MARKET DEVELOPMENT MODELS FOR HOUSEHOLD PV SYSTEMS IN DEVELOPING COUNTRIES

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ABSTRACT: Three main market development models for household PV systems in developing countries have been analysed: the greenfield project model, the system engineering houses model and the traders model. Although the traders model may have the best track record in serving end-users in developing countries, little is done to support and expand this model. The paper calls for a broader view on PV market development in developing countries, and for instruments to be developed to strengthen especially the free market for household PV products in developing countries.
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1. BACKGROUND

Utility investment in rural electrification has been proven over the past three decades to be unable to reach an estimated target group of 2 billion people. A self-sustaining market for household PV systems seems to be the main option for basic rural electrification.

We have observed two different, not related PV market models that can currently be found in developing countries.

Table 1. Characterization of two existing market models,

	Project market	Free market
Defined by	Project developers	End-users
Main products	30-50W c-Si	10-15W a-Si /c-Si
Price level	400-1000 USD	50-200 USD
Distribution	(Semi)utility	Traders
Estimated annual installations	30,000-40,000	150,000-200,000
Interventions	Government and donor support	No support Distorted by projects

1.1 The project approach

The project approach is characterized by the fact that project developers and project managers are the principal actors deciding the products and prices in the market.

Defined by actors external to the market, projects have shown a tendency to a focus on singular and standardized market systems[1]. For instance, the World Bank has defined "best practices for Photovoltaic Household Electrification Programs" [2]. In Europe, the European Union has recently developed similarly narrowly defined "Universal technical standard for Solar Home Systems" [3].

Martinot [4] has evaluated twelve on-going World Bank group projects to promote Solar Home Systems and has come to the preliminary conclusion that "more project flexibility is needed for local partners to allow them to develop good business models". Notably the review suggests that customers desire a range of component options and service levels and can benefit "from even small systems".

We estimate that the annual number of installations in project approaches is currently between 30,000 and 40,000 systems per year.

World wide experience with this project type has however shown that it has not created self-sustaining markets yet. Significant numbers of systems have been diffused in projects, but personal communications in former project areas time and again show that when a project has stopped, the market has generally largely stopped. Surprisingly, there is little evaluation of this failure of this project model to create sustainable PV markets.

1.2 The free market approach

In a free market for PV systems, demand and supply (end-user and vendor) interact directly to define products and prices. In most cases, this definition takes place when a customer is in a shop and discusses with the salesperson which product components to include and what will be the price he is willing to pay.

Outside the scope of donor-supported projects as described above, several countries have seen the development of fully commercial markets for household PV systems. Most often, these markets are based on 10-12 Watt , traded by commercial traders on a "cash-over-the-counter" basis. The end-user price is in general affordable to a significant part of the population at 60-200 USD.

Distribution channels generally depend on the traditional trading infrastructure in the market, and mostly build on existing distribution channels, micro-enterprises and the informal sector.

We estimate the market volume of commercially traded household solar energy systems at around 150,000-200,000 systems per year.

This market is already self-sustaining and depends on investment by importers and re-traders in developing countries, and equipment suppliers, such as Free Energy Europe.

1.3 Donor support for market interventions

Despite its proven potential for serving the end-user, the free market model has not received support from the international donors and development aid organizations. Sometimes it is even distorted through projects in their drive for strict technical standards that exclude the small

1 in most cases the 30-50 Watt "Solar Home System", costing 400-700 USD. Due to the high price, substantial market is only seen in long term credit or fee-for-service dissemination [1][2].

systems from "market development projects". In Kenya, Morocco and China projects have even been financed with the explicit objective to transform the existing free market from its current state to a "better practice" high quality market. In these interventions, the better practice markets are defined by the project developers and managers, including implicit or explicit technical standards. Therefore we would characterize these interventions as replacing the free market by a project market.

Two main reasons appear to play a role behind this bias of the major international donors towards project markets:
1. *Lack of awareness*: international project developers and donors may be largely unfamiliar with the functioning of self-sustaining free markets in developing countries
2. *Lack of capacity*: International donors and project actors may not have adequate instruments for supporting dispersed free markets in which small enterprises operate. Their existing instruments may only fit a focus on large-scale operations such as nation-wide credit schemes and "fee-for-service" programs, inherently oriented towards project markets.

2. PURPOSE

In view of the above, the research presented in this paper has aimed to provide insight in the ways in which self-sustaining markets for household PV systems in developing countries can be created.

The objective of the research has been to identify and map the various market development models and their dynamic relations between actors and factors. The objective has also been to identify critical processes in these market development models.

