

INTERNATIONAL STRATEGIES TO ENHANCE THE MARKET PENETRATION OF PV

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Abstract – In this paper promotion programs for grid-connected residential PV systems introduced in recent years in various countries are investigated. The major focus is to examine international experiences with various types of financial incentives. The major conclusions of this investigation are: (i) Financial incentive programmes do work as dissemination strategies. (ii) economics is important, but for many households it does not necessarily mean that PV systems have to be cost-effective. It appears rather that affordability is the crucial issue; (iii) With respect to programmes launched by electric utilities most important is the credibility; (iv) Private initiatives as shareholder projects are a promising new strategy for the future.

1. INTRODUCTION

In the last decade of the 20th century the market penetration of decentralised PV installations in OECD countries has been increased tremendously.

While in 1990 there were mainly stand-alone systems in remote areas and the number of such systems was fast and easy to count in every country at the end of the decade it was only possible by means of using statistical tools. This development was brought about by means of a wide variety of promotion strategies and dissemination programmes. Of special interest is that these initiatives were launched by quite different organizations and institutions. Governmental bodies on national as well as on local levels has launched strategies as well as electric utilities and NGO's.

In this paper the most important programme types are described and the experiences regarding success criteria for further dissemination strategies are derived.

2. DIMENSIONS OF MARKETING / RELEVANT PLAYERS

For deriving promising marketing strategies for the future it is of special interest to find out what were the major drivers for this development in the past. Proceeding in a systematic way first we analyze the principles of marketing. There are four important dimensions of marketing to be identified before launching dissemination programmes:

- Barriers (e.g. lack of technical reliability, high investment costs)
- Benefits (e.g. environmental benignity)
- Target groups (e.g. private individuals, PV industry, architects, governments)
- Possible strategies, e.g. financial incentives, information and education campaigns

Aside from this dimensions the relevant players has to be analyzed see Fig. 1. Market aspects as competition, transaction costs, transparency play a role as well as individual preferences of customers and their WTP. Moreover, technical issues as standardization and reliability are of relevance and finally the status and the acceptance of the technology in society has to be considered.

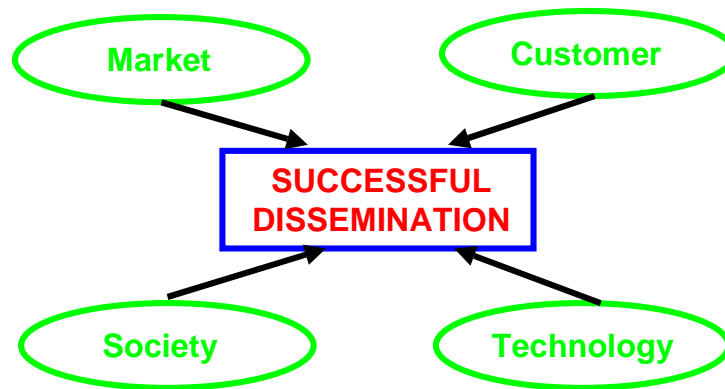


Figure 1. Relevant issues for successful marketing strategies

3. GOVERNMENT PROGRAMMES

3.1 National Programmes

The most ambitious countries with respect to promoting PV on a national level are Germany, Japan, The Netherlands and Switzerland. While the German and the Japanese programmes provide(d) substantial monetary incentives, the programmes in The Netherlands and Switzerland focus mainly on information, education and demonstration.

Some countries focus on a certain target for a market share or an installed capacity of PV respectively renewables. Such programs has been introduced and are still under way in Switzerland (ENERGIE 2000), The Netherlands (NOVEM program), the USA (Renewable portfolio standards), and Austria (3% renewables by 2005).

3.1.1 Germany

In 1989 Germany was world-wide the first country that launched a substantial dissemination programme the "1000 roofs program". This program was completed in 1994. Some 2250 German roofs were equipped with PV systems of an average size of 2.6 kWp and a total capacity of about 6 MW. Average system costs were 15000 US\$/kWp, average subsidies 70% of the investment costs. During the program and in the aftermath comprehensive investigations on technical and sociological aspects of this program took place. The major results of these program were that PV systems reached a certain standard of technical reliability, that PV system cost dropped, and that the acceptance of this technology increased considerably. Moreover, experiences gained in this program were also used for similar activities in Austria and Japan. The major references for the German 1000 roofs program are Genennig/Hoffmann (1996), Hoffmann (1995), and ISE (1994).

Since 1999 a new financial approach is pursued in Germany with the 100,000 roofs programme. Within this programme very attractive credits (soft loans) are provided by the public. In the first nine months of this programme about 3000 new projects (about 7000 kWp) have been approved.

3.1.2 The Japanese residential PV promotion program

The world-wide largest dissemination program so far has been launched in Japan in 1994. This program is still ongoing and expected to expire in 2001. Up to the end of FY1998 about 15000 small grid-connected systems with an average capacity of about 3,6 kWp has been installed. Subsidies were decreasing continuously over time. They were reduced from 50% of the total investment costs in 1994 to about 30% in 1999. In 1998 about 8000 systems were promoted. For FY1999 it is expected that the number of applications will exceed 15000. The upper limit for rebates has been reduced from

900,000 ¥ in FY1994 to 500,000 ¥ in FY1996 respectively to 329,000 ¥ in FY1999. Major references: Ikki 1998, 1999, 2000.

3.1.3 The Swiss "ENERGIE 2000" program

In Switzerland in the early 1990s the so-called "ENERGIE 2000" program has been launched by governmental institutions. Within this program the promotion of various energy conserving and solar energy converting technologies was planned and specific goals of market penetration should be reached by the year 2000. For PV a capacity of 50 MWp is planned. At the end of 1999 about 14 MWp were installed. Until 1999 the PV systems were subsidised to 30%. Currently no government rebates are available.

3.1.4 The Dutch "NOVEM" program

In 1994 in The Netherlands various organisations under the leadership of the ministry for energy and environment (represented by NOVEM) launched a cooperation for a broader market dissemination of decentralised PV systems. Due to the Dutch "PV introduction plan" it is planned to install 7.7 MWp of PV capacity till the year 2000 respectively 1400(!) MW till 2020. Due to Schoen (2000) the target for 2000 will not only be met but even exceeded, Within this program to some extent also rebates are provided but mainly for unconventional applications and commercial buildings. (NOVEM, 1997).

3.1.5 Others

In the USA in 1997 president Clinton announced the so-called Million Solar Roofs Initiative. Within this program a million roofs in the USA should be equipped with a PV system and/or a solar thermal system for water heating, pool heating, or space heating. With respect to PV the Team-Up initiative with its "friendly PV programs" is of special relevance. Yet, currently it is not clear to what extent this programme will be put into practice.

In Italy in spring 2000 a 10,000 roofs programme will be launched.

3.2 Local Programmes

Especially in Germany and Switzerland many PV promotion programmes on a local level has been launched. Most famous were the so-called Rate-based incentive programmes. This means that the public utility has to buy back PV electricity at (almost) the full production costs. This idea has gained attention mainly in cities where municipal utilities are responsible for power supply and where local politicians have the power to put these full cost rates into practice. They have gained special attention in Germany, Switzerland, and Austria. They vary currently between about US\$ 0.7 and US\$ 1.0. Figure 2 shows the installed PV capacity per capita in some cities with rate-based incentives.

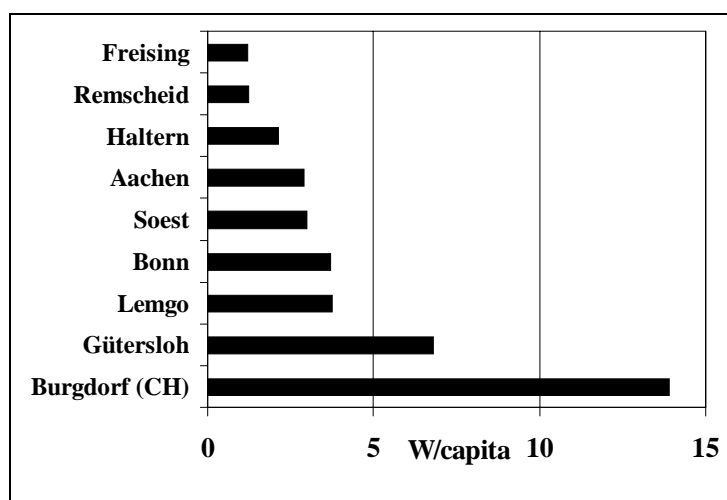


Figure 2. Installed PV-capacity per capita in German cities with rate-based incentives (as of 31 December 1997)

4. UTILITY PROGRAMMES

4.1 Green Tariffs

The major feature of this type of financing program is that participants pay a premium per kWh over regular rates. This type of financing program has gained attention up to now in Germany, the USA, Austria, and The Netherlands. Within this program type utilities offer „green“ electricity – that is to say, electricity generated by wind turbines, biomass, small-scale hydro, and PV – at a price that by and large meets the generation costs.

The major criticism with respect to Green tariffs is that on the one hand utilities do reveal the actual costs of PV and other Renewables. Yet, on the other hand utilities do not show the real costs of other sources (e.g. no peak-load pricing!); Table 1 describes major features of some popular green tariffs in some countries.

Table 1. Green tariffs schemes

Utility (country)	Technologies	Time period	Status	premium (EURO cents/kWh)	Total number of participants	participation rate	Total capacity installed (kW)	Electricity generated (GWh)	Money per participant (EURO)	Total money raised (EURO)
RWE (D)	PV (30), Wind (50), Hydro (20)	6/96-6/98	On-going	10 (Mix)	15800	0.5 %	1033 (PV) 1100 (Wind)	2.7	17.1	270000
ENBW (D)	PV, Wind, Biomass, Hydro	7/97-12/98-	On-going	80 (PV) 5 (others)	1500	0,07	50 (PV) 600 (others)	0.05 (PV) 1.0 (others)	60	90000
OKA (A)	Variable Mix of PV, Wind, and biomass	9/97-12/98	On-going	89 (PV) 26 (biom.) 11 (wind)	89 (PV) 91 (biom.) 203 (wind)	0,1%	20 (PV) 500 (wind)	0.016 (PV) 0.85 (wind)	32.9	12600
Göteborg Energi(S)	PV	1/97-12/98	On-going	1 öre/kWh	1800	n.a.	10	0.007 (PV)	36	65000
EDON (NL)	PV, Wind, Biomass	1/96-12/98	On-going	2	8500	0.9 %	n.a.	21	42.4	360000

Source: Own investigations, Sweden: Mats Andersson

4.2 Private Shareholders/Participation shares

Another concept that has attracted attention mainly in Germany is to sell shares of a PV plant to private customers in blocks of e.g. 100 W. That is to say the customer becomes a shareholder on a renewable power station. An example for this programme type is the “Bürger für Solarstrom” – Model of the “Bayernwerke”. Table 2 provides some features of some programmes.

Table 2. Private Shareholder programmes

Utility	Technologies	Time period	Status	Costs (DM/W _p)	Total number of participants	participation rate (%)	PV capacity installed (kW)	Money raised per participant
Bayernwerk	PV	1994-96	Compl.	13	101	0.01	50	6436 DM
Konstanz	PV	1995-97	Compl.	14.3	200	0.57	63	4500 DM
Halstenbeck	PV	1995-?	On-going	n.a	50	0.63	n.a.	1260 DM
Hamburger Elektrizitätswerke (HEW)	Wind	1995-?	On-going	1.75	600	0.07	2000	5833 DM

Source: Own investigations

4.3 Contribution programmes

Within contribution or donation programmes customers can contribute to a fund for renewable energy projects. Usually these funds are managed by electric utilities. It is an approach which focuses mainly on a promotion of PV systems in the public e.g. schools. The projects developed are unrelated to the customers electricity usage. An important project has been achieved by SCHLESWAG in Germany. The major features of this programme are depicted in Table 3 where also some other programmes are described.

Table 3. Donation projects

Utility (country)	Technologies	Time period	Status	Total number of participants	participation rate (%)	Money raised per participant	Total PV capacity installed (kW)	Total electricity generated (MWh)
SCHLESWAG (G)	PV	1995-12/96	Completed	1000 (HH)	0.17	45 DM		
FÜW Nürnberg (G)	PV, Solar-thermal	1995-12/96	Ongoing	197	0.07	25 DM		
EBM (CH)	PV	Till 12/96	Ongoing	800	2.00	250 sFr		
Hamburger Klimaschutzfonds (G)	PV	n.a.	n.a.	2500	0.28	69 DM		

Source: Own investigations

4.4 Solar stock exchange

Another idea of promoting PV systems which combines the two models mentioned above is a so-called "Solar stock exchange". The idea is that electricity is generated by private-owned PV systems and fed into the public grid. Other customers may buy this electricity and pay rates corresponding to the PV production costs. On the supply-side only the most cost-effective projects are selected by a bidding process.

The utility acts as a "power exchange". That is to say it organises the balance between supply and demand. usually, the utility bears the administration costs but has no other expenses.

The advantages of this strategy are:

- Customers WTP is fully exhausted;

- efficient operation is ensured
- private "green" PV owners ensure that only the best examples for PV will be constructed;

This idea has firstly been developed for the city of Zurich in Switzerland and has in the meantime attracted attention also in other cities. Some examples and their major features are described in Table 4.

Table 4. Solar Stock Exchange

Utility (country)	Time period	Status	Costs	Total number of participants	Participation rate	Total PV capacity installed (kW)	Total electricity generated (MWh)	Money raised per participant	Total money from participants
EWZ (CH)	1997 – 10/1998	On-going	1.20 sFr/kWh	4480	3.8 %	1600 install.	1200	120 sFr	537600 sFr
CKW (CH)	4/1998-10/1998	On-going	1.10 sFr/kWh	61	n.a.	n.a.	40	656 sFr	44000 sFr
BEWAG (D)	2/1998-12/1998	On-going (revised)	0.80 DM/kWh	602	n.a.	1218	31	42 DM	25000 DM
FÜW (D)	5/1998-12/1998	On-going	1.40 DM/kWh	240	n.a.	29	23	134 DM	32200 DM

Source: Own investigations

5. NGO PROGRAMMES

Aside from green tariffs private shareholder and donation projects has been launched by different other types of organisations e.g. NGO's. An example for a very successful shareholder programme is the "SONNENSCHHEIN" campaign in the Austrian province of Vorarlberg where from 1998 till 1999 about 100 kW of decentralised systems has been installed. This programme is still ongoing.

Another successful example is the SOLARIS programme launched by GREENPEACE in 1997 in The Netherlands. Within this programme up to the end of 1999 about 15000 applicants has registered and 3000 systems has been installed (Schoen, 2000). Within this programme no financial incentives are provided for residential customers!

6. EVALUATION / SUCCESS CRITERIA

Investigations about the effects of the programs are still ongoing. Yet, some major conclusions may already be drawn, see e.g. Haas (1999), Hoffmann (1995):

- Different subsidy strategies led to different effects of cost reduction. In the German programme subsidies were a constant share of the investment costs (about 70%). This led to almost no cost reduction within the duration of the program in comparison to before. After the programme was terminated investment costs dropped. A similar effect happened in Austria where the over-all investment costs during the programme decreased only slightly and dropped after the programme was terminated. The most advanced strategy is currently pursued in Japan. Over the period 1994 till 2000 the rebates (in 1994 about 50% of the overall investment costs) are cut every year by about 10-15%. This type of a dynamic strategy led to considerable cost reductions mentioned above;
- Investment costs on the market dropped, mainly due to a decrease in non-module cost components. E.g. in Austria investment costs for PV systems dropped from about 20000 US\$/kWp in 1991 to about 8000 US\$/kWp in 1999;
- Reliability and technical performance parameters were improved;

- Rebates as a constant percentage of total cost are the wrong incentives;
- Rate-based incentives work as a dissemination strategy and they ensure good technical performance. Yet, they need strong lobbying.
- Green tariff programmes need a lot of public relations work from the utility to make them work (See e.g. the RWE programme in Germany). Yet, in most cases they loose attraction after some years, see Fig. 3.

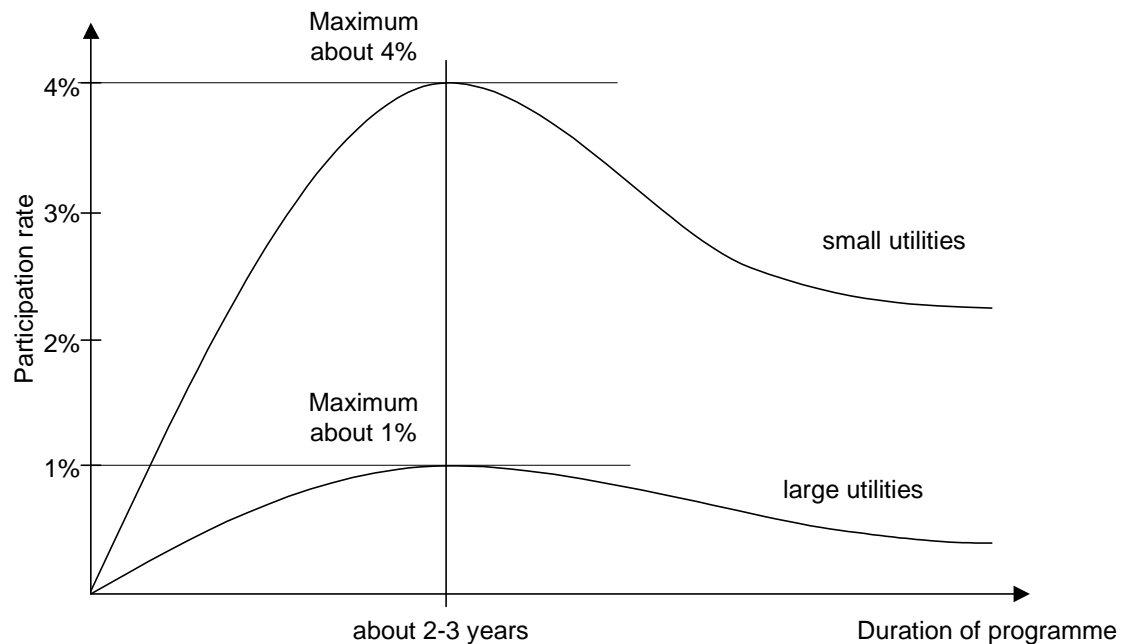


Figure 3. Possible saturation and dying out of green pricing programmes

7. CONCLUSIONS

The major conclusions of this investigation are:

- The core issue of strategies is to find out what can motivate consumers to purchase PV systems. Of course, economics is important, but for many customers it does not necessarily mean that PV systems have to be cost-effective. It appears rather that affordability is the crucial issue.
- Financial incentive programmes do work as dissemination strategies.
- With respect to programmes launched by electric utilities most important is the credibility. Typically, incentives set by municipal utilities e.g. EWZ (Switzerland) or SMUD (California) are by far more successful than programmes launched by large utilities.
- Private initiatives as shareholder projects are a very promising strategy for the future.

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