PV in Urban Policies- Strategic and Comprehensive Approach for Long-term Expansion

WP5- Deliverable 5.1: Report on "Economical Drivers and Market Impacts of Urban PV"

Promotional drivers for PV

by

Assumpcio Lopez-Polo

Reinhard Haas

Demet Suna

Energy Economics Group

Vienna University of Technology,

Gusshausstrasse 27-29 / 373-2, A-1040 Vienna, Austria.

Phone: +431/58801-37365, Fax: +431/58801-37397

E-Mail: haas@eeg.tuwien.ac.at

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Vienna University of Technology, Institute of Power Systems and Energy Economics, Energy Economics Group (EEG)

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A-1040 Wien

Österreich

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Contact details:

Technische Universität Wien
Energy Economics Group (EEG)

Gusshausstrasse 25 / 373-2

A-1040 Wien

Österreich

Reinhard Haas

Tel.: +43(0)1/58801-37352

Fax: +43(0)1/58801-37397

Email: haas@eeg.tuwien.at

Demet Suna

Tel.: +43(0)1/58801-37365

Fax: +43(0)1/58801-37397

Email: suna@eeg.tuwien.at

Assun Lopez –Polo

Tel.: +43(0)1/58801-37360

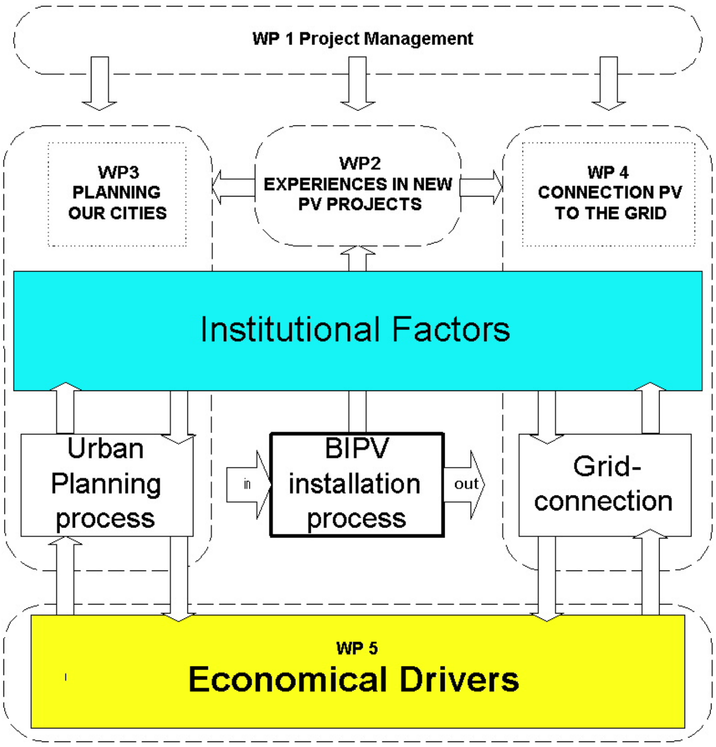
Fax: +43(0)1/58801-37397

Email: lopez@eeg.tuwien.at

PV Upscale: Urban Scale Photovoltaic Systems

PV UP-SCALE, is a European founded project related to the large-scale implementation of photovoltaic (PV) in European cities Intelligent Energy for Europe programme.

Its objective is to bring the stakeholders in the urban planning process to attention the economical drivers, bottlenecks like grid issues, the do and don'ts within the PV-urban planning process. To reach the urban decision makers workshops will be organised and a quality handbook will be written using gained experience with PV-Urban projects in the Netherlands, Germany, France, Spain and the United Kingdom. The project suits the activities that are executed in the IEA PVPS implementing agreement, in particular IEA PVPS Task 10. It takes information from Task 7 (building integrated PV), which ended in 2001 and Task 5 (grid issues), ended in 2003.



Structure of Project PV upscale

Work package (WP) 5 of the project, to where this report contributes to, will analyse economic and non-economic institutional drivers and barriers for an increase of the market penetration of Building-integrated PV on an urban scale

This Task will be carried out:

1. Survey on value analyses;
2. Identification of the most important stakeholders (PV system owners, manufacturers, utilities, local politicians...) in the market penetration process;
3. Analysis of the impact parameter in the decision making process of these stakeholders;
4. Investigation of the economic and financing aspects;
5. Discussion of successful policy strategies.

The project PV UP-SCALE

Year of implementation:	01-2006 – 06-2008
Client:	European Commission, DG TREN; EIE Programme Contract No. EIE/05/171/SI2.420208
Partners:	ECN- Energieonderzoek Centrum Nederland, Research Institute, Netherlands (Projekt co- ordinator) HORISUN- Consulting, Netherlands Fh ISE- Fraunhofer Institute für Solare Energiesysteme, Germany EEG-Vienna University of Technology, Energy Economics Group, Austria HESPUL- Consulting, France Halcrow- Halcrow Group Ltd, Consulting, United Kingdom Universidad Politecnica de Madrid, Spain Ecofys- Ecofys Energieberatung und Handelsgesellschaft mbH, Consulting, Germany Continuon Netbeheer NV, Utility, Netherlands MVV- MVV Energie AG, Utility, Germany
Web:	www.pvupscale.org

FOREWORD

The work within this European research project is closely linked to activities set on a global scale within the framework of the International Energy Agency's research programme on *Photovoltaics in the Built Environment (IEA-PVPS)*, particularly *Task 10 - Urban-Scale Photovoltaic Applications*. Both research activities complement each other by involving partners from differing countries with differing characteristics of and viewpoints on PV. The whole set of involved countries are indicated in the Figure below, which depicts all partners by their country of origin for both research activities. It is especially the aim and duty of those few partners who participate in both activities to strengthen cooperation in order to meet the common objectives of both activities. This report represents the results of this collective work on Market Drivers and has been prepared based on contribution of both PV Upscale and IEA-PVPS-Task 10 partners.

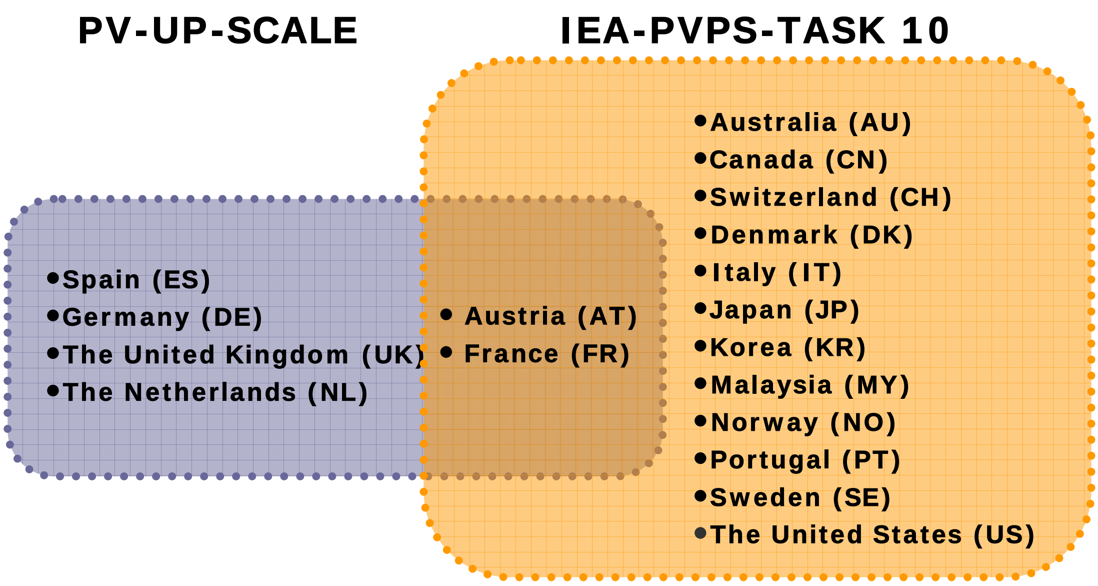


Figure: Overview on countries participating in the EIE-project PV Upscale and the activities as set in the frame of IEA-PVPS Task 10.

More information of the activities of PV Upscale and Task 10 can be found on:

- www.pvupscale.org
- www.iea-pvps-task10.org

This report has been prepared for PV Upscale under the supervision of PV Upscale and PVPS Task 10 by EEG (Energy Economics Group- Austria).

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CONTENTS

FIGURES

TABLES

1 INTRODUCTION

1.1 CORE OBJECTIVE

The core objective of this study is to analyze the success of various regulatory state promotions (i.e. governmental programs) and marketing (governmental and not governmental) programs for grid connected PV systems worldwide. To meeting this objective a review of the most important past and current programs around the world will be conducted. The final mission of this study is to analyze the effect of these programs in terms of "Market transformation". Market transformation makes reference to the process towards a self sustainable market.

Derived from this core objective related targets of this report are:

-to describe and document the largest and most influent PV promotion programs worldwide;

-to extract crucial success factors to help designing new strategies.

1.2 CURRENT STATE OF THE ART

In 2005 grid connected residential/commercial PV applications represented more than two thirds of the total PV market as represented in Figure 1. This was mainly caused by recent progress in Germany and Japan where more than 85% of global grid connected installations took place, see Figure 2.

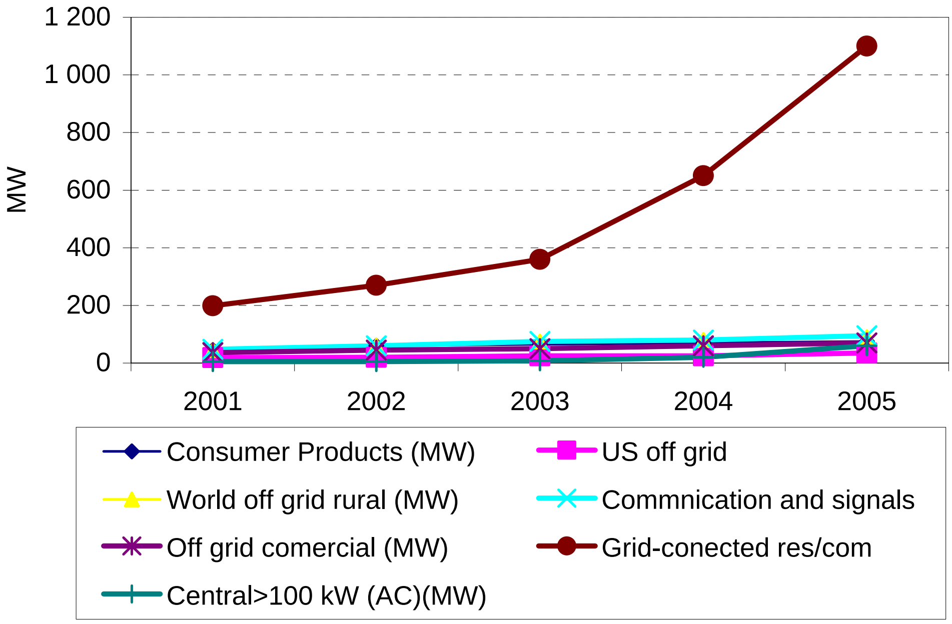


Figure 1: Worldwide yearly installed capacity by application until 2005 (sources: IEA-PVPS, 2006 and Maycock, 2006)

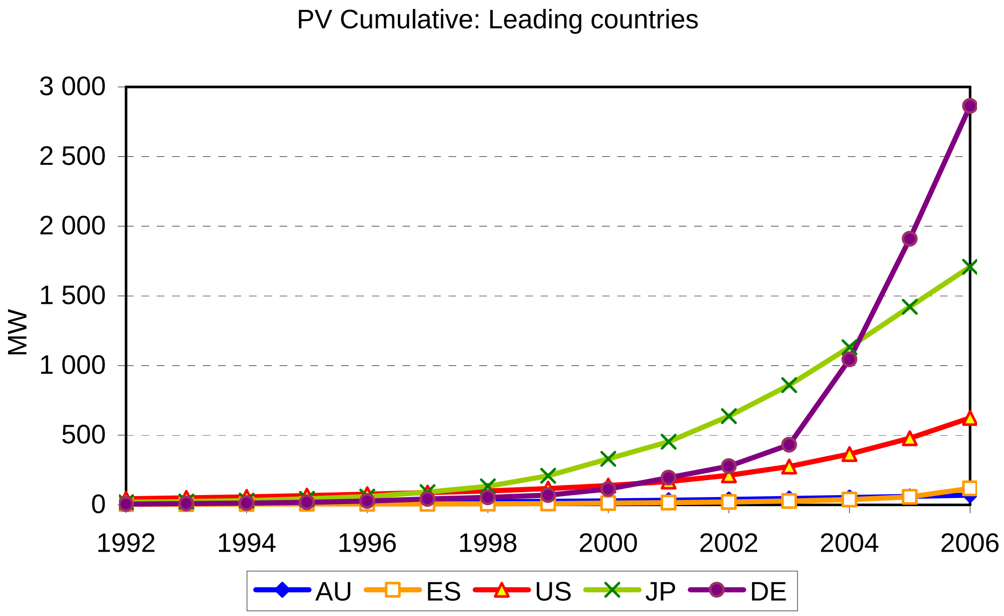


Figure 2: Cumulative installed total PV capacity of leading countries 1992-2006 in MW (source: IEA-PVPS-Homepage)

This trend continued in 2006. As can be seen in Figure 3 Germany and Japan are the largest PV markets at moment. They are followed by California in the US.

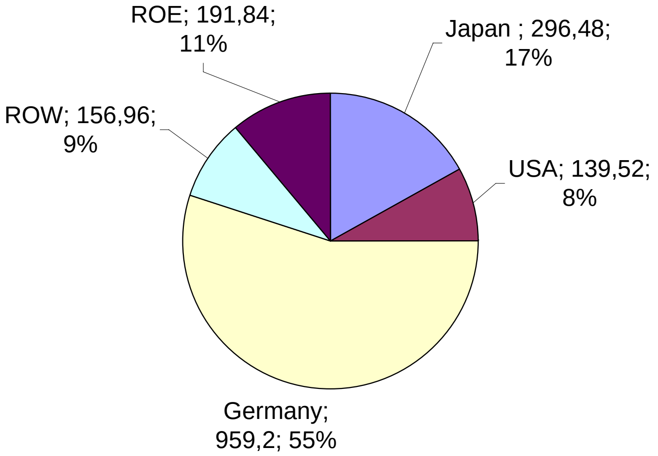


Figure 3: PV installed capacity in 2006 in MW (source: Solarbuzz –Homepage)
Notes: ROW = Rest of the World, ROE= Rest of Europe

This fact can be seen mainly as a consequence of two policies:

a) The amended "Renewable Energy Act" (EEG) in Germany which introduced favourable feed-in tariffs for PV applications and

b) The long term subsidy strategy applied in Japan for residential systems.

Yet, also in many other "emerging" markets like Italy, The Netherlands, Spain, Austria where comprehensive promotion activities took place significant increases were achieved, see Figure 4.

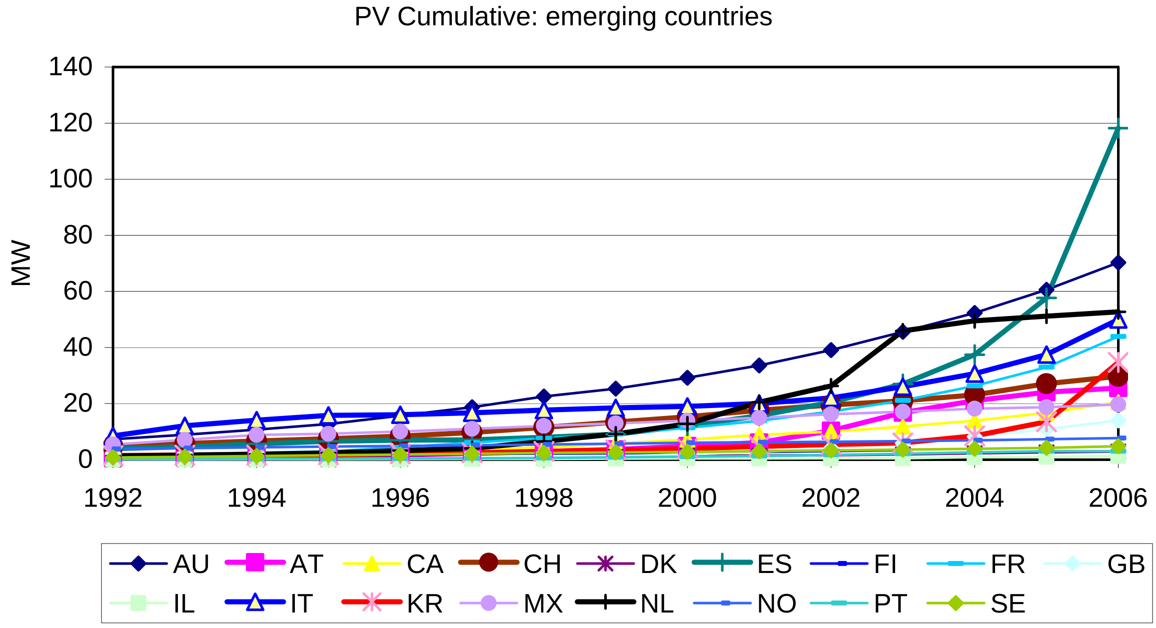


Figure 4: Cumulative installed total PV capacity of emerging countries 1992-2006 in MW (source: IEA-PVPS-Homepage)

If installed capacity is related to the population as can be seen in Figure 5 and Figure 6 emerges. Smaller countries like The Netherlands, Switzerland, and Austria are coming closer in the performance compared to the large ones.

