INTERNATIONAL ENERGY AGENCY
CO-OPERATIVE PROGRAMME ON
PHOTOVOLTAIC POWER SYSTEMS

Task 1

Exchange and dissemination of information on

PV power systems

National Survey Report of PV Power Applications in The Netherlands 2009

Prepared by KEMA Nederland BV, J-OB & TU/e

Co-ordinated by

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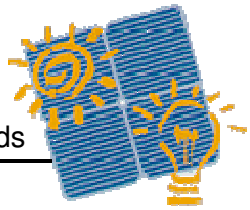
for NL Agency & the Ministry of Economy, Agriculture & Innovation



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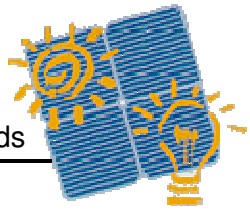
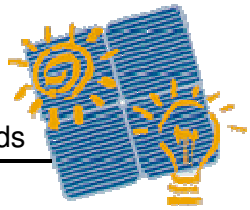




DEFINITIONS, SYMBOLS AND ABBREVIATIONS

For the purposes of this and all IEA PVPS National Survey Reports, the following definitions apply:

PV power system market: The market for all nationally installed (terrestrial) PV applications with a PV power capacity of 40 W or more.

Installed PV power: Power delivered by a PV module or a PV array under standard test conditions (STC) – irradiance of 1 000 W/m^2, cell junction temperature of 25°C, AM 1,5 solar spectrum – (also see 'Rated power').

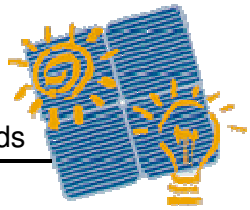
Rated power: Amount of power produced by a PV module or array under STC, written as W.
PV system: Set of interconnected elements such as PV modules, inverters that convert DC current of the modules into AC current, storage batteries and all installation and control components with a PV power capacity of 40 W or more.

Module manufacturer: An organisation carrying out the encapsulation in the process of the production of PV modules.

Off-grid domestic PV power system: System installed to provide power mainly to a household or village not connected to the (main) utility grid(s). Often a means to store electricity is used (most commonly lead-acid batteries). Also referred to as 'stand-alone PV power system'. Can also provide power to domestic and community users (plus some other applications) via a 'mini grid', often as a hybrid with another source of power.

Off-grid non-domestic PV power system: System used for a variety of industrial and agricultural applications such as water pumping, remote communications, telecommunication relays, safety and protection devices, etc. that are not connected to the utility grid. Usually a means to store electricity is used. Also referred to as 'stand-alone PV power system'.

Grid-connected distributed PV power system: System installed to provide power to a grid connected customer or directly to the electricity grid (specifically where that part of the electricity grid is configured to supply power to a number of customers rather than to provide a bulk transport function). Such systems may be on or integrated into the customer's premises often on the demand side of the electricity meter, on public and commercial buildings, or simply in the built environment on motorway sound barriers etc. They may be



specifically designed for support of the utility distribution grid. Size is not a determining feature – while a 1 MW PV system on a rooftop may be large by PV standards, this is not the case for other forms of distributed generation.

Grid-connected centralized PV power system: Power production system performing the function of a centralized power station. The power supplied by such a system is not associated with a particular electricity customer, and the system is not located to specifically perform functions on the electricity grid other than the supply of bulk power. Typically ground mounted and functioning independently of any nearby development.

Turnkey price: Price of an installed PV system excluding VAT/TVA/sales taxes, operation and maintenance costs but including installation costs. For an off-grid PV system, the prices associated with storage battery maintenance/replacement are excluded. If additional costs are incurred for reasons not directly related to the PV system, these should be excluded. (E.g. If extra costs are incurred fitting PV modules to a factory roof because special precautions are required to avoid disrupting production, these extra costs should not be included. Equally the additional transport costs of installing a telecommunication system in a remote area are excluded).

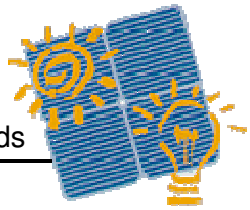
Field Test Programme: A programme to test the performance of PV systems/components in real conditions.

Demonstration Programme: A programme to demonstrate the operation of PV systems and their application to potential users/owners.

Market deployment initiative: Initiatives to encourage the market deployment of PV through the use of market instruments such as green pricing, rate based incentives etc. These may be implemented by government, the finance industry, utilities etc.

Final annual yield: Total PV energy delivered to the load during the year per kW of power installed.

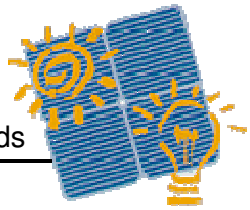
Performance ratio: Ratio of the final annual (monthly, daily) yield to the reference annual (monthly, daily) yield, where the reference annual (monthly, daily) yield is the theoretical annual (monthly, daily) available energy per kW of installed PV power.



Currency: The currency unit used throughout this report is Euro (€).

PV support measures:

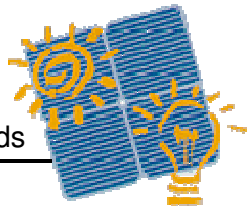
Enhanced feed-in tariff	an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility) at a rate per kWh somewhat higher than the retail electricity rates being paid by the customer
Capital subsidies	direct financial subsidies aimed at tackling the up-front cost barrier, either for specific equipment or total installed PV system cost
Green electricity schemes	allows customers to purchase green electricity based on renewable energy from the electricity utility, usually at a premium price
PV-specific green electricity schemes	allows customers to purchase green electricity based on PV electricity from the electricity utility, usually at a premium price
Renewable portfolio standards (RPS)	a mandated requirement that the electricity utility (often the electricity retailer) source a portion of their electricity supplies from renewable energies (usually characterized by a broad, least-cost approach favouring hydro, wind and biomass)
PV requirement in RPS	a mandated requirement that a portion of the RPS be met by PV electricity supplies (often called a set-aside)
Investment funds for PV	share offerings in private PV investment funds plus other schemes that focus on wealth creation and business success using PV as a vehicle to achieve these ends
Income tax credits	allows some or all expenses associated with PV installation to be deducted from taxable income streams
Net metering	in effect the system owner receives retail value for any excess electricity fed into the grid, as recorded by a bi-directional electricity meter and netted over the billing period
Net billing	the electricity taken from the grid and the electricity fed into the grid are tracked separately, and the electricity fed into the grid is valued at a given price



Commercial bank activities	includes activities such as preferential home mortgage terms for houses including PV systems and preferential green loans for the installation of PV systems
Electricity utility activities	includes 'green power' schemes allowing customers to purchase green electricity, large scale utility PV plants, various PV ownership and financing options with select customers and PV electricity power purchase models
Sustainable building requirements	includes requirements on new building developments (residential and commercial) and also in some cases on properties for sale, where the PV may be included as one option for reducing the building's energy foot print or may be specifically mandated as an inclusion in the building development

List of abbreviations:

EIA	Energie Investeringsaftrek (Energy Investment Rebate)
EOS	Energie Onderzoek Subsidie
FiT	Feed in Tariff
fte	full time equivalent
FP7	seventh framework programme
IEA	International Energy Agency
IEE	Intelligent Energy Europe
JSP	Joint Solar Programme
NMP	Nanosciences, materials & production technologies
PV	photovoltaic
SDE	Stimulering Duurzame Energieproductie (Promotion of Renewable Energy Production)
SME	Small & Medium Enterprise
STW	Stichting Technische Wetenschappen (Foundation for Technological Science)
UKP	Unieke Kansen Programma (Unique Opportunity Programme)
WBSO	Wet Bevordering Speurwerk en Onderzoek (Tax incentive for RTD)
W_p	Watt-Peak



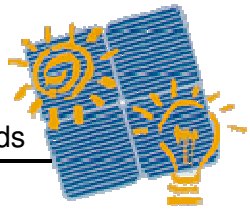
FOREWORD ABOUT IEA

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD) which carries out a comprehensive programme of energy co-operation among its 23 member countries. The European Commission also participates in the work of the Agency.

The IEA Photovoltaic Power Systems Programme (IEA-PVPS) is one of the collaborative R&D agreements established within the IEA and, since 1993, its participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The 21 participating countries are Australia (AUS), Austria (AUT), Canada (CAN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Malaysia (MYS), Mexico (MEX), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), the United Kingdom (GBR) and the United States of America (USA). The European Commission, the European Photovoltaic Industry Association and the US Solar Electric Power Association are also members.

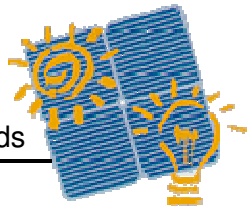
The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual Tasks (research projects / activity areas) is the responsibility of Operating Agents. Information about the active and completed tasks can be found on the IEA-PVPS website www.iea-pvps.org.



INTRODUCTION

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of photovoltaic power systems.

An important deliverable of Task 1 is the annual Trends in photovoltaic applications report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the Dutch National Survey Report for the year 2009. Information from this document will be used as input to the annual Trends in photovoltaic applications report. The PVPS website www.iea-pvps.org also plays an important role in disseminating information arising from the programme, including national information.



1 EXECUTIVE SUMMARY

1.1 Installed PV power

A total of 10,5 MW of PV were installed in the Netherlands in 2009, a 150% increase on 2008 levels. This was grid-connected and for 92% realised in medium and small systems. Total installed capacity in the Netherlands is now 67,5 MW.

1.2 Costs & prices

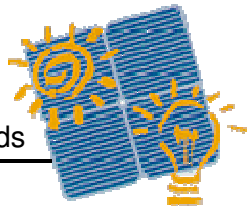
Typical module and system prices decreased in 2009. Module prices are estimated at between 1,5 and 2,3 €/W_p, small grid systems between 3,4 - 4,0 €/W_p and large ranging from 3,3 to 3,8 €/W_p.

1.3 PV production

The main PV cells producer Solland Solar (18 MW) opened a second line (40 MW) in 2007 and a third line (110 MW) in 2008. In 2009 Helianthos opened its pilot production line for flexible cells. Ubbink Solar Modules B.V. had to close its 45 MW solar module manufacturing plant in Doesburg. Scheuten Solar (Venlo) opened a module production line on the other side of the border (Germany). Furthermore, Dutch companies, Mastervolt, Nedap and Exendis, produce PV inverters, mainly for the export market. Equipment suppliers, such as OTB, Smit Ovens and Tempress, for manufacturing lines are increasingly more important.

1.4 Budgets for PV

The policy for PV in the Netherlands is focussed on both cost reduction through research and development, and the stimulation of PV application through energy subsidies. This is well reflected in the budgets spend on PV in 2009. 28,2 M€ of the total national spending for PV went to research and development. Tax and renewable energy incentives and subsidies for implementation amount to a total of 144,5 M€. Funding provided by local and regional authorities are becoming more and more important relative to national funding since national funding programmes are reduced. The Netherlands is still in the top of PV RTD: in European framework programmes on solar energy Dutch partners get 2,5 times higher funding than the European average and 10% of the projects are coordinated by Dutch participants.



2 THE IMPLEMENTATION OF PV SYSTEMS

2.1 Applications for photovoltaics

In the Netherlands the PV market is divided in 6 segments or sub-segments:

1. grid connected systems (division based on the SDE-scheme (see § 4.1.1))
   a. large systems: more than 100 kW
   b. medium sized systems: less than 100 kW, but more than 15 kW
   c. small systems: less than 15 kW
2. stand alone systems (parking meters, sluices and locks, flood gates, emergency telephones, etc.)
3. mobile systems (caravan's, mobile homes, ships, mobile road marking, etc.)
4. consumer goods (watches, battery chargers, radio's, garden lights, etc.)

In 2009 the overall market for PV grew with 150% (10,5 MW versus 4,2 MW in 2008). Of the newly installed power 92% was realised in segments 1b and 1c, small and medium sized grid connected systems. The rest was taken by the large grid connected systems. Little appears to happen in segments 2. stand alone systems and 3. mobile systems. Stakeholders experience a stable market. The CBS data however show a net decrease in total installed power in these segments. No market information is available for segment 4, consumer goods, as these are not registered as PV products.

2.2 Total photovoltaic power installed

The total cumulative installed PV power in the Netherlands at the end of 2009 was 67,5 MW. The growth of the cumulative installed power is almost 20%. The annual growth and the distribution of the cumulative installed power are given in table 2.1.

Table 2.1: Cumulative installed PV power in 3 sub markets

Sub-market / Application	*1993 [MW]*	*1994 [MW]*	*1995 [MW]*	*1996 [MW]*	*1997 [MW]*	*1998 [MW]*	*1999 [MW]*	*2000 [MW]*	*2001 [MW]*	*2002 [MW]*	*2003 [MW]*	*2004 [MW]*	*2005 [MW]*	*2006 [MW]*	*2007 [MW]*	*2008 [MW]*	*2009 [MW]*
Off grid domestic + non domestic	1,59	1,85	2,13	2,55	3,00	n.n.	3,89	4,1	4,3	4,6	4,7	5,1	5,4	5,7	5,3	5,2	5,0
Grid connected distributed	0,05	0,11	0,27	0,70	1,03	n.n.	5,31	8,5	13,7	19,2	38,8	41,3	42,6	43,7	44,4	48,5	58,2
Grid connected centralised	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,2	2,5	2,5	2,5	3,2	3,2	3,3	3,4	3,5	4,3
TOTAL	**1,64**	**1,96**	**2,40**	**3,26**	**4,04**	**n.n.**	**9,20**	**12,8**	**20,5**	**26,3**	**45,9**	**49,5**	**51,2**	**52,7**	**53,1**	**57,2**	**67,5**

From the 67,5 MW 58,2 MW (86%) is grid connected decentralised (sub-segments 1b + 1c). The total installed power for off-grid domestic + non domestic (segment 2 + 3) decreased in 2009. This appears to be an ongoing trend since 2007. As no statement of any dismantlement of PV systems was made however, it is not clear, whether this is caused by unreported dismantling of old PV systems, or by statistical fluctuations in the collection of data.

The total PV power, installed in the sub-markets of grid connected distributed and grid connected centralised in 2009, amounts to 10,5 MW. The market growth is impressive: more than 150% (10,5 MW in 2009 versus 4,2 MW in 2008). Due to the decrease in off-grid domestic + non domestic, the increase in total cumulative installed power in 2009 was only 10,3 MW. From the 10,5 MW, 9,7 MW (92%) was grid connected distributed. This is most likely a direct consequence of the new SDE support scheme for systems up to 100 kWp, opened in 2008.

Figure 2.1 clearly shows the dependence of the PV market on support schemes: several support schemes, directly following each other, caused a continuous growth up to 2003, with a burst out in the last year, caused by the announcement of the end of the last scheme (EPR). Without subsidy scheme very few systems were realised between 2003 and 2008, and even these were mostly supported by the 'after life' of the previous schemes. Implementation picked up again in 2008, when a combination of the SDE, a renewable energy production tariff, and a limited net metering obligation for energy companies the was provided for private sustainable energy producers. With the combination of these incentives and RTD support the Dutch government aims at both the development of cost effective sustainable energy and the preparation of the market for the large scale implementation after cost effective sustainable energy has been achieved.

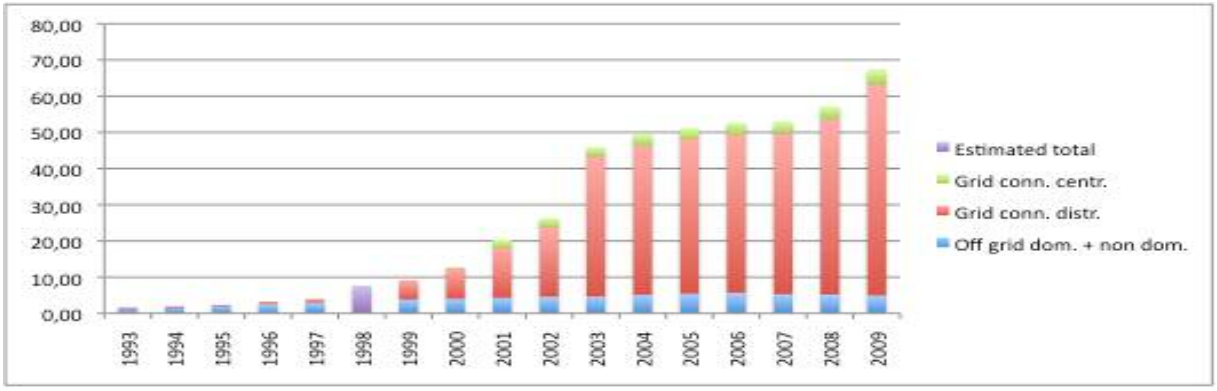


Figure 2.1: Cumulative installed power in MW since 1993, divided over 3 submarkets

2.3 PV implementation highlights, major projects, demonstration and field tests

In 2009, the Dutch PV activities were still mainly subsidy dependent. This holds for both RTD and implementation. In the Netherlands PV is supported by different programmes, each supporting a part of the development process: fundamental R&D, product development and improvement, unique opportunities, pilots and demonstration and market deployment. Furthermore many Dutch companies, research institutes and universities participate in European programmes.

2.3.1 BIPV

Most of the PV systems installed in the Netherlands are decentralised grid connected building attached systems. Building integration was still very small, but new products are opening the way to a larger PV building integrated market:

In 2008 ESHA, now part of Icopal, developed the now called Icosun, a bituminous roofing material with integrated thin film solar cells (fig. 1).
in 2009, Oskomera installed the Suntech full roof integration system MSK Just Roof, This system provides full roof integration, combines PV with roof functions (fig. 2).

Figure 2.2: Icosun, a bituminous roofing material with integrated thin film amorphous Si modules integrated in on a storehouse in the south of the Netherlands [photo: Icopal]

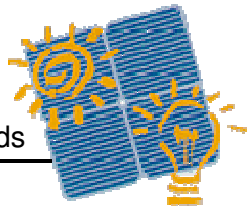
Figure 2.3: Roof integrated PV system on hotel Zomerlust in Zoutelande, Netherlands, using the Suntech MSK Just Roof system [photo: Oskomera]

Especially interesting is the Almere project by The Sun factory. Here coloured façade integrated panels were developed for this particular project (fig. 2.4).

Figure 2.4: Red and black PV façade – elements in a new neighbourhood in Almere, Netherlands [photo: The Sun Factory]

The project started in 2006, when the architect asked for façade integrated coloured PV panels. As no such panels were available, the The Sun Factory, project development bureau for PV solar systems, set out to develop such panels. In close collaboration with Han van Zwieten Architecten, The Sun Factory developed the red and black coloured CIS solar panels (TSF-60-red and TSF-80-black), in which the colouring is realised by impregnation in the encapsulating glass. This has now led to a new product range, in which every desired colour (except white) can be produced. Depending on the colour, energy losses range from 3% tot 20% of the original efficiency.

As PV is still an expensive sustainable energy option, the Dutch government mainly aims at RTD to decrease the cost of PV electricity, while providing a modest support for deployment.



The large scale implementation will thus depend on the realisation of grid parity. The first segment to achieve grid parity will be the domestic segment, where it can compete with the highest grid electricity price.

In view of this development, the government is preparing a programme supporting the development of building integration solutions. This programme is set out to be opened in 2010

2.3.2 Regional and Local Initiatives

2009 appears to be the starting year for a growing number of regional and local initiatives. Some highlights:

- The BOM, the Development Company of the province of Noord Brabant and the consultancy group EUKEP brought together a large number of stakeholders to organize a strong solar industry and knowledge sector in Noord Brabant. This led to a large number of collaborations, the move of two research institutes to Brabant and the campus in Eindhoven, and recently to a provincial budget allocation of 49 M€.
- On Texel, one of the islands of the province of Noord Holland, a cooperative sustainable energy company was established. This company is set out to realize full sustainable energy production capacity for its own members and for the future a fully self supporting Texel. PV will be one of the main renewable energy sources.
- The province of Friesland and the city of Leeuwarden formulated a target of respectively 50 and 15 MW of installed solar power before the end of 2015, and commissioned the preparation and implementation of a road map to achieve these targets.

Furthermore, many provinces set up support schemes (see also § 4.2.1.).

Apart from these larger initiatives, many communities organised local initiatives and subsidy schemes or joint national schemes such as the MMM, Meer met Minder (More with Less) campaign or the sustainability loans.

2.3.3 The renewable energy targets

The Netherlands have formulated their own renewable energy targets. In 2009 these were still 30% CO_2 emission reduction with respect to 1990, 20% renewable energy and 2% energy savings per year. These targets were higher, than those formulated for the Netherlands by the European Commission: for 2020: 20% CO_2 emission reduction, 14%

renewable energy and 2% of energy savings per year. These targets however can not fully be compared, as they are based on slightly different calculation methods.

2.3.4 Demonstration and field test programs

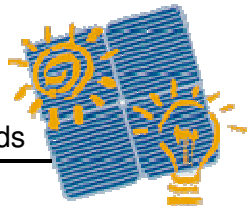
In the field of demonstration and field test, the Netherlands has 2 support schemes:

1. The EOS – DEMO programme: a support program, helping companies to bring their products, often developed under the RTD programmes, to the market. The scheme supports up to 40% of the eligible cost (+10% for SME's). No DEMO projects were granted in 2009.

2. The UKP programme: a tender programme, granting the projects which best fit the programme's objectives. For 2009 the focus of the programme was set on energy neutral schools and office buildings. In 2009 no PV project was granted under this scheme.

In 2008 and 2009 the first autonomous network was installed in which a large part of the energy was provided by PV. With support of European Seventh Framework (FP 7) the GROW-DERS project demonstrated the use of PV, storage and grid control in the holiday park Bronsbergen in the city of Zuthpen. More than 3000 m^2 of PV was installed on 108 of the 200 houses. They provide over 300 kW_p of power.

Figure 2.5: Half of the holiday cottages in a holiday park in Zutphen provide PV electricity.



2.3.5 Electricity utility and public stakeholder developments

The electricity utilities took a double role in the FiT process: on the one hand, they were obliged by law to deduct the grid-fed electricity from the purchased electricity before billing, therewith paying the full grid price, including energy tax and VAT for solar electricity. On the other hand, most of them offered their customers to fill in subsidy requests and organise, where successful, the installation of the PV system.

Apart from the initiatives to promote PV, some utilities and distribution companies play an active role in regulation: In particular Liander and Greenchoice actively search for possibilities to overcome regulatory and legal uncertainties and thresholds with respect to for example net metering.

Furthermore in collaboration with KEMA, ECN and Humiq, Essent is investigating the possibilities to implement smart grids and demand side management to improve the coincidence of demand and production for discontinuous sustainable energy technologies such as PV. In a demo project in the city of Hoogkerk 25 dwellings are now connected to virtual sustainable energy sources, including windmills and a large PV system.

2.4 Highlights of RTD

The Netherlands are still in the top of PV RTD. This is shown, for example, by the strong position of Dutch companies and RTD institutes in the European framework programmes, where the Dutch funding per capita is 2,5 times higher than the European average, and where 10% of the EU projects in PV is coordinated by Dutch participants (where the Dutch population is only 3,5% of the EU population).

Some highlights of the Dutch RTD activities in 2009:

In November 2009 Linda Aarts finished her PhD thesis at the University of Utrecht. She developed a method for down conversion of high energy photons with an almost 100% efficiency. In this process a high energy green or blue photon is split into two low energy infra-red photons. As most PV cells are more effective for low energy photons, the efficiency of these cells can be increased by 30%, when provided with a coating of the material developed in this study

ECN and Solland Solar have been working on the MWT (metal wrap through) cells for some years. In the technology the advantages of back-contacts are utilized. One of the main goals of this technology is to reduce the length of the conductors at the front-side of the cell in order to increase the effective surface of the cell and simplify the assembly of the modules,

as MWT cells no longer need front-to-back connections between adjacent cells. Solland Solar and AT&S have recently started to build up a pilot line for production of these cells, called Sunweb cells.

2.4.1 Dutch Universities and institutes

At academic level, R&D activities are carried out in a limited number of highly specialised groups. The main players are the Universities of Utrecht, Groningen and Amsterdam (UvA), Radboud University of Nijmegen and the Technical Universities of Delft and Eindhoven. A relative new and small player is the University of Twente. Furthermore three colleges of higher education are active in PV RTD: Hogeschool Zuid (Rijswijk), Hanze hogeschool (Groningen) and the NHL (Noordelijke Hogeschool Leeuwarden). Apart from these, the Netherlands count 3 institutes active in the field of PV: ECN, TNO (incl. Holst Centre), FOM-Amolf and KEMA. In the 34 projects currently running a total of almost 300 fte at universities and institutes is committed (fig. 2.5). With an average duration of 5 years per project, 60 fte research positions are filled in annually.

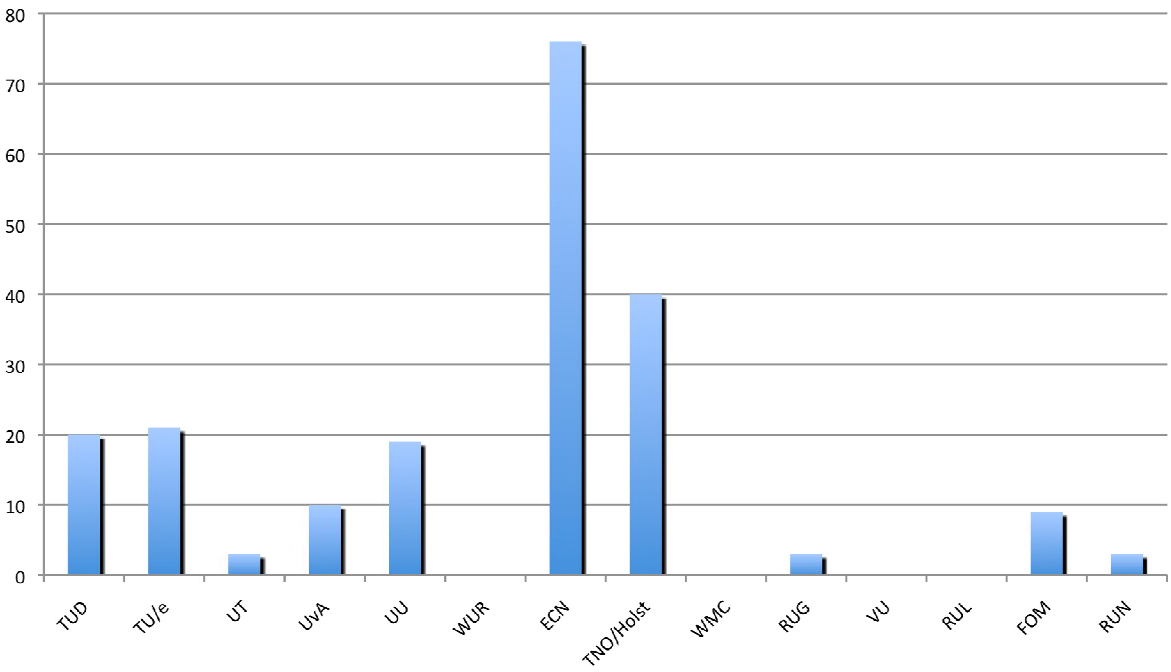
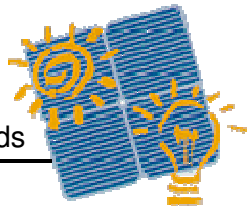


Figure 2.6: Committed fte's in 34 running RTD projects



2.4.2 Dutch companies

Though limited in number, the Dutch companies hold a strong position in international innovation. As mentioned before, the role of Dutch institutes and companies in the EU is far above average. They cover a broad range including production machine, inverters, panels and cells. Important and (for the PV industry) long-established companies are: Solland, Scheuten solar, OTB, Mastervolt and NUON Helianthos. Relative new players are Tempress, Smit Ovens and Icopal (previously ESHA).

2.5 Public budgets for market stimulation, demonstration / field test programmes and RTD

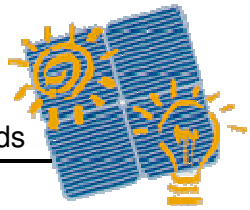
In 2009 the total national budget for stimulation of PV grew considerably. This was mainly caused by the additional budget for the SDE. The budget for this feed-in-tariff scheme grew from 0 € in 2007 to 80 M€ in 2008 and onwards to 143 M€ in 2009.

In 2008 and 2009 for new installed power from renewable sources the SDE was introduced resulting in a five fold increase of PV production sites in 2009. 75% of all production sites participating in the green certificate scheme is now solar PV. Still the majority of all Dutch PV capacity, 74%, is not participating in the green certificate scheme regulation.
The produced 6567 MWh solar green NL certificates in 2009 only contributes less then 0,1% of the total green certificates (mainly wind and biomass).

Table 2.2: Overview of Dutch solar PV green certificates (source: CertiQ)

	2007	2008	2009
Green NL certificates (per MWh solar)	4990	5743	6567
% PV of total Green NL certificates	0,074	0,064	0,064
Solar production sites for certificate scheme	619	740	3817
% PV of total production sites for certificate scheme	35	37	75
Combined capacity of solar production sites (MW_p)	12,3	12,4	18,0

Although the absolute budget for both labour and profit tax incentive measures experienced an almost equal growth, their absolute contribution is small. Apart from the national budgets, several regions and communities provided local investment subsidies. These are described



in section 4.1.2. The support for RTD activities also showed a considerable growth, mainly caused by the new PID scheme.

2.5.1 Stimulation through subsidies

The main support mechanism for market stimulation is the SDE (Promotion of Renewable Energy Production). This programme provides a tariff per kWh for produced solar electricity. Detail are described in § 4.1.1.

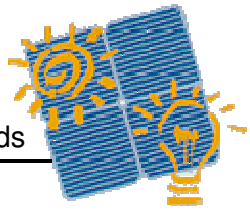
For RTD several subsidy programmes have been set up, each covering a specific part of the RTD activities:

- JSP - Joint Solar Programme: This is a joint initiative of the nationally funded organisations FOM and NWO and the two private companies, Shell and Nuon. This programme aims at very fundamental and new research activities, such as application of quantum dots and up- and down conversion of light
- NWO – Dutch Organisation for Scientific Research: this programme supports scientific research at universities and institute. Selection of topics is not based on the field of application, but the scientific quality and challenge.
- STW – Foundation for Applied Science: STW stimulates transition of technology, supporting the transfer of knowledge and results from RTD to application. Subsidies are granted for collaboration projects between universities and/or institutes and industry
- EOS – Energy Research Subsidy: EOS is a national programme of the ministry of Economic Affairs, supporting research from fundamental to demonstration. The latter are described in § 2.3.4. The more fundamental sub programmes are NEO (New Energy Research): stimulating completely new ideas, LT (Long Term Research): supporting long term fundamental research and KTO (Short Term Research): funding development of products based on scientific results

2.5.2 Stimulation through tax incentives

Two other incentives are not provided directly to RTD and employment projects as subsidiary funding, but through tax benefits that companies and institutes can receive for the PV-RTD hours or PV-investments.

First, for RTD hours part of the employment tax can be refunded through the WBSO (Wet Bevordering Speurwerk en Onderzoek) regulation. Since the exact amount of WBSO hours and funding per company is confidential information, a generalized scan was made of all



WBSO applications. By means of company names and key words related to the solar PV industry a number of projects and corresponding totals of working hours was obtained. 115 of the 208 provided company names were found in the database of which 25% was indicated as being a large company (more than 250 employees). Based on the key words the 115 companies applied for hours in 16 projects during 2009. In total 67 solar projects were identified to which 280 021 hours were spent. When assuming 1 635 hours in one fte, the total amount of fte's that was applied for in the WBSO incentive is 171 fte. The total amount of money that the companies and institutes received is hardly predictable since the hourly rates of all people involved differ very much.

Second, for PV-investments, companies could use the EIA (Energy Investment Rebate) regulation. This regulation allows a company to deduct 44% of the costs of a PV installation from the company's net profit. At an average profit of 25% this would result in a net financial advantage of 11% of the cost of the PV installation.

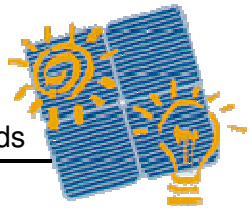


Table 2.3: Overview of the public budgets for PV in the Netherlands in M€

Instrument	***2007 [M€]***	***2008 [M€]***	***2009 [M€]***	***Source:***
National market stimulation	**0,62**	**80,5**	**144,5**	
SDE		80	143	Jaarbericht 2009 SDE en MEP
EIA	0,62	0,52	1,54	NL Agency
National RTD subsidies	**8,09**	**9,33**	**14,17**	
JSP	1,80	3,80	3,80	JSP Ann. Rep.
NWO	n.a.	n.a.	0,60	NAER – raw data
STW	n.a.	n.a.	1,20	NAER – raw data
EOS	6,29	5,46	5,45	NL Agency
NEO	*0,40*	*0,30*	*0,28*	NL Agency
LT	*1,20*	*2,36*	*2,15*	NL Agency
KTO	*2,90*	*2,80*	*3,02*	NL Agency
DEMO	*1,79*	*0,00*	*0,00*	NL Agency
PID	0,0	0,07	3,12	NL Agency
RTD tax incentives [fte] [2]				
WBSO	25 fte	100 fte	171 fte	NL Agency
Direct national RTD funding [1]				
ECN	5,75	5,90	6,15	NL Agency
TNO	7,90	7,90	7,90	NAER – raw data
International Programmes [1]				
FP7 - Energy [3]	6,3			EG Liaison
FP7 - NMP [4]	4 projects			EG Liaison
EFRO: OP-Zuid			1,4	Brabantse Ontw. Maatsch.
Polymol	0,5			NL Agency

[1] Part of the information for this category was not available at the time of writing, therefore no totals are given.
[2] WBSO is a labour cost tax deduction subsidy. At the time of writing, only the labour hours, claimed by RTD performing companies were available.
[3] Information on the distribution of the budgets over the years was not available at the time of writing.
[4] Dutch institutes participate in 4 NMP projects. The allocation of project budgets over the participants however was not available at the time of writing.

The overall support programme for PV in the Netherlands is build up to support the development and introduction from the very first idea until implementation. Figure 2.7 shows how the different instruments support the different phases along the S-curve for market development of innovations.

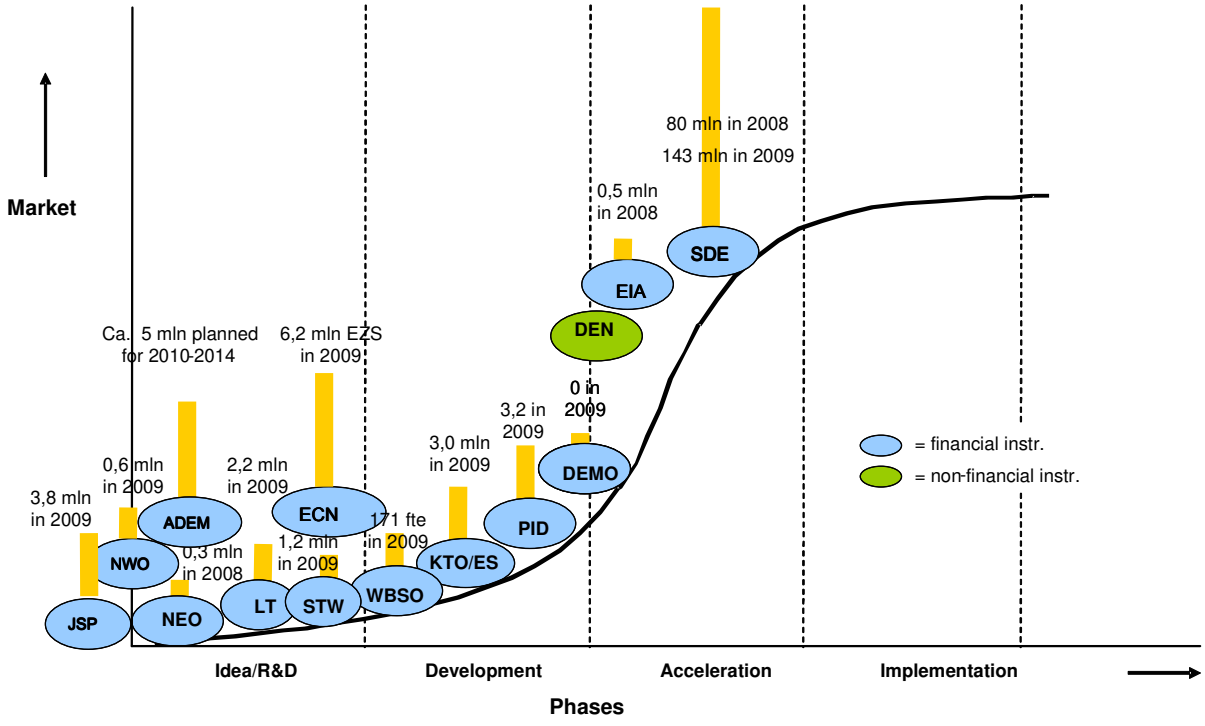


Figure 2.8: position of the different Dutch support instruments along the S-curve for market development of innovations.

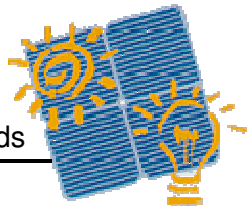
3 INDUSTRY AND GROWTH

3.1 Production of photovoltaic cells, modules and equipment

The production of PV cells remained a small part of the total industry. The most active companies in cell production are Solland Solar and Nuon Helianthos of which in 2009 Helianthos is only producing for demonstration project rather than large scale commercial production. Solland Solar started using a second production line of 40 MW in May 2007. In October 2008 the third line of 110 MW was established.

In the mid of 2009 one of the main modules producers, Ubbink Solar Modules B.V. (Ubbink Solar), had to close its 45 MW solar module manufacturing plant located in Doesburg. This was caused by the loss of the main customer, Ecostream Switzerland GmbH. Ecostream was affected by a suspension of payment order concerning its parent, Econcern N.V. The Dutch Econcern was since 1984 one of the fastest growing companies in Europe, but went bankrupt after failing to secure refinancing.
Scheuten Solar is one of the growing companies in the production of PV modules. Since 2006 the Dutch company which is located next to the German border opened a modern module production line in Germany. The installation of systems is by the Dutch part of Scheuten Solar and it is done all over the world.

Figure 3.1: Production line of crystalline PV modules by Solland Solar



Since last years the national facts and figures about the actual production of PV cells and modules are not published any more due to the low number of active companies. These numbers are considered confidential. Table 3.1 provides a trend until 2009 of the trade in solar modules in the Netherlands as published by the Dutch Central Bureau for Statistics.

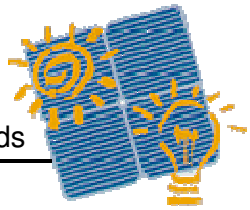
In the sector of production equipment manufacturers the Dutch manufacturer of equipment for crystalline PV modules, OTB, was acquired by the German company Roth & Rau. The engineering company DHV has expanded its activities in equipping solar production plant. Their activities are mainly in factory design and implementing new production lines.

Table 3.1: Production of PV modules and components is not published. Up to 2009 the trade data are provided. (source: CBS, 17-11-2010).

Topics	Trade in solar modules							
	Import	Production	Sales to installers				Export	Trade
			Total	Autonomous systems	grid connected systems, utilities	grid connected systems, other		
Periods	kW							
2000	.	.	3 564	194	180	3 190	.	.
2001	.	.	7 750	250	2 300	5 200	.	.
2002	.	.	5 817	302	-	5 515	.	.
2003	.	.	19 845	300	-	19 545	.	.
2004	13 160	-	3 604	434	679	2 491	9 770	4 767
2005	23 677	x	1 663	323	-	1 340	20 942	6 500
2006	25 052	x	1 521	278	160	1 083	22 148	x
2007	x	x	1 399	558	66	775	34 005	x
2008	x	x	4 444	239	151	4 054	64 898	x
2009	x	x	10 669	91	802	9 776	127 419	x

3.2 Module prices

Studies to module prices often lead to different values since the conditions that the studies apply can be different. Based on consults of key players in the sector and published reports, the price of modules is estimated at between 1,5 and 2,3 €/W_p (ECN, Technisch-economische parameters van duurzame energieopties in 2009-2010).



3.3 Manufacturers and suppliers of other components

3.3.1 PV inverters

Several companies in the Netherlands sell PV inverters for grid connected and off-grid applications. One of the largest Dutch companies that supplies the Dutch market with PV inverters is Mastervolt B.V. They offer solar inverters in the range of 0-100 kW_p. Also a monitoring devices for PV systems are provided by Mastervolt. Nedap N.V.'s Power Router is able to connect PV to wind and batteries in order to offer independence of the grid status. The Dutch company Exendis with around 20 employers is another manufacturer of PV inverters, but their activities focus rather abroad. Nevertheless, they contribute to the Dutch employment in the PV sector.

3.3.2 Storage batteries

Batteries specifically manufactured for connections with PV systems are not produced in the Netherlands. Most companies producing batteries focus on the automotive market.

3.3.3 Battery charge controllers and DC switch gear

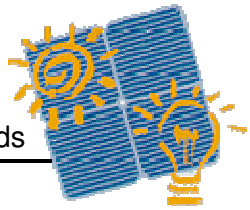
The producers of charge controllers are similar to the PV inverter manufacturers. Mastervolt and MG electronics are examples of companies that manufacture battery charge controllers and switch gear.

3.3.4 Supporting structures

The Oskomera group consists of a number of companies that design, produce and install windows, fronts and grids. In recent years they specialized in solar projects. Oskomera offers complete solar rooftop systems (i.e. Sunkit, lightbox) as well as BIPV solutions. An example of this is the integration of solar panels in the glass front or roof of a building (i.e. SF60). In addition, Oskomera has its own R&D group researching new innovative and sustainable product, market combinations.

3.4 System prices

The Central Bureau for Statistics does not mention system prices in which the price per W_p of a PV system is included. The prices of PV modules/systems can be extracted from applications for "Groen Beleggen" which in English means "Green investments". In this



regulation buyers of PV modules/systems can benefit from loans with lower interest rates. The average price per Watt-peak of the 85 applications for the regulation in 2009 is €3,4 with a standard deviation of 0.9. For integrated systems the Balance of System costs are higher since custom made structures may increase the price. On average this is 0,5 €/W_p.
The evaluated system price of 3,4 €/W_p is for small roof mounted systems. Other sources report also on larger or roof-integrated system prices. The data are stated in table 3.2, in which small roof mounted systems are evaluated at 4 €/W_p.

Table 3.2: Systems prices of typical applications (source: ECN, Technisch-economische parameters van duurzame energieopties in 2009-2010).

	Small	Large
Roof-integrated	Not available	3,8 €/W_p
Roof mounted	3,4 - 4 €/W_p	3,3 €/W_p

3.5 Labour places

The total of fte's in the PV-sector in 2009 is 588. The Central Bureau of Statistics does not specify the employment numbers of the PV sector other than for R&D. As an indication table 3.3 shows the trend of the years before 2009 with in addition the turnover of the PV sector.

Table 3.3: Facts of employment in the PV-sector in the Netherlands (source: CBS, 3-12-2010).

	Total	Research & Development (not including companies)	Production of modules and components (including company R&D)	Other	Turnover
Periods	fte				
2004	147	23	10	115	89 866
2005	141	17	21	103	113 018
2006	232	28	92	112	160 663
2007	403	32	198	173	252 488
2008	566	41	263	262	412 971
2009	588	56	x	x	483 840

3.6 Value chains

Figure 3.2 shows where Dutch companies are active in the PV value chain for both crystalline and thin film based technologies.

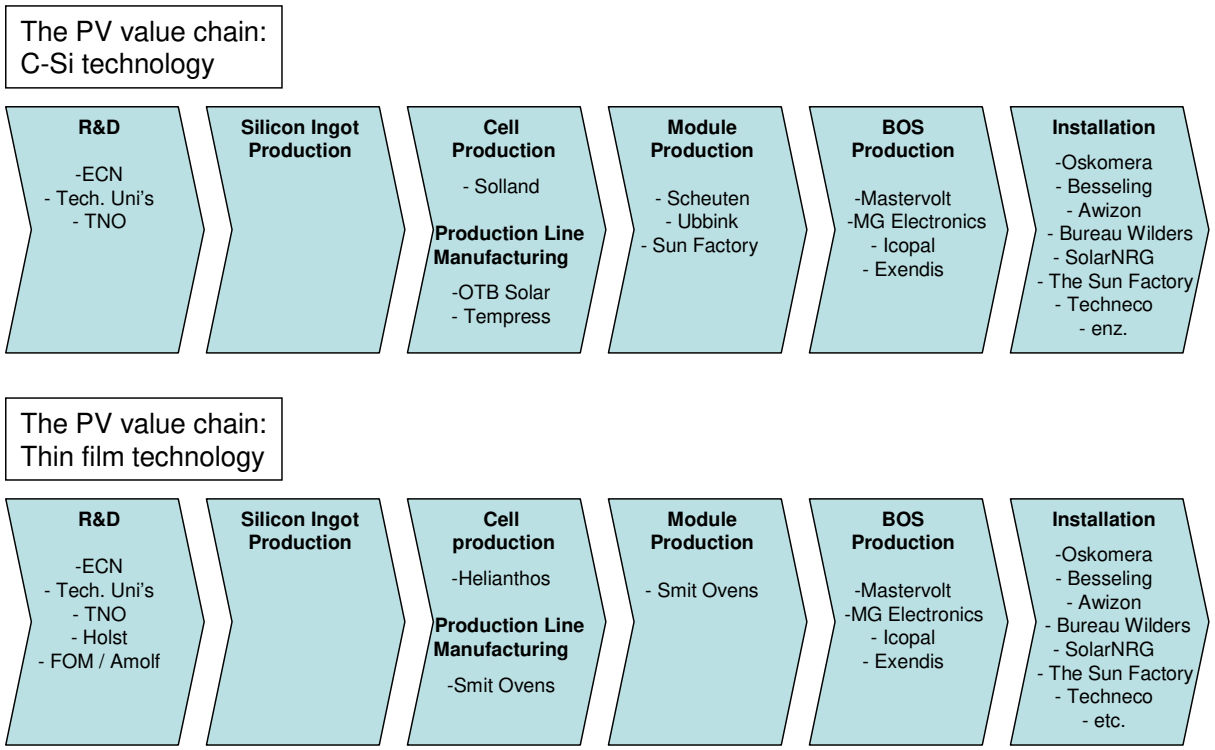


Figure 3.2: The values chains for respectively crystalline silicon and thin film technology show that in the Netherlands most business is done in crystalline technology. The companies and institutes give an indication of the distribution of Dutch companies in the PV sector.

3.7 Business value

The business value of the PV sector in the Netherlands can be estimated at several hundreds of millions of Euros. In the calculation the currently installed PV capacity is converted into a monetary value by multiplying the capacity with the price per W_p. The export of PV products provides an additional indication of the added value by the Dutch market. The import is not an effort of the Dutch market and should be subtracted of the total business value. Similarly, the reduction of stocks leads to a lower business value. Since the W_p prices are given for a range, the estimation of the market value also covers an indicative range.

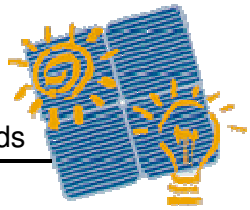
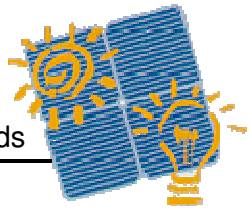


Table 3.4: Indicative estimation of the PV business value in the Netherlands. When estimated, a range is provided (source: CBS, 3-12-2010).

Sub-market	**Capacity installed in 2009 (MW)**	**Price per Wp (€)**	**Value Million €**	**Totals Million €**
Off-grid	5	3,4 - 4	17 - 20	
Grid-connected at utilities	4	3,4 - 4	13,6 - 16	
Grid-connected other	58	3,4 - 4	197 - 232	
				228 - 268
Export of PV products (panels)	127,4	1,5 – 2,3	191 - 293	
Change in stocks	-0,2	1,5 – 2,3	0,3 - 0,46	
Import of PV products	30*	1,5 – 2,3	45 - 69	
				146 - 224
Value of PV business				374 - 492

*Estimation based on data up to 2006.

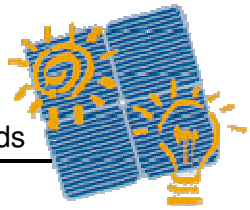


4 FRAMEWORK FOR DEPLOYMENT (NON-TECHNICAL FACTORS)

Table 4.1 lists the main support measures for PV during 2009. Further details on new initiatives are provided below.

Table 4.1: PV support measures

Support measure	**Ongoing measures**	**Measures that commenced during 2007-2009**
Feed-in tariff	MEP measure until 2006; 10 year duration	Two categories exist in the Dutch SDE (Stimulering Duurzame Energieproductie; Promotion of Renewable Energy Production): - Small (1-15 kWp): 52,6 €ct/kWh - Large (15 - 100 kWp): 45,9 €ct/kWh
Direct capital subsidies	Regional: • €0,50 – €2,50 per Wp or • up to 20% of system and installation costs. Differentiated per province.	
PV-specific green electricity schemes		One energy supplier is well known for selling merely green energy.
Renewable portfolio standards (RPS)	none	
PV requirement in RPS	none	
Investment funds for PV		"Groen Beleggen" (Green investments) is a tax benefit in to which any renewable energy system can apply. Banks provide the service stimulated by the government.
Tax credits	EIA Energie Investeringsaftrek or Energy Investment Rebate): rebate of 44% of investment in energy-saving technologies or renewable energy from fiscal profit.	
Net metering	National for private grid connections up to 3,000 kWh/yr (balancing). Some utilities apply 5,000 kWh/yr. Overall this means that if more electricity is being fed into the system than being used, a utility is then not obliged to balance, which means a higher kWh price.	
Net billing	Depends on supplier, but the feed tariff is always lower than the buy-tariff.	
Commercial bank activities		In 2009 several banks provided Green Mortgages (ASN, Triodos, ING, Rabobank). These all have about 1% lower market interest rate. The max. amount of mortgage for Triodos is 100,000 €. Other banks may differ.
Electricity utility activities	No specific subsidies available through utilities. However, they offer to assist in applying for the SDE-subsidy. Several suppliers apply feed-in tariff constructions.	
Sustainable building requirements	PV provides points for the required building energy performance coefficient.	



4.1 Description of new support measures introduced in 2009

New measures for the deployment of PV are described below. In section 2.5 the support measures for R&D and test programmes through public budgets are presented.

4.1.1 Enhanced feed-in tariffs

Until 2006 the MEP feed-in subsidy applied to PV generated power. Since the duration of the contracts within that measure lasts for 10 years, the MEP construction is still ongoing, but not provided anymore.

The successor of the MEP subsidy is the SDE subsidy. The SDE bridges the gap between the costs of renewable energy and conventional energy during 12 or 15 years. This gap is calculated yearly. In 2009, the scheme was divided into two trenches: small systems: 0,6 – 15 kW and medium sized systems: 15 – 100 kW. The total budget was originally set to subsidise 20 MW (62 M€) of small systems and 5 MW (26 M€) of medium sized systems. After it turned out, that the subsidy was well over-subscribed on the first day of the opening, the trenches received an extra budget covering another 5,9 MW each (resp. 24,5 M€ and 30,5 M€). This resulted in a total budget of 143 M€. As in 2008, the total available budget is awarded within only one day.

The SDE programme is a generic programme. The SDE is a Feed-in-Tariff scheme, subsidising the additional production costs with respect to electricity from the grid. In 2009 the prices per kWh are 52,6 €ct/kWh for small installations (1-15 kWp) and 45,9 €ct/kWh for large systems (15-100 kWp). The SDE pays the difference between the estimated grid price and the actual cost of a solar kWh. For Small installations:

- cost of solar electricity: € 0,526
- price of grid electricity: € 0,223
- uneconomic top € 0,303

The subsidy is paid to the individuals, as an advanced payment, based on an expected grid electricity price. The final payment is done in the beginning of the next year and is based on the actual average cost of grid electricity of the year before. The subsidy is granted for 15 year.

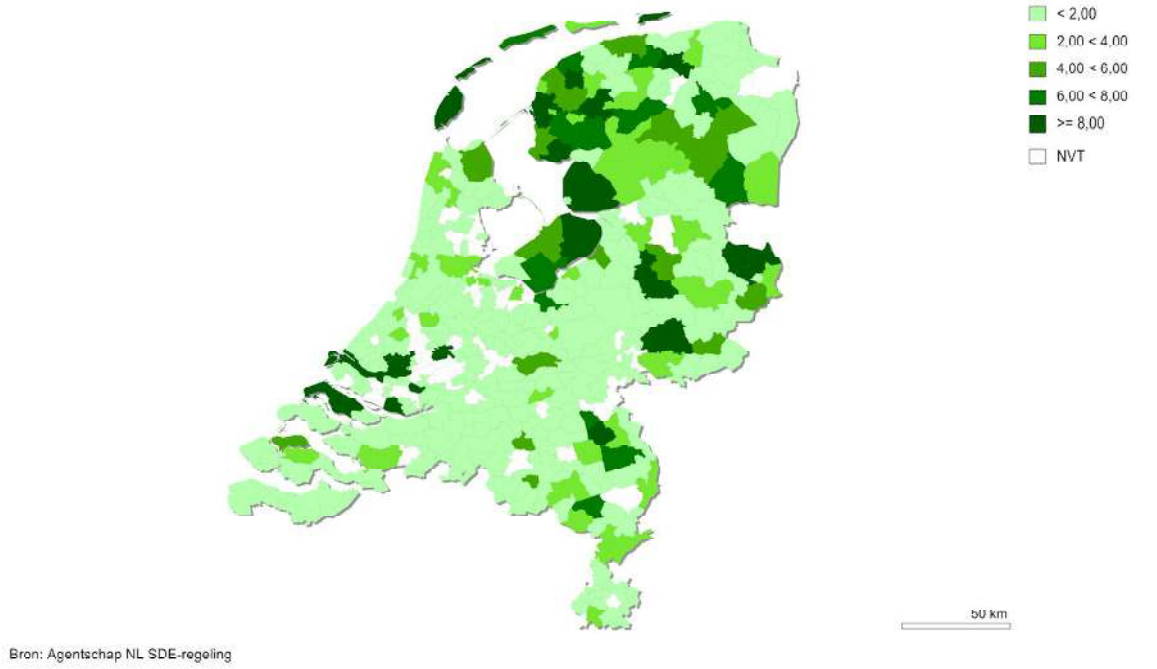


Figure 4.1: Distribution of the nominal power of PV-panels in the SDE grant in 2009 showing the Dutch communities in W_p per 1000 inhabitants (source: Agency NL).

4.1.2 Capital subsidies

On a national level direct capital subsidies are not provided. Apart from the national feed-in schemes, several provinces organise regional support schemes for PV. Table 4.2 provides an indication of subsidies that were granted to installing PV systems.

Table 4.2: Capital subsidies in several Dutch provinces

Province	Subsidy	Comment
Friesland	€ 0,50 / Wp	"Uitvoeringsregeling projectsubsidies economie, recreatie en toerisme" (implementing regulation project subsidies economy, recreation and tourism)
Drenthe	20% of system and installation cost	SNN – SEBB scheme
Groningen	20% of system and installation cost	SNN – SEBB scheme
Noord Holland	€ 2,50 / Wp	Actie Zonnesteek: NB: only in cities, which signed the Climate Agreement
Limburg	€ 2,- / W_p	LES (Limburgse Energie Subsidies)
Noord Brabant	€ 2,- / W_p	Vlagheidefond
Zeeland	€ 1,- / W_p	

Apart from the regional support schemes, several local communities provide support for implementation of PV. Fig. 4.1 shows the distribution of these communities over the Netherlands

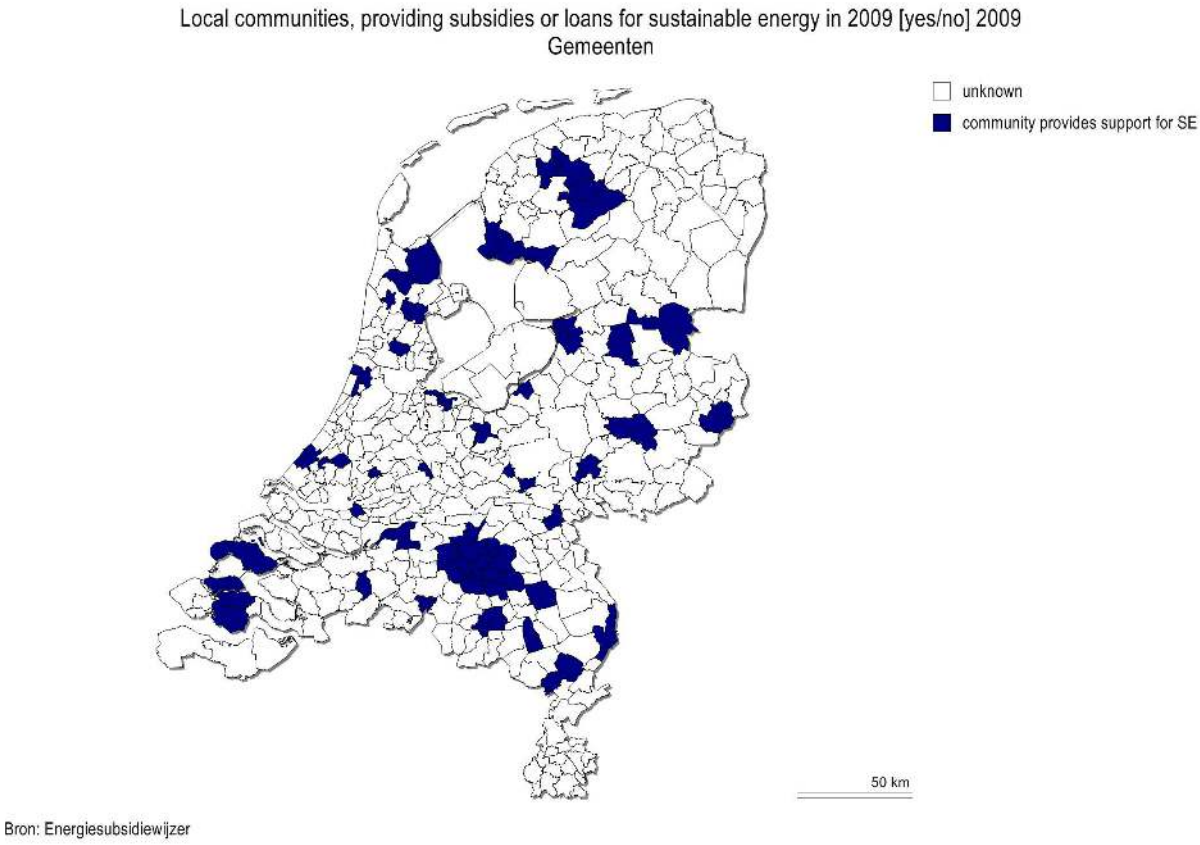


Figure 4.2: distribution of communities, subsidizing the application of solar electricity

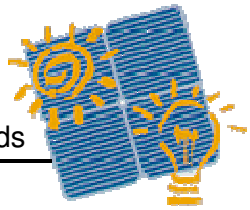
4.1.3 Electricity utility activities

No specific subsidies are available through utilities. However, they offer to assist in applying for the SDE-subsidy.

4.2 Indirect policy issues

4.2.1 International policies affecting the use of PV power systems

There are no international policies directly affecting the use of PV.



4.2.2 Taxes on pollution, carbon footprint, cradle to cradle

REB: The Regulerende Energie Belasting (REB, or Regulating Energy Tax) was introduced in 1996 with the aim to encourage efficient energy use. This tax is levied per kWh electricity or m^3 gas. The tax amount depends on the use. Consumers are partly being compensated by a levy deduction ('heffingskorting'). This deduction compensates the REB for about 1,500 kWh electricity and 1,000 m^3 gas. This is being balanced each year.
If electricity is being generated by an own PV-installation, consumers can feed in this electricity back to the grid. Up to a certain threshold (between 3,000 and 5,000 kWh) a customer received an amount for this electricity, which includes the REB (and VAT).

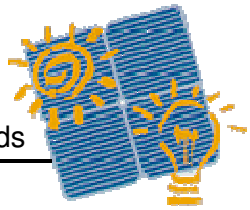
CO_2-levy: This levy is a tax directly coupled to the CO_2-emission of cars which is directly coupled to renewable energy investments. If a car emit more CO_2/km that a certain reference, a certain amount has to be paid for each additional gram when buying this car. This levy was introduced on 1 February 2008. The 2009 levy is as follows: if a petrol car emits more than 212 gram CO_2/km the car owner has to pay 125 € per extra gram emission; for diesel cars the threshold is 176 gram CO_2/km with the same penalty per extra gram emission. It is the idea that the money generated by this levy is used for RE-investments.

4.2.3 Dutch policies and programmes to promote the use of PV in non-EU countries

For the promotion of renewable energy in general and solar energy in particular in Developing Countries Dutch companies participate in the Clean Development program (CDM) as part of the Joint Implementation. One of the utilities (NUON) was cofounder of FRES (Foundation of Rural Energy Services). FRES leases solar panels to local communities starting in Mali and South Africa.

In 2008 the former Dutch Minister for Development Aid, Bert Koenders, put Energy as one of the main topics on the agenda. He made available 500 M€ for Renewable Energy Projects mainly in sub-Sahara Africa and Indonesia. As 70% of the population in sub-Sahara Africa lives off the grid and transport of fossil fuel is expensive off-grid solar projects are competitive and supported by this fund.

A large part of the Dutch international cooperation is through agencies such as the World Bank. In November 2009 the Dutch parliament support an amendment (motie Vendrig) only to support World Bank projects in the energy field under the criterion 100% sustainable which also support strongly the implementation of solar energy in the developing world.



4.3 Standards and codes

4.3.1 Technical regulations for PV plant construction and operation

No specific regulations for PV plants are present in the Netherlands. When operating a PV system the rules for connecting an energy source to the grid apply as described in the next paragraph.

4.3.2 Standards, wiring codes and grid interconnection rules for PV systems

In the Netherlands three national standards/codes have to be considered:

- National Grid code:
  The technical regulations for PV-systems are incorporated in the National Grid Code. PV is not specifically mentioned, but considered as a standard feed-in grid application. Systems should be reported to the grid operator.
- Dutch Technical Agreement NTA 8493:
  Smaller systems (< 2,25 A) can be connected without notice, but should comply with the Dutch Technical Agreement NTA 8493, on Small Grid-connected Photovoltaic Systems.
- Bouwbesluit 2003 (Building Code 2003).
  In the Bouwbesluit 2003, the Dutch building directive, a minimum energy efficiency is prescribed. This requirement stimulates the implementation of PV, and will do so even more with the foreseen sharpening thereof.

Furthermore all relevant CENELEC and IEC codes apply. Except for the grid connection regulations, no other requirements, such as an approval of building inspection authorities, are necessary for PV. When complying with the regulations, PV electricity producers are entitled to grid connection by law. Tables 4.3 and 4.4 summarize the contents of the norms that apply to PV systems in general, PV systems in the built environment and for connector and grid connection.

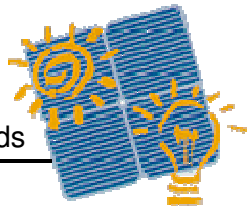
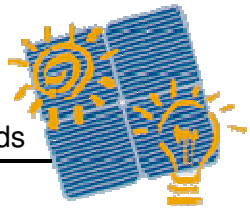


Table 4.3: Some relevant norms for PV systems in the Netherlands

Norm	Title
IEC61215	Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualifications and type approval
IEC61646	Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval
IEC62108	concentrator photovoltaic (CPV) modules and assemblies - Design qualification and type approval
IEC61730	**EN61730_1**: Photovoltaic (PV) module safety qualification -Part 1: Requirements for construction
	EN61730_2: Photovoltaic (PV) module safety qualification -Part 2: Requirements for testing
IEC61701	Salt mist corrosion testing of photovoltaic (PV) modules
IEC60904	Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics
	Photovoltaic devices - Part 2: Requirements for reference solar devices

Table 4.4: Some relevant norms for PV in the built environment

Norm	Title
EN13707	Flexible sheets for waterproofing - Reinforced bitumen sheets for roof waterproofing - Definitions and characteristics
IEC 60364	Electrical installations for buildings
NEN1010	Safety regulations for low voltage installations'
NVN7250	Solar-Energy Systems - Integration in roofs and facades - building aspects
NEN7120	Energy Performance of Buildings (in development)
IEC61984	Safety requirements and tests for Connectors
EN 50521	Connectors for photovoltaic systems - Safety requirements and tests

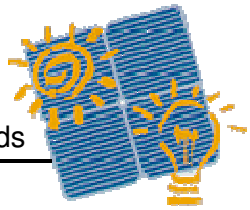


Dutch companies (Het Hellend Dak, Stroomwerk, TNO-Delft and TU/e) participated in the EUR-ACTIVE ROOFer project (www.euractiveroofer.org) which was finished in July 2008. The main strategic aim of EUR-ACTIVE ROOFer is to supply tools for the European roofing trade, which enables the European roofer to:

1. respond to the new demands for integration of roof accessories and fittings
2. to upgrade from delivering just roof tiles to delivering total (active) roofs.

The conclusions are used in the preparation of the Dutch pre-norm NVN 7250: Solar-Energy Systems – Integration in roofs and facades – building aspects.

The Dutch norm committee "Energieprestatie van Gebouwen" is working since 2005 on the development of a new norm NEN 7120. This norm should be applied to determine the energy performance and energy savings of a building.



5 HIGHLIGHTS AND PROSPECTS

5.1 Key aspects of PV deployment and production in the Netherlands during 2009

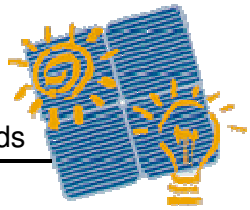
2009 has been a very turbulent year for the PV-sector in the Netherlands. The SDE-scheme introduced in 2008 for stimulating small to medium sized PV-installations, has attracted an enormous interest in 2009. The budget was not at all sufficient to meet award all requests. There has also been a lot of criticism on the details of the scheme and the bureaucratic procedure. This has resulted in an increase of installed capacity with about 6 MW in 2009, much less than expected.
The industry has been hit by the financial crisis. The project developer Econcern went bankrupt and had to sell two of its PV projects (total 21 MW) to Scheuten Solar. In addition, thin film manufacturer Helianthos has been taken over by Nuon. More players entered the PV market for installation activities and project development than the market could absorb. However, some of these companies have successfully expanded their business internationally and the entire industry by now has a clear international character with strong European, Asian and American ties.

5.2 Prospects for future

5.2.1 Details from industry of planned increases in PV cell- and module production capacity

In 2009, a thin film plan was opened by Nuon (i.e. called Helianthos) in Arnhem. Helianthos is developing a roll-to-roll process for solar cell foil. The application of solar cell foil is expected to make solar energy considerably cheaper. At the moment 30 cm wide solar cell foil is made that will be applied in pilot projects.

Furthermore, currently several plans are made for further extension of the Dutch PV production capacity. The Dutch manufacturing company, Alinement, has signed letters of intention with the German machine producer Roth en Rau and the Canadian module producer Days4Energy. They aim at becoming the Netherlands first producer of both high class solar cells and modules with a production capacity of 500 MW. In addition, Solar Module Netherlands is working on a subsidy free proposition for solar cells. In their first year (start in May 2010) they expect a production of 25 MW. The final aim is to have an annual production capacity of 170-200 MW.



Finally, the Al Manhal International Group (AMIG) will invest €500 million in the new silicon factory The Silicon Mine situated in the south of the Netherlands (Geleen).

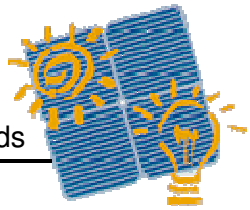
5.2.2 Significant technology developments and solar flagship

The PVPS annual report of 2009 describes that the former flagship of sustainable development in the Netherlands project developer Econcern went under and turned the majority of its activities over to Eneco, one of the leading utilities. With the earlier participation of the utility Delta in Solland Solar and the take over of thin film manufacturer Helianthos by Nuon it can be said that the utilities in the Netherlands are firmly on board the production side of PV. In 2009 Nuon/Helianthos opened a thin film pilot plant in Arnhem; The ECN spin off RGS Development established a pilot production line for ribbon-growth-on substrate (RGS). Solland Solar planned to open another production line in 2009 but instead production was limited.

5.2.3 PV as innovation system

The Innovation System approach focuses on the network of agents operating in an industrial area under a particular institutional infrastructure; this network is involved in the generation, diffusion and utilization of technology. The Dutch PV Innovation System is still rather vulnerable. The R&D infrastructure in the Netherlands is well developed and research is productive and of high quality in international perspective; also, there is a reasonable coordination of these activities at the national level. Positive developments are initiatives to create new networks and industrial activities. This includes the Joint Solar Program (Shell-Nuon-CW) with a focus on fundamental research; new production facilities for silicon and solar cells and the new Solliance network (ECN, TNO, TU/e and Holst centre) that aims to concentrate activities in the region between Eindhoven, Leuven and Aachen. This Alliance wants to exploit in particular the strong position of the research institutes and close links to the regional industry of this region in the area of process and production technology development in thin film and wafer carried silicon cells and in the field of BIPV. Furthermore, the activities of a new FOM institute for fundamental research on energy will be aligned with TUe Solliance activities. The province of Noord-Brabant will invest a total of €41.7 million in FOM and Solliance.

The Netherlands will have an almost complete value chain for several PV technologies in the nearby future. The main weakness of the Dutch PV sector is the problem to create a home market. There is a lot of criticism by industrial actors on the government policy, as there have been frequent changes in support measures and instruments, whereas a stable, long term



policy support is needed. This creates uncertainty and is perceived as a major barrier for successful market development of the Dutch PV-market. As a result Dutch companies have to operate predominantly on international markets.
Another weak point is the lack of political and societal support for PV. Although the general perception of PV is very positive and expectations of the future potential is very high, this has not yet translated in consistent and extensive policy support. In the context of climate policy support for wind off shore and biomass has been much stronger than that for PV. The main arguments are that wind and biomass are regarded as more promising options for the reduction of the emissions of greenhouse gases for the nearby future. The mobilization of resources and the creation of legitimacy should be a major focal point for the PV sector.

5.2.4 National subsidy versus bottom-up initiatives

In 2010 the applications to SDE scheme for PV have again exceeded the available budget substantially. However, in November 2010 the new Dutch government has decided to cancel all specific subsidies for private PV installations. In order to acquire funding PV projects now have to compete with other renewable energy technologies, in particular wind onshore, biomass digestion and waste combustion which are regarded as more efficient. As the PV-market has been highly dependent on the SDE-scheme, this could be a major setback.

However, several new initiatives for the implementation of solar power that are independent of governmental subsidies have been recently set up. The “Wij Willen Zon” (We want sun) foundation aims at buying large amounts of solar panels so that the price per panel is reduced. In this way they hope to make solar energy available for everyone. In addition, Zoneco is a new company that will lease solar panels. Finally, people can become the (partial) owners of solar panels via the Zonvogel (Sunbird) cooperation. By providing funds for the projects of the cooperation, people obtain a share in the cooperation and in the profits that are made. People can use their own rooftop for this purpose, but this is not necessary. All of these bottom-up initiatives point at a new trend in the Netherlands, the start of subsidy independent implementation of solar power.

5.2.5 PV value chain

As stated above research in the Netherlands is very well developed and of high quality also from an international point of view. New networks are created to further increase the alignment and speed of development of research activities. These include the Joint Solar Programme (FOM, Shell, Nuon, CW) and Solliance (ECN, TNO, TUe and Holst Centre).

Technology has been developed and exported by a number of players in the Netherlands including Delta, Sunergy, Scheuten and Nuon Helianthos. The Netherlands also has a strong position in the Supply industry (OTB Solar, Tempress, Smit Ovens). Almost 90% of the Dutch PV turnover comprises export. Thus, focus in the Netherlands is currently mainly on R&D activities and the supply industry in the PV value chain. The challenge for the Dutch industry is to take commercial advantage of this position.

In regard to the production of solar cells, this is currently concentrated in 5 countries: China, Taiwan, Japan, Germany and the US. It is expected that these countries will remain the main producers in the nearby future due to scale benefits. The Netherlands are therefore not expected to play an important role in this respect. However, the production of PV modules is moving towards Europe as transport costs for these modules are very high compared to production costs. This opens new possibilities for the Netherlands as their track record on innovations in the field of modules is excellent.

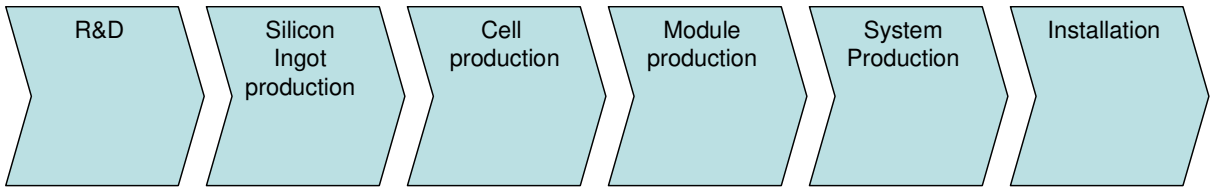
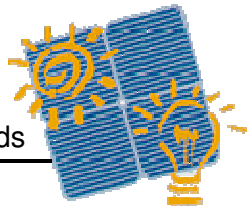


Figure 5.1: The general PV value chain.



ANNEX A COUNTRY INFORMATION

This information is simply to give the reader some background about the national environment in which PV is being deployed. It is not guaranteed to be 100 % accurate nor intended for analysis, and the reader should do their own research if they require more detailed data.

1) retail electricity prices:
   household: ca. € 0,22 depending on the utility
   small business: ca. € 0,18 depending on the utility
   large business: by contract
   The difference between the different tariff groups is mainly caused by the difference in energy tax.

2) typical household electricity consumption ~ 3430 kWh per year (source: Nibud, 12-2010).

3) typical metering arrangements and tariff structures for electricity customers – choice between single or double metering. Double metering refers to different tariffs for day and night periods.

4) average household income – € 33400 per year (source: CBS, 12-2010)

5) typical mortgage interest rate 5.3 % average 20 year mortgages (source: 'Hypotheekshop.nl', 12-2010)

6) voltage:

Household :	50 Hz, 240 V
Medium Voltage distribution network:	50 Hz, 10 kV (also: 20, 25 and 50 kV)
High Voltage distribution network:	50 Hz, 110, 150, 220 and 380 kV

7) The electricity sector has separate retail, distribution, transmission and generation businesses. Unbundling has taken place. The Netherlands is one of the most progressive countries regarding unbundling.

8) price of diesel fuel per litre: € 1.16 depending on company and region (source, BOVAG Jan-2010)

9) typical values of kWh / kW for PV systems in the Netherlands: 850 kWh/kW