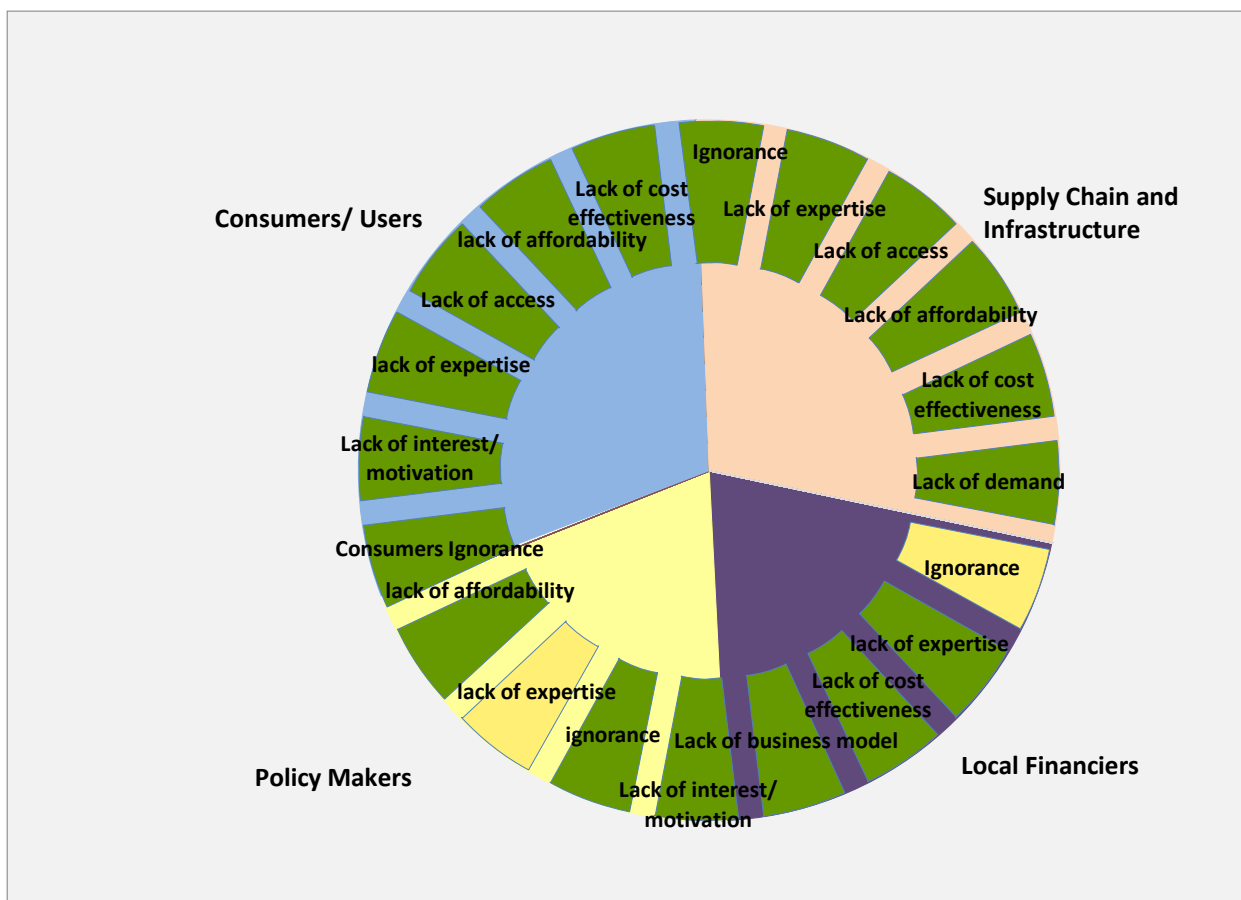


The project (Figure 3) negotiated directly with 5 local manufacturers and one importer to build consensus about the introduction of thin lighting tubes into Thailand. The thinking behind this negotiation was that if they all moved towards thin tubes in a coordinated fashion this would alleviate competitive concerns as all of them would incur comparable investments for changing their production processes. Thus, a new product was generated and all of the manufacturer would still be able to sell in Thailand. As all manufacturers switched at the same time they all encountered similar investment costs and similar rises in their input costs. Thus, the cost effectiveness concerns were also alleviated. This was an attractive solution to the manufacturers because in the long run thin tubes were cheaper and more competitive to produce due to reduced material costs.

In addition, on the other side of the barrier circle, the government financed a marketing campaign for thin tubes which created consumer awareness and interest. The World Bank observes: "Within one year, all manufacturers had completely switched to the T8 thin tubes and the one importer complied shortly thereafter" (WB 2000, p. 21). In 1994, T8 tubes had had a market share of 40%, in 1995 of 100% (Martinot & Birner, 2003).

Separately, a GTZ project was working on capacity building in the policy making institutions and contributed to some degree to the understanding and activities of the policy makers in this area (Meyer et al. 2007). The barriers on the side of the financiers were considered to be irrelevant in project design. In fact, they proved to be relatively minor once there was a market for the product. Figure 4 demonstrates the success of the project: The interventions had removed all relevant barriers to the market for thin tubes.

Figure 4 Barrier circle for T8 light tubes in Thailand in 2000 after successful project implementation



Looking at the barrier circle, the projects' activities and the outcome, the following aspects of the transformation of the thin tube market in Thailand are remarkable:

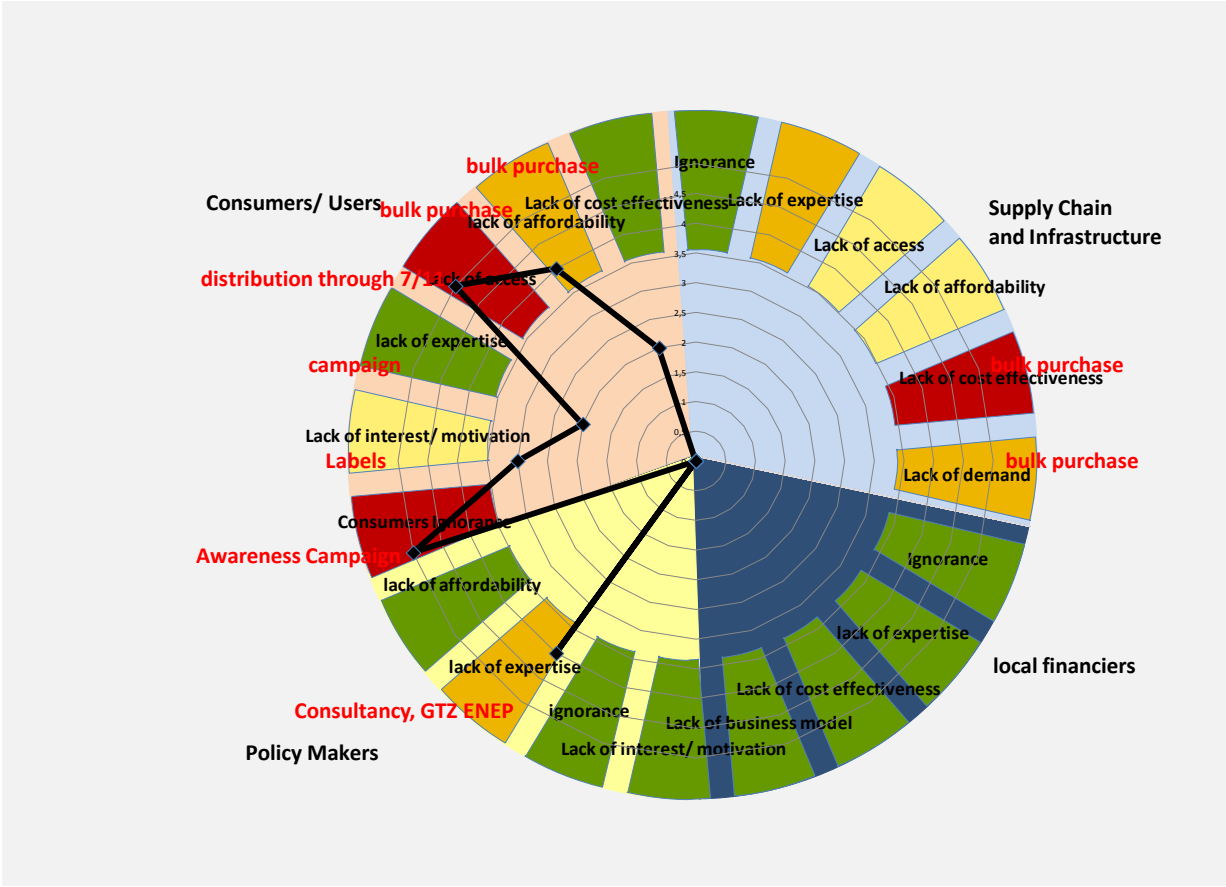
- The interventions were well tailored to the local barriers.
- The market could not have been transformed from the supply side only. It was crucial that interventions took also place on the demand side.
- Some of the interventions were executed in a very culture- and context-specific manner: An informal negotiation process with a significant group of industrial partners is not necessarily a very effective intervention, but in this case it has worked.