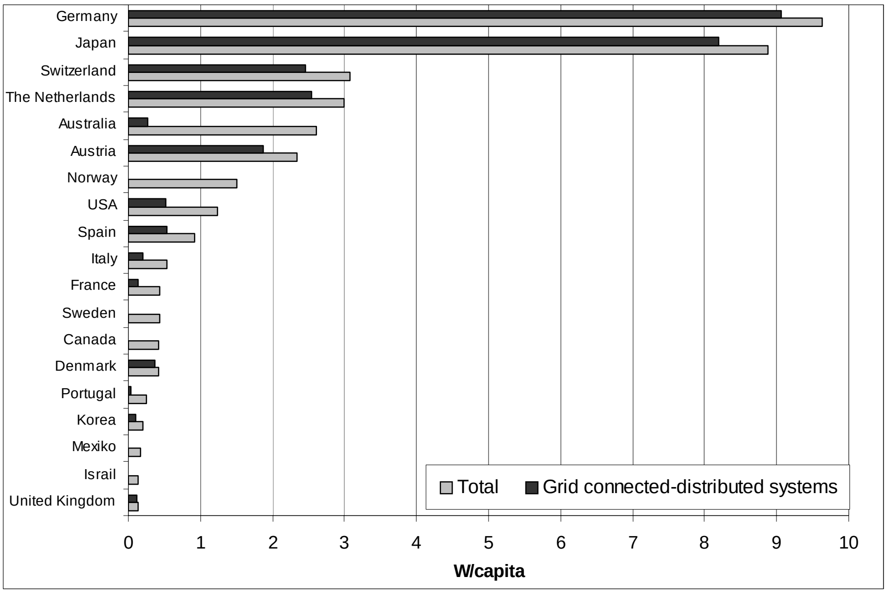


Figure 5: Installed total PV capacity and capacity of grid-connected distributed systems in 2004 in Watt per capita (source: IEA-PVPS-Homepage)

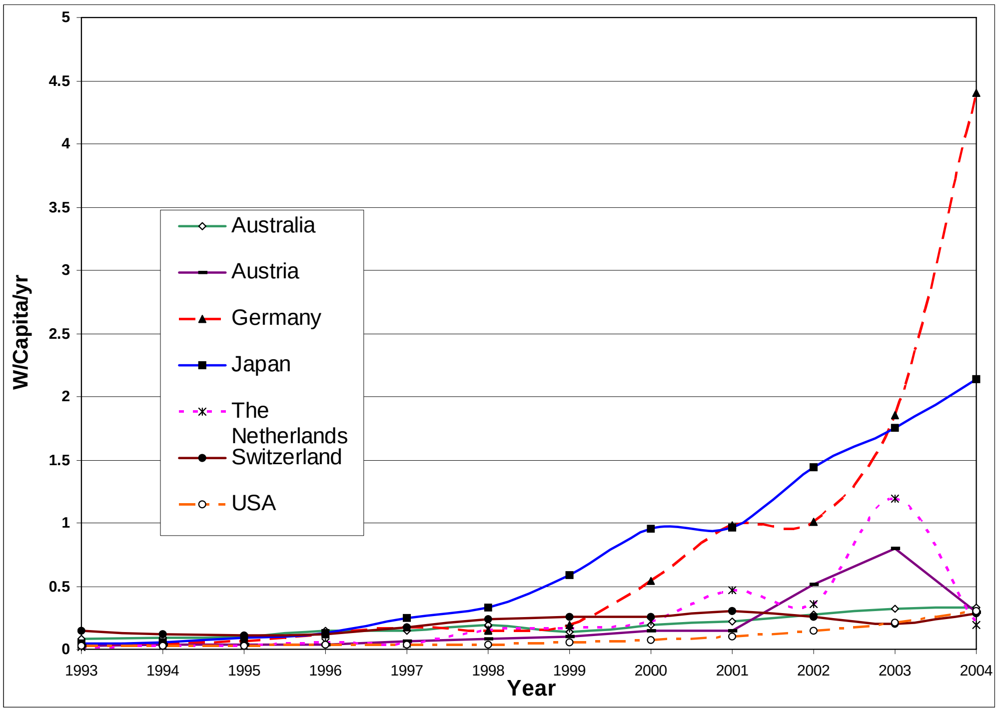


Figure 6: Installed PV capacity per capita and year 1993 – 2004 (of grid-connected distributed systems) (source: IEA-PVPS- Homepage)

1.3 STRUCTURE OF THIS REPORT

This report is structured as follows:

The theoretical bases of supply and demand are explained in the next section. They determine the behaviour in the market of consumers and producers. Moreover, the types of existing strategies are documented in Section 2. In Chapter 3 different programs around the world are described. Chapter 4 bases on a definition of success criteria which will be used for the analysis of the programs. Finally, the major conclusions complete this analysis.

2 WHAT ARE MARKET DRIVERS AND PROMOTIONAL DRIVERS?

2.1 THEORETICAL BACKGROUND

Some theoretical background (see Haas, 2002) has to be explained in order to understand the importance of policies and the meaning of some terms used. A major issue is to understand the factors of prices, costs, willingness to pay (WTP) for a product or willingness to invest and how they may vary.

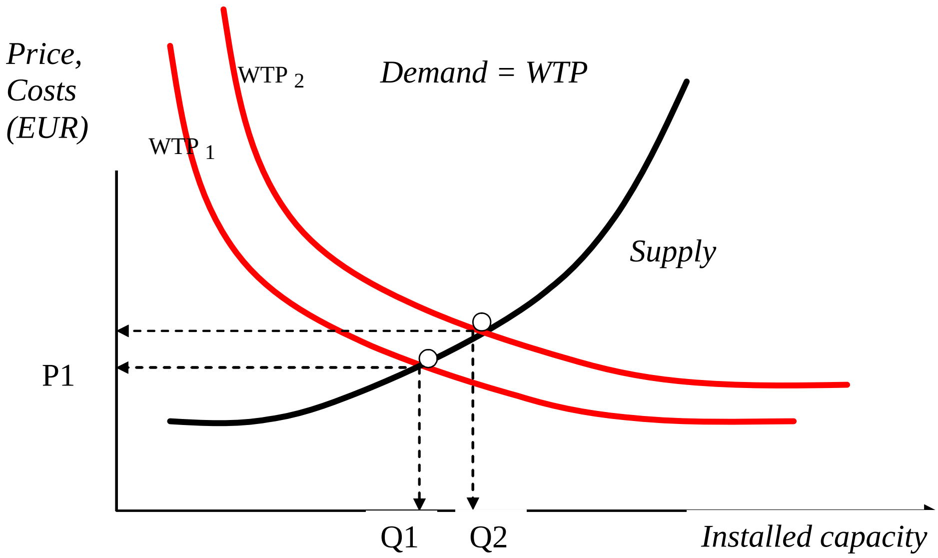


Figure 7: Supply and demand curves

Figure 7 shows the supply and demand curves. The demand curve (WTP_1 in Figure 7) characterizes how much a consumer is ready to pay for a commodity (in our case a kW or kWh of PV). The supply curve is defined by the costs to produce a certain number of units of a product (kWh or kW of PV). The price market P1 is the point where supply curve and demand curve meets. P1 will be the market price if no factor affecting these curves changes. At P_1 consumers are ready to buy (to install) the quantity Q_1 and producers to produce the quantity Q_1. Nevertheless there are factors that can affect the supply curve and demand curve moving them and altering the final installed capacity Q_2 (for simplicity only a change of the WTP_1 represented by WTP_2 has been depicted in Figure 7). The most important factors which can affect the supply curve and demand curve are depicted in Figure 8.

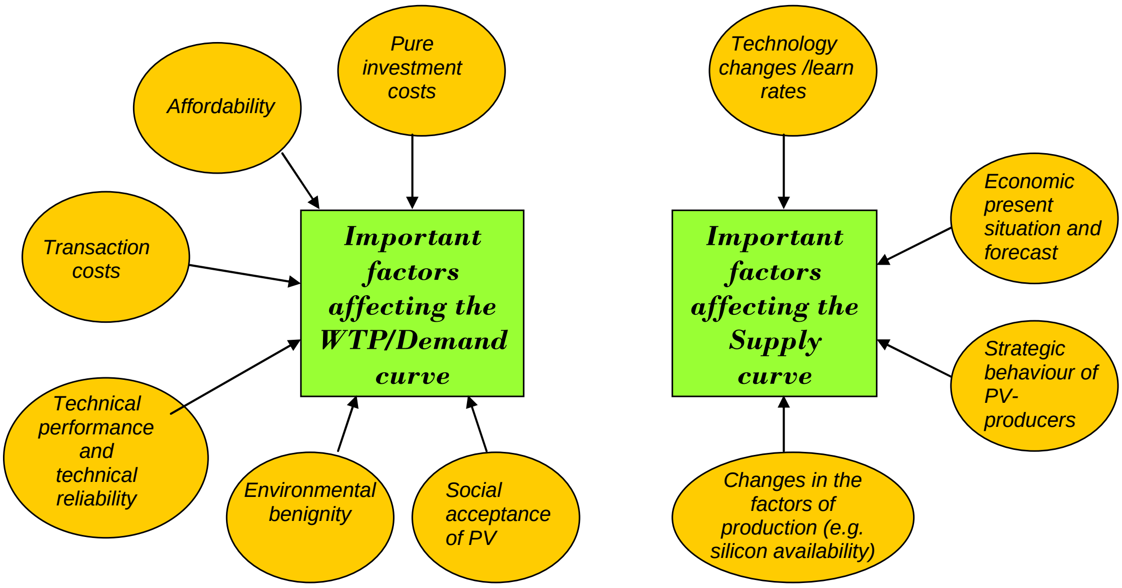


Figure 8: Factors affecting WTP/demand curve and Supply curve

A major objective of this study is to analyze which measures affect consumer's WTP and which rebates are necessary to achieve a favourable change of the supply curve. These effects are explained in detail in Figure 8. An important aspect to consider is that Figure 7 represents the case of a mature market. In a mature market supply curves are increasing because if prices increase more producers will be ready to produce and therefore there will be more amount of product available in the market. In the case of an emergent or imperfect market as it is the case of the PV market supply curves are decreasing. The reason is that in the long run of an imperfect market prices decrease if quantity increases (as effect of a learn rate) (see Haas et al). Considering this fact we can focus on the effect of policies on the demand of PV systems. This is depicted in Figure 9.

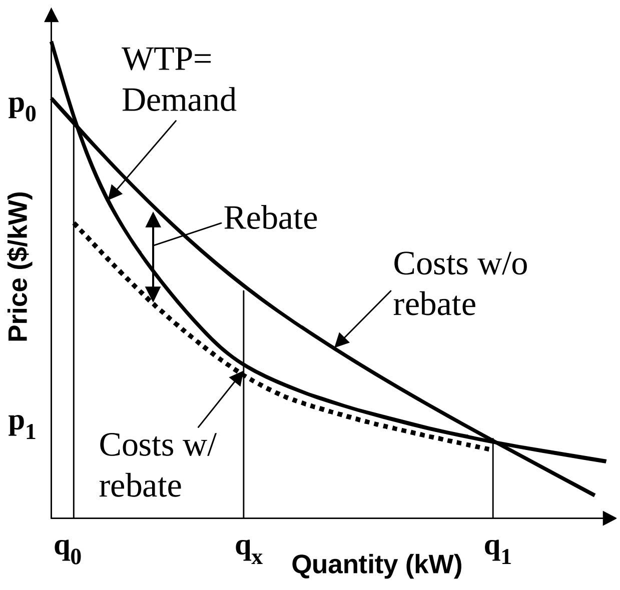


Figure 9: Rebates required to increase market penetration (source: Haas, 2002)

Since we suppose that we are in an imperfect market the dynamic supply curve is decreasing. In these circumstances we can suppose that besides the present equilibrium in which the installed capacity is Q0 there also exist an equilibrium where the installed capacity is higher and equal to Q1. We have two ways to reach the new equilibrium:

- By shifting the WTP[1:](as seen in Figure 8 –for example by increasing the PV acceptance)
- By giving the needed rebates and therefore by causing an apparent shift in the supply curve.

If we consider the second point the most important aspect is to investigate the exact amount of rebates to give. It is necessary to take into account that they have to represent so low costs for the public as possible. In fact economic incentives represent a fictitious change of the price for the consumer and in his investment costs moving the supply curve from the consumer's point of view. The effect is observed in Figure 9. Certainly subsidies to be given have to be at the most the difference between supply curves and WTP. Moreover and as it is observed in

Figure 9 subsidies have to be reduced over time. Obviously until reaching the amount Qx cannot be more and more higher because the consequences were that nothing is installed since all would wait for the next increase of rebates. These are the subsidies to be given if neither the demand curve nor the supply curve moves. As the state of the market improves are both an increase of the WTP and costs reduction expected. Therefore a reduction of subsidies from the first moment is required. Thus prices are forced to be reduced at the same time as production costs become lower.

2.2 TYPES OF PROMOTIONAL STRATEGIES

The most habitual strategies/policies/programs can be classified according to different criteria as it is observed in Table I. This table is based on the works of Haas, 2002, Haas et al, 2001, and Hoff , 2006 The terms are very common and only a short description of some of them will be given [2].

1 Considerations about movements in the supply curve go beyond the scope of this study.

2 More detailed information about the meaning of each program can be found in Haas, 2002, Haas et al, 2001, and Hoff , 2006

Table I: Type of market strategies (Source: Haas, 2001; Haas, 2002 and Hoff 2006)

				REGULATORY	VOLUNTARY	
TARGET PROGRAMMES				Renewable Portfolio Standards or Quotas	National instalment or capacity targets	QUANTITY DRIVEN
TARGET PROGRAMMES				Tenderings	-	PRICE DRIVEN
FINANCIAL INCENTIVES	GENERATION-BASED	ONE UP FRONT PAYMENT	EXPECTED PERFORMANCE	Expected performance buydown	▪ Green Power Marketing ▪ Green tariffs	PRICE DRIVEN
FINANCIAL INCENTIVES	GENERATION-BASED	ONE UP FRONT PAYMENT	ACTUAL PERFORMANCE	Performance based buydown	▪ Green Power Marketing ▪ Green tariffs	PRICE DRIVEN
FINANCIAL INCENTIVES	GENERATION-BASED	MULTIPLE PAYMENTS	EXPECTED PERFORMANCE	–	▪ Green Power Marketing ▪ Green tariffs	PRICE DRIVEN
FINANCIAL INCENTIVES	GENERATION-BASED	MULTIPLE PAYMENTS	ACTUAL PERFORMANCE	▪ Feed-in tariffs ▪ Net metering ▪ rate-based incentives	▪ Green Power Marketing ▪ Green tariffs ▪ solar stock exchange	PRICE DRIVEN
FINANCIAL INCENTIVES	INVESTMENT FOCUSED	ONE UP FRONT PAYMENT		▪ Soft loans ▪ Capacity based buydown(1) ▪ Tax deductions ▪ Tax exemptions ▪ Tax credits	▪ Contracting ▪ Shareholder program. ▪ Contribution ▪ Bidding	PRICE DRIVEN
FINANCIAL INCENTIVES	INVESTMENT FOCUSED	MULTIPLE PAYMENTS		▪ Capacity based incentive ▪ Tax credits	▪ Contracting ▪ Shareholder program. ▪ Contribution ▪ Bidding	PRICE DRIVEN
OTHER				▪ Buildings codes	▪ NGO-marketing ▪ Selling green buildings ▪ Retailer program. ▪ Public building programmes.	PRICE DRIVEN

Notes:
(1) Commonly known as investment subsidies

From the consumer's point of view the strategies that more directly affect him are those that provide financial incentives. Financial incentives can be received as a payment for every kWh produced or as a payment for the system capacity (money for every kW). Unlike Europe where this division is almost equivalent to speak of Feed in Tariffs or investment subsidies there are (specially in the United States) different conceptions programs that correspond to this main subdivision (see Hoff, 2006). This subdivision is explained in more detail in Table II.

Table II: Type of financial incentives

<table>
<tr><th colspan="4">FINANCIAL INCENTIVES</th></tr>
<tr><td colspan="2">INVESTMENT FOCUSED
System capacity incentive o per kWh</td><td colspan="2">GENERATION BASED
incentive per kWh</td></tr>
<tr><td>ONE UP FRONT PAYMENT
(only one payment at the beginning)</td><td>MULTIPLE PAYMENTS
(different payments over time)</td><td>ONE UP FRONT PAYMENT
(only one payment at the beginning)</td><td>MULTIPLE PAYMENTS
(different payments over time)</td></tr>
<tr><td></td><td></td><td colspan="2">Expected performance</td></tr>
<tr><td></td><td></td><td colspan="2">subsidy given according to long term expected system output obtained by means of calculations</td></tr>
<tr><td></td><td></td><td colspan="2">Actual performance</td></tr>
<tr><td></td><td></td><td colspan="2">subsidy given according measured system output over time</td></tr>
</table>

As explained in further chapters these conceptions are very important because they represent an intermediate step between the so discussed Feed in tariffs and the common investment subsidies, having the advantages of both systems: a start capital for the consumer and the promotion of technical performance.

Except for some innovative cases the emphasis of this study focuses on regulative financial incentives. The Renewable Portfolio Standards will not be discussed in detail due to the low impact for PV until now.

3 THE MOST SUCCESSFUL PV DEPLOYMENT PROGRAMS WORLD-WIDE

The three large current PV markets: Germany, Japan and California can be observed in the Figure 10 which represents the cumulative installed capacity over time. The effect of the new Renewable Energy Law which came into force in January 2004 in Germany stands out. The effect of the respective policies in Japan and California is also observed but in a softer way.

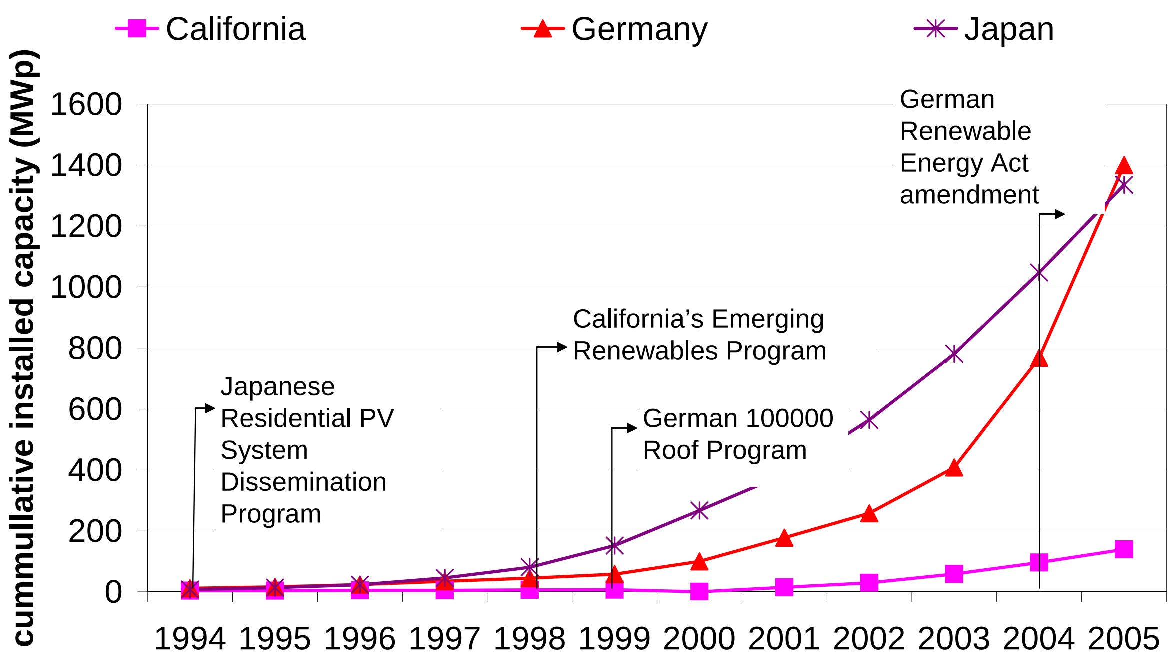


Figure 10: Cumulative grid installed capacity with important milestones in the largest grid connected markets. (Source: IEA, 2006 and California Energy Commission - Homepage)

Notes:
German data depends strongly on the source. Both the International Energy Agency (IEA) and the official European data from the PV Eurobarometer accounts for less installed capacity than other sources like the magazine Photon. According the IEA the cumulated grid installed capacity end 2005 in Germany was 1429 MWp. According the Eurobarometer the cumulated grid installed capacity end 2005 in Germany was 1508 MWp. According Photon the cumulated grid installed capacity end 2005 in Germany was more than 1970 MWp. In this study the IEA data is considered

Figure 11 shows the cumulative installed capacity in some emerging markets. In Netherlands the effect of an oversubsidized market is observed. The market collapsed when the generous EPR disappeared in 2003 and the moderate MEP started. The start of the Spanish feed-in tariff in 1999 and the Italian Roof Top program in 2001 correspond with the increase of installed capacity in these years.

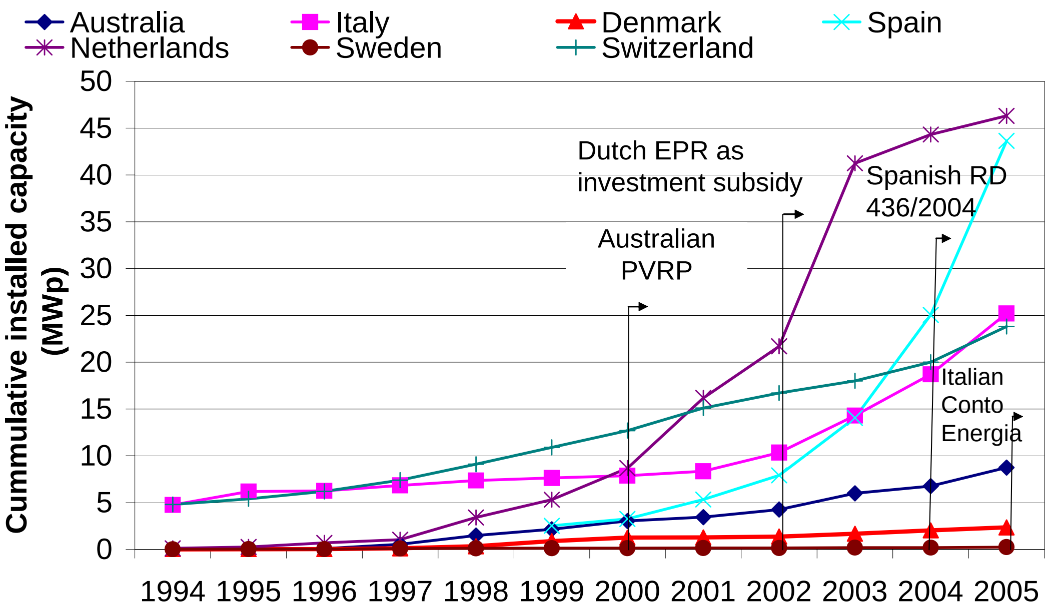


Figure 11: Cumulative installed capacity with important milestones in emerging grid connected markets (source IEA-PVPS, 2006)

Table XXI and Table XXII in the appendix provide an overview of the most relevant programs in the past and at present. The comparison of Table III (next chapter) Table XXI and

Table XXII and the PV capacity installed over time (see Figure 10 and Figure 11) provide evidence that continuity and evolution of promotion schemes are necessary to assure stable and sustainable markets. Switzerland is a good example. Switzerland disposed of the largest installed capacity of the world by inhabitant after the introduction of the first voluntary full cost rate (a type of voluntary feed in tariff paid by the utilities) feed-in tariff (FIT) of the world in the mid 90s. Nevertheless and due to a long lack of political will the Swiss PV market had to survive long time thanks to some voluntary initiatives promoted by utilities and lost its place among the big PV power markets. In 2007 Switzerland has introduced a national wide feed in tariff.

In this Section different programs are described. Most of them are still in operation or they have finished recently. The programs with enough data available are used for a later analysis according to the success criteria explained in the following chapter.

Programs which are not included in the later analysis are described in more detail in this chapter. In order to be able to locate the context of these programs it is interesting to observe the evolution of the different policies over the time. This can be observed in Table III. The described programs follow the classification given in Table I.

Table III: Evolution of most influent PV policies for the residential sector in selected countries

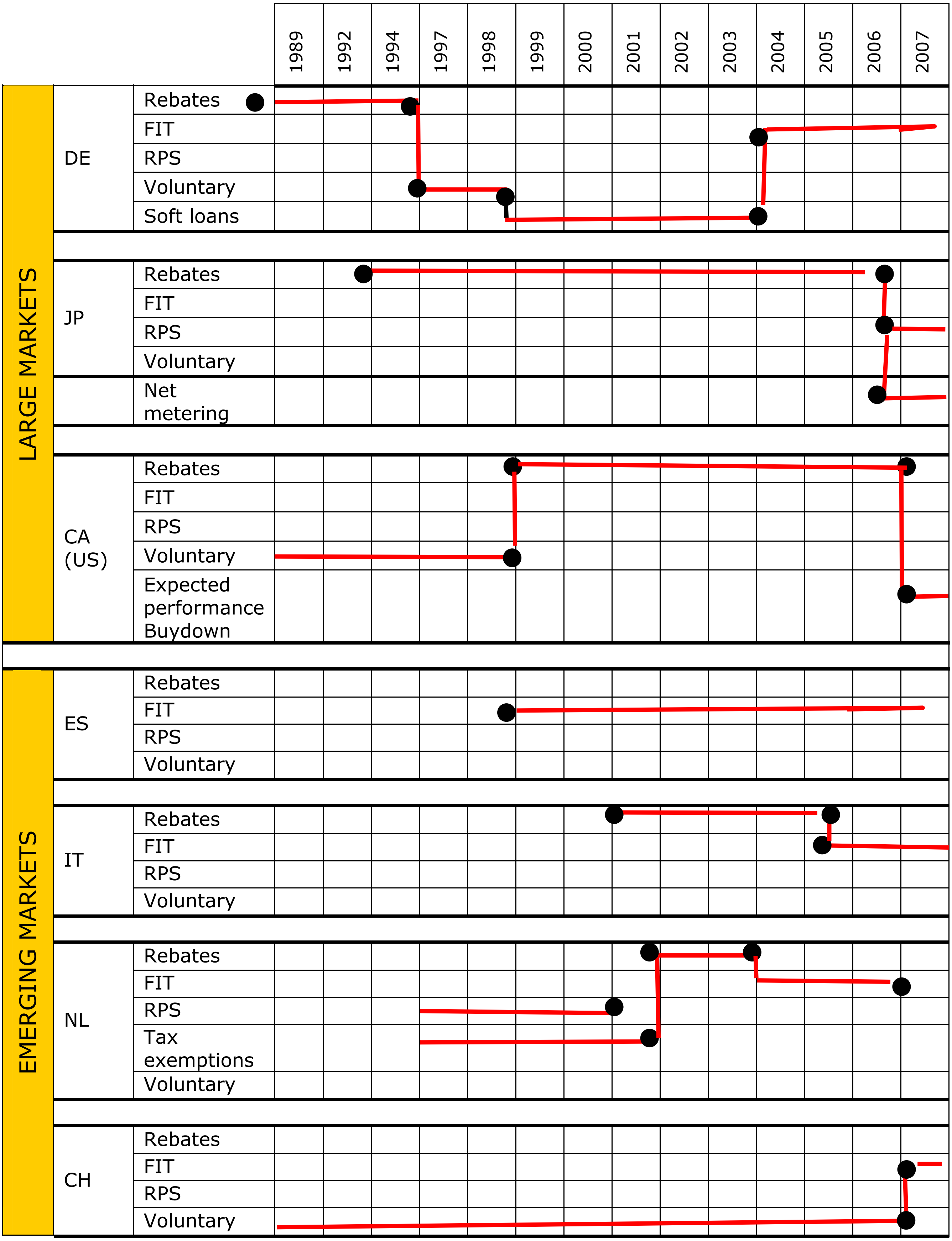
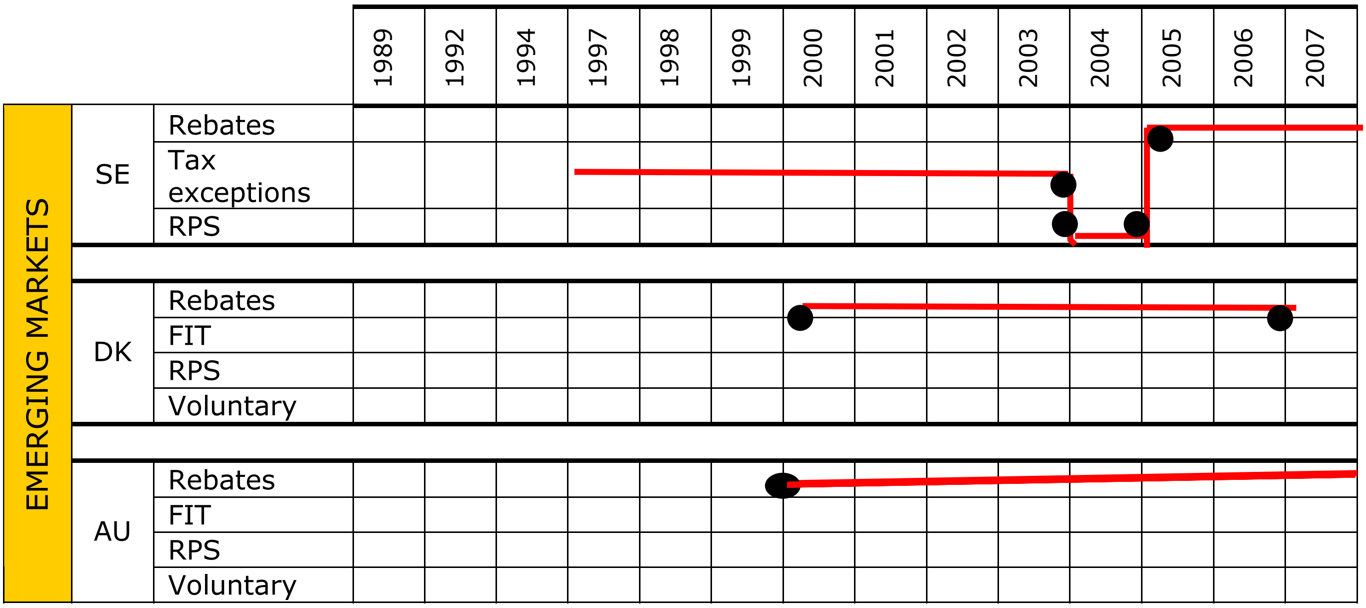


Table IV: Evolution of most influent PV policies for the residential sector in selected countries (Continuation)



3.1 INVESTMENT FOCUSED FINANCIAL INCENTIVES WITH ONE UP FRONT PAYMENT

3.1.1 Energy Premium Regulation (EPR) and MEP Netherlands

The EPR was in operation between 2001 and 2003 and it was during this period the most important market tool for private consumers. Although it was a fiscal measure at the beginning the EPR was converted into a direct investment subsidy in 2002. Investment subsidies between 3,5 €/Wp and 4,375 €/Wp were granted. Moreover many utilities also granted investment subsidies (approx. 1 €/Wp) to PV systems with or Feed-in- Tariffs (0,18-0,25 €/Wp). After the finish of the EPR the MEP (Milieukwaliteit van de Elektriciteitsproductie) came into force in July 2003 and finished in 2006. 9,7 €c/kWh were guaranteed for 10 years in the framework of the MEP. At present net metering is applied.

3.1.2 Italian PV Roof Program

The Italian PV- Roof Program "Tetti fotovoltaici" was launched in March 2001. The second phase of the program was managed by the 19 Italian regions through local announcements. As a consequence each region was adopting its own amount of incentives. Some regions adopted a 70% incentive, while others adopted 65% with a maximum investment cost ranging from 7 to 7,5 €/Wp, depending on plant size. The maximum investment subsidy permitted was 70% of the total costs.

3.1.3 Danish SOL 300 and SOL 1000

SOL1000 builds on the previous SOL300 which operated from 2000 to 2001. It targeted at a total capacity installed of 750 kWp. SOL1000 expired end of 2006. The goal was set at 1000 kWp at the start of the program but a reduction in budget by the government caused also a reduction of the goal which was finally set at 700 kWp. Exceptional low prices occurred due to tenderings for supply fully installed systems. Investment subsidies amount 40%.

3.1.4 Australian Photovoltaic Rebate Program (PVRP)

The Australian PVRP was launched in January 2000 by the Australian Greenhouse Office (AGO). Until May 2007 a minimum size of 450 Wp was required and the rebate for the residential sector, community buildings and schools amounted AUS$ 4000 per kWp capped at 4000 AUS$ (or 1 kWp) although there is no was a maximum size. Extensions to existing PV systems could receive rebates of AUS$ 2500 per kWp capped at AUS$ 2500. The rebate had to be gradually reduced from AUS$ 4000 per kWp to AUS$ 3500 through a series of 10 cent steps until the end of the program in June 2007. Furthermore housing estate developers and builders can also apply for rebates which amount to AUS$ 3500 with also gradually reductions of 10 cent steps. A new amendment of the program was announced in May 2007. An increase of subsidies for the residential sector from 4000 AUS$ per kWp to 8000 AUS$ per kWp and capped at 8000 AUS$ is expected.

3.1.5 German 100000 Roof Program (HTDP) and "Solarstromerzeugen"

The German 100000 Roof Program was launched in 1999 and finished in June 2003. Within this program soft loans were put at public's disposal. Initially the interest rate was set at 0% for 10 years pay back. The initial response of the program was rather disappointing. In 2000 the Renewable Energy Act EEG came into force with the introduction of a feed-in tariff of 0,5 €/kWh. In the last period of the program PV installations with more than 1kWp were eligible for the program and the interest rate was still 4,5 points under the habitual market. The objective of the program was to promote 100000 plants with an average size of 3kWp i.e. 300 MWp and was complied at the end of the program. The program "Solarstromerzeugen" started in January 2005. As the previous 100000 Roof Program it is managed by the KfW bank and basically addressed to private persons. Table V shows the guaranteed rates for 2007.

Table V: "Solarstromerzeugen" conditions at present (May 2007)

Interest rate(1)	nominal between 3,9% and 4,4%
Repayment	Up to 20 years (max 3 year with exclusion of repayment)
Maximum loan	Up to 100%. Max 50000 €/project

Notes:
(1) Interest rate depends on number of repayment years, number of years with exclusion of repayments and number of years with fixed interest

3.1.6 Spanish Financing Line ICO-IDAE (ES ICO-IDAE)

Between 2000 and 2005 soft loans for public and private beneficiaries were available. The program is managed by the Institute of Energy Diversification and Savings (IDAE) and the Spanish Official Credit Institute (ICO). Until 2003 only systems larger than 100 kWp were eligible since investment subsidies granted by the IDAE were available for systems smaller than 100 kWp. The program ran out in 2005. Table VI shows the guaranteed rates for 2005.

Table VI: ICO-IDAE conditions in 2005

Investment subsidy	Up to 20% of reference costs
Interest rate	EURIBOR + 1%
Repayment	8 or 10 years (1 year with exclusion of repayment)
Maximum loan	Up to 80% of reference cost. Max 0,6 M€/project

After the Finish of the Financing Line ICO-IDAE other banks are offering soft loans to photovoltaic plants. These initiatives can be considered a continuation of the Financing Line ICO-IDAE managed by different banks.

3.1.7 UK Low carbon building program

The Low carbon building program was launched in April 2006 by the Department of Trade & Industry (DTI), replaces all previous PV Programs in the UK and will run over three years. Besides PV other eight technologies for energy efficiency and renewable energy production in buildings are granted. Households, building developers, Business, local authorities and public bodies, energy service companies, NGO´s and government offices are eligible. £18 Million are available for households (for all technologies and not only PV). Up to £3000/kW (not exceeding £15000 and 50 % of total costs) grants for private households. £18 Million are available for households (for all technologies and not only PV).

3.1.8 Swedish PV Program

100 MSEK were foreseen for the installation of PV in public buildings in the Swedish PV program which started mid 2005 and should be in force until end of 2007. In 2006 the financing was increased to 150 MSEK and the program was extended to the end of 2008. Subsidies amounts up to 70%.

3.1.9 Japanese Residential PV System Dissemination Program (RPVDP)

The Japanese Residential PV System Dissemination Program was launched in 1994. The program was combined with low-interest consumer loans and comprehensive education and awareness activities for PV. The subsidy was given in three categories: a) individuals who are going to install PV systems to their own house b) supplier of housing development complexes or supplier of houses built for sale and c) local public organizations that introduce PV systems to public buildings. Subsidies in FY 2005 were 20000 ¥/kWp[3] with a maximum output capacity of the PV system of 4 kWp. Rebates have been decreasing continuously over time. While in the first years of the program (1994-1999) the subsidies were a fixed percentage of the costs (decreasing from 50% to 33%) this concept changed into fixed amounts per kWp.

3.1.10 Japanese Field Test Projects on New PV Power Generation Technology Program

The Japanese Field Test Projects on New PV Power Generation Technology Program started in 1992 (former Field Test Project on new Photovoltaic Power Generation Technology) and it was addressed to public buildings till 1998 and to industrial facilities till 2003. At present the program includes public buildings, industrial facilities and "advanced technology".

Four technologies are included:

- Systems employing new modules
- Systems integrated with construction materials
- Systems using new control methods
- Systems seeking better efficiency

After the finalisation of the Japanese Residential PV System Dissemination Program METI (Ministry of Economy, Trade and Industry) enhanced the program and considered it to be of high importance for PV power dissemination. The long term strategy is comparable to the strategy followed by the Residential PV System Dissemination Program. It is intend to create a self sustainable PV market in the non residential market.

Table VII shows the installed capacity and the yearly budget.

[3] 20000 Yen are approx: 150€ in 2005

Table VII: Installed capacity within the Japanese Field Test Projects on New PV Power Generation Technology Program (source: Ikki, different issues; IEA-PVPS -Annual report, 2004)

	Installed capacity (kW)					
	Systems employing new modules	Systems integrated with constructio n materials	Systems using new control methods	Systems seeking better efficiency	total	Total Budget (Billion Yen)
FY 2003	10	370	60	4040	4480	3,50
FY 2004	10	760	30	6361	7161	5,03
FY 2005	130	383	321	16875	17709	9,23
FY 2006	30	1064	434	20552	22080	11,2

Notes: FY= Fiscal year

3.1.11 California's Emerging Renewables Program (CA ERP)[4]

The California's Emerging Renewables Program was managed by the California Energy Commission (CEC) and started accepting applications in March 1998. At the beginning five tiers were planned. The maximum buydown was set for the first tier in $3000 per kWp declining $500 per tier to $1000 per kWp in the final tier. The tiers were not subject to calendar years or specific time frame but each block would be available until exhausted. Due to the disappointing number of applications the program concept was changed in 2001. Since 2003 Program focuses on small and residential systems under 30 kWp. In July 2006 rebates were set at $2600 per kWp declining about $200 per kWp every 6 months.

