INTERNATIONAL ENERGY AGENCY
CO-OPERATIVE PROGRAMME ON
PHOTOVOLTAIC POWER SYSTEMS

Task 1

Exchange and dissemination of information on

PV power systems

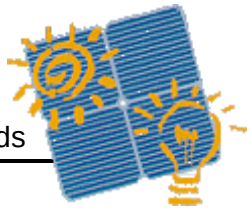
National Survey Report of PV Power Applications in The Netherlands 2011

Prepared by Ecofys Netherlands BV

June 2012

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

Agentschap NL
Ministerie van Economische Zaken, Landbouw en Innovatie



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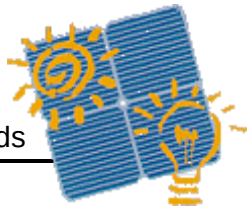
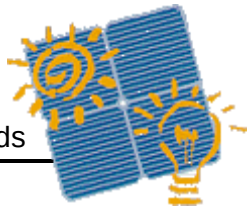




DEFINITIONS, SYMBOLS AND ABBREVIATIONS

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^{o}C, AM 1,5 solar spectrum – (also see 'Rated power').

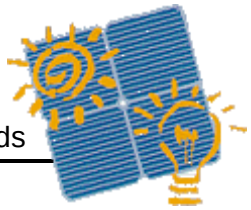
Rated power: Amount of power produced by a PV module or array under STC, written as W.
PV system: Set of interconnected elements such as PV modules, inverters that convert DC current of the modules into AC current, storage batteries and all installation and control components with a PV power capacity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

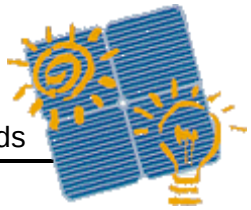
Field Test Programme: A programme to test the performance of PV systems/components in real conditions.

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.

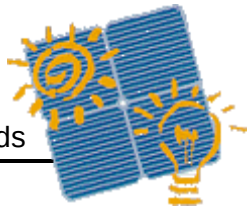
Performance ratio: Ratio of the final annual (monthly, daily) yield to the reference annual (monthly, daily) yield, where the reference annual (monthly, daily) yield is the theoretical annual (monthly, daily) available energy per kW of installed PV power.



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

PV support measures:

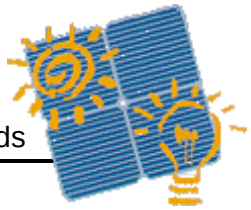
Enhanced feed-in tariff	an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility) at a rate per kWh somewhat higher than the retail electricity rates being paid by the customer
Capital subsidies	direct financial subsidies aimed at tackling the up-front 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



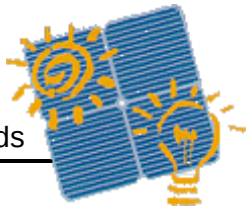
FOREWORD ABOUT IEA

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.

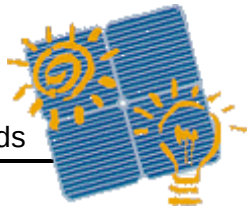
The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual Tasks (research projects / activity areas) is the responsibility of Operating Agents. Information about the active and completed tasks can be found 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 2011. 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.



EXECUTIVE SUMMARY

1.1 Installed PV capacity

A total of 21 MW of PV were installed in the Netherlands in 2010 and 43 MW in 2011, a 30% and 50% increase on 2009 and 2010 levels. Total installed capacity in the Netherlands is now 131 MW.

1.2 Costs & Prices

Typical module and system prices decreased in 2011. Single module prices from all types can be bought at estimated between 1,11 and 4,70 €/W_p, (including 19% tax). The price erosion at the end of 2011 resulted even in single module prices around 0,85 €/W_p (including 19% tax). The majority of the systems are installed with mono or poly crystalline modules in the low price range.
Complete installed system prices range from 2.80 €/W_p for small 600 W_p systems and 1.90 €/W_p for larger 50 kW_p systems. Prices are including 19% tax. It is seen that the price erosion at the end of the year has dropped prices from 10 up to 30%[1].

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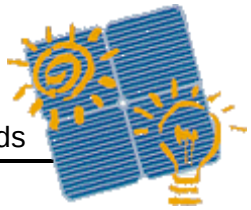
1.3 PV production

The production of PV cells remained a small part of the total industry. The most active companies in cell production were Solland Solar and Nuon Helianthos (flexible thin film) of which in 2011 Helianthos was only producing for demonstration projects, rather than large-scale commercial production. Nuon has been looking for investors to scale-up the production facilities for their innovative thin film technology. In april 2012 a new formed group Hyet Solar, by entrepreneur Rombout Swamborn, has aquired Helianthos and will continue to develop the thin film production technology.