2.2.2 Compact Fluorescent Lights Program

A second DSM project run by EGAT in the 1990s attempted to transform the light-bulb market towards the use of CFLs. The barriers to the CFL market are displayed in Figure 5. Users of light bulbs had insufficient access to CFLs (Sulyma et al., 2000). In addition, they were much more expensive than incandescent light bulbs so that affordability and cost effectiveness were perceived to be important barriers for their mass introduction. Sulyma et al (2000) also attest to a consumer information barrier about the benefits of CFLs in terms of energy conservation.

Unlike in the case of light tubes, there were no national producers of CFLs in Thailand. The industrial consensus approach was therefore not applicable but the program had to exert market pull on the importers. On the other hand, financing was not a major barrier for CFL deployment.

Figure 5 Barriers to CFL market and EGAT and GTZ interventions

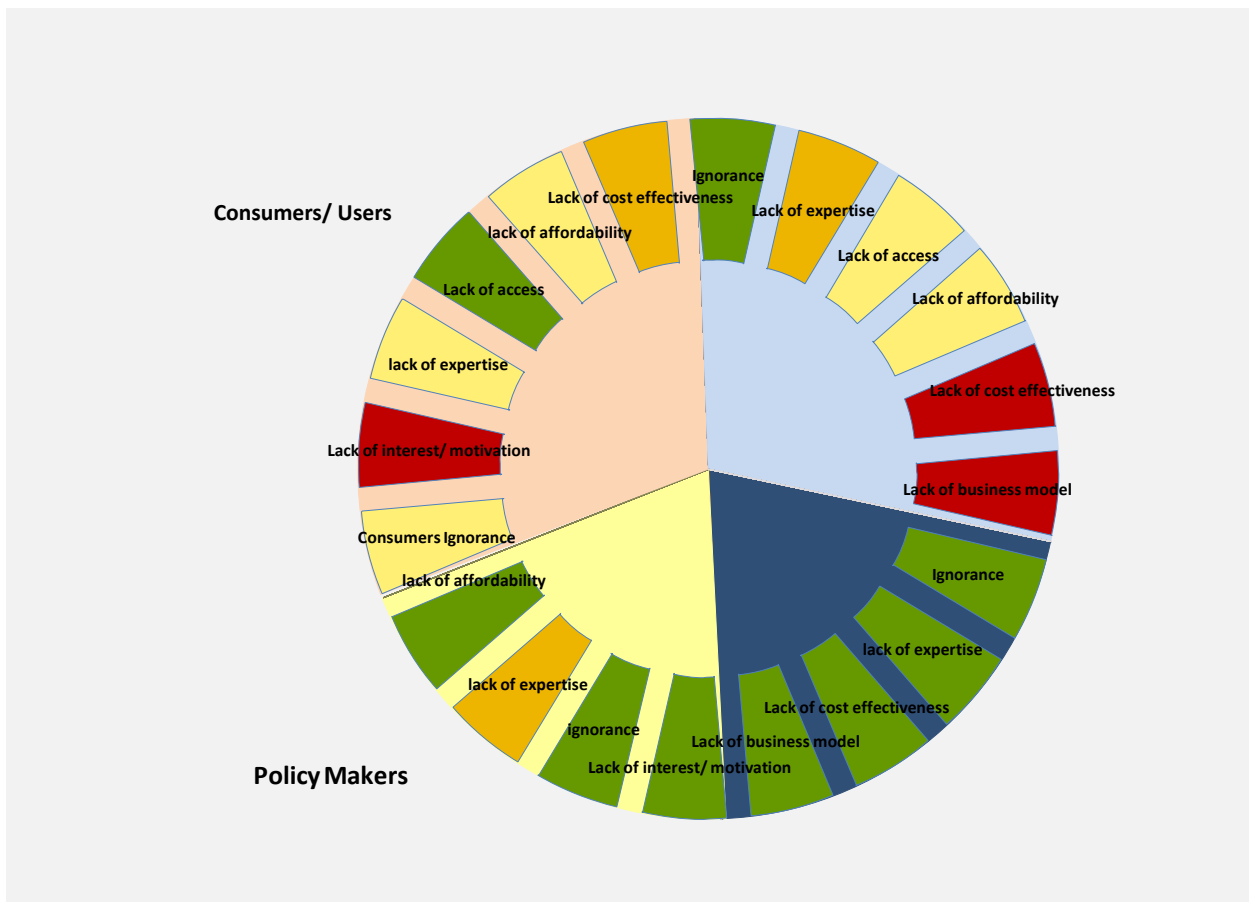


The objective of the project was to increase the market penetration of CFLs. The project had identified the affordability, access and awareness barriers with the consumers of light bulbs properly. The intention of the project was to provide cheaper light bulbs through bulk purchasing 13 W and 11 W with built-in magnetic and electronic ballasts and distributing them through 7/11 outlets (Figure 5). Over 900,000 CFLs were sold under the program at 40% below the prevailing market price (World Bank 2000).

However, the program failed to take into account the supply chain issues with respect to quality of the CFLs. In fact, the project circumvented the traditional supply chain by replacing it with a project activity- Even if some of the product that was bulk-purchased by EGAT might have come from Thailand, the project took on the function of a motor in the supply chain. After the project’s activities were over, the market was lacking that driving force and no self-sustaining situation had been achieved by the end of the project in 2000 (cf. Figure 6).

This is an expression of the lack of expertise on the market and its proper regulation on the side of the policy makers. A large number of CFLs were imported from China which was the main source of cheap CFLs at the time: “These lamps, which had a much lower average operating life, severely affected public perception with CFL technology and became a major barrier to EGAT’s CFL program. EGAT was eventually able to overcome this problem by active testing and labeling of the lamps, but not before severe damage to CFL public confidence and a substantial delay in program implementation was experienced” (World Bank 2000).

Figure 6 Barriers to CFL market in Thailand in 2000



Thus the project did address some information barriers but exchanged them for negative preconceptions, i.e. the project had introduced a new barrier, the “lack of motivation / interest” barrier by not paying heed to the quality of the product. The program failed to effectively and sustainably increase market share of CFLs in Thailand, as indicated by the barrier situation in 2000 (Figure 6): It was still not cost-effective for the supply chain to provide CFLs to the Thai market, as consumers had active disinterest in buying CFLs, and actually, the lack of demand was now a show-stopping, red barrier.

Further, Sulyma et al (2000) suggest in their evaluation that the project left out important options for a sustainable reduction of the cost-effectiveness and affordability barriers in that the reduction of import duties and taxes would be an opportunity to reduce the price. She recommends that future efforts to transform the CFL market should address the “tradeoff between price and quality by educating consumers”, should consider providing access to CFLs through traditional light bulb distribution channels instead of special distributors, educate sales staff in these channels on the advantages of CFLs, and should include the full range of models and types of CFLS.

This example demonstrates that the model is able to predict situations with incomplete transformation. The fact that the bulk purchase was not developing a market sustainably was predicted by the model in that fundamental barriers in the supply chain were not tackled by the intervention, or by any intervention going on in Thailand at the time. In addition, the project activity itself – bulk purchase – could not be properly mapped on the barrier circle which – if the barrier circle concept is correct – could indicate that the project activity is addressing something that does not really affect the market. Thus, the barrier circle can serve as an analytical tool to help identify where the project failed to achieve the intended results, e.g. when a barrier that was addressed with a project activity persists after the project, or where a project activity introduces a new barrier, like in the case of the lack of interest. But it can also demonstrate where a barrier was successfully removed even if the market was not fully transformed. In