3. METHODOLOGY

The research has started from contemporary innovation theory, dynamic business modeling and knowledge systems analysis.

The used research methodology is basically a knowledge management methodology. This means that the results from the study give insight in the present level of knowledge and insight in market development models by the combined actors involved in the study. The research has involved all supply side actors in the Netherlands and all demand side actors in South Africa. It has been carried out between September 1998 to July 1999.

4. MARKET DEVELOPMENT MODELS

Based on the interviews and secondary information, three typical PV-market development models (business models) have been identified. These models can be seen as very 'pure' business models for introducing PV to rural areas. In reality, several mixtures of these models will be found. Below, the basic characteristics (Organization(s), Applications, Market and Technology) of each model are described.

4.1 The project model

Organization

In this type of development, a donor, consultant or NGO defines a green-field project. The main purpose of most projects is the development of a new distribution infrastructure. The exposure of such projects is very large whereas the development process can be relatively slow (3-7 years).

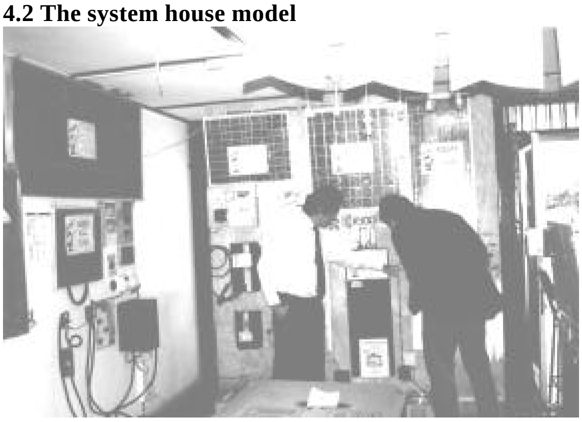
Technology & Application

The main application in household electrification projects is a standardized solar home system with a crystalline silicon panel with a nominal power of at least 40 Wp. In most cases, this application is offered in combination with credit structures in order to increase the affordability.

Market

Projects are aimed at the rural population living in pre-selected areas in developing countries. To reach these actors a new distribution& financing, installation and after-sales structure is developed. Market development depends primarily on the success in building this new infrastructure.

4.2 The system house model



Organization

The central actors in this development model are 'systems engineering houses': organizations or companies that have the knowledge and know-how to put together components to tailor a solar home system to the needs of an end-user.

Most of the time solar energy is the main business activity of these companies.

These actors perform an engineering as well as a small-scale wholesale function and are, in both cases, quite flexible in their activities.

Technology & Application

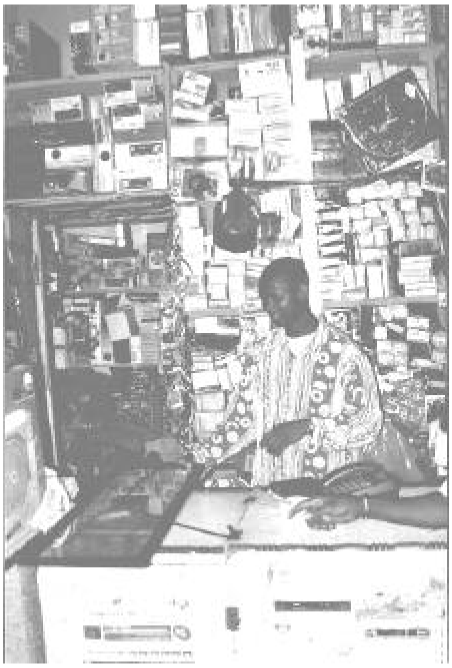
The main applications is a solar energy system tailored to the needs of specific clients. SEH's use panels of different sizes, based on different PV-technologies (i.e. crystalline and amorphous silicon). They tend to have a strong focus on technical standards developed in projects.

Market

Based on the applications described above, SEH's often aim for niche markets, such as NGO installations and the telecommunications market. This causes a bias towards the project model. SEH's are also actually attracted by donors into their project model.

Market development depends primarily on evolutionary expansion of the business of the system houses.

4.3 The traders model



Organization

PV systems are imported and distributed by companies that have a well-developed commercial distribution infrastructure, that reaches the target group of PV systems. This can be most successful when PV complements trading in other products (for example black and white televisions and batteries). In general PV is only a small percentage of the turnover of the trader.

Application & technology

The main application is a standardized trading product that has been optimized in the market to fit the needs of the end-users in terms of product and price. For instance a 12W panel as battery charger, or a complete basic lighting system.

There is a strong focus on the end-user needs and choice of technology becomes a less important factor. As long as the needs are properly identified and fulfilled, IEC certified as well as not certified, crystalline as well as amorphous silicon PV technology can be used.

Market

The market depends on the market for the complementary products or the existing distribution network from which one tries to profit.

Market development depends on the expanding market reach of the distribution network and the recognition of the product by vendors and end-users.

5. NON LINEAR MECHANISMS

The insights gathered from the interviewed and investigated actors (governments, donors, NGOs, utilities, equipment manufacturers, importers, distributors, consultants, systems engineering houses, financial institutions, project companies, retailers and end-users), have been explicated and linked together in dynamic business models in the indicated causal diagrams.

The mapping analysis has revealed several non-linear mechanisms that play a role in the relation between supply and demand and that can be critical processes in market development. These critical processes are summarized below:

5.1 Project model

A strong focus on affordability of expensive extensive design systems and the resulting development of credit structures causes a low level of product and price differentiation, which again increases the focus on financing for affordability.

PV projects create consumer awareness and initiate (free) market development, although the latter is a slow process. On a short time scale projects can also damage existing markets.

Where PV projects introduce extensive-design products, the free market will not develop and follow-up can only be in more projects.

5.2 System house model

The involvement of system houses and their focus on product engineering tends to reinforce the development of PV projects and vice versa.

System houses may have a temporary role in the market because of a shift from engineering to distribution.

5.3 Complementary traders model

PV sales by complementary traders can have positive effects on the PV market development process in three ways: combined use products, use of existing infrastructure and high local involvement.

Use of an existing distribution infrastructure makes quality assurance more difficult.

A lack of commitment by complementary traders can slow down the market development process.

6. CONCLUSIONS

The analysis has revealed that there are three market development models that may be the ingredients to a particular market development for household PV systems in a certain country.

It is possible to make some conclusions on the use of the basic approaches (development models) presented in this paper:

6.1 Projects

First of all, project development can lead to sustainable PV-market development, but only if a 'free market' follows-up on these projects.

We conclude that offering the end-user a larger enough differentiation of PV-products can play a critical role to attain sustainability. The end-user should be able to make a choice from a variety of products.

This implies that the focus on technology quality should not lead to over harmonization of options, such as suggested in [2] and [3].

Increased competition within projects can lead to more product differentiation, a better match with end-user needs and local habits resulting in an increased level of commercial activities i.e. sustainable market development.

6.2 System engineering houses

Secondly, the activities of system engineering houses can also lead to sustainable PV-market development. Creative system engineering houses can give the PV-business the product-differentiation, which it so badly needs.

There is however little incentive for system engineering houses to focus on product differentiation towards less extensive-design products. First of all, project customers mainly ask for extensive-design products and secondly the small distribution capacity of system engineering houses withholds them from focusing on simple-design products because they can be easily 'copied' by existing free market distributors, that can operate with higher financial and distribution capacity.

By combining their engineering function with a stronger focus on distribution, system engineering houses can very well initiate and maintain sustainable PV-markets in less developed countries.

6.3 Traders

Thirdly, traders of complementary products such as batteries, radio's and televisions can open up a way for sustainable PV-market development. PV-market development can benefit from the combined use of PV and complementary products, the use of an existing distribution infrastructure and a high level of local involvement.

This way has proven hard to combine with the development of PV-projects. It has to be prevented that PV projects undermine the market development through traders.

To assure best value for money for the end-user, easy to use products are to be offered in combination with very clear information and development of a certain level of technical capacity on the grass-root/market outlet level.

Although the conclusions described above are mainly based on information gathered in The Netherlands and South Africa, one can assume that the dynamics of these market development models have a more universal validity. Further research, in different countries and involving different stakeholders, can add to the insights.

7. RECOMMENDATIONS

The main challenge for donors and governments is to develop instruments to support the development of self-sustaining market models, tailored to the situation of a particular country.

Currently donors and governments focus only on the project model and more recently on supporting system engineering houses (with a bias towards projects). There is still no active support for the traders model, even though this may hold a large potential for market development.

We propose that the free market development in which the traders operate can be supported in the following ways:

- Assist the development of an effective and efficient PV trading infrastructure through supporting development of retailers and outlets;
- Remove market barriers such as standards that may prevent trade-able products from entering markets;
- Facilitate development of the inherent knowledge base in markets regarding realistic PV options, on the level of the vendor and the end-user.
- Facilitate the learning process of markets to distinguish between good and bad quality products, by arranging for consumer information feedback and independent product information services;
- Prevent all distortion of free market development by projects.

Finally, we propose to accept that best practices for market development can only be defined by markets, in which end-users and vendors are the main actors, rather than consultants, project developers or international donors.

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