Due to fierce competition from PV producers in particularly China, Taiwan and Japan, the global prices for PV panels and cells have declined significantly over 2011. As a result, it has become increasingly difficult for western (USA and EU) and therefore also Dutch producers

[1] Ecofys field experience in the market.



to compete and consolidate or increase market share. In the Netherlands, there have been virtually no investments in new production capacity for PV over 2010 and 2011. The credit crisis and recession are of course contributing to this effect.

1.4 Budgets for PV

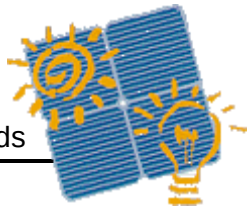
In 2011, the Dutch PV activities were becoming independent from subsidy. Most existing programmes for supporting PV were cut or stopped. This has mainly affected the businesses in fundamental R&D, product development and improvement, pilots and demonstration.

At the end of the year in December the contours became clear of the new innovation contract that will replace the subsidy scheme for R&D in the Netherlands. This is a public-private partnership with shared funding that will ensure a closer connection between research, development and market deployment, and a more effective employment of available funds. The innovation contract focuses on three main program lines: PV systems and applications, wafer-based silicon PV technologies and thin film PV technologies.

The implementation of PV-system in the field showed not to be affected by the subsidy cuts. Due to the SDE grants still in the pipeline and the declined PV-prices the implementation of PV projects showed a continuation of installed capacity growth as in the previous years. 50% of the installed capacity was without subsidy in the household sector. Net-metering results in a relative low payback time for household also without direct subsidy.(± 10 years).

The SDE+ was not granted to PV-installations of < 15 kW_p or installations with ≥ 15 kW_p that were connected to the grid with a connection allowing net metering. Nonetheless, 35 M€ was awarded to investments in PV-systems over 2011. Remarkable was that the granted projects settled for a low subsidy-amount. For the majority of the granted projects the income is complemented up to 9 cents/kWh, which resulted in 2011 in a subsidy of 3,6 cents/kWh.

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 2011. 17,8 M€ of the total national spending for PV went to research and development programmes. Tax and renewable energy incentives and subsidies for implementation amount to a total of 35 M€.



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 2010 and 2011 the overall market for PV grew with 30% and 50% respectively, with 21 MW in 2010 and 43.2 MW in 2011. This growth in 2011 has increased significant irrespectively of the absence of subsidies for small systems in 2011. Market prices have decreased significant and local initiatives in 2011 have been implementing PV without subsidy. Grid parity has been reached in several segments of the market (such as households, where net-metering is allowed).

At the time of writing there was no subdivision available of the different sub segments. There appears to be little activity in segments 2. stand alone systems and 3. mobile systems. No market information is available for segment 4, consumer goods, as these are not registered as PV products.

Stakeholders experience a stable market, where growth can continue without subsidy support. However stimulating regulations such as net-metering are needed.

2.2 Total photovoltaic power installed

The total cumulative installed PV power in the Netherlands at the end of 2011 was 131 MW. The growth of the cumulative installed power in 2011 was 43 MW. This is almost 50% compared to 2010. The annual growth and the distribution of the cumulative installed power are given in
Table 2-1

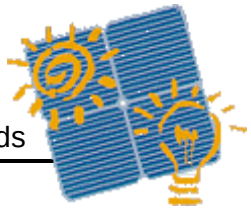


Table 2-1 Cumulative installed PV power in 3 sub markets

Sub-market / Application	1993 [MW]	1994 [MW]	1995 [MW]	1996 [MW]	1997 [MW]	1998 [MW]	1999 [MW]	2000 [MW]	2001 [MW]
Off grid domestic + non domestic	1,59	1,85	2,13	2,55	3,00	n.n.	3,89	4,1	4,3
Grid connected distributed	0,05	0,11	0,27	0,7	1,03	n.n.	5,31	8,5	13,7
Grid connected centralised	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	2,5
Total	**1,64**	**1,96**	**2,40**	**3,25**	**4,03**	**n.n.**	**9,20**	**12,6**	**20,5**

Sub-market / Application	2002 [MW]	2003 [MW]	2004 [MW]	2005 [MW]	2006 [MW]	2007 [MW]	2008 [MW]	2009 [MW]	2010 [MW]	2011 [MW]
Off grid domestic + non domestic	4,6	4,7	5,1	5,4	5,7	5,3	5,2	5,0	5,3	5,4
Grid connected distributed	19,2	38,8	41,3	42,6	43,7	44,4	48,5	58,2	77,8	n.n.
Grid connected centralised	2,5	2,5	3,2	3,2	3,3	3,4	3,5	4,3	5,1	n.n.
Total	**26,3**	**46,0**	**49,6**	**51,2**	**52,7**	**53,1**	**57,2**	**67,5**	**88,2**	**131,4**

In 2010, roughly 82MW (93%) of the total 88 MW is grid connected decentralised (sub-segments 1b + 1c). Although the information is not available for 2011, it is expected that this trend has continued, as grid parity only has been achieved in the decentralised market household segment where net-metering is allowed.