3.1.12 The CPUC's Self Generation Incentive Program (SGIP)[5]

The CPUC´s Self Generation Incentive Program was managed by the California Public Utilities Commission (CPUC) and started accepting applications in July 2001. Rebates were available for PV systems of at least 30 kWp in size. Although systems could exceed 1 MWp only 1 MWp was eligible for the rebate. In 2006 rebates were set at three levels depending on the requested capacity. For the first 50 MW rebates were set a 2800$ per kWp. After that rebates were set at 2500$ per kWp. If requested capacity had surpassed 120 MW rebates had been set at 2250$ per kWp.

[4] From 1st January 2007 rebates for PV under the CA ERP are replaced by the state's California Solar Initiative

[5] From 1st January 2007 rebates for PV under the SGIP are replaced by the state's California Solar Initiative

3.1.13 New Jersey's Clean Energy Program's Customer ON-Site Renewable Energy (CORE)

The CORE is part of the New Jersey Clean Energy Program which started in 2001. Table VIII shows the present approved rebates for PV systems. Moreover applicants purchasing systems which include modules manufactured in New Jersey receive an additional rebate of $250/kW.

Table VIII: Subsidies in the New Jersey's Clean Energy Program's Customer on Site (source: New Jersey's Clean Energy Program's homepage)

Subsidies in the New Jersey's Clean Energy Program's Customer On-Site		
Size of the system (kW) (S= Size of the system)	Private Sector ($/kW)	Public and Non –profit sector($/kW)
<10	3800	4400
10,001<S<40	2750	3450
40,001<S<100	2500	2800
100,001<S<500	2250	2600
500,001<S<700	2000	2050

3.1.14 Major PV Demonstration Programme

The Major PV Demonstration Programme was officially launched by the Department of Trade & Industry (DTI) in March 2002 and ended in March 2006. An investment subsidy of up to 50% was granted and both grid and on grid systems were eligible in two different categories: small scale applications from 500 W to 5 kW and medium to large scale from 5 kW to 100 kW. The Program disposed of a budget of £31,75 Million. 1920 plants with less than 5 kW and a total capacity of 4740 kW were installed. 202 plants larger than 5 kWp with a total capacity of 5950 kW were installed.

3.2 INVESTMENT FOCUSED FINANCIAL INCENTIVES WITH MULTIPLE PAYMENTS

3.2.1 US PV Investment Tax Credit

The Federal Energy Policy Act of 2005 includes a federal tax credit of 30 percent of total system cost of a solar system. The credit is available to homeowners and commercial owners if solar systems were installed from 1st of January 2006 through 31st of December 2008. The Tax Credit directly reduces the amount of income tax a ratepayer has to pay unlike a deduction which reduces the amount of income subject to tax. For homeowners the tax credit s limited up to $2000 per system.

3.3 GENERATION FOCUSED FINANCIAL INCENTIVES WITH ONE UP FRONT PAYMENT

3.3.1 California Solar Initiative (CSI)

In January 2006 the CEC and the CPUC established the California Solar initiative which started in January 2007. Goal of the program is to install 3000 MW by the end of 2017. The CSI offers incentives of up to $2500 kWp. These incentives combined with federal tax incentives can cover up to 50% of the total cost of a solar system. The CEC manages incentives for all new residential construction while the CPUC manages incentives for existing homes and all other properties. Systems up to 5MW are eligible although incentives are only paid for the 1 MW. Table IX offers a more detailed description of the program.

Table IX: Overview of the California Solar Initiative Source (IKKI, PV activities in Japan, November 2006; CSI- Homepage)

CEC	CPUC	Publicly Owner Utilities (POU)
	Budget	
$400 million	$2165 million	$784 Million
	Installed capacity	
360 MW	1940 MW	700 MW
	Target	
New home constructions	All except new home constructions (existing residential homes and existing and new commercial, industrial, and agricultural properties)	Definition after January 2008
	Program description and incentive structure	
New Solar Homes Partnership - Systems >1kW$_{AC}$ - Expected Performance Based Incentive(1) Incentives will decline over the life of the programm. The decline will be given as a specific volume in capacity (MW) has occurred. The initial base incentive for a reference system (variations depends on the calculated expected performance) is set at $2500/kW (custom homes and small developments) or $2600/kW (Production housing with solar as a standard feature(2))	The program offers two types of incentives: - Expected Performance Based Buydown[1] for systems <100kW: Applicants receive an initial incentive of $2500/kW (residential and commercial) or $3250/kW (non profit and gov´tl). Incentives will decline over the life of the programm. The decline will be given as a specific volume in capacity (MW) has occurred(3) - Performance based incentive for systems >100 kW. (systems <50kW after 2008 and ysztems < 30 kWp after 2010). Applicants receive an initial incentive of $0,39/kWh (residential and commercial) or $0,50/kWh (non profit and gov´tl). Incentives will decline over the life of the programm. The decline will be given as a specific volume in capacity (MW) has occurred(4). Payments will be received during 5 years. Systems <100 kW may choose between both incentive types.	Definition after January 2008
	Start date	
January 2007	January 2007	Definition after January 2008

Notes:

(1) Expected performance based incentive: Applicants have to use the California Energy Comission PV calculator which calculated the expected performance

(2) In the first case incentive will be reduced until $250/KW for the last 100 kW contingent. In the second case initial incentives will be reduced until $350/KW for the last 100 kW

(3) In the first case initial incentives will be reduced until $200/kW and in the second case initial incentives will be reduced until $700/kW respectively for the last 350 MW to be installed by the CPUC under the CSI

(4) In the first case initial incentives will be reduced until $0,03/kWh and in the second case initial incentives will be reduced until $0.10/kWh respectively for the last 350 MW to be installed by the CPUC under the CSI

3.4 GENERATION FOCUSED FINANCIAL INCENTIVES WITH MULTIPLE PAYMENTS

3.4.1 German Renewable Energy Act (EEG)

The German Renewable Energy Act is the main market driver in Germany. The present EEG came into force in April 2000 and was afterwards amended in 2004. It builds on the previous Electricity Feed Law from 1991. The 20 year fixed tariffs which are granted for new projects each year decrease 5%. Table X shows the guaranteed rates for 2007.

Table X: German Feed-in-Tariffs in 2007

GERMAN REMUNERATION PV ELECTRICITY (€c/kWh)	
Roof top systems	
<30 kWp	49,21
Capacity >30 kWp	46,82
Capacity >100 kWp	46,30
Façade systems	
<30 kWp	54,21
Capacity >30 kWp	51,82
Capacity >100 kWp	51,30
Ground mounted systems	
No limitation	37,96

3.4.2 Spanish feed-in tariff-ROYAL DECREE 436/2004 (RD 436/2004)

The Spanish feed-in tariff built on the Royal Decree 2818/1998. Grid connected PV systems had the option to deliver the PV electricity to a price related to the "average electricity tariff" or to participate in the regular electricity market whereby PV rates vary monthly. Nevertheless the Royal Decree Law 7/2006 from June 23rd separated the feed-in tariff from the Average Electricity Tariff. Rates were guaranteed for so many years as the system is running. Table XI shows the guaranteed rates for 2006 as fixed under the RD 436/2004. A definitive new legislation came into force on 1st June 2007 (see chapter 3.4.3).

Table XI: Spanish feed-in-Tariffs in 2006

SPANISH REMUNERATION PV ELECTRICITY (€c/kWh)			
<100 kW		>100 kW(2)	
Year 1-25	44,04 (5,75 x AET(1))	Year 1-25	22,98 (3 x AET(1))
Year 26 on	(4,6 x AET(1))	Year 26 on	18,38 (2,4 x AET(1))

Notes:
(1) *AET*="Average Electricity Tariff" estimated at the beginning of the year considering the generation costs of 1 kWh.
(2) Systems over 100 kW have also the option to participate in the regular market. In this case PV electricity is paid by summing up market price + an incentive depending on *AET*. In practical terms this option is not used.)

3.4.3 Spanish feed-in tariff-ROYAL DECREE 661/2007 (RD 661/2007)

The present Spanish feed-in tariff built on the Royal Decree 436/2004 und came into force on 1st of June 2007. Tariffs are annually reviewed and will be reduced on the following way:

Consumer Price Index – 0,25% till 2012

Consumer Price Index – 0,50% after 2012

Tariffs are guaranteed until 371 MW are installed.

Table XII: Spanish feed-in-Tariffs in 2007 according RD 661/2007 (source: ASIF, 2007)

SPANISH REMUNERATION PV ELECTRICITY (€c/kWh)					
<100 kW		>100 kW and ≤ 10MW		>10MW and ≤ 50MW	
Year 1-25	44,038	Year 1-25	41,75	Year 1-25	22,9764
Year 26 on	35,23	Year 26 on	33,4)	Year 26 on	18,3811

3.4.4 Italian feed-in tariff – "Conto Energia"

The present main driver in Italy came into force in September 2005. A yearly cap of 85 MW is set. Systems are accepted in rigorous order of submission. Accepted systems receive guaranteed rates for 20 years. The 20 years fixed tariffs which are granted for new projects each year decrease 5%. Systems larger than 50 kW are subject to a tender mechanism. Table XIII shows the guaranteed rates for systems accepted in 2006. A new law with amendments to the described "Conto Energia" came into force in February 2007. The new tariffs which decrease 2% every year are described in Table XIV.

Table XIII: Italian Feed-in-Tariffs in 2006

ITALIAN REMUNERATION PV ELECTRICITY IN 2006 (€c/kWh)	
1≤kWp≤20	44,5$^{(1),(3)}$
20≤kWp≤50	46$^{(1),(4)}$
50≤kWp≤1000$^{(2)}$	49$^{(1),(4)}$

Notes:
(1) Additional 10% for build integrated systems;
(2) Tender mechanism;
(3) Rate for PV electricity if it is self consumed. For the surplus energy net metering is applied. PV electricity can also be totally sold at 46 €c/kWh;
(4) Self consumed electricity is paid as bonus for the next year

Table XIV: Italian Feed-in-Tariffs in 2007 (after the amendment in February 2007)

	ITALIAN REMUNERATION PV ELECTRICITY IN 2007 (€c/kWh)		
	Ground mounted systems	Buildings (part integrated$^{(1)}$)	Buildings (integrated)
1-3 kWp	40	44	49
3-20 kWp	38	42	46
>20 kWp	36	40	44

Notes:
(1) PV modules are coplanar to the surface without substitution of building materials

3.5 RENEWABLE PORTFOLIO STANDARDS FOR PV

3.5.1 Japanese Renewables Portfolio Standard

The Japanese Renewables Portfolio Standard (Law on Special Measures Concerning New Energy Use by Electric Utilities) was enforced from Fiscal Year 2003. In 2007 the new quota for new energy by FY 2014 was set at 1,63% of the total electricity sales (16 billion kWh). From FY 2011 PV generation is directly affected by this measure as 1 kWh PV power generated accounts for 2 kWh in order to equal PV to other less expensive renewable energy electricity generators.

3.5.2 New Jersey's Renewable Portfolio Standard (NJRPS)

The New Jersey Board of Public Utilities (NJBPU) approved in 2006 each supplier/provider is required to include 22,5% of renewable electricity in the electricity it sells to retail customers by 2021. This mandate also includes a 2´12% of solar electricity or approx. 1500 MW. That is the US´s largest solar goal on a per capita basis. Table XV shows the prices for solar Renewable Energy Certificates (SRECs, 1SREC = 1MWh) and the quantity traded until December 2006.

Table XV: Solar Renewable Energy Certificates in New Jersey (source: New Jersey's Clean Energy Program's homepage)

Data	SRECs Traded in Month	Monthly High ($/MWh)	Monthly Low ($/MWh)	Cumulative SRECs Traded	Cumulative Weighted Average Price ($/MWh)
Dec 2006	2750	$260	$110	5351	$195.44
Nov 2006	1022	$260	$110	2601	$197.89
Oct 2006	464	$250	$160	1579	$205.99
Sept 2006	747	$255	$174	1115	$206.08
Aug 2006	131	$235	$150	368	$213.77
July 2006	237	$240	$150	237	$218.60
Aug 2006	6923	$275	$100	19335	$215.09
July 2006	3132	$275	$150	12412	$208.95
June 2006	3909	$260	$165	9280	$203.68
May 2006	1314	$260	$100	5371	$204.48
April 2006	448	$297	$150	4057	$203.34
Mar 2006	1037	$265	$115	3609	$201.97
Feb 2006	486	$265	$115	2572	$192.04
Jan 2006	755	$250	$150	2086	$192.47
Dec 2005	796	$230	$150	1331	$190.12
Nov 2005	71	$200	$174	535	$179.42
Oct 2005	250	$211	$160	464	$178.78
Sep 2005	106	$240	$150	214	$176.35
Aug 2005	100	$230	$150	108	$170.70

New Jersey, the second solar market in the US also has since 2001 a solar rebate -New Jersey´s Clean Energy Program- which provides investment subsidies for residential, commercial and public sector (see description in 3.1.13). After the introduction of the NJRPS the NJBPU has designed a transition which is gradually reducing the investment subsidies in order to finance PV systems solely by means of solar certificates[6].

[6] Moreover solar system owners receive the US PV Investment Tax Credit and also can save money in the electricity bill by means of net metering

3.5.3 Australian Solar cities

"Solar Cities" was announced in June 2004 and will be implemented by Department of the Environment and Water Resources. 4 cities (Adelaide, Townsville, Blacktown and Alice Springs) have been chosen. The total budget is AUD 75 million and duration of the program until 2013 is foreseen. Energy efficiency and Energy saving measures, and the installation of thermal and PV systems are included. In particular the installation of 3262 PV systems in the residential and commercial and public sector with a total capacity of more than 5 MW are foreseen. The idea is to extend the lessons learned to other cities in Australia.

3.6 VOLUNTARY GENERATION FOCUSED FINANCIAL INCENTIVES WITH MULTIPLE PAYMENTS

3.6.1 Swiss Solar Stock Exchange Programs

The Swiss market was until March 2007[7] substantially sustained by solar stock exchange programs (Solarstromboersen) offered by utilities. The market volume thereby created annually amounts to approx. 2MWp. 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. One of the most well known programs is the Solar Stock Exchange of the EWZ (Elektrizitätswerk der Stadt Zürich) in Zurich. At present (April 2007) Green electricity consumers of the EWZ pay Fr.0,85[8]/kWh (Fr 0,9146/kWh incl. VAT) for their solar electricity. About 8500 consumers participate in the program (until July 2006). Bidding processes are open every 1,5 years whereby the best offers receive a contract for selling their PV electricity during 20 years.

3.7 OTHER REGULATORY PROGRAMS

3.7.1 Spanish Technical building code

The new Spanish Technical building code came into force in March 2006. Concerning PV, its use is compulsory in certain building depending on their use and minimum size. It is applicable to new as well as retrofitted buildings if their surface is bigger than 1000 m² with more than 25% of the enclosure modified by retrofit. Table XVI shows the characteristics of building which installation of PV is compulsory. In these buildings a minimum PV power is to be installed depending on the local climatic conditions.

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[7] Swiss Parliament decided on March 7 to introduce feed-in tariffs for plant built after 1.1.2006

[8] Approx 0,57€ in 2005.

Table XVI: PV requirement in the new Spanish Technical Building code

TYPE OF BUILDING AND USE	MINIMUM SIZE
Commercial, large supermarkets	5000 m² surface
Commercial, multi-stores	3000 m² surface
Commercial big stores	10000 m² surface
Showgrounds (for trade fairs)	10000 m² surface
Office and public buildings	4000 m² surface
Hotels and guesthouses	100
Hospitals and clinics	100

3.8 OTHER VOLUNTARY PROGRAMS

3.8.1 Japanese Green Power Fund

The Japanese Green Power Fund was established in 2000. The Fund is formed from donations from customers and aims to promote PV and windmills. Donators are charged with monthly 500 JPY/share/month. The utility contributes with the same amount as it is collected from supporters. From FY 2001 to FY 2005 12812 kW and 598 projects have been installed

4 SUCCESS CRITERIA FOR MARKET DEPLOYMENT STRATEGIES

Success has to be defined in order to be able to carry out an analysis of the success of the marketing programs. In this study diverse success parameters have been extracted. They will be compared for a few thoroughly analyzed programs. In the case of California a different number of programs have been offered by different Energy suppliers. Due to its impact in the residential the CA EPR has been chosen for the further analysis in this study. This is shown Figure 12. Table XVII shows the most important features of the analyzed programs in this study.

Table XVII: Features of analyzed programs

PROGRAM	ABBREVIATION	COUNTRY	TYPE OF PROGRAM	YEAR
German 100000 Roof Program	DE HTDP	Germany	Investment focused financial incentives with one up front payment	1999-2003
Solarstromerzeugen		Germany		Since 2005
Japanese Residential PV System Dissemination Program	JP RPVDP	Japan		1994-2005
California's Emerging Renewables Program	CA ERP	US (California)		1998-2006
Spanish Financing Line ICO-IDAE	ES ICO-IDAE	Spain		2000-2005
Italian PV Roof Program "Tetti fotovoltaici"	*IT "Tetti PV"*	Italy		2001-2005
Energy Premium Regulation	NL EPR	Netherlands		2001-2003
"Milieukwaliteit van de Elektriciteitsproductie"	NL MEP	Netherlands		2003-2006
Danish SOL 300 and SOL 1000	DK *SOL 300 + SOL 1000*	Denmark		2000-2006
Australian Photovoltaic Rebate Program	AU PVRP	Australia		Since 2000
German Renewable Energy Act	DE EEG	Germany	Generation focused financial incentives with multiple payments	Since 2000
Spanish Feed in Tariff- ROYAL DECREE 436/2004 and ROYAL DECREE	ES RD 436/2004	Spain		Since 1999
Italian Feed in Tariff – "Conto Energia"	*IT "Conto Energia"*	Italy		Since 2005
EWZ Swiss Solar Stock Exchange Program	CH EWZ	Switzerland	Voluntary generation focused	Since 1996

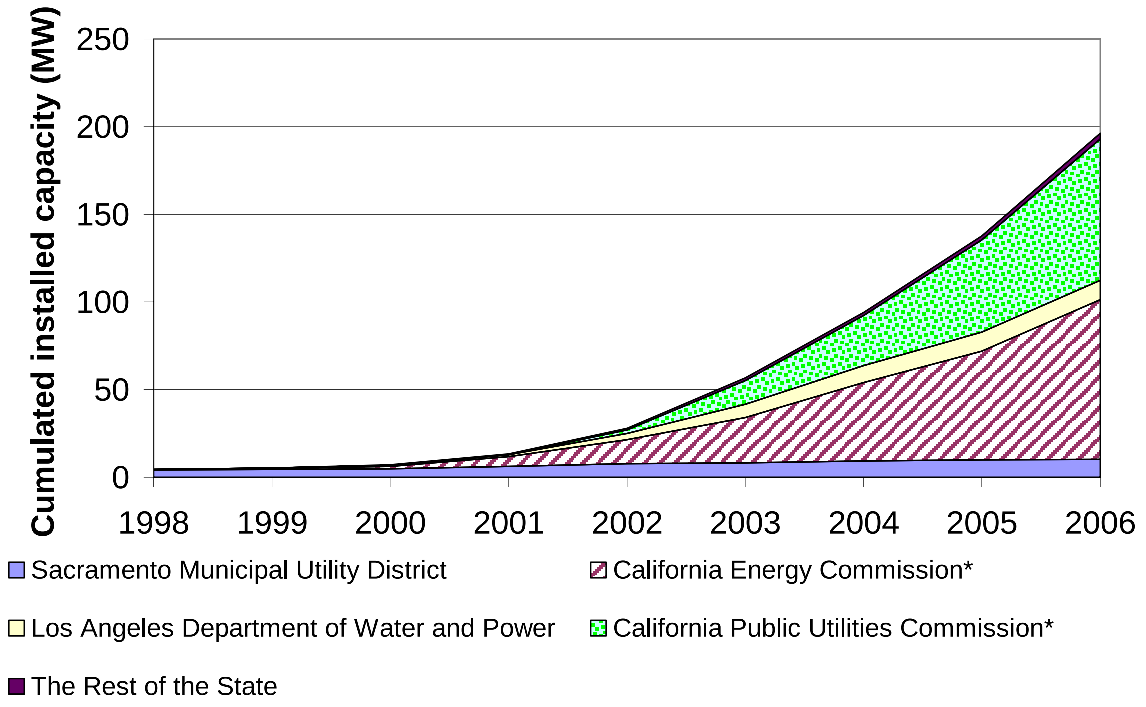

Figure 12: Development of cumulated grid PV installed capacity in California (Source: CEC- Homepage)

4.1 DEFINITION OF SUCCESS CRITERIA

The success criteria as it will be studied are resumed in Table XVIII.

Table XVIII: Definition of success criteria

Success criteria	Definition	Quantitative parameters
Dissemination effectiveness	Degree to which a measure maximize the installed power and reach a maximum of participants that play a decisive role as multiplier agents.	Global effectiveness: Total installed capacity Local effectiveness: installed capacity per inhabitant
Costs for the public	Measurement of the efficiency of a program. Amount of money spent for subsidies and other financial incentives compared with the output of the policy (e.g. installed capacity)	Monetary unit/ installed capacity
Cost reductions	policies can contribute to system cost reductions over time	Monetary unit/ kW
Improvement of technical performance	Measure of how policies can contribute to improve and secure the technical performance of the installed systems over time	
Market conformity	Contribution of a policy to a self sustainable PV market by satisfying the needs of the market	-Willingness to Pay (WTP) for PV electricity -Cost effectiveness -Willingness to Invest(WTI)

4.2 DISSEMINATION EFFECTIVENESS

One of the objectives of any program must be to maximize the installed power and to reach a maximum of participants that play a decisive role as multiplier agents. For this reason dissemination effectiveness will be quantified in the following way:

- Global effectiveness: Total installed capacity
- Local effectiveness: installed capacity per inhabitant

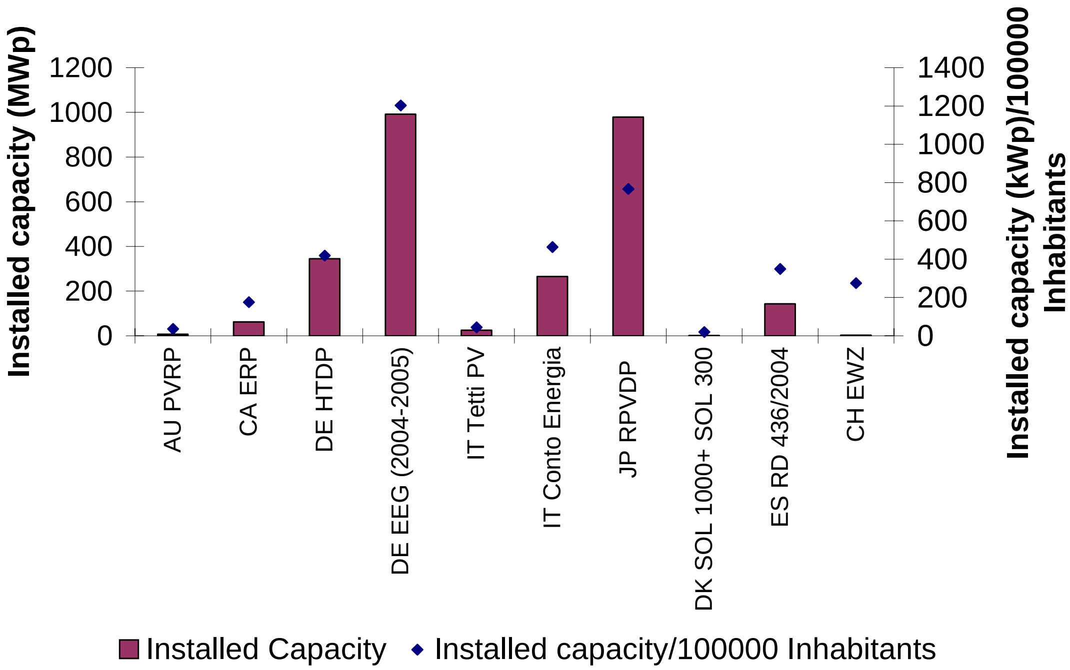

Figure 13: Global effectiveness [own calculations]

Notes:
(1) The data corresponding to Spain comes from program ICO-IDAE and represent accepted power rather than installed capacity. It includes also a small percentage of off grid plants.
(2) For the Swiss program of EWZ the inhabitants of Zurich have been considered.
(3) For the Italian FIT capacity accepted capacity and not installed capacity has been considered in order to give a better idea of the market.

Figure 13 shows the installed capacity both in absolute values and in relative values in different countries and programs. The existing difference between Germany and the rest of programs stands out. The difference between capacity installed during the program Tetti fotovoltaici and the approved capacity of the Conto Energia in only 3 months of operation is also remarkable. Although the installed capacity by the Swiss solar stock exchange of EWZ is unspectacular compared with the big markets it is practically twice as much as the installed capacity in the national program in Denmark with SOL 300 and SOL 1000.

It is important to highlight those measures in this context in which the "mass public" is affected and no only "the green" buyer or "the typical innovator" of emergent markets. We refer to measures which imply a process of socialization of the energy. Among them ans as example the "Builder mandates" like the new Spanish Technical Building code in Spain that came into force in March of the 2006 and which makes the use of PV obligatory for certain types of public and commercial buildings.

4.3 COSTS FOR THE PUBLIC

The costs for the public are a measurement of the efficiency of a program[9]. This means that at the end of the program it must have obtained a maximum of capacity installed with a minimum monetary cost for the society. Usually this is one restriction to fulfil by the organizer of the program, government or local agency by designing the program. Theoretically different conceptions entail different costs for the society. As a example Figure 14 depicts the public costs (hatched surface) for a Feed in Tariffs with a fix duration and tariff for each PV owner but changing over time for new applicants and for an one up front time investment subsidy which is changing over time.

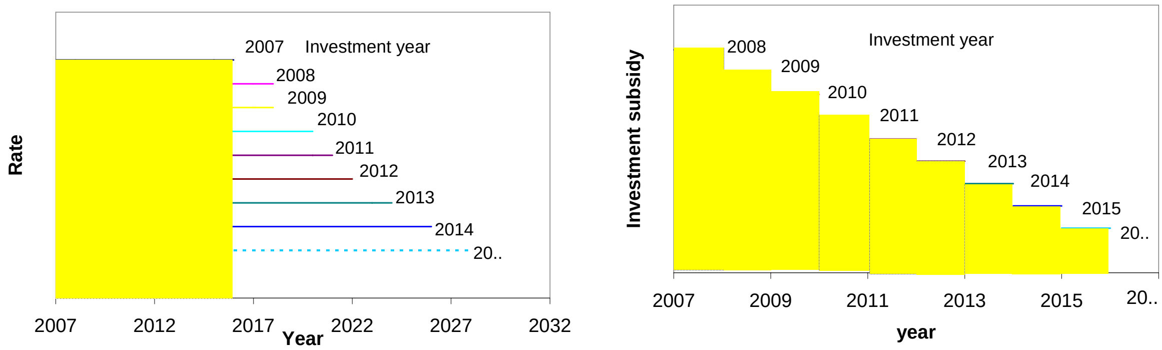

Figure 14: Costs for the public for a feed in tariff and for a one up front investment subsidy. (Source: Hoff et al., 2006; own researches)

Figure 15 and Figure 16 and show economic efficiency. The costs for the public are calculated in three ways:

- In the case of investment subsidies: Cost for the public are calculated by multiplying the investment subsidy per installed capacity unit (e.g. kWp) times installed capacity.
- In the case of soft loans: Cost for the public are calculated by considering the difference of electricity costs considering an interest rate of 6,5% and the costs of electricity by subtracting the granted interest rate
- In the case of feed in tariffs costs are taken from the literature i.e. official sources[10]

The total spent money by kW until 2005 is quite similar in Australia, California and Denmark. Japan comes out on top and it demonstrates the greater economic efficiency. The subsidy just reached approx. 20000 Yen/kW[11] in the last year of the program. Germany and Spain represent a special case which is difficult to compare in this context to the other programs since the conception for the financing of the systems is quite different (feed-in

[9] A comprehensive explanation of the theoretical background of costs of the public for different deployment strategies can be found on Hoff et al, 2006.

[10] CNE in Spain: www.cne.es and VdN in Germany www.vdn-berlin.de

[11] 20000 Yen ≈144 € in 2005

tariffs). Taking in consideration the money spent for the feed-in tariffs the German and Spanish concept is more expensive than the concepts of rebates in the other countries - especially if compared to Japan.

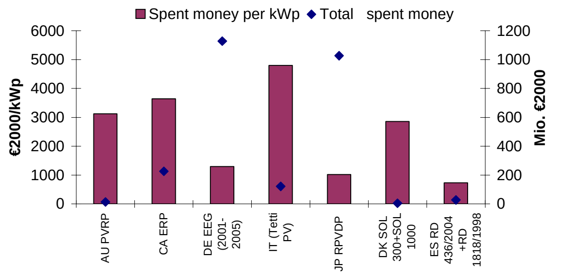

Figure 15: Costs for the public

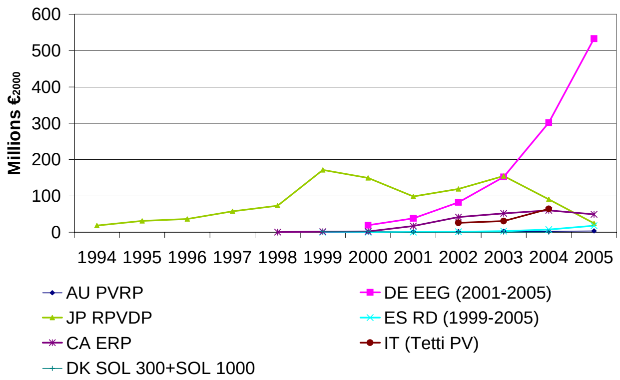

Figure 16: Evolution of the costs for the public over time

Notes:

(1) The costs depicted for Spain and Germany are only the costs occurred until 2005. The tariffs in Spain are paid for 25 years and in Germany for 20 years.

In Figure 16 stands out that the same amount of money was spent in Japan in 1994 as in 2005 whereas about 1860 kWp were installed in 1994 and in 2005 more than 130 MWp.

Figure 17 shows the evolution of the investment subsidies in different years for some countries. It can be seen that Italy and Netherlands were oversubsidized. In Netherlands the effect of this excess is seen clearly in Figure 11 where the market collapsed after the investment subsidy was abolished. Nevertheless the high subsidies received in 2003 in Netherlands were given by different parties (national government and local energy companies) without proper coordination and it was certainly not done intentionally. Probably the main problem in The Netherlands was the complexity and the large number of different subsidy schemes, together with a lack of political support for RE within the new government after 2004. The rebates in California and Australia in 2005 had the same level as Japan reached in 1998.

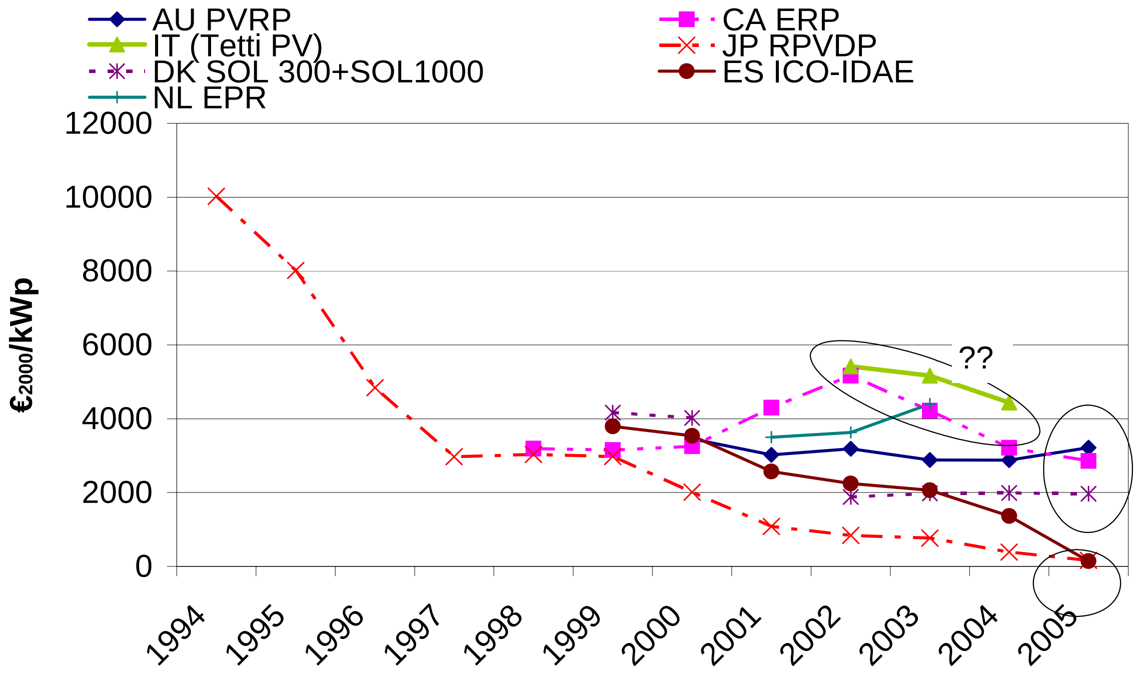

Figure 17: Development of rebates over time and in various countries

4.4 DEVELOPMENT OF COSTS OVER TIME

The cost development of a technology can be used as criteria to see how a policy has contributed to a technical change. For that reason and according to previous studies different incentives lead to different reductions costs (see Haas, 2002 and Lopez-Polo, 2004). Moreover we have to consider two components: a global component and a local component. Whereas the module prices are determined essentially by international and global market laws, installation costs are mostly determined by the local market. Nevertheless policies have to be designed in a way that they represent an incentive to reduce basically installation costs.

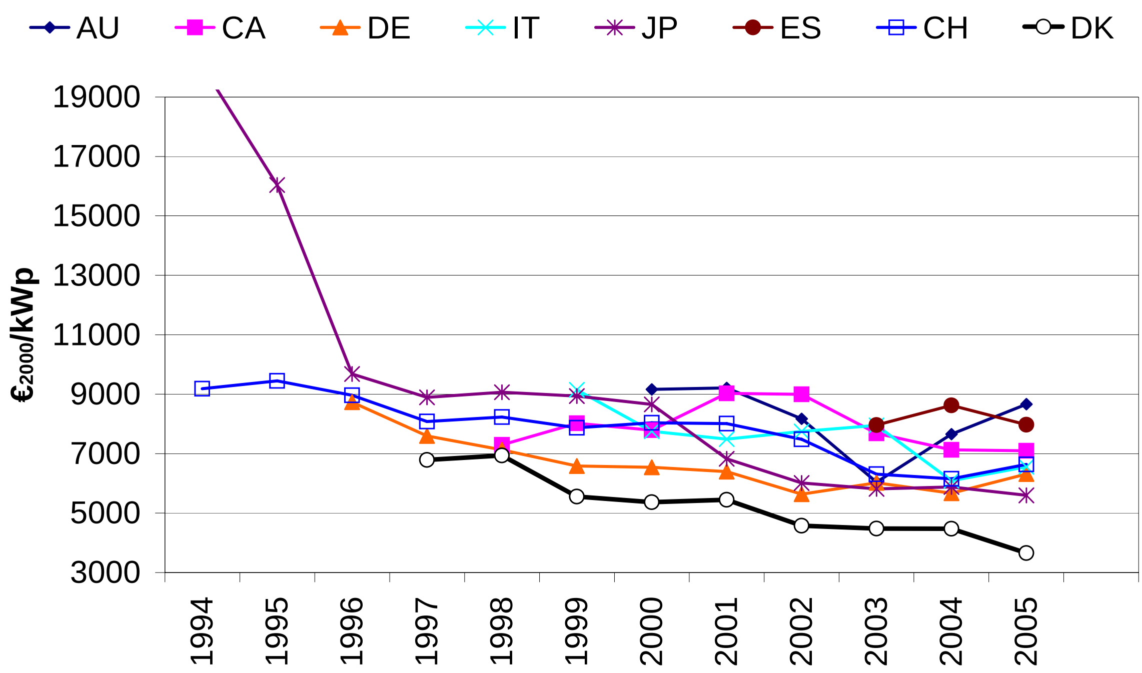

Figure 18: Costs reductions over time (source: IEA-PVPS, 2006; California Energy Commission- Homepage; IEA-PVPS, national status reports, different years; Ikki, various years (1998-2004); IDEA, 2006)

Notes:
(1) System costs do not include VAT and charges after installation.
(2) Costs for California have been extracted from data provided by the California Energy Commission. From this Data 8% sale taxes have been subtracted.
(3) In the case of data is provided in a range of values no average value has been taken but the minimum value since the author supposed minimum system costs are a better representation of cost reductions.
(4) Low costs in Denmark are due to bulk purchases in SOL 300 and SOL 1000.

Figure 18[12] shows the costs evolution in different countries for the residential sector. Taken into account that data represent real costs (inflation is included) most represented countries have experienced an increase of costs in the last years or only a slight decrease. The high demand caused by the beginning of the amended EEG in Germany in 2004 has caused an increase of prices both in modules worldwide and in installation in Germany[13]. Although the global dynamical component of global costs[14] needs more investigation it can be stated that facts follow classic economic theory: "The short term development in an imperfect market –

[12] Most programs outside of the US use a DC-STC rating (basically, the standard test conditionrating on the back of the modules, in DC). This is a rather poor rating system, and CA has made two adjustments: applying inverter efficiency ratings and adjusting module ratings to PTC (not STC). The combination of these two "fixes" results in ratings that are, on average 0.84 as much as DC-STC. Therefore the author considered that cost data is given according to a DC-STC rating in all countries except for California where costs are given according to a PTC rating with inverter efficiency adjusting.

[13] In this analysis factors affecting the production chain as the increase of silicon prices due to shortage have not been extracted.

[14] E.g. how developments in Germany have influenced the development of costs in other parts of the world

as it usually exists for an emerging new technology – is that costs increase if demand increases. Yet, this leads to the emergence of new companies, competition increases and costs drop. In the long run prices will decrease till a perfect competitive market is reached" (see Haas, 2002). This explains the global costs increase tendency in the last years argued in most cases by the increase of module costs due to a silicon shortage. In fact markets could also have experienced an increase of installation costs.

In the case of Germany an increase between 1% and 4% occurred in 2005. Although this does not represent a big increase given the volume of annual installation (see Figure 10) it shows the existence of an imperfect market in which a certain sector is increasing its margins of benefit and not showing in the final pricing the learn rates that the sector experiences. That is clearly seen in Figure 19 and for 2003 in Germany. In this year total system cost increased although module costs dropped. Module cost reductions were compensated with an increase of installation costs.

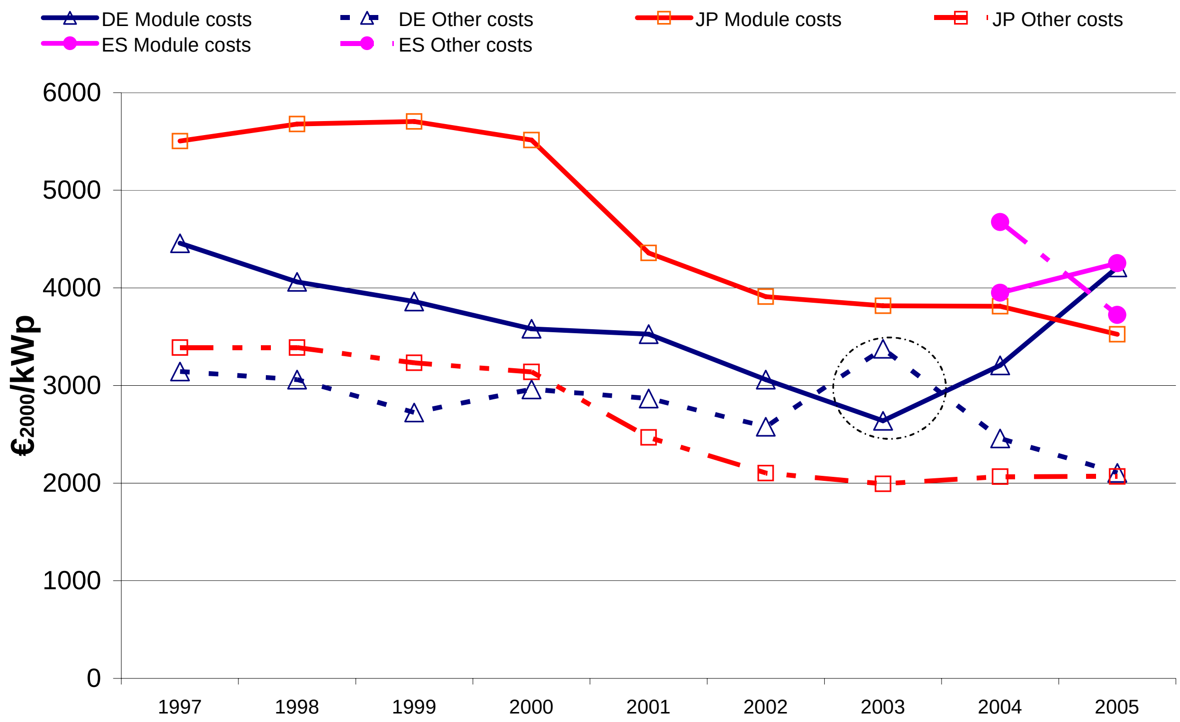

Figure 19: Evolution of module costs and non module costs for Germany, Japan and Spain (Source: IEA-PVPS, 2006; IDAE, 2006)

This confirms the importance of the reduction over time of financial incentives so that costs reductions and prices occur parallel and not independently of each other and causing a distortioned market. If financial incentives are not reduced over time the market prices are not forced to be lower in order to meet the demand. A continuous reduction of financial incentives also entails less cost for the public. In fact all analysed programs except the Spanish feed-in tariff have a dynamic concept and incentives are reduced over time. Till recently[15] the Spanish feed-in tariff was tied in with the electricity tariffs and therefore they were expected to get higher. Nevertheless the financing line ICO-IDAE established eligible maximum costs of reference. This contributes to improve the market transparency since it is a very useful tool to compare budgets but it is also an obvious incentive to maintain the costs of the facilities within margins. In fact the final costs of the supported plants only differ 1 % from the reference costs established by the program. Although it is a good concept the presented reference costs diminish scarcely in three years of duration of the program and therefore they did not lead to significant reductions as depicted in Figure 18. Figure 20 show the evolution of module costs and non module costs for Spain, Germany and Japan. The part corresponding to the non-module costs is higher in Spain than in Japan and Germany. Nevertheless a fast reduction of the part which includes labour costs is observed in Spain.

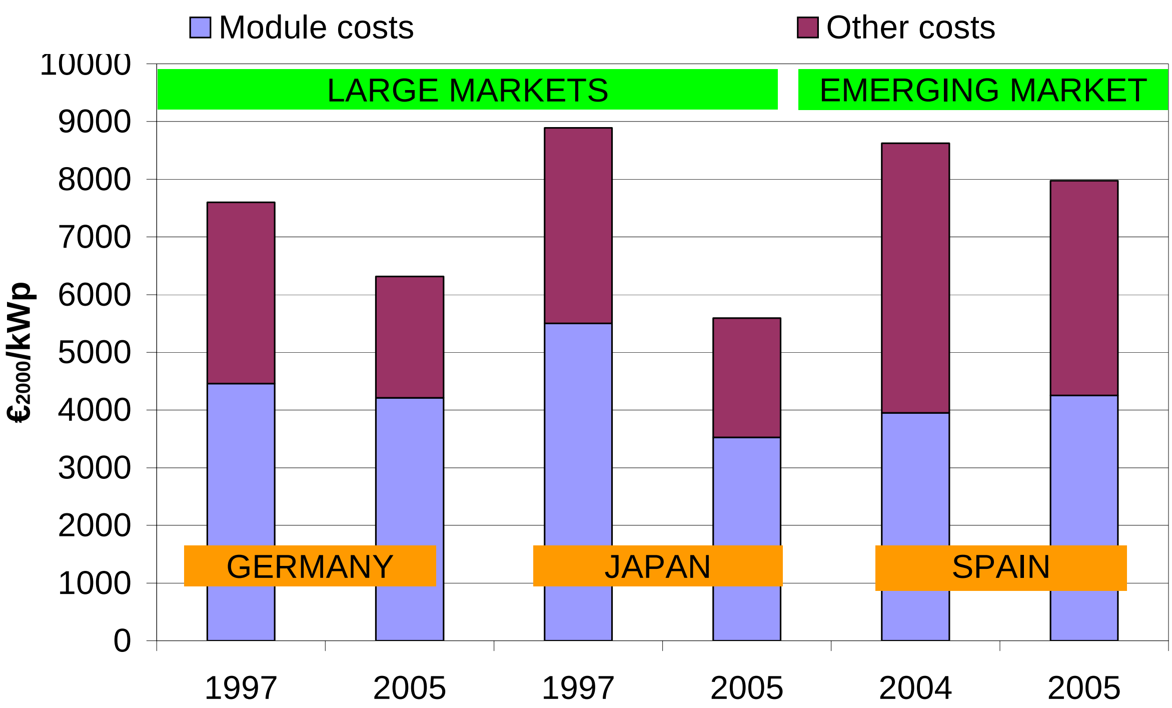

Figure 20: Comparison of module costs and non module costs for two large markets (Germany, and Japan) and one emerging market (Spain) (Source: IEA-PVPS, 2006; IDAE, 2006)

California is a particular case. Systems costs have been reduced in all ranges of power except for plants between 2 KW and 5 kWp (depicted in Figure 18[16]). This can be an effect of the STOP and GO policy observed in Figure 17 to which the residential sector could be more sensible than other. Moreover two differentiated phases are observed. The first phase includes the period from the beginning of the program to 2002. In this first period system prices were increasing. From the year 2002 they were diminishing. This coincides with the

[15] Until the introduction of the Royal Decree Law 7/2006 from June 23rd, 2006

[16] if we considered the totality of systems costs declined from $12000/kW (2004$) in 1998 costs to less than $9000/kW in the last year.

subsidies showed in Figure 17. In spite of these changes the buyers of a system paid almost the same amount for a system[17]. It means subsidy variations often are caught by retailers increasing or diminishing the prices of the systems but leaving the final price invariable to the buyer (see Wiser et al, 2006).

In the Danish SOL 300 and SOL1000 two tenders were carried out to obtain the best prices for the offered equipments. The resulting prices are depicted in Figure 18. The attainment of these prices offered by big companies of international character can cause two effects: on the one hand destabilize the local market incapable to compete with these prices and on the other hand to impede the development of independent Know how. These effect can also be observed in New Jersey's Clean Energy Program's CORE (see 3.1.13) were applicants purchasing modules produced by local modules receive 250$/kWp in addition to the general subsidy.

Some programs take into account the size of the system (economies of scale) and installation type. In general additional incentives for the integration of PV in buildings have only been considered in the EEG of Germany and the Conto Energia in Italy. The Australian PVPR also offers subsidies distinguishing between housing builders, residential owners, communities and schools.

4.5 IMPROVE OF TECHNICAL PERFORMANCE

An optimal PV policy must contribute:

- On the one side to the necessary technological change that helps to establish a mature market and
- On the other side should secure the technical performance of the systems in order to be aware public funding is really used to full capacity (see Wiser et al, 2006, Barbose et al., 2006).

That refers not only to a production point of view, which is not object of this study, but from the point of view of the user and the distribution chain. Firstly it implies that the systems work correctly and secondly a minimum level of standardization. Not all programs have focused these questions in the same way. The first obvious difference is that feed-in tariffs (and performance based programs in general) contribute to the good functioning and design of plants and components since the incentives depend directly on the energy output. The question is how other types of programs beside the classical feed in tariffs used in Europe until now could contribute to it. Some examples are documented in the following:

- Japan is carrying out the Field Test on New Photovoltaic Power Generation Technology which focuses on public and industrial sectors similarly as it were done in the residential sector. In this program stands out that most of the accepted projects from FY 2003 and FY 2006 fall into the category which aims at high efficiency (in FY 2006 610 systems corresponding to 20552 kW came

[17] This question is explained in detail in the next section.

from projects seeking better efficiency, the second most asked category accounted 33 systems and 1064 kW integrated with construction materials).

- Australia demands certified installers in its program
- California only allows a certified list of elements which have to fulfil a minimal guarantee of 5 years.

These actions not only improve the supply chain but increase also the market transparency reducing transaction costs. A well working supply chain is fundamental. Italy is a good example. Although the program Tetti Fotovoltaici included various courses for the training of installers some of them free of charge, the present market has to improve its distribution networks by increasing the number of installers in order to meet the demand caused by the "conto energia".

The measures that can be adopted to guarantee or to improve the technical performace in promotion programs have been analyzed in detail by Barbose ET al, 2006. In their work 8 forms to improve the technical performance by means of an incentive program and 5 performance factors affecting the operation of a PV system are defined. They are depicted in Figure 21.

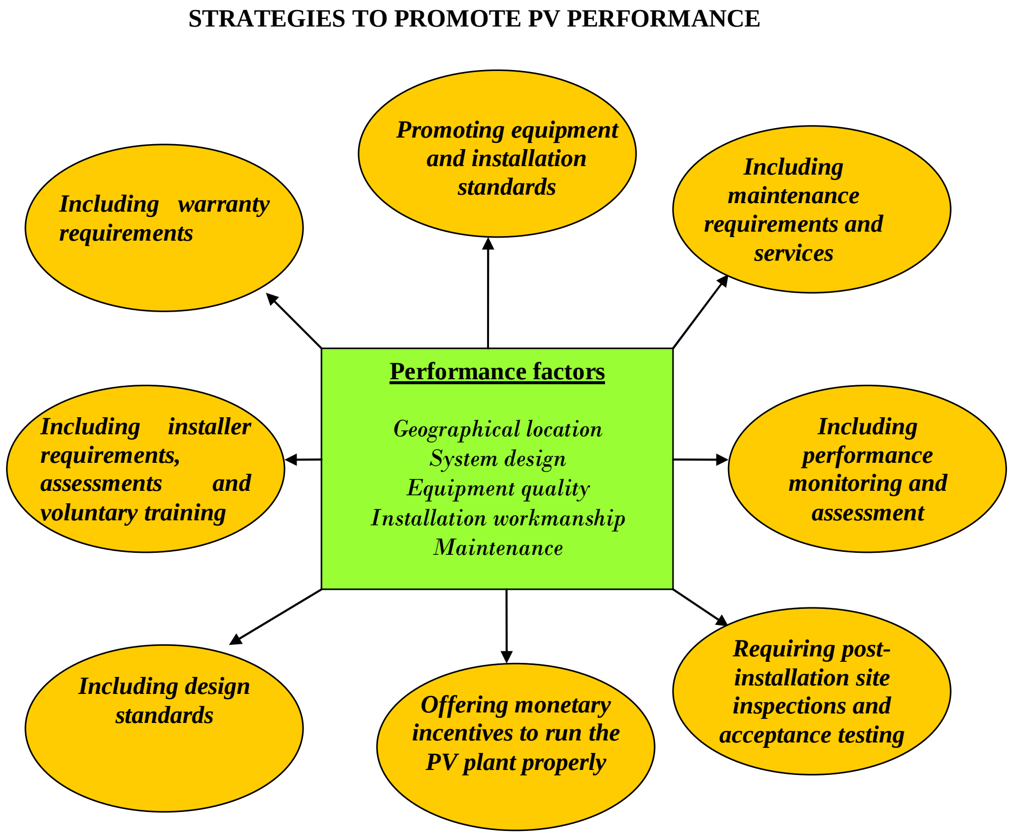

Figure 21: Strategies to promote PV Performance (Source: Barbose et al., 2006)

Table XIX shows by means of examples how these strategies have been applied in some programs:

Table XIX: Strategies to promote the technical performance (Source: Barbose et al, 2006, own researches)

	Performance factors				
Strategies	Geographical location	System design	Equipment quality	Installation workmanship	Maintenance
Promoting Equipment and installation standards	-	-	By accepting only certain eligible systems/ equipment which meets minimum standards.	By requiring certified installers. E.g. Australian PVRP or , California ERP	-
Including maintenance requirements and services	-	-	-	-	By requiring that project contractors conduct maintenance services
Including Performance monitoring and assessment	-	-	-	-	Collecting data of systems output. E.g. Japanese Test on New Photovoltaic Power Generation Technology.
Requiring post-installation site inspections and acceptance testing	-	E.g.: California CSI by paying the incentive after a Third Party Field Verification			-
Offering monetary incentives to run the PV plant properly	Feed in tariffs. E.g.: German EEG or Spanish feed in tariff by offering money per kWh produced during the time of operation				
Including design standards and administrative design review before giving funding	Including solar access regulations which guarantee solar access to each adjacent property.	By requiring minimum standards to orientation, shading to subsidised PV systems etc.	-	-	-
Including installer requirements, assessments and voluntary training	-	By requiring a minimum experience in designing PV systems	-	By including voluntary training for installers E.g.: Italian Tetti Fotovoltaici	-
Including warranty requirements	-	-	E.g. the California CSI requires a 10 year warranty provided by installers and manufacturers. During these ten years consumer is protected against defective workmanship, system and component.		

4.6 MARKET CONFORMITY

The contribution of a policy to a self sustainable PV market will be analysed. In this chapter two perspectives will be considered:

- A first one dealing with small PV grid connected systems and
- A second one dealing basically with larger PV plants.

In the first case we have to evaluate the consumers´ Willingness to Pay (WTP) for PV electricity and in the second case the investor’s Willingness to Invest (WTI). Moreover existing financing possibilities[18] (bottom up approach) e.g. soft loans will be evaluated.

4.6.1 Exhausting Consumer’s WTP in the Residential Sector

A good design of a program must capture the WTP of the citizens. Subsidies should be the difference between the real system costs and the amount which the consumer is ready to pay. A fundamental point of any program is the right estimation of the WTP and to not offer more than necessary. Each program should have the following objectives a) Increase the WTP over time and b) exhaust the WTP

Increase the WTP over time: Two opposite tendencies are observed regarding the increase of WTP over time if we compare Germany and Japan.

- ***WTP has increased***: Up to 50 MW could have been installed in Japan without subventions in 2005 (nevertheless subsidies in FY 2004 were only 45000 Yen /kWp and in FY2005 20000 Yen /kWp)[19.].

- ***WTP has remained invariable: L***ess installed capacity was installed in 2005 than in 2004 in Germany. Among the reasons for the decrease of installed capacity in 2005 in Germany are also the increase of system costs and the reduction of the feed-in tariff. Both reduce the profitability of buyers.

If the WTP remains invariable market sustainability completely depends on the supply side as seen in chapter 2.1 and Figure 7 by means of factors explained in Figure 8.

Exhaust the WTP: In order to exhaust the WTP an important aspect is to avoid "STOP and GO" strategies as it happened in California in 2000. Many applicants cancelled their request for a subsidy when they noticed that in the following year the subsidy was going to be higher. This is a clear example of not exhausting the WTP: consumers paid less than they were willing to. This fact is also depicted in Figure 22[20]. In Figure 22 the total amount of money paid by each participant in two large markets and one emerging market is depicted. The total amount paid by a participant is considered a parameter to analyse the consumer’s WTP.

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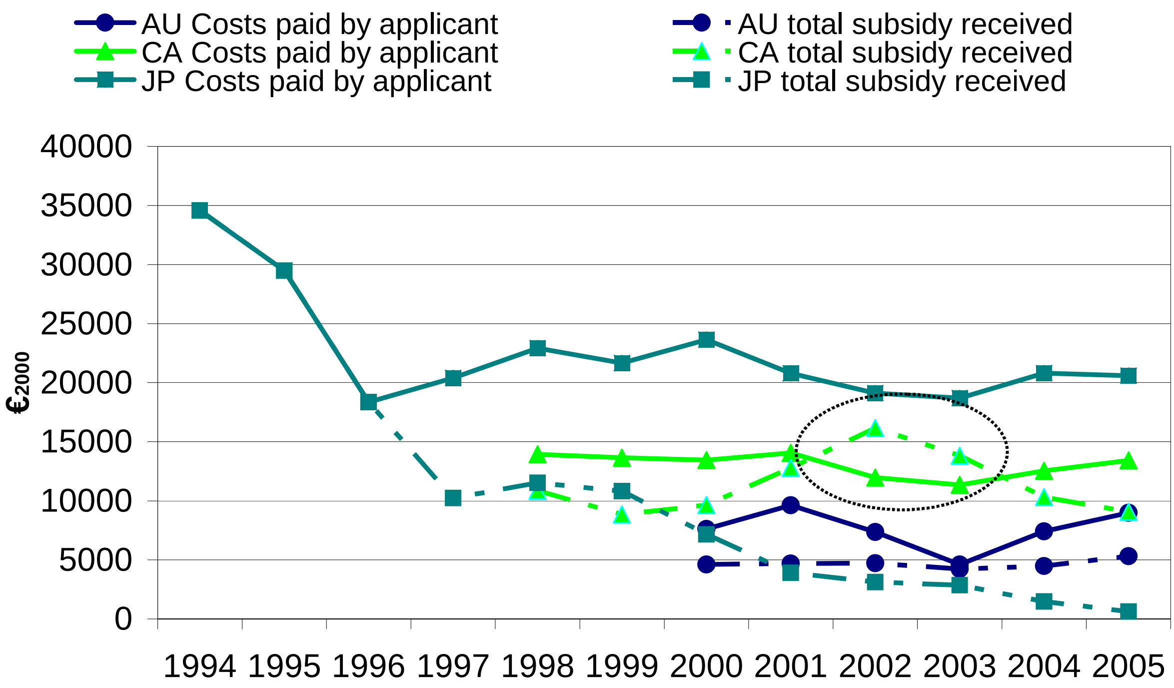
[18] The difference between financing possibility and financial aid is that the first one refers to a bottom up approach and the second one to a top down approach

[19] 45000 Yen ≈335 € in 2004 and 20000 Yen ≈144 € in 2005

[20] For the calculation of the total given subsidy per installed system and the total money spent by the participant (residential sector) the average size of the installed systems is considered in each year.



	Average plant size assumed (kWp)											
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Japan	3,4	3,7	3,8	3,4	3,8	3,6	3,6	3,6	3,7	3,7	3,8	3,8
California					3,4	2,8	3	3	3,1	3,3	3,2	3,2
Australia							1,3	1,5	1,5	1,5	1,59	1,6

Figure 22: Money paid by the applicants per plant vs. subsidies granted per plant over time in two large markets (California and Japan) and one emerging market (Australia) (own calculations)

Notes:
(1) Only systems between 2 kW and 5 kWp are considered in California for the calculation of the average system size.

Two important aspects can be observed: On the one hand only Japan has been able to reduce gradually and from the beginning the subsidy given per applicant what indicates a greater public economic efficiency. On the other hand a slight increase of the money paid by each purchaser is generally observed in the last 2 years in all three countries. In terms of WTP that is a very positive point. If we take into account that Japanese participants were paying ever less money from 2000 to 2003 and that in FY 2002 part of the budget remained without utilizing and was translated to FY 2003 can be stated that WTP was in the last two years well exhausted. Although the subsidies received in the last years in Japan are the lowest of the three markets depicted the money invested by the applicants in Japan is the highest of the three depicted markets. If we consider that the subsidy offered in Australia do not limit the size of the PV plants (Although the amount of financed kW was limited to 1 kWp) can be affirmed that the WTP in the emerging market Australia is lower than in the other two large markets: California and Japan. The WTP in Japan is obviously the highest. This point is also confirmed in Figure 23 where the total installed capacity is divided into capacity paid by private money and by public money[21]. As reference GDP is also shown[22] in order to verify the increase of WTP not only occurred due to an increase of GDP.

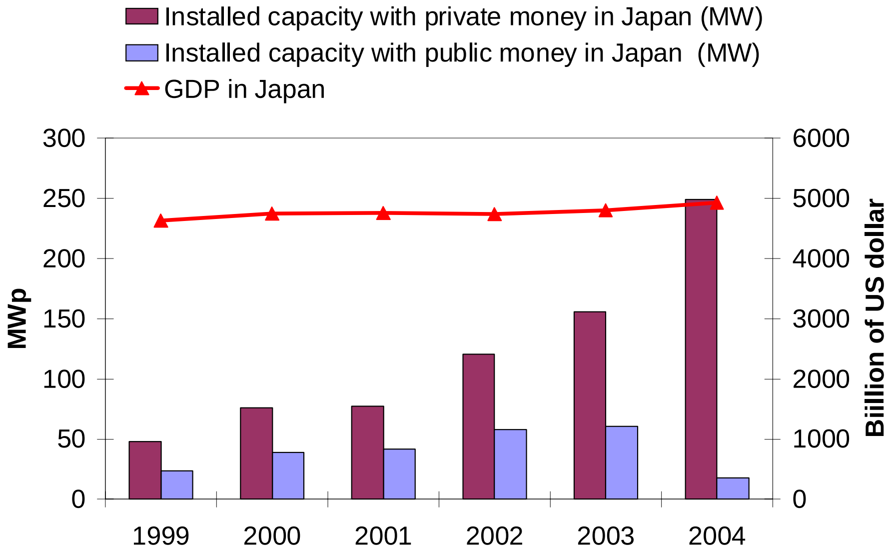


Figure 23: Installed capacity in Japan (Source: OECD stat homepage, own researches)

Voluntary programs which are based on the WTP deserve special mention. Figure 24 shows the evolution of the program offered by the EWZ in Zürich, considered one of most important in Switzerland. The price paid per each kWh by program participants has been reduced considerably from the beginning of the program in 1996 to the present whereas the household electricity rates have remained almost constant. Nevertheless the rate of participation in the program has not increased over the years remaining at a constant 15% of the EWZ clients.

[21] For this calculation total installed capacity was divided into two parts: the first part includes the total capacity which could have been installed with the total of subsidies given i.e. capacity paid by public money. The second part refers to the total capacity which could have been installed by summing up all money invested by applicants

[22] There is a direct relation between WTP and GDP

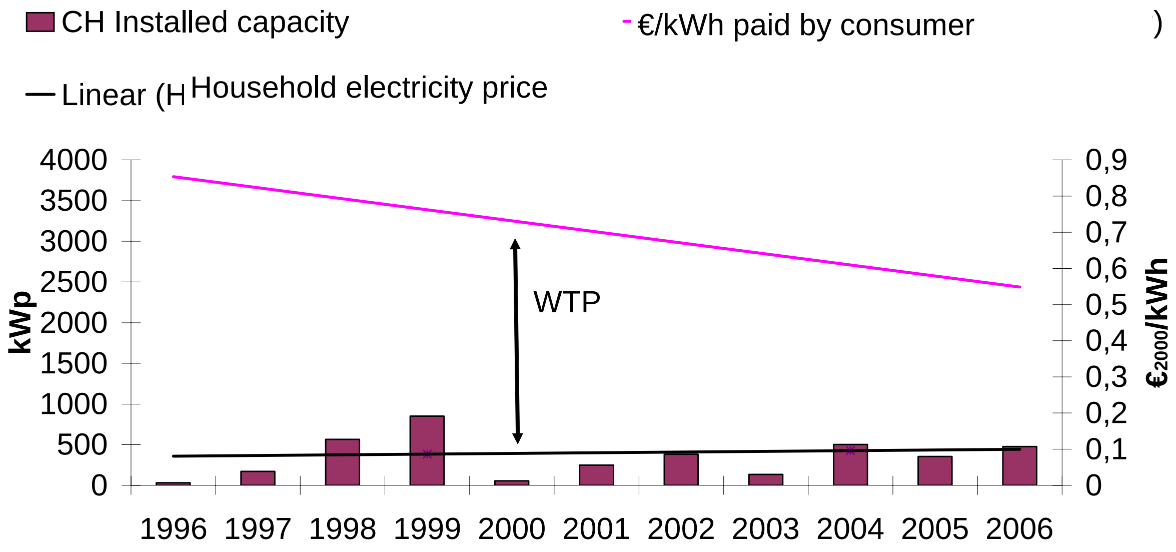


Figure 24: Installed capacity in the framework of the EWZ Solar Stock Exchange (Data available until March 2007) (Source: EWZ homepage)

Although this type of initiatives maintained the market in Switzerland Figure 24 demonstrates that they are not enough to create a sustainable market in the long run.

4.6.2 Profitability for the Consumer

This chapter deals with the following question: How important were the economical margins in a policy/strategy/program? The higher the profitability of PV electricity is the more attractive is PV for the applicants. It depends in the case of feed-in tariffs mostly on the height of the tariff and output of the system, in the case of rebates on the amount of subsidies, electricity rates and also output of the system.

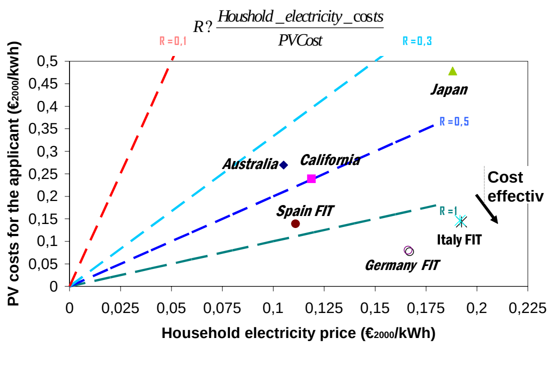


Figure 25: PV electricity cost effectiveness for the consumer including subsidies in 2005 (Source: Eurostat homepage, IEA, Energy Prices & Taxes, 2006 - own calculations)

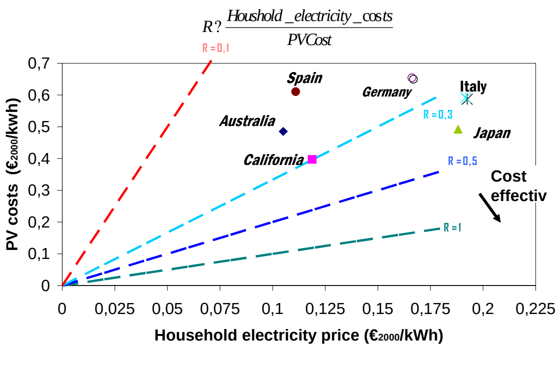


Figure 26: PV electricity cost effectiveness for the consumer without including subsidies in 2005. (Source: Eurostat homepage, IEA, Energy Prices & Taxes, 2006 - own calculations)

Notes:
(1) Japan: The household electricity prices depend upon utility company (e.g. region) and amount of consumption in one month. However, the averaged price would be about 23 JPY/kWh [own researches]
(2) California: Retail electricity rates contain only modest taxes, which may be ignored due to their size. The average retail price of electricity in CA is *11.63 $cents/kWh, *though this varies considerably across customer classes and different utilities: [own researches]
(3) Household electricity prices include all taxes except VAT or sale taxes 4Assumptions for the calculation of PV electricity: Life time 20; IRC = 6%, Full load hours: Australia: 1300 hours, California: 1300 hours, Germany: 850, Italy 1000 Hours, Japan: 1000 hours, Spain: 1150 hours

Figure 25 and Figure 26 show the cost effectiveness of PV electricity from the point of view of a participant. Figure 25 considers the subsidies given in each case and the prices of the electricity in the domestic sector. Figure 26 does not consider the subsidies. Germany is at the margin of the cost effectiveness like Italy and Spain in case of adding the existing FIT with a 20% subsidy[23]. In the case of Australia the low prices of the household electricity play against the PV cost effectiveness in spite of the high levels of solar radiation in this region. It is remarkable that in spite of the relatively low cost effectiveness in Japan (lower subsidies) a big amount of systems has been installed each year. This confirms the high WTP analysed in the previous section.

4.6.3 Providing Financing Possibilities

In this study financing is defined as the money to be borrowed or available for the start up project. In the residential sector it is relevant to offer a financing possibility in addition to the financial aid. Although the most common way to finance systems is by means of soft loans Table XX shows some other examples of financing possibilities in the residential sector over the world.

[23] Most of autonomous regions offer investment subsidies of at least 20%

Table XX: Example of financing programs

COUNTRY	FINANCING TYPE	DESCRIPTION
Germany	PV Soft loan	Solarstromerzeugen
Spain	PV Soft loan	Spanish Financing Line ICO-IDAE
California (US)	Special soft mortgage loans for renewable energy systems	Different banks are providing soft mortgage loans secu by the property.
Japan	New house financing offered by housing manufacturer	Some Japanese prefabricated housing manufacturers include PV as standard equipment (rather than option). They tend to invest the money saved from lowering production costs through mass production to equip buildings with more high quality components like PV.
Germany(1)	Leasing	Costumers rent the PV system. Payments are received by the leasing company which has financed the systems and which transfer the system to the consumer after a period of time.

Notes:
(1) Leasing is mostly used for the financing of large plants.

Classical investment subsidies are also a way to have a start up capital for the financing of the PV plants. Nevertheless and as already mentioned in chapter 4.5 they do not foster the good operation of the systems without additional measures. In this sense the hybrid between subsidies and feed in tariffs which is being applied within the framework of California CSI has to be mentioned: the "Expected performance based buydown" given is based on receiving an amount of money at the beginning of the program depending on the expected Energy output of the system.

In this study two similar financing programs have been chosen for comparison: the Spanish ICO-IDAE Line and the German "Solarstromerzeugen". Figure 27 shows the capacity financed by both programs in 2005. The program "Solarstromerzeugen" offers a maximum loan of 50000 € and therefore beneficiaries are mostly residential[24].

[24] Systems financed by ICO-IDAE and <10kWp only amount to 18.5% of the total financed systems

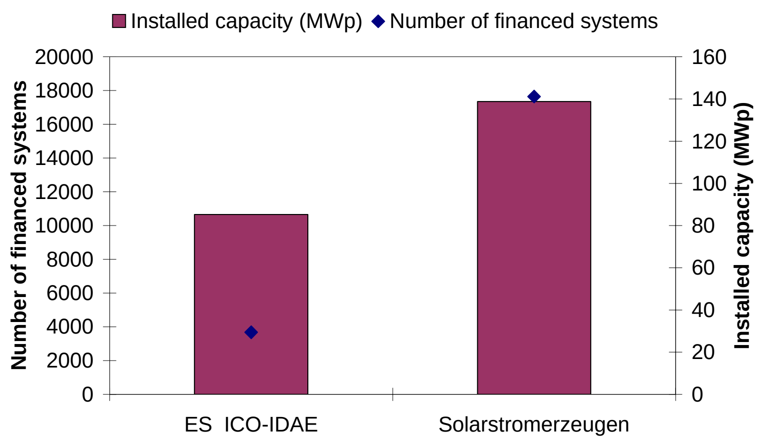


Figure 27: Capacity and number of systems financed by both programs in 2005

Whereas the ICO-IDAE has cooperation agreements with a list of financial organizations the Solarstromerzeugen program is organized by the KfW but it is managed by the house banks. This generates ample transaction costs due to the frequent ignorance of the program among many house banks. On the other hand the ICO IDAE line did not differentiate between different plant sizes. Since the systems to finance were accepted according to the order of entrance large plants received not only the financing of the systems but also an investment subsidy. Small plants often received only the soft loan but not the investment subsidy since the budget was finished when they came to know of the program. It seems that great investors were more prepared for the call than small investors. Moreover the improvement of the efficiency of the Spanish program stands out. While only 4,8% of presented projects were financed in 2001 this rate rose to 92, 3 % in 2005. This is a positive example for WTP well exhausted as discussed in previous sections.

4.6.4 Enforcing Investor's WTI Effects on the System Sizes

Many authors maintain that the success of a policy depends on the attractiveness for investors in the long term. Certain countries have experienced a real boom in the sector coinciding with the introduction of certain policies. That's the very well known case in Germany but also in Spain and a promising Italy (see Figure 10 and Figure 11). Nevertheless this situation entails some effects. The most important effect is the ever increasing plant sizes and the number of centralized plants. This indicates a market characterized by ever larger investments. This effect is depicted in Figure 28, Figure 29 and Figure 30.

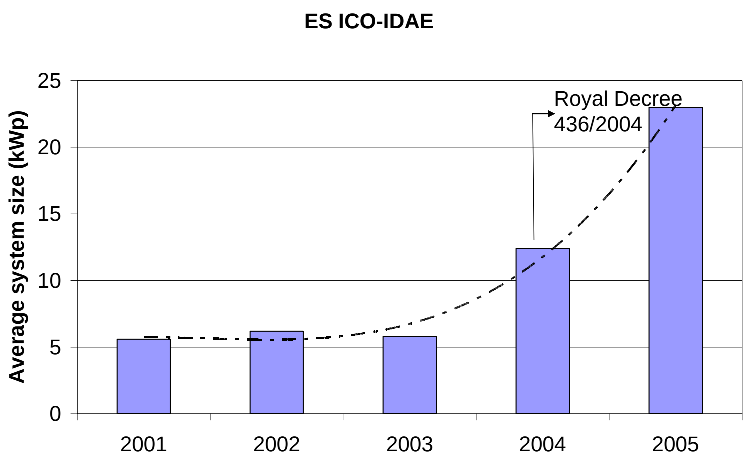


Figure 28: Average plant sizes approved in the Spanish Financing Line ICO-IDAE. (Source: IDAE, 2006)

Figure 28 shows the average size of requested plants in the program ICO-IDAE.

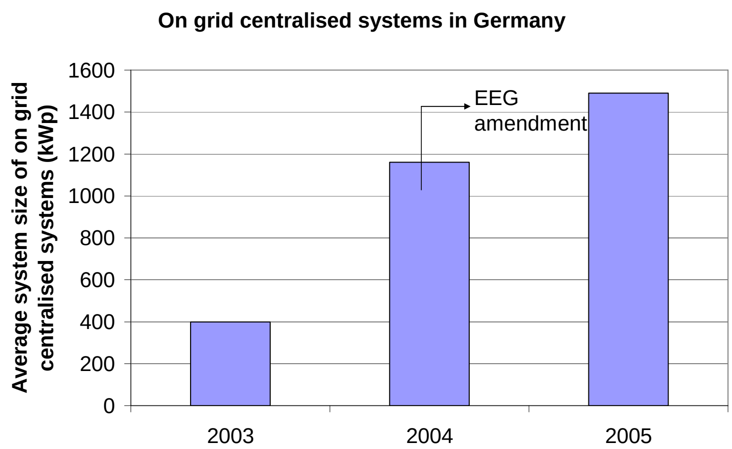


Figure 29: Average plant sizes of on grid centralised systems in Germany (Source: ARGE Monitoring PV Anlagen, 2006)

Figure 29 shows the increasing size of grid centralised systems in Germany since 2003. The same effect is depicted in Figure 30 for plants > 50kWp which have been accepted until now in past calls.

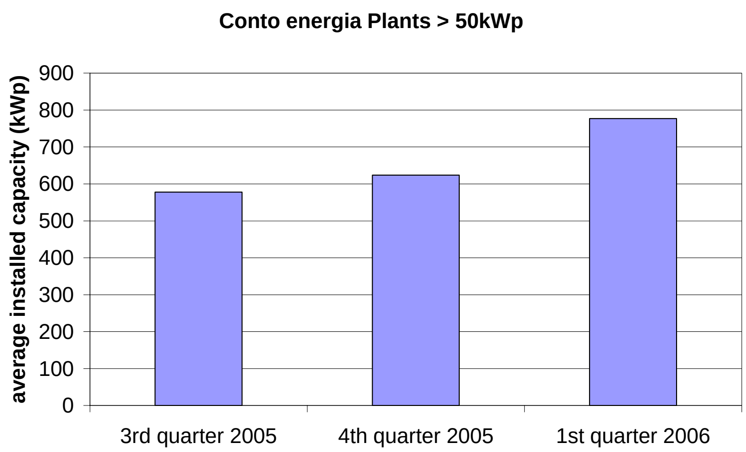


Figure 30: Average plant sizes of approved systems >50kW through the Italian "Conto Energia" (Source: GRTN homepage)

This tendency is contradictory to one of the greatest advantages of PV use: its decentralized use as integral part of a building. This advantage (so-called added value) affects and benefits both consumers and general public due to lack of acceptance problems and environmental benignity.

5 OVERALL PERFORMANCE: MARKET TRANSFORMATION

Figure 31 shows two curves each for the Japanese Residential PV System Dissemination Program and for California Energy Commission Program: the total system costs and the system costs for each consumer taking into account the rebates given. The figure follows the theory explained in

Figure 9. The x-axis represents the yearly installed capacity per 100000 inhabitants. It can be observed that in Japan both curves arrive at a single point, what indicates that each time less subsidies have been given as already has been indicated in other sections but also that the WTP of the population is converging with the prices of the systems. This could indicate that the systems could be competitive without aid of more subsidies. The other rebate programs analysed (e.g. California) are still far away from this converging point although they may show the same tendency as observed in Japan. Although PV installation in 2005 by JP RPVDP was less than in 2004, total installation including "without subsidies" and "using other scheme" in 2005 was slightly over in 2004. Although we have to wait in order to speak about a self sustainable and mature market there is no doubt that Japan is in the right way to get the needed market transformation.

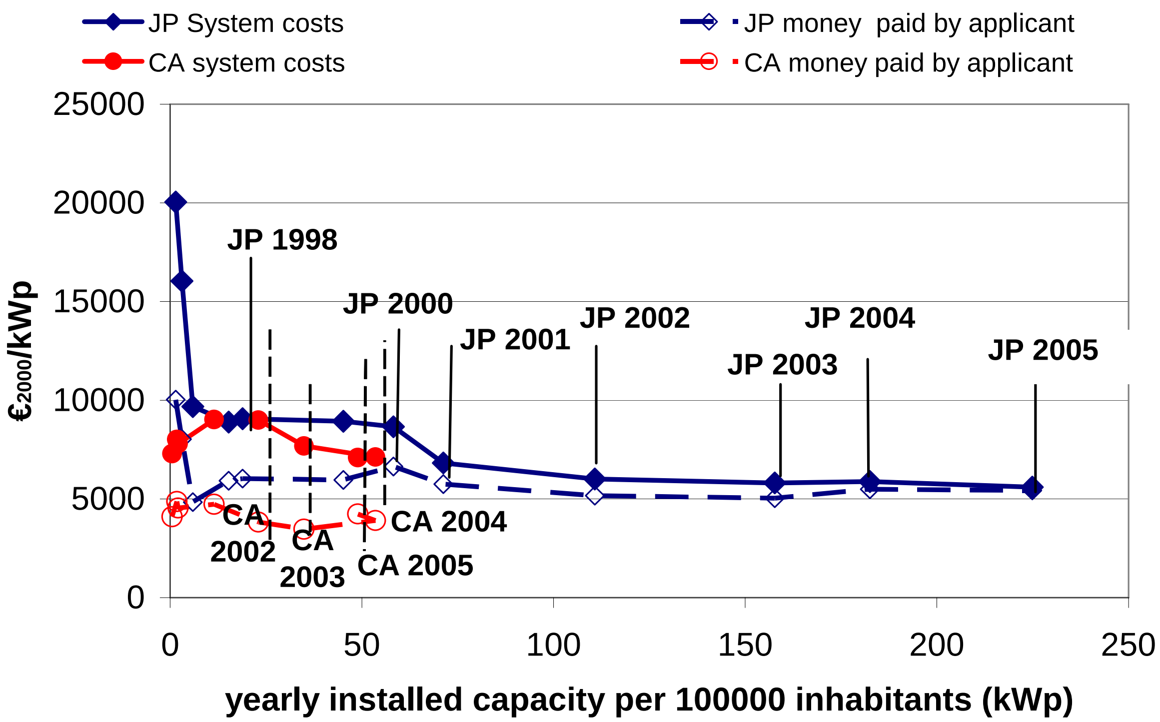


Figure 31: System costs per kWp vs. costs for the applicant per kWp – evolution in two large markets with investment subsidies (Japan and California) (own calculations)

6 CONCLUSIONS

The development of the large grid connected PV markets show that promotion policies and marketing programs are currently the most significant drivers for the increase in PV deployment. Worldwide a wide spectrum of promotion policies and marketing programs exist. The success of these programmes depends on many variables and has to be evaluated from supply side as well as demand side points of views

On the supply side the major conclusions are:

- Regarding the effect of promotion policies on system market prices it can be stated that there exist an imperfect market yet. Although system costs decreased significantly in the last 10 years they generally increased or only experienced a slight decrease in recent years. This increase can be argued not only due to global aspects as lack of silicon. Important reasons are also the increase of costs caused by increase of demand and the fact that some sectors can be increasing their benefits despite the decrease of production costs for modules. Both facts are short term effects in imperfect markets.
- Whereas the module prices are determined essentially by international and global market laws, installation costs are mostly determined by the local market. Nevertheless policies have to be designed in a way that they represent an incentive to reduce mostly installation costs.
- The Japanese Residential PV System Dissemination Program has proven to be the most efficient one regarding system cost decrease. It was reached basically due to a long program continuity which was able to give confidence to the industry by creating a solid and stable market.
- Market transparency is essential. For this reason is necessary to encourage system standardization and to improve the supply chain. This can be done by including, installer courses (as it was done in Italy), guarantees requirements (as it was done in California), eligible certified installers (as it was done in Australia) or reference prices (as it was done in Spain)
- Although rebates on investments do not ensure an optimal performance of the PV system over its lifetime due to the lack of incentive to run the installation properly after the subsidy has been paid, other measures like monitoring programs, supervision or subsidies dependent on the efficiency system (as in the Japanese Field Test on New Photovoltaic Power Generation Technology) can have a positive effect.

The most important conclusions on the demand side are:

- More important than the achievement of cost effectiveness is the convergence of system costs and consumers' Willingness to Pay. In this spirit investment subsidies as in Japan, California or Australia has been proved to be more successful than feed in tariffs
- Well designed feed-in tariffs have proved successful in order to boost larger projects with high investment volumes. In addition feed in tariffs in Spain, Italy

and Germany proved successful in order to develop a fast market by installing (or requesting) a big amount of capacity in a short time.

- The Italian, Spanish and German markets are characterized by increasing specific investments. The most important effect is the ever increasing plant sizes and the number of centralized plants. This tendency is contradictory to one of the greatest advantages of PV use: its decentralized use as integral part of a building which permits a lack of acceptance problems and environmental benignity.
- Private and voluntary initiatives can sustain a market in the short term if a certain level of solar awareness is available (as it occurred in Switzerland). Nevertheless they are not sufficient to develop a sustainable local market. On the one hand they do not give the sufficient long term confidence to the industry and on the other hand saturation of consumer demand is reached. It can be stated as pioneer work.

Moreover a few recommendations for policy maker can be derived:

- all programs should include in the design the following goals:
  - Exhaust the Willingness to pay and
  - Increase the Willingness to pay over time
- Coordination between policies within a country is necessary in order to avoid oversubsidized markets. It is very important to avoid stop and go policies to give confidence to investors and consumers

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APPENDIX 1

Table XXI: Major Marketing Programs and important milestones in the past

MAJOR MARKETING PROGRAMS IN THE PAST and important MILESTONES			
Program	**Country**	**Year**	**Type of program**
Burgdorf Full Cost Rate	**CH**	**1991-1998**	**feed-in tariff**
The city of Burgdorf introduced in 1991 the Full Cost Rate. It is considered the first feed-in tariff. 1Fr/kWh was paid			
The German 1000 roofs program	**DE**	**1989-1994**	**Investment subsidy**
The German 1000 roof program was the first comprehensive international dissemination program. 2250 German residential roofs were equipped with PV systems. A total capacity of about 6 MW was installed. The systems received average subsidies of 70% of the investment costs.			
California ERP	**US**	**1998-2006**	**Investment subsidy**
The ERP was funded by ratepayers of four investor-owned utilities in California. In the last periode (July 2006) $2.60/kW for systems up to 30 kWp were offered			
Green Pricing Programs	**Various (CH,DE,AU,AT, US,NL)**	**Early 90s until now**	**Voluntary generation-based financial incentives**
Utilities or other companies sell electricity generated from renewables at a higher price and take this premium to provide financial incentives for a PV generator. The incentive is paid by the green customer per kWh or kWp			
The Austrian 200 kW rooftop program	**AT**	**1992-1994**	**Investment subsidy**
About 100 small residential grid-connected systems were installed. They were subsidized by authorities and electric utilities with about 58% of the investment costs			
Japanese Residential PV System Dissemination Program	**JP**	**1994-2005**	**Investment subsidy**
Rebates have been decreasing continuously over time. While in the first years of the program (1994-1999) the subsidies were a fixed percentage of the costs (decreasing from 50% to 33%) this concept changed into fixed amounts in €/kWp			
German 100000 Roof Program	**DE**	**1999-2003**	**Soft loan**
Within this program soft loans were put at public's disposal. In the last period of the program PV installations with more than 1kWp were eligible for the program and the interest rate was still 4,5. More than 300 MWp were installed			
Italian "Tetti fotovoltaici"	**Italy**	**2001-2005**	**Investment subsidy**
The program was managed in its second phase by the 19 Italian regions through local announcements. As a consequence each region has adopted its own amount of incentives. Some regions adopted a 70% incentive, while others adopted 65% with a maximum investment cost ranging from 7 to 7,5 €/Wp depending on plant size.			

Table XXII: Major Marketing Programs at present

<table>
<tr><th colspan="5">MAJOR PV PROMOTION PROGRAMS at PRESENT</th></tr>
<tr><th colspan="5">INVESTMENT SUBSIDIES</th></tr>
<tr><th colspan="2">Program</th><th>Country</th><th colspan="2">Period</th></tr>
<tr><td colspan="2">California Solar Initiative</td><td>US</td><td colspan="2">2007-2017</td></tr>
<tr><td colspan="5">3 GW PV will be installed until 2017. Initial PV incentive levels of $2.50 per Watt will be set and they will be reduced by an average of approximately 10% annually.</td></tr>
<tr><td colspan="2">Japanese Field Test Project on New PV Power Generation Technology Program</td><td>JP</td><td colspan="2">Since 2002</td></tr>
<tr><td colspan="5">With a budget of 1,2 billion Yen for FY 2006, PV systems for public, industrial facilities and other non residential applications will be promoted on a large scale</td></tr>
<tr><td colspan="2">Swedish PV Program</td><td>SE</td><td colspan="2">2005-2007</td></tr>
<tr><td colspan="5">100 MSEK are foreseen for the installation of PV in public buildings. Subsidies amounts up to 70%.</td></tr>
<tr><td colspan="2">SOL1000</td><td>DK</td><td colspan="2">2001-2006</td></tr>
<tr><td colspan="5">The Danish SOL1000 builds on the experience of the previous SOL 300 and is managed by the Danish Energy Agency. House owners received 40% of investment costs.</td></tr>
<tr><td colspan="2">Australian PVRP</td><td>AU</td><td colspan="2">2000-2007</td></tr>
<tr><td colspan="5">Investment subsidies are provided to household owners and community builders. At present 8AUD/Wp are granted.</td></tr>
<tr><th colspan="5">FITS FOR SMALL RESIDENTIAL ROOF TOP SYSTEMS</th></tr>
<tr><td>Country</td><td>€c/kWh</td><td>years</td><td>Cap (MWp)</td><td>Annual degression</td></tr>
<tr><td>BE (Flemish)</td><td>45</td><td>20</td><td>NO</td><td>NO</td></tr>
<tr><td>DE</td><td>49,2</td><td>20</td><td>NO</td><td>5%</td></tr>
<tr><td>IT</td><td>44,5</td><td>20</td><td>3000</td><td>2%</td></tr>
<tr><td>PT</td><td>44</td><td>15</td><td>150</td><td>NO</td></tr>
<tr><td>GR</td><td>45</td><td>20</td><td>NO</td><td>NO</td></tr>
<tr><td>FR</td><td>30,51</td><td>20</td><td>n.a</td><td>5%</td></tr>
<tr><td>ES</td><td>44,04</td><td>25[25]</td><td>150</td><td>NO</td></tr>
<tr><td>Washington State</td><td>0,35</td><td>10</td><td>n.a</td><td>n.a</td></tr>
<tr><td>KR</td><td>58</td><td>15</td><td>n.a</td><td>n.a</td></tr>
<tr><td>Canada (Ontario)</td><td>28</td><td></td><td></td><td></td></tr>
<tr><th colspan="5">GREEN PRICING</th></tr>
<tr><th colspan="3">Program</th><th>Country</th><th>Period</th></tr>
<tr><td colspan="3">EWZ Solar Stock Exchange</td><td>CH</td><td>1996-now</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><th colspan="5">RENEWABLE PORTFOLIO STANDARDS (RPS)</th></tr>
<tr><th>Program</th><th>Country</th><th colspan="3">Period of time</th></tr>
<tr><td>New Jersey's RPS</td><td>US</td><td colspan="3">2006-2020</td></tr>
<tr><td colspan="5">The New Jersey Board of Public Utilities (NJBPU) approved 20% of electricity must come from Renewables until 2020. This mandate also includes a 2% of solar electricity or approx. 1500 MW. That is the US´s largest solar goal on a per capita basis.</td></tr>
<tr><td>Japanese Renewables Portfolio Standard</td><td>Japan</td><td colspan="3">2003-2014</td></tr>
<tr><td colspan="5">The quota for new energy use was set at 1,63% of the total electricity sales by FY 2014 (16 billion kWh). PV generation is directly affected by this measure as 1 kWh PV power generated accounts for 2 kWh in order to equal PV to other less expensive renewable energy electricity generators</td></tr>
</table>

[25] After 25 years 35,23 €c/kWh until decommission.

APPENDIX 2

In order to be able to consider monetary real values of costs and prices the year 2000 has been taken as reference just as it has been done by the OECD in some of the data offered in the OECD statistic data homepage. The used values results in $€_{2000}$. This value indicates the real value of the currency in 2000 considering the real effective exchange rate of each country.

That is to say:

$$€_{2000} = (\text{Monetary value}_{\text{year x, country y}} * \text{Currency exchange rates}_{\text{year 2000, country y}}) / \text{Real effective exchange rates (reference year 2000)}_{\text{year x, country y}}$$

The values of Currency exchange rates $_{\text{year 2000, country y}}$ and Real effective exchange rates (reference year 2000) $_{\text{year x, country y}}$ are shown in following tables:

	Real effective exchange rates, Index 2000=100												
Country	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Denmark	101,6933	105,3591	103,8233	101,1883	103,5091	103,5641	100	101,4983	103,3525	108,4099	109,1374	107,9283	107,5608
Germany	113,4766	117,824	113,0891	107,6516	108,9124	106,3499	100	99,915	100,6333	105,5341	106,8641	105,2533	104,6091
Italy	100,0467	92,89012	102,815	103,3558	104,8749	103,9183	100	101,1858	103,2216	108,894	110,6157	109,354	109,214
Japan	103,7483	105,5433	88,22667	83,35833	84,205	94,48917	100	89,47833	83,8925	85,03083	86,28416	81,27666	73,42
Netherlands	107,9049	112,0216	108,9699	103,2583	106,2783	105,5658	100	102,9291	106,7333	114,2265	115,8874	114,2915	112,9699
Spain	102,415	103,9567	105,635	101,1067	102,1208	101,9592	100	102,0792	104,4434	109,3517	111,5568	112,3218	113,9493
Sweden	104,5975	103,7967	111,7317	106,2725	103,3333	101,3833	100	91,6625	93,98	99,3825	99,54667	95,3975	94,92667
Switzerland	108,2625	114,8025	110,6633	102,2575	104,0758	102,8692	100	102,15	105,8192	106,16	105,1742	103,1642	100,3658
United States	84,94096	83,7068	86,31678	90,79758	98,06918	96,82669	100	105,7183	105,8325	99,715	95,58504	94,12589	93,40005

	Currency exchange rates, National units per US-Dollar												
Country	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Australia	1,369075	1,349558	1,276883	1,348025	1,5923	1,549667	1,726525	1,935375	1,841308	1,541542	1,359233	1,312783	1,3271
Canada	1,3659	1,372483	1,363783	1,385008	1,483492	1,485533	1,485108	1,548408	1,570042	1,400358	1,301092	1,211708	1,134317
Denmark	6,360209	5,60375	5,798242	6,604075	6,699308	6,9799	8,088034	8,320808	7,884284	6,577	5,987558	5,996092	5,943008
Japan	102,2286	94,06539	108,817	120,9966	130,8945	113,888	107,8347	121,4838	125,2549	115,9363	108,1469	110,0971	116,3544
Korea	804,2682	771,398	804,4202	950,5074	1400,477	1186,706	1130,64	1290,41	1251,045	1190,959	1145,197	1024,226	951,8166
Sweden	7,7157	7,133616	6,707067	7,634608	7,947075	8,26235	9,160583	10,33838	9,721042	8,078217	7,346	7,472408	7,373333
Switzerland	1,367058	1,182092	1,236133	1,450017	1,44965	1,502733	1,687933	1,686958	1,556758	1,344808	1,242742	1,24815	1,253192
United	0,6532583	0,6337	0,6408167	0,6105	0,6035666	0,6180916	0,660575	0,6942917	0,66655	0,6122833	0,5457583	0,5501167	0,5433916
Euro area	0,8430667	0,7649546	0,78779	0,8823804	0,8941227	0,9385333	1,085083	1,116625	1,061067	0,8851584	0,8048583	0,804625	0,7967

Data extracted on 2007/04/05 from OECD.Stat