SUBSIDIES VERSUS RATE BASED INCENTIVES; FOR TECHNOLOGY-, ECONOMICAL- AND MARKET-DEVELOPMENT OF PV. THE EUROPEAN EXPERIENCE.

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ABSTRACT

Photovoltaic as a reliable and renewable power source is on its way from the "research laboratory" to real product and market. Different countries have different energy-polices and different situation between the photovoltaic installation owners, the utilities and utility customers. The market development for a new product follows certain «rules of thumb» for the market introduction and -penetration. The author has described this situation in the paper "success stories of photovoltaic financing in Europe" 1997 [1]. Six years later it is an opportunity to evaluate the improvements on the PV market development in Europe and elsewhere.

1. How is a new product introduced to a market place?

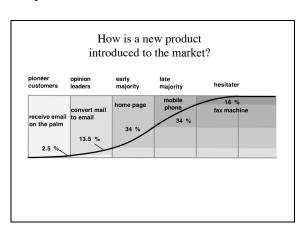


Fig. 1 The market development for a new product follows certain «rules of thumb» for market introduction and -penetration.

New markets are starting with innovative, pioneer companies and - most important - pioneer customers who are willing to pay a high price for a new attractive product or solution, even if it is not economical. The market share of these pioneer customers is estimated to be 5.5%. If this part of the market has been developed successfully the next sequence of the market development can begin. The pioneer costumers influence the opinion leaders. They are curious to know what is the next step on the road map in advanced energy technology. A critical number of pioneer customers are needed to attract the opinion leaders to enter into the market. Such costumers can be: the government, on national- state- and local level, educational institutions as universities, colleges, schools but also individual investors.

These are often professionals as doctors, lawyers, bankers, teachers even politicians who have enough free cash in the budget to put their "Porsche" on the roof. The market share of the opinion leaders is estimated to be approximately 13.5%. The third step of market penetration is the involvement of the early majority. This group is attracted and learning from the opinion leaders. The suppliers of the (PV-) technology have to convince this larger group, estimated to be approximately 35% of the whole market. These investors expect the product to be not only technologically mature, but also somehow economical. Another 34% of the market is called the late majority. They are hard to catch. Almost impossible is it to generate the demand to the last market share the hesitators 16%. They need a long time to adapt to new behaviours, products, ideas and solutions.

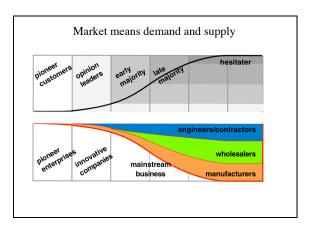


Fig. 2 The bottle model of market development. The production and the supply of PV modules are global, but all markets are local.

Today the production and the supply of PV modules are global, but all the markets are local! If you apply above figure 1 to the recent progress of PV market you have to distinguish different stages in different national markets in different countries.

To understand this local market you should not only look at the total installed PV capacity but more important to the cumulated Wp/capita installed in each country. Most important is the year-by-year new installed PV power capacity per capita.

The key numbers of important PV key markets for grid-connected applications in the Netherlands, Switzerland, Germany, Japan and the United States are given in table 1.

Key numbers for five national PV market							
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	Germany	Switzerland	Netherlands	Japan	USA		
new MW 2001	80.9	2.3	7.8	122	29		
Totale MW	195	17.6	20.5	452	168		
W/capita	2.37	2.45	1.29	3.57	0.60		
Data: IEA PVPS Task 1 • Survey 2002							

Table. 1 Key numbers for five national PV markets

The fastest driving PV markets worldwide are Germany and Japan. Germany has reached at the end of 2001 a total installed capacity of 194.7 MWp. This market has reached an annual gross rate of newly installed PV capacity of 1 W/capita (2000 and 2001). Japan has an even higher numbers total capacity. At the end of 2001 it was 452.2 MWp and an annual market growth of 0.96 W/capita. [2]

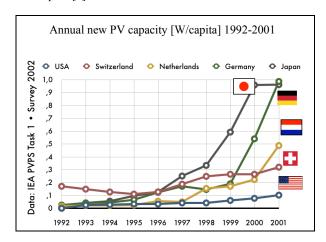


Fig. 3 The year-by-year new installed PV power capacity per capita

2. MARKET STIMULATION WITH SUPPORTED FINANCIAL ENGINEERING

The major obstacle for PV today is the high upfront cost for the investors in this technology. Not every investor is aware that he is not only buying the PV equipment but also free use of solar energy for the live span of his investment. A number of different concepts have been developed and used on different markets in different countries.

We are discussing three successful tools: PV subsidies, the PV stock exchange model and the rate based incentives for PV. It is important to understand the different market stimulation concepts in these tools.

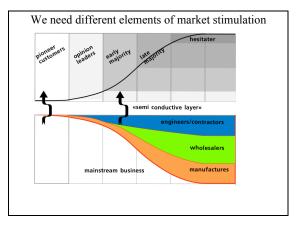


Fig. 4 different concepts of market stimulation with supported financial engineering have been developed and used on different markets in different countries.

2.1 PV subsidies

Subsidies given by the government or utilities are for the investor a "none refundable cash support" From the point of view of financial engineering, the high upfront cost of PV power are artificially lowered with this concept. Such a program simulates a future situation where the total costs of a PV system is expected to be much lower. In addition the owner of the PV system gets compensated for his total PV power production by the utility. The buy-back-rate is in the order of 1:1 to compared to the normal cost of electricity. In less favourite situations only the amount of the excess or surplus production by the independent power producer (IPP) is purchased by the utility. A cash flow analysis of this situation is shown in figure 5.

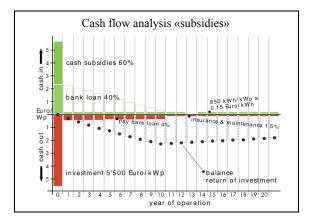


Fig. 5 The year-by-year cash flow analyses for a typical PV installation with subsidies. All €(or US\$) values given in €/Wp for the complete system including BOS cost, in 2003 €

The investment of the IPP is partly compensated by a subsidy (between 30 to 70 %). In such an environment the owner of the PV installation (IPP) has no chance to

amortise his investment. Such a concept of financial support to market simulation is only addressing pioneer customers and a small part of the opinion leaders. A typical representative of this concept was the German PV 1000 roof program 1990 - 1995 with an annual national market of 2 - 5.4 MWp per year [3].

2.2 The PV stock exchange concept

This approach developed by TNC Consulting 1994 for the ewz the Zurich Municipal Electric Utility in Switzerland. It is applied since 1995 very successfully [4]. What is the role of the different players? The utility ewz is periodically making a call for tender asking for new PV power capacity. IPP's in the service territory of ewz can offer their estimated power production for new, to be built PV- capacity to the utility ewz.

The IPP's get 20-year long contracts

The IPP is an investor from the motivated opinion leaders group – in the market diffusions model ewz is making 20 years long contracts with the most economical and technical sounding offers of IPP's. a. The IPP gets a high rate for all his PV power at a present for new IPP's typical 0.50-0.53 \in per kWh. This approach helps the IPP to finance his project. In this situation he will also be very motivated to keep his PV installation in perfect shape. Only a trouble free operation will allow to successfully performing the business plan,

The utility as a PV power broker

The solar power, purchased by the utility at high cost, needs to be refinanced in the business plan of the utility. The product: "Premium Solar" therefore is offered to all customers of the utility. Typically 3-5 % of these 367'000 customers voluntarily purchase a part of their own electrical demand by "premium solar" from the utility. In this concept the utility is not owner or operator of the PV installation. The utility works as a PV power broker. Using his established marketing arm to find the PV enthusiastic minded customers. The utility profits from the – today most needed - good image as the future-minded supplier without having the burden for capital investments in new power production capacity.

"Premium Solar" for the opinion leaders

The early majority is purchasing for a part of the electrical demand "premium solar" from the utility. They cannot afford to have their own PV installation on their own house.

ewz has reached 6.3 W/capita

In Zurich this model has generated new PV installations for a total capacity of 2.32 MWp in only 9 years. It has created a new PV capacity of 9.56 W/capita. Today it is the successful model for all major cities Basel, Bern, Lausanne and Geneva and the Swiss PV market.

2.3 Rate based incentives

The model of rate-based incentives has been most successfully adapted in Germany. [5] It was first pioneered in a number of small cities like Aachen or Gütersloh. Later the German Parliament has adapted this concept as a law (the renewable energy law EEG) to compensate and protect the renewable energy sources as wind, solar and small hydro. It was a complementary decision for the immediate deregulation of the German electrical power market. In this concept each renewable energy technology

gets his own cost orientated price for the IPP. In case of PV in Germany the rate-based incentive covers the production costs but not the full cost of financing. Therefore this measure can be combined with a special low cost credit program by the German development bank KfW- called the 100'000 roof program.

The private PV IPP gets 100 % of his investment-financed loan for his new PV installation for a very attractive interest rate and pay-back-plan. 2003 the annual interest he has to pay is 1.9 %. For the first two years of operation he only needs to pay the interest not to repay the investment. Within the next eight years he also has to pay back the loan and the interest rate for the remaining amount of the loan. Figure 2 shows the cash-in-cash out flow in the eyes of a private investor and the remaining equity balance in his pocket.

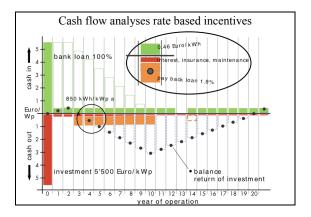


Fig. 6 The year-by-year cash flow analyses for a typical PV installation with rate-based incentives and the German 100'000 roof loan. All € (or US\$) values given in €/Wp for the complete PV system including BOS cost, in 2003 €

The concept of rate-based orientated payments for the private IPP allows him within the lifespan of twenty years to fully compensate his investment financially. After 20 years he has his "Porsche" of his PV installation on the roof for free.

This business model attracts a growing number of early adopter as investors in Germany. They are in favour of solar energy, willing to take some operational risks but on the long range not willing to pay more for power. Also in this situation he or she will be very motivated to keep his PV installation in perfect shape. Only a good operation will allow to successfully performing his business plan.

3. Conclusion

Table 2 shows the benefit and shortcomings of different models of market stimulation with supported financial engineering and the areas where they can be adapted most successfully.

Subsidies in a traditional way are useful to start a new PV market and to attract pioneer customers. Because of the high costs a successful program is soon short on cash. Normally this decision for the financial outfit of such a program is decided on an annual base. There is the danger of a «go and stop» situation to the market place. This can damage the PV industry and the market

The stock exchange model is a reasonable concept if the utility has a well-educated base of environmentally minded customers. There are limits to this model: "A few customers are paying everything".

Rate based incentives, this concept has the highest market potential because the financial engineering is done by the cost of power and not with tax money. "Everybody pays a little bit. In this case all utility customers together share the financial burden. Because PV has still a very small market share of less than 0.1% the extra cost of the big utility's the business plan is small.

Over all there is no ideal financial stimulation concept for all photovoltaic markets. In the authors opinion the financial stimulation has to follow the majority of the customers and the PV density in the utility grid. To start with subsidies is fine. The stock exchange model can bridge the time gap for the political process towards rate-based incentives.

For the PV industry it is inessential to have a stable steadily growing market place. Only such a situation will allow further economical and technological improvements and lowering the costs of the technology. In the future third world countries can also benefit for off-grid situations. The developed countries can show and demonstrate the impact of this reliable and renewable power source to the third world countries.

4. REFERENCES

[1] "Success stories of photovoltaic are financing in Europe" Th. Nordmann, 14. European Photovoltaic solar energy conference, Barcelona, Spain, 30. June – 10. July 1997, pp 5 Proceedings ISBN 1-901675-01-9.
[2] Trends in Photovoltaic Application PVPS Task 1 Annual survey report T1–11:2002 www.iea-pvps.org (pdf) [3] 1'000 PV roof program, Germany 19990 – 1995 Finale report by BMFT 1996 Bonn, Germany [4] ewz, Zurich, Municipal Electric Utility www.ewz.ch [5] The German renewable energy law and its impact on PV, paper at WCPEC-3, Osaka May 2003 W. Langen, Federal Environment Ministry, Berlin, Germany

Table 2. Market stimulation with supported financial engineering • PV-Promotion strategies compared:

	Cash Subsidy: % of Investment /kWp	Rate based incentives $\approx 43 cents/kWh$	Green power marketing (at higher price)	Minimum PV quotas of power production
Who is the Investor?	home owner or private company IPP	home owner or private company IPP	utility, industrial investor (IPP)	utility, industrial investor (IPP)
Operator of PV installation	owner or contractor IPP	owner or contractor IPP	utility, home owner or private company	utility, home owner or private company
Who pays for the extra costs of energy	investor and government subsidy	all customers pay a little bit	some volunteer customers pay all	all customers pay a little bit
Who is using the PV power	investor excess to grid	part of the utility mix	virtual assign to individually customers	part of the utility mix
Who bears the operational risk	owner or operator IPP	owner or operator IPP	owner or operator or contractor of the PV installation IPP	utility
Possibility of public control	yes strong «stop and go»	yes (adjustment in the law by parliament)	by volunteers	by law
Needed conditions to make the model work	availability of tax money and policy or law	adjustment in the law in parliament	by volunteers	adjustment in the law by parliament or by volunteers