The total PV power, installed in the sub-markets of grid connected distributed and grid connected centralised in 2011, amounts to 131 MW. The market growth is more than 50% (43 MW in 2011 versus 21 MW in 2010).

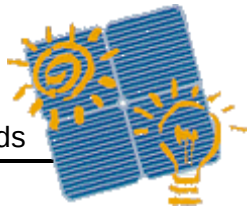
In 2008 and 2009 in total of 49MW of SDE subsidy was given[2]. In 2010 SDE subsidy was given to 20MW of small systems (< 15kWp) and 5MW to large systems (>15kWp)[3]. This shows that in the total three years on average 25 MW per year on SDE subsidy was granted. End 2010, 18MW of the total 69 MW was realized, taking into account that the realization period of the first subsidy rounds was not closed yet.

In 2011 50MW subsidy was granted under SDE+ giving a total of 111MW[4] granted within SDE and SDE+ at the end of 2011. Of which end 2011, 38 MW was installed, where the

[2] Jaarbericht 2009 SDE en MEP, Agentschap NL, Ministerie van Economische Zaken Landbouw en Innovatie.

[3] Jaarbericht 2010 SDE en MEP, Agentschap NL, Ministerie van Economische Zaken Landbouw en Innovatie.

[4] Taking into account (partial) withdrawals



2009 and 2010 realization periods were not closed yet. Concluding that in the year 2011 20MW was added under the SDE/SDE+ scheme[5]

Figure 2-1 clearly shows that in the past years there was a dependence of the PV market on support schemes: several support schemes, directly following each other, caused a continuous growth up to 2003, with a peak 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 was provided for private sustainable energy producers. With the combination of these incentives and RTD support the Dutch government aimed 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.

Clearly the trend of dependency of support schemes appears to be broken for private households as from 2011. In 2011 a total of 20MW was added under the SDE scheme, but 2011 is also being the first year where at least 23MW of growth can be allocated to growth without subsidy. In the years 2008 and 2009 the SDE cap was reached and significantly over asked. People waited for the next year to participate. 2011 however is the year that local and national combined initiatives use the net-metering regulations solely to implement PV. 10MW in 2011 is contributed by the "Wij Willen Zon" (We Want Sun) initiative outside the SDE scheme.

[5] Jaarbericht 2011 SDE+ SDE en MEP, Agentschap NL, Ministerie van Economische Zaken Landbouw en Innovatie