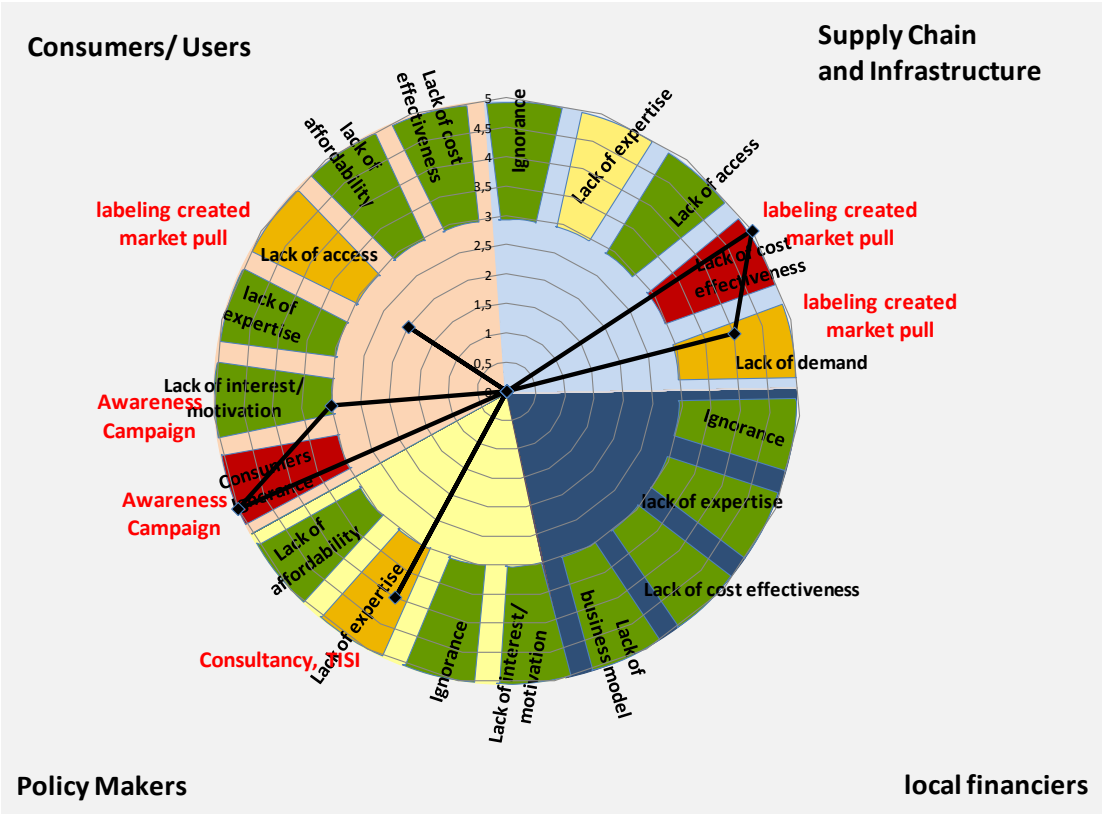
that sense it is able to reflect positive and negative contributions to market transformation, which is a step towards resolving the attribution puzzle.

Unfortunately, however, the model is at this stage not able to reflect structural characteristics of the supply chain, which was the distinguishing difference between the T-8 light tube case and the CFL case: In the case of light tubes, the market was predominantly served by Thai manufacturers, while in the case of CFLs; the product was mainly imported into Thailand.

2.2.3 Refrigerator and Air Conditioner Programs for Households

In a third DSM Program, EGAT worked together with appliance manufacturers in a voluntary labeling program for refrigerators and air conditioners. The objectives of the appliance program were to reduce electricity consumption through refrigeration (Figure 7) and cooling (Figure 8). The markets suffered from significant barriers: Firstly, only very few energy efficient refrigerator models were on the market, i.e. there was a significant access barrier. Appliance shoppers had no information on the energy consumption of the appliances, i.e. there was a significant awareness / information barrier. On the other hand, even the more energy efficient refrigerator models had only marginally higher cost so that affordability or cost effectiveness were no decisive barriers (Figure 7).

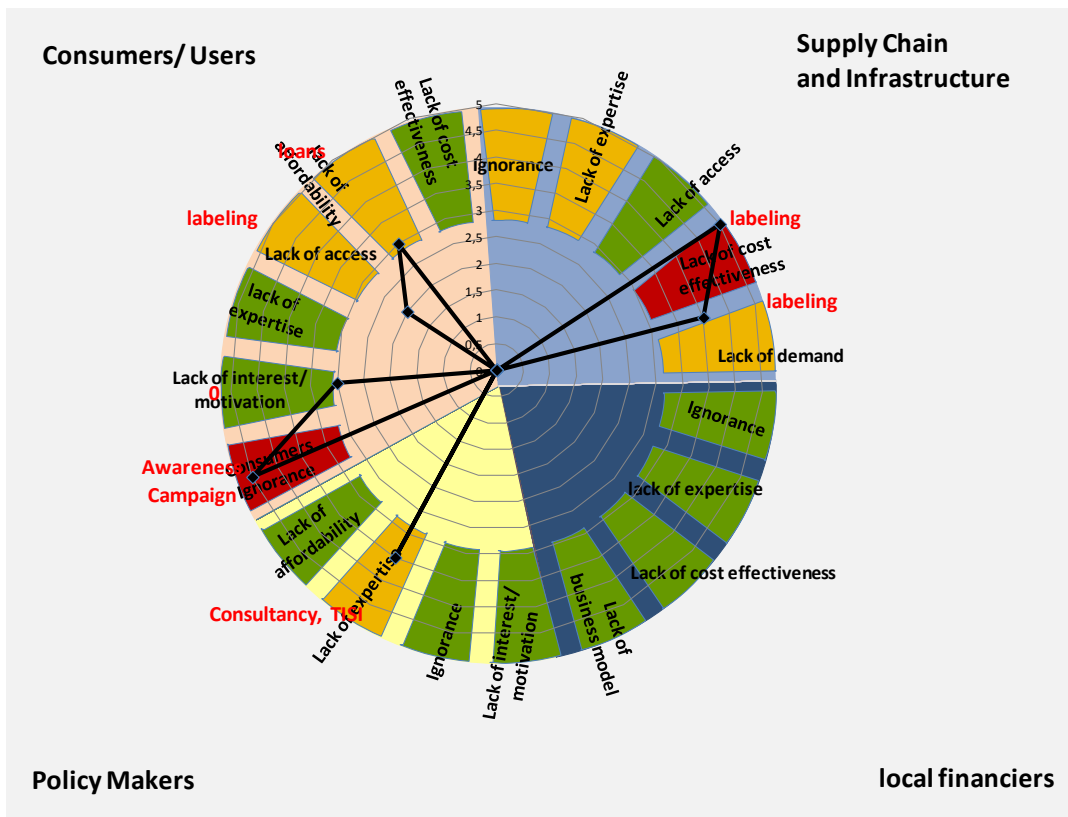
Figure 7 Barrier circle and project intervention for efficient refrigerators in Thailand in 1994



On the supply side, for manufacturers there was no need to introduce better models. There were 10 manufacturers and distributors of refrigerators in Thailand at the time of project implementation, 7 of which had local manufacturing facilities, 2 distributors whose brands were produced by one or more of the 7 manufacturers, and only 1 importer. For 5 of the refrigerator manufacturers, a strong disincentive to produce more efficient models consisted in the need to modify their production line, resulting in higher production costs and a potential loss of competitiveness (Sulyma et al 2000), very similar to the situation in the case of the T8 light tubes.

For AC the barrier circle looked very similar, except that higher-efficiency AC models were typically more expensive than low-efficiency ones (Figure 8) so that people needed to spend much more money initially even for models that were cost efficient to operate over their lifetime. There were more than 200 manufacturers or distributors of AC units in Thailand, most of them small assemblers (Sulyma et al 2000). This obviously made it harder to generate an industry consensus and create a sustainable market.

Figure 8 Barrier circle and project intervention for efficient AC units in Thailand in 1994



Building on the experiences from the thin tube program, both appliance programs started out with negotiations with the manufacturers, starting in 1994 with 5 manufacturers for refrigerators, and continuing in 1995 with 55 for AC units) regarding the specifications of the 5 energy efficiency classes for the two types of appliances. A second common component in both programs was the testing of appliance efficiency through the national technical supervision institute TISI. EGAT’s Demand Side Management Office awarded official energy efficiency labels to the manufacturers on the basis of the test results. As in the cases of thin tubes and CFLs, EGAT provided significant support for a public awareness campaign (Figure 7, Figure 8). In addition, the AC program also provided for a no-interest loan program for appliances of the highest efficiency classes in order to defray the affordability barrier (Figure 8). Thus the project were designed very similar but worked with two groups of appliance makers with different industry structures and barrier situations.

Interestingly, these programs were all designed without a systematic data-based market study. Du Pont (1998) in his study of the impact of energy efficiency labels on consumer behavior investigates policy makers’ and the supply chains’ preconceptions towards consumer labels:

“Only about half of the policymakers (...) appeared cognizant of value of basing policy on detailed consumer research; an even smaller percentage pointed to explicit input from consumers in the policymaking process. When asked about consumer preferences, policymakers tended to frame

their responses in personal terms, using anecdotes or relying on their own personal experience or that of friends.”

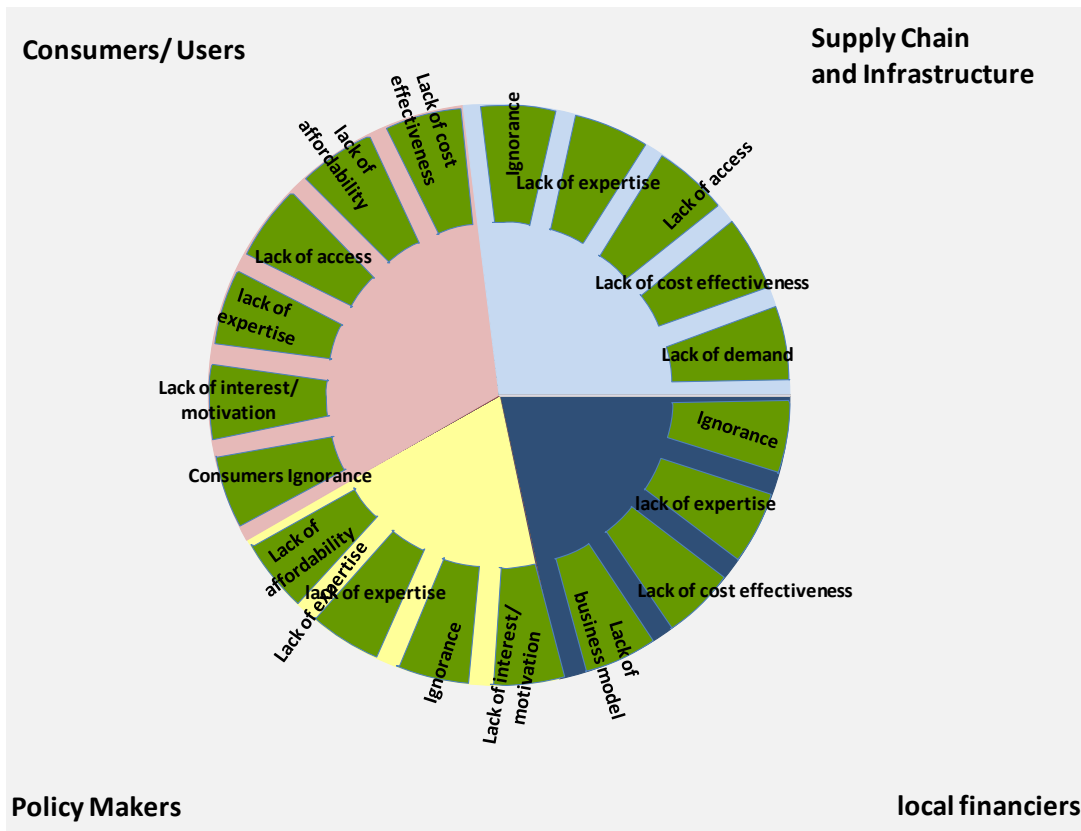
“Thai policymakers tended to draw conclusions about consumer behavior based largely on their own experience. When asked a general question (“Do you think that consumers actively seek information about energy use when they buy an appliance?”), seven of the 11 Thai policymakers provided a yes or no response without citing any specific research. Instead, they cited sources such as “I ask salespeople,” “from my own experience,” or “common sense.” Two provided a response but admitted they lacked data, and two provided at least some reference to support their response.”

“My interviews and surveys with Thai salespeople and consumers indicate that policymakers may be underestimating consumer interest in energy efficiency.”

This is not unusual. Du Pont himself quotes similar observations for the U.S.. However, the discrepancy between policy maker’s notion of consumer decisions and the sales peoples’ practical knowledge demonstrates in du Pont’s view that systematic barrier research might help projects pick the right barriers to address.

Nevertheless, the Thai labeling program and the consumer campaigns for refrigerators resulted in some successes: In terms of outcomes the market share of both types of appliances has increased significantly. For refrigerators, the labels were made mandatory (World Bank 2000). While in 1994 only one model of refrigerators was able to obtain the (most efficient) class 5 label, in 2000 all single door refrigerators sold were of class 5, and for AC units, their market share went up to 38% from 19% during program implementation. An empirical evaluation showed that the campaign made Thai consumers attach much higher priority to energy efficiency when buying appliances than US consumers (du Pont 1998). A much higher share of Thai appliance purchasers were able to understand and shop for the energy label than US customers in the US. Barrier removal has been significant through these projects, and in particular for the refrigerator part (Figure 9). Sulyma et al. (2000)’s evaluation attributes most of the effect of the refrigerator program to a market pull provided by the awareness campaign. Du Pont (1998) states: “In interviews with 43 Thai salespeople in three cities, energy efficiency was rated as the second highest consumer priority in the purchase of refrigerators, after brand. In the survey, 366 Thai consumers who had recently purchased a refrigerator gave energy efficiency a lower ranking (fifth overall), but nearly one-third (29%) listed efficiency as one of their top-three priorities.”

Figure 9 Market barrier circle for efficient refrigerators in 1999

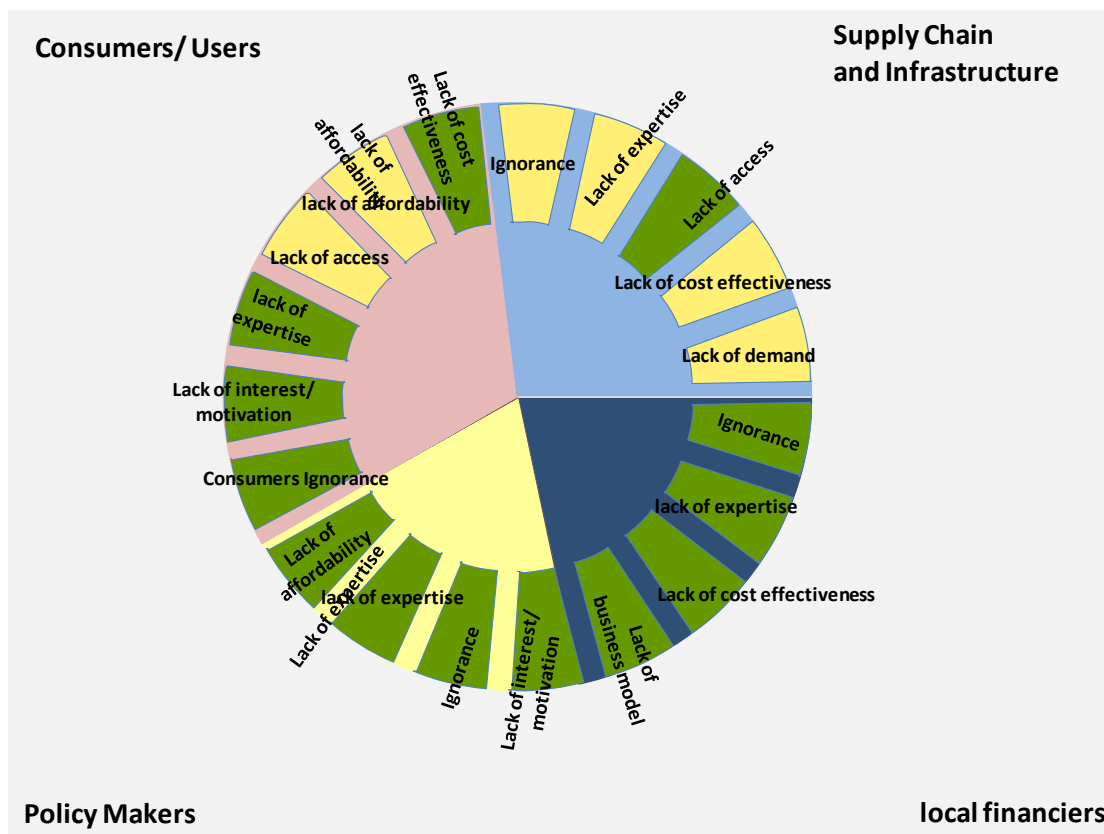


The AC program proved to be much less effective than the refrigerator program (Figure 10): As the number of manufacturers was so much higher, the barriers on the supply side were significantly stronger for efficient AC units than for efficient refrigerators. More intense activity to remove this barrier would have been needed in this case to achieve the same barrier removal effect (Figure 10).

This example illustrates that market development needs to continue even when it has been successful. The fact that in 1994 only one refrigerator model complied with the requirements of energy efficiency class 5, but a post-project evaluation in 2005 (World Bank 2006a) found, that at that point 100% of the refrigerators were in the highest energy efficiency label class. It deserves mention that in this situation the labels would lose their ability to distinguish between more and less efficient models on the market if they were not continuously adjusted with technological development. In order to keep promoting the highest standards, continuous adjustment of the market interventions is necessary to keep market development in line with product trends⁵. In Thailand 2000, the DSMO agreed with the manufacturers to strengthen the energy efficiency standards by 20% in 2001 in order to maintain the effectiveness of the labeling program in promoting efficient models to consumers and incentivizing the industry to keep improving the models.

⁵ This is the tenet of the best practice in energy efficiency standards, the Japanese Top-Runner model.

Figure 10 Efficient AC unit market in 1999



Summing up, the barrier circle model analysis shows that we had two rather similar interventions – as indicated by the spider webs in Figure 7 and Figure 8 which look very similar with the exception of the financing for final consumers in the AC case. As the barrier circles were slightly different in both cases, the match between the barriers and the interventions was not quite perfect in the case of AC. Complete transformation only happened in the case of refrigerators. Here, the lack of demand for efficient refrigerators was abated by the introduction of a labeling program, and customer demand was strengthened through a public campaign that made the benefits of efficient refrigerators better known.

In general, an exact match between barriers and the appropriate barrier removal activities is the most effective way to transform markets. However, as the two contrasting cases of refrigerators and AC units demonstrate that in one case the intensity of the activity was sufficient to remove the concerns on the supply side of the equipment, in the other case it was not. Unfortunately, the barrier circle model currently is not able to reflect the intensity of the barrier removal activity. It would be valuable to find a way to calibrate activities to reflect their relative and expected impact on the barriers. This will be discussed in later stages of this work and in the main paper.

Nevertheless, in some cases, barriers can be “co-removed” if strong market pull or market push is exerted by effective market transformation. However, the sounder project design strategy is to account for the barriers and remove them with purpose. So far, no quantitative or reliable model for “co-removal” effects is available.

These programs all worked on markets in the residential sector in Thailand. With the exception of the financing for AC units where credit card companies were involved in extending and administering the incentives from the government, the project did not actively work with the financial sector. Therefore, the barrier circle also did not assign a major role to financiers. In fact, for the lighting projects, financing is usually not necessary, and as the example shows, it also does not need to be reflected here. This

indicates that in the general Theory of No Change it might be useful to work with different types and numbers of stakeholder groups depending on the market to be transformed. Such a suggestion should be made in follow-up work.

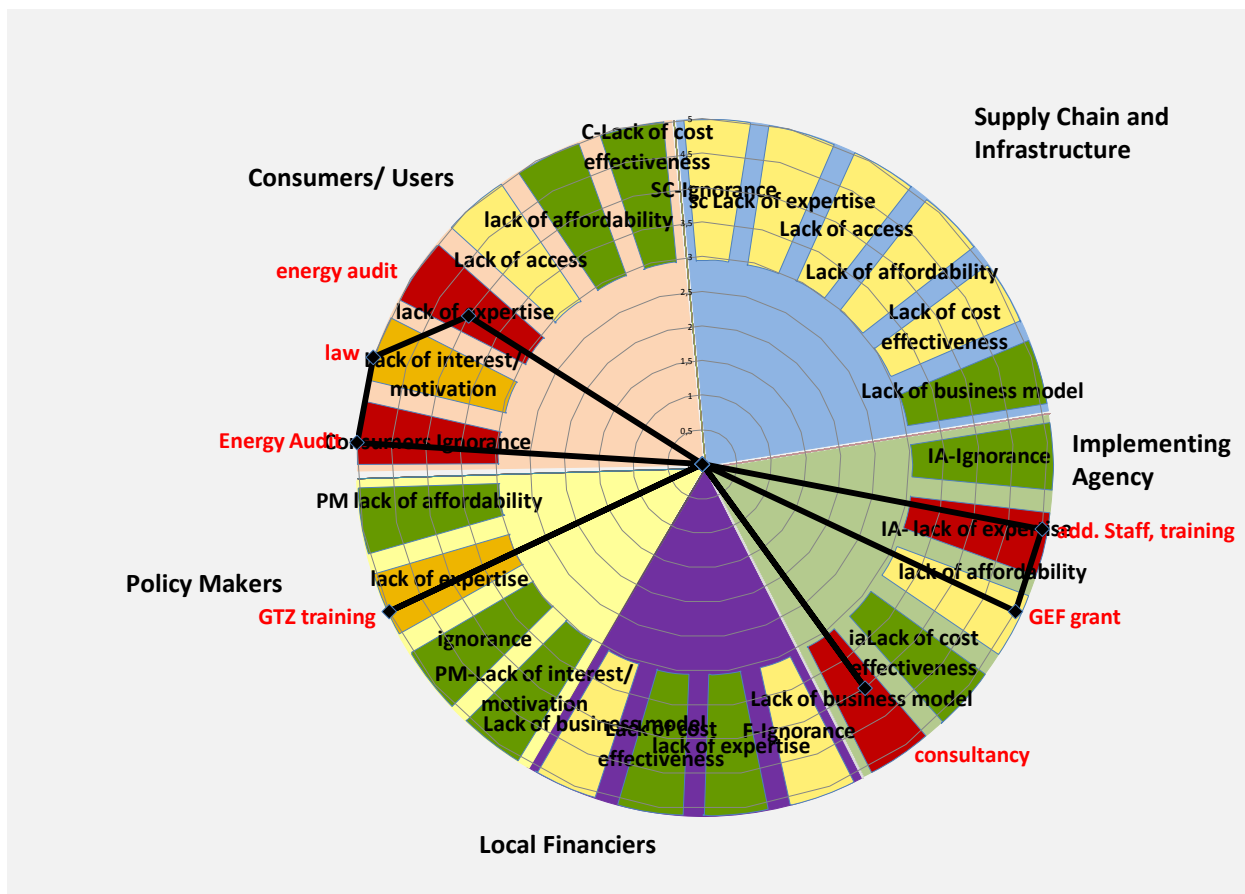
The utility in this case was the implementing agency. Therefore, it played several f roles that were not typical for a utility or an implementing agency. Consequently, when privatization of EGAT was discussed, the role of the DSMO moved back into the public domain. Sustainable market transformation is questionable as long as it depends on an entity that is not part of the four stakeholders to the market as visualized in the barrier circle. We will check whether it adds explanatory value to the TONC if the implementing agency is added as a stakeholder group.

2.3 Green Building Programs

A second set of energy efficiency efforts in Thailand around the turn of the millennium dealt with energy efficient buildings, including commercial facilities, and large scale building chillers (as opposed to single-household AC units). Like the DSM programs in the residential sectors, the effort started in the early 1990s, triggered by the sustained economic growth and the fear of energy shortages. Already in the decrees to the first law 1992, large energy consumers had to conduct energy audits. The Royal Decree on Designated Buildings (B.E. 2538 of 1995) stipulated that buildings with high energy use were obliged to implement energy conservation activities.

These measures were cost effective for the users who in this case were the industrial and commercial entities running such large buildings. For them, the energy savings would have paid for the investments. Typically, in a period of rapid economic growth, investment capital and loans would have been available to finance cost effective investments so that affordability is not a barrier for the users to implement energy efficiency measures – both barrier wedges are green and the circle segment for local financiers does not show any major barriers (Figure 11). However, the users and owners of these large facilities did not know enough about these opportunities to save energy and cost, and had insufficient expertise to tap them. Their attention was captured by the rapid economic growth Thailand was experiencing, leading to a motivation barrier. They had show-stopping lacks of knowledge and expertise.

Figure 11 Barrier circle for industrial energy efficiency and EGAT activities throughout the 1990



Four different interventions were trying to address the problem of inefficient building chillers, and for three of them, evaluations could be analyzed for this study:

1. the WBG/GEF/EGAT DSM project discussed above that also worked on the residential energy efficiency opportunities,
2. a follow-up project of WBG/GEF and the Industrial Finance Corporation of Thailand IFCT,

3. a parallel effort of the Department of Industrial Works (DIW) for which no evaluation is contained in the database,
4. and a support program of EGAT with financing from the National Energy Conservation Fund (ENCON Fund).

As Figure 11 indicates, the supply chain for industrial energy efficiency equipment is not considered relevant by the projects, or discussed by the evaluations. The barrier color yellow was chosen for lack of more specific information. For the sake of completeness, the thematically more open GTZ capacity building program is also included in the barrier circle analysis.

As with the other markets, the GTZ training program in the 1990s supported policy makers in their understanding of the sector as indicated by the black line in the policy makers' wedge in Figure 11. None of the other intervention evaluations mention the GTZ program. In the method chosen for this analysis—where barrier removal activities are identified based on evaluations of interventions of different agencies – it is not unusual that one agency does not mention the activities of the other agency. Therefore in most cases the interaction between different interventions cannot be distilled from the studies.

In order to test the barrier framework model further, the diagrams in this section contain a wedge for the implementing agency. As mentioned above, a utility is not necessarily part of an energy efficiency market or its transformation. However, for building chillers, EGAT played various roles, including technical assistance counterpart and financier. It also had a vested interest in increasing the energy efficiency of building chillers in order to reduce peak load and stabilize the electricity system. The rationale to include it here is to test whether or not it adds explanatory value to the logic model to include a wedge for the implementing agency.

EGAT's DSMO launched a program on commercial buildings in 1995 financed – like the DSM interventions discussed earlier in this study - by the World Bank GEF DSM program. It offered preliminary and detailed energy audits as well as investment advice for retrofits including lighting, cooling, load management and building envelope measures (Singh and Mulholland, 1999). The idea was to support the compulsory parts of the energy law.

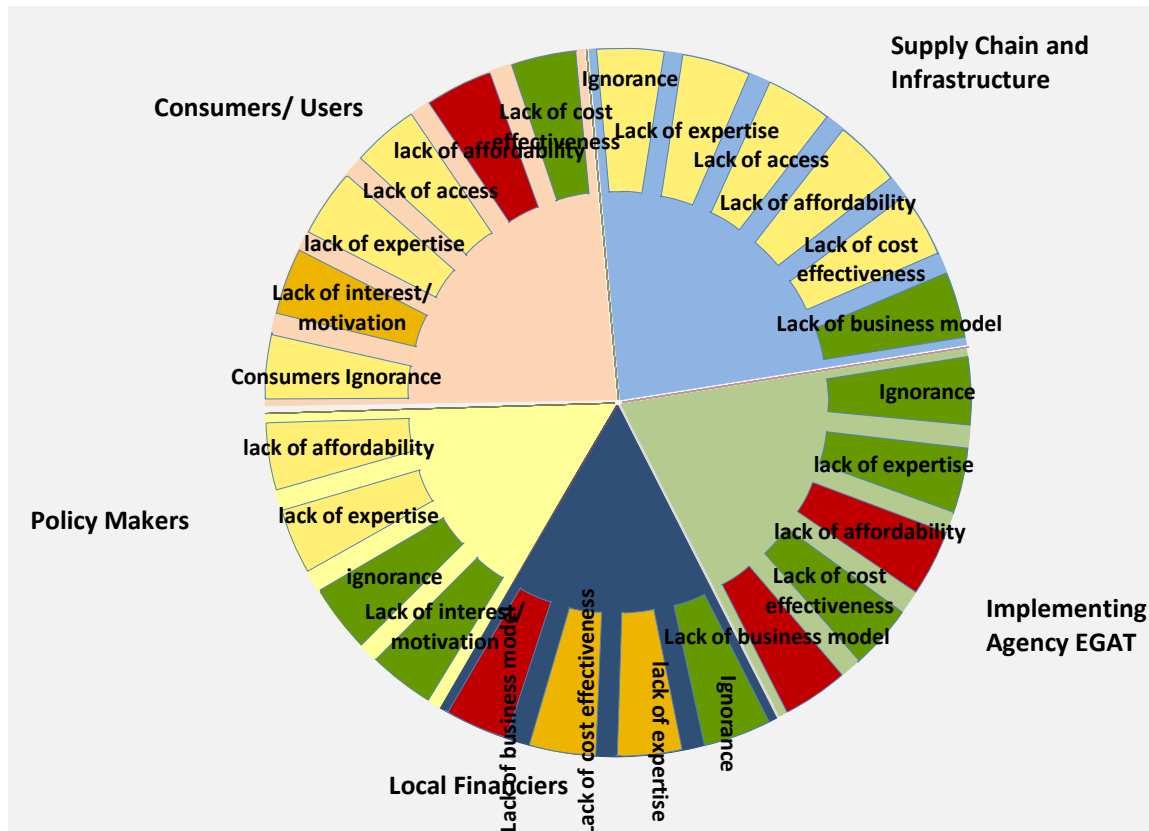
The World Bank / GEF DSM project enhanced EGAT's capacity through additional staff and consultant support as well as grant funding for financing energy audits. Their objective was to generate more knowledge and awareness among the users of energy for energy efficiency opportunities. Ultimately, EGAT's DSMO supported within the project a total of 252 commercial and industrial energy audits, 86 audited hotels and a number of demonstration projects, with many more building owners and managers applying for the audits (Singh and Mulholland 1999).

After the project, there was no more grant financing for conducting the energy audits, so that due to a "lack of viable financing mechanisms to follow-up EGAT's energy audits and consultations". At that time, also, the Asian financial crisis had added financing issues on the side of the financial intermediaries which increased the affordability barriers for the consumers. Thus, very few of these energy audits and consultation resulted in actual investments. The World Bank's Implementation Completion Report rated the commercial buildings and factory programs as less successful than the residential DSMs described above (World Bank 2000). Singh and Mulholland (1999)'s recommendation does not relate to the financing barrier but to the communication with the owners of large buildings in general, in the sense that overall the DSM programs seemed to have been delved into without proper project planning and strategy.

In terms of the barrier circle this translates into an incomplete removal of barriers, where the lack of motivation on the side of the consumers is not fully reduced and an affordability barrier is newly generated as a show-stopper on the consumer side. Local financing is not available anymore (Figure 12). Both are new barriers: as indicated by Figure 11, the barrier of affordability on the side of the consumers and the lack of a business model on the side of the financiers had not existed during the

early 1990 when Thailand was experiencing an economic boom and funds were available. This later barrier has newly sprung up during the financial crisis. In fact, at one stage, the Bank of Thailand prohibited “all commercial banks to provide additional loans to any enterprises with any amount outstanding non-performing loans. This seriously limited the pool of potential clients” (World Bank 2006).

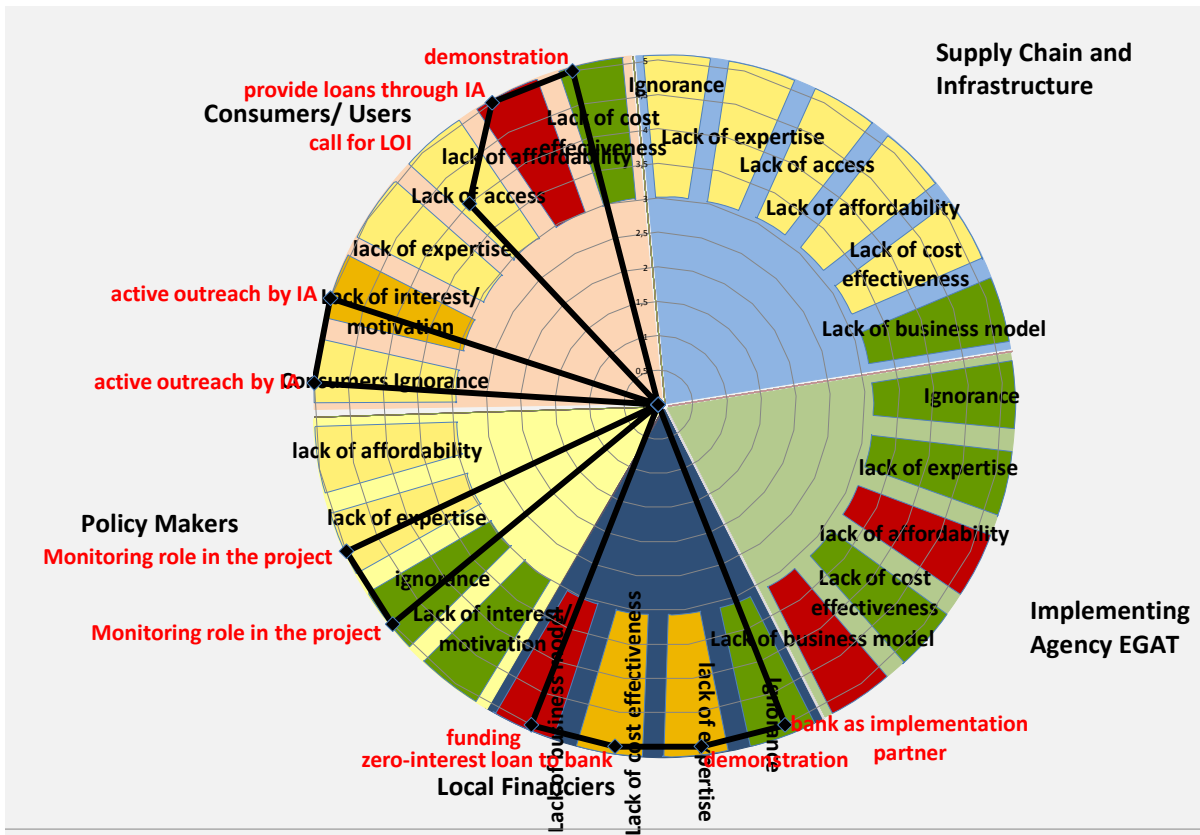
Figure 12 Barrier circle for industrial energy efficiency in 1999



As the energy audit programs proved insufficient for mobilizing investment, WB, GEF and EGAT started developing a building chiller replacement program to continue the activities. The exact date at which this project started to be developed could not be identified by the World Bank ICR (World Bank 2006) but the assumption is this happened before the larger DSM program actually came to a close. As the Asian Financial Crisis had negatively impacted the availability of financing as well as the interest of the financiers to lend money for non-core-business-related investments (Figure 12) another intervention seemed necessary and promising. After the funding had been approved by the GEF but before project appraisal, EGAT dropped out of the new project due to organizational uncertainties. Part of the measures to abate the financial crisis was that some of the major state owned enterprises needed to be privatized, and EGAT was a potential candidate. The World Bank looked for another implementing agency and settled on the Industrial Finance Corporation of Thailand IFCT, a private bank specializing in industrial clients. As this was a loan program rather than a technical assistance program, this choice seems rational and it brings the project closer to the actual barrier which was the availability of and request for financing. Thus, the East Asian Financial Crisis first delayed project start-up from 1998 to 2001 and then triggered the privatization of major state-owned corporations in Thailand, which led to the change of implementing agency from Electricity Generating Authority of Thailand-EGAT to IFCT.

In the barrier circle diagram analysis IFCT is not represented by the “Implementing Agency EGAT” segment, but part of the “Local Financiers” segment.

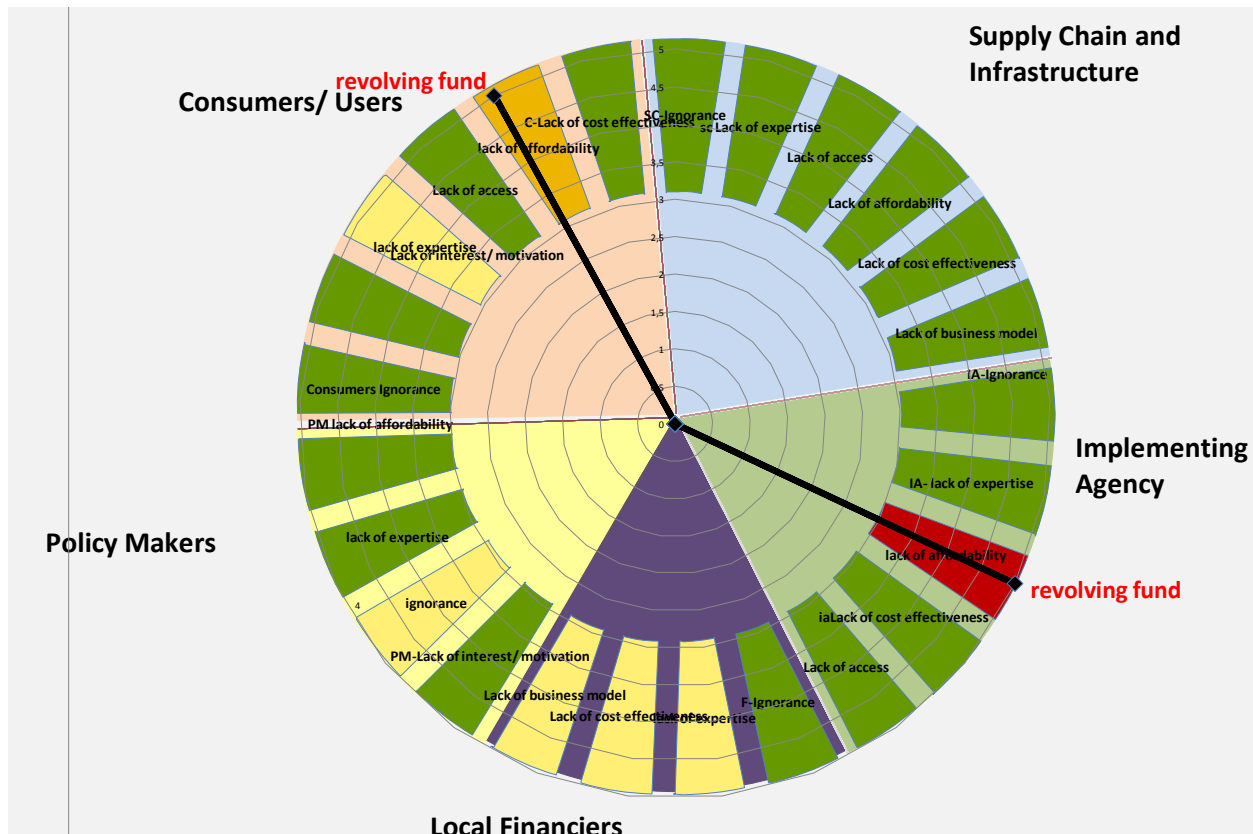
Figure 13 Barrier circle for industrial energy efficiency at the turn of the century plus WB/GEF Chiller project in 2001



Ultimately, removing the financing barrier proved difficult. One result of switching from EGAT to IFCT was that the loans to users of energy equipment were not as concessional as before anymore. EGAT would have given loans at 0% interest; IFCT on the other hand charged 4.5% interest in order to recover its transaction costs. “In addition, non-IFCT clients found it difficult to get loans from IFCT while the collateral remained with other banks. Finally, the interest rates available on the market became extremely competitive to the point that the difference between the rate offered by IFCT and the market rate were not as attractive” (World Bank 2006).

IFCT tried to actively recruit enterprises to participate in their chiller replacement program, e.g. by holding 13 seminars in Bangkok and other cities attended by 340 owners with a total of 1000 chiller units. “From those who were technically qualified, 64 chillers in all were replaced, though only 29 ‘participated in the program’ and only 19 agreed to accept financial support under the program.(...) A large number of conversions were occurring outside the scope of the project, i.e. the CFC chillers were replaced using the clients’ own resources” (World Bank 2006). The financing conditions offered under the program were not concessional enough, or, the barrier removal activity of this project was not targeted to the actual barrier – sufficient “normal” financing sources seemed to have been available at the time of actual investment. Whether or not the project has contributed to abating the information or motivation barriers was not evaluated in the ICR. Nevertheless the project is considered a success and the cause for the market transformation in Thailand by its ICR (World Bank 2006). This is an example for the difficult judgments necessary to assess attribution of greenhouse gas emissions savings to an intervention. Potentially, nothing would have happened without the IFCT program, or maybe almost or just as much would have

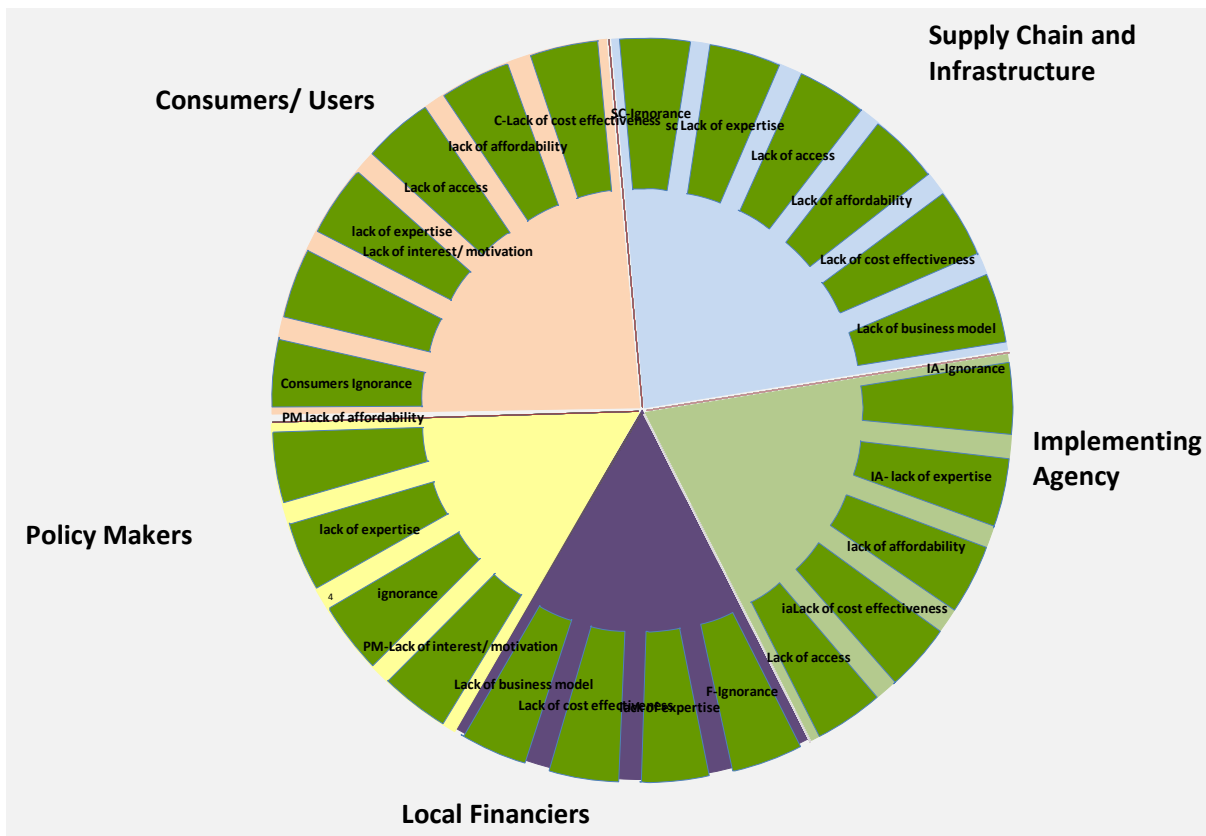
Figure 14 Barrier circle in 2003 (start of the EGAT / ENCON program)



Distinguishing between contribution and causality becomes even more complicated as the story continues: when EGAT finally resolved its institutional issues it received funds from the ENCON fund to also make financing available for building chillers (Figure 14). The barrier circle as drawn on the basis of the other studies did not actually show such a barrier anymore so that this seems in the light of the barrier analysis to result in a “super-barrier-removed market” (Figure 15). At that point, IFCT provided loans from the World Bank / GEF program, commercial banks provided financing without any program, and EGAT provided financial incentives. The ICR for the WB/GEF Building Chiller project (World Bank 2006) described the situation as follows:

“Clear Policy and Incentive Mechanism. The project experience has shown that unclear policy and competing financial subsidies could lead to the suboptimal outcome. With the proven high internal rate of return, the government may not need to provide additional incentive to replace the remaining CFC chillers provided that the private sector has the complete information and clear message from the government. It is crucial that the government clearly declares its subsidy policy. Otherwise, the private sector will wait to get the best deal from the government.”

Figure 15 Barrier circle for building chillers in 2005



The ICR (World Bank 2006) also points out a number of implementation details that might have been the reason for the failure to achieve the targeted output figures in the WB / GEF / IFCT program: The project schedule was unrealistic, some administrative details were solved in an inconsistent manner, the selection criteria for the beneficiaries were very rigid, and the program put a “complex set of requirements” on the suppliers of efficient equipment (performance guarantees, detail proposal submission and bank guarantees) so that only one supplier participated in the program. After the EGAT revolving fund became operational, the IFCT project was terminated without having reached its full output target but is still correctly evaluated as a successful market transformation: while before the project, the non-CFC chiller market was “virtually” nonexistent after the project a flourishing market has been generated.

3 Summary and Conclusion

Thailand is a well suited case of study as it has a 20 year long history of energy efficiency interventions, which is extremely well documented in evaluations. A number of interventions, in particular on the household level, have been evaluated multiple times and from different angles. Using a market transformation barrier framework for reconstructing the history of energy efficiency in Thailand in the 1990s and early 2000s has provided a number of insights into the logic of climate mitigation interventions and the difficulties of attributing the ultimate GHG-emission reduction to a single project intervention, or even the intervention conglomerate financed and implemented by different national and international entities.

The first four programs discussed in this case study were classical “market transformation” programs for lighting equipment and appliances. They were run centrally by the Demand Side Management Office (DSMO) of the national utility EGAT whose ultimate motivation was to avoid additional investment needs on the utility level. Demand side management in this context was a cost-effective, self-motivated exercise of a public utility. The DSM programs worked well in those cases where – in a specific Thai way – the DSMO collaborated with local manufacturers to move collectively from producing and selling an inefficient product to a more efficient one, like in the case of the T8 light tubes or the refrigerators. In those cases, where the supply side consisted of too many participants (AC units) or relied on imports (CFLs), the “Thai” way of voluntary agreements and incentives was less successful than for example a legally binding prescription might have been. Nevertheless, the barrier circle analysis demonstrated that in these cases, the projects’ strategies were appropriate for the barriers and removed them mostly effectively.⁶

The second set of three interventions dealt with the building chillers for industrial buildings. Here, the first DSM program had undertaken a large number of energy audits with little actual investment following. Therefore, three interventions tried to offer financing services and ultimately, a significant number of building chillers were replaced.

3.1 Who gets the credit?

Thailand’s government understood early on that concerted and active energy efficiency activities were useful in abating some of the constraints to economic growth and leveraged a number of other benefits. Drawing on experiences from the US and adapting them to the local circumstances worked very well for household sectors and for those sectors where a small number of manufacturers or investors were to be addressed and convinced of the energy efficient technologies. Commercial actors provided the bigger challenge for these efforts. This led among other things to competing efforts for some cases.

The tool has helped identify the fundamental attribution problem of climate mitigation interventions: The actual reduction of GHG emissions always happens at the user level. The user is responsible for reducing his or her energy consumption, or for the ensuing emissions. The user is the beneficiary of cost reductions through energy savings or additional revenue through carbon finance. However, without a number of stakeholders being involved in market transformation and enabling the user to behave more climate-conscious, the user will in many cases not be able or willing to save GHG emissions.

Attribution issues obviously are an important challenge of climate mitigation evaluations. Two different efforts for replacing inefficient building chillers were discussed, a third set of activities were underway with the Department of Industrial Works, for which no evaluation could be found. This is not an unusual situation. In fact, in many situations more than one government agency works on the same political or economic priority, even if this is rarely highlighted in evaluations. For a project-focused evaluation it is rather hard to detect this overlap between the two interventions without a full discussion of the

⁶ Ultimately also for CFLs, but there was no evaluation available in the database for this transformation that happened only after the turn of the century.

context. For example, the ROTI analysis for the purpose of the GEF Overall Performance Study 3 looked at only the WB/GEF project and attested to its significant market development impacts (GEF EO 2009).

Nevertheless, if we would like to attribute the GHG-savings to any one of these actors, we would probably follow the logic of the established carbon markets and attribute it to the actual investors: The companies and persons who own the houses and facilities and who were to buy the chillers, have them installed, and take out loans for financing them. Following this logic, we would then perhaps⁷ see that most building chillers were financed on the private market without any IFCT help, and thus consider the project unimportant. But would they really have invested if the supply chain, the local financiers, the policy makers and the implementing agency would not have done anything? This question could perhaps be resolved with the barrier circle analysis if closer-to real-time information would be available, for example when it would be used for monitoring, and if consistent outcome indicators for barrier removal were developed.

The example also demonstrates that the amount of carbon avoided is not necessarily proportional to the effort (or money) spent on barrier removal, as can be easily seen from the example of the IFCT Chiller project: If this intervention really transformed the market – as indicated by the “successful” rating of the ICR -, the actual number of financed installations bore no direct relationship with the overall GHG emissions that were saved in Thailand through the replacement of inefficient building chillers. The project had the same impact on carbon no matter whether the funds would have been spent as planned, or whether smaller funds were spent on a smaller number of actual installations. Again, the attribution question is also not solved here as in the stricter sense of the meaning, the building owners are responsible for the GHG savings. The financial intermediary was just an enabler. In the end, this observation draws into question the cost effectiveness analysis of GHG interventions. Can it be measured by the ratio of “funds expended on barrier removal” to GHG reductions?

3.2 Methodological aspects of the barrier circle model

The barrier circle analysis that was tested in this study was able to grasp all significant barriers for the relevant stakeholders.

In well documented cases, like the case of the building chillers, it was possible to reconstruct on the basis of evaluations almost yearly snapshots. Yearly snapshots could also be produced when using this tool as a monitoring tool, which would offer a number of interesting advantages:

- The traffic-light-like coloring allows for intuitive understanding and visualization of non-quantitative information. In many cases, qualitative changes “for the worse” or “for the better” can be more easily and more economically identified than quantitative data. This is important in order to identify and communicate the need for action in project management.
- If available, quantitative data can be visualized in the traffic lights, too.
- Progress can be visualized almost like in an animation.
- Newly arising barriers can be identified in close-to-real-time and in a systematic manner, as the barrier circle contains warning signs for all relevant barriers.

The barrier circles allowed for the depiction of multiple interventions in the same situation. This is an important aspect when analyzing project success in the context of a whole market. Most of the time, outside influences are ignored in intervention evaluations which might lead to wrong conclusions as to the effectiveness of a project, or might limit the insights to be drawn from an evaluation. The information for this was drawn from separate project or policy evaluations and aggregated in the same barrier circle diagram. This means that the barrier circle can be used as an aggregating tool to reflect the sectoral situation for a specific energy efficient product in a more complete way than single project evaluations would do.

⁷ No quantitative assessment of the chillers that were financed through unsupported banks is available.

The barrier circles were able to reflect the success and failure of barrier removal activities and in turn predicted where markets would be working well in the future. This attests their suitability not only for the illustration of project success, for analyzing the contribution of program components but also for project design.

They were also able to reflect newly introduced barriers. These were partially introduced through badly executed projects and partially through external influences like the Asian Financial Crisis.

The tool also bears some predictive power – if an orange or red barrier is not addressed by an explicit project activity, indirect effect, activity of another stakeholder or a general (e.g. economic) trend, there is a high likelihood that the project will fail (or has failed in the case of an ex-post evaluation).

In addition, by analyzing a large number of interventions, one could come up with an optimized set of barrier - barrier removal interventions pairs to guide project implementation.

Using the tool in e.g. yearly updated snapshots for monitoring could thus facilitate adaptive project management. The barrier circle and its intuitive traffic light color scheme raises red flags when the situation does not improve or becomes worse in unexpected spots as it keeps a tab on every relevant market barrier. The ease of illustration comes at the cost of not being able to reflect structural local specifics in great detail.

On the other hand, Thailand is not such a representative case when it comes to building barrier – strategy couples. Thailand has been a place where non-standard policy approaches have worked rather well. In particular, agreements between government and industry, for example in the labeling programs, have been quite successful. This is not necessarily always the case but has been blamed on country specifics like culture (du Pont 1998). Size and industrialization level might also play a role. In order to draw more empirically founded conclusions it is advisable to conduct further case studies testing the barrier model and its value in particular for intervention design.

In the course of analyzing the barriers in the Thai example it also became clear that there is some judgment required in terms of the definition of the proper barriers and stakeholder groups. The smaller the set of barriers and stakeholders the higher the usefulness of the tool as the data and research requirements are proportional to the number of barriers. It is therefore desirable to reduce the numbers of barriers and stakeholders in the model as far as possible without losing the ability to explain and reflect the status of the market. More research is needed in order to identify the smallest complete set of barrier definitions possible. This analysis should also include other mitigation areas, if the process is supposed to lead to a general framework for climate change mitigation that would also have a unified set of barriers. It should be investigated how to adjust the number of stakeholder groups to the respective market to be changed. Some guidelines on this issue could be developed and would be very helpful even to guide project design for market change.

The barrier circle had one major drawback: It was not fully possible to calibrate the intensity of the barriers with the intensity of the barrier removal activity. This limits the explanatory and the predictive powers of the instrument. An option for future research would be to define semiquantitative indicators and tools for the strength of the barriers (or conversely the thresholds of non-barriers) and the intensity of interventions. This would help significantly in the analysis of the attribution issues in evaluation as well as in project design.

Last but not least, these could serve for the definition of a set of SMART outcome indicators for market barriers that would help systematic market barrier analysis, project design, and monitoring and evaluation. Further research is necessary.

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