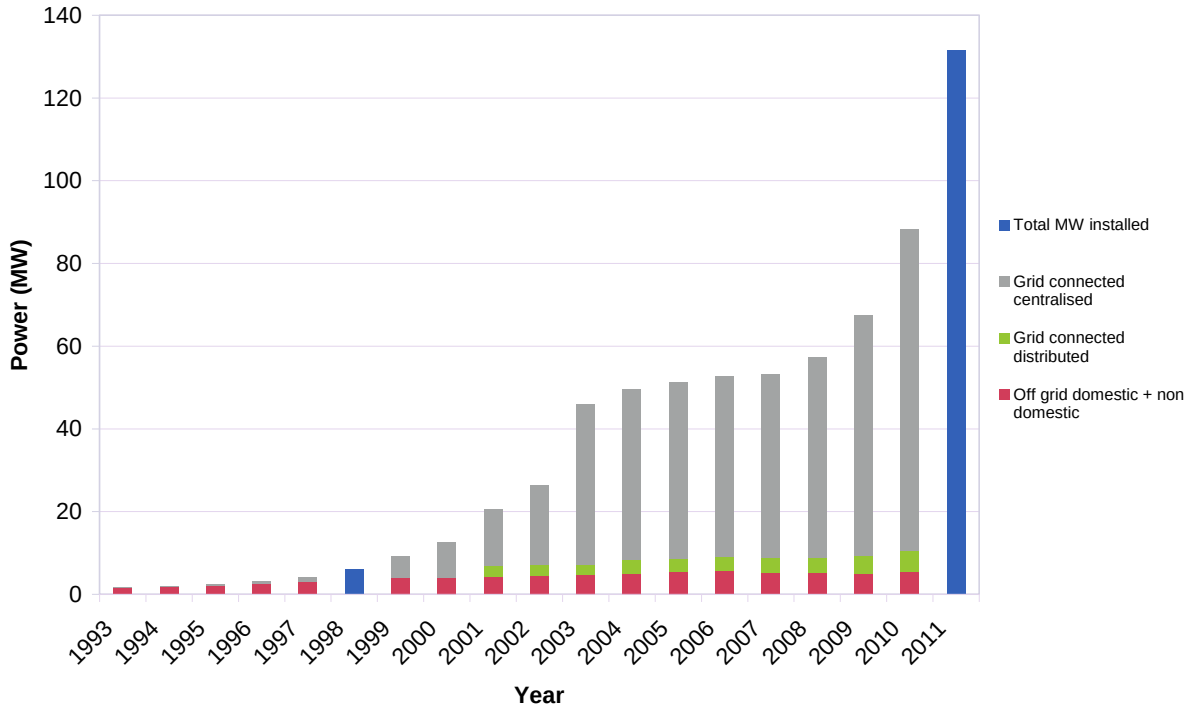


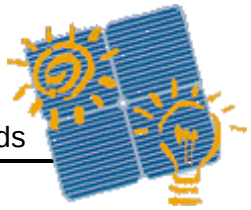
Figure 2-1: Cumulative installed power in MW since 1993, divided over 3 submarkets

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

In 2011, the Dutch PV activities were becoming independent from subsidy. Although the subsidies for small-scale PV were stopped, the implementation of PV-system in the field showed not to be affected by the subsidy cuts. Due to the declined PV-prices the implementation of PV projects showed a continuation of installed capacity growth as in the previous years. Policies for innovation and R&D were temporarily on hold, while a new innovation programme was developed in consultation with the sector. This has mainly affected the businesses in fundamental R&D, product development and improvement, pilots and demonstration.

2.3.1 The renewable energy targets

As EU Member State, the Netherlands is working towards meeting the EU goal of limiting temperature increase to no more than 2°C by 2050. The Netherlands embrace the EU



targets to reduce greenhouse gas emissions in 2020 by reducing energy consumption and by using a higher proportion of renewable energy.

The Netherlands have a binding national target to reduce emissions in various non-ETS sectors, including housing, agriculture and waste, by 16 % in 2020. Overall target for emission reduction from non-ETS sectors is 10 % in 2020 on 2005 levels. In addition, The Netherlands has a binding national target of 14 % in 2020 for renewable energy.

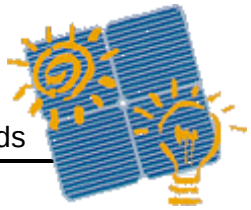
2.3.2 National initiatives

On national level, there was a boost of new initiatives to promote the purchase of solar panels. These initiatives can be either large-scale, combined purchasing actions to decrease the price of the panels and the installation, substantial discounts on PV panel offerings by utility companies, or smart propositions in which the solar panels are for free but remain in the ownership of the utility.

Large scale combined purchasing actions group private parties interested in acquiring PV installations to offer them the lowest prices. A number of (public interest) parties formed these kinds of groups. Some of the most noticeable ones are:

- ’123 zonne-energie’ (translated: 123 solar energy) is an initiative of the association ‘Eigen Huis’ (house owners) in cooperation with the Ministry of the Interior and Kingdom Relations. ‘123 zonne-energie’ delivers a turn-key system to its clients (incl. installation and maintenance). Solar panels will be installed on a total of 2.500 houses.
- “Wij Willen Zon” is a cooperation between Urgenda and Private Energy. They have an initiative only delivering the solar panels and do not provide the installation service. Since the start of the program in 2011 several 10.000 solar panels have been delivered to private customers.
- “Iedereen zonne-energie” is a national, combined purchasing collective in which the price for the first 1,99 MW solar panels has been established upfront. This means that the customers do not have to wait with the actual purchase of their solar panels until a large enough group has been found to ensure the necessary critical mass. Instead, the initiative takes this responsibility on itself.

Examples of programs, developed by utilities, to promote solar energy are:



- E.On has a package deal consisting of an energy contract and three possibilities for solar panels offering a discount of 100 Euro on purchasing and installation costs.
- GreenChoice offered a proposition to a limited number of their consumer customers to place solar panels on their roofs. The solar panels remain property of GreenChoice for 20 years and become private property after that period. GreenChoice and the customer agree to a set tariff for 20 years and the private parties are allowed to subtract the energy delivered to the net from their energy bill

2.3.3 Regional and Local Initiatives

In addition to the national initiatives, a number of regional and local initiatives occurred in 2011. Most regional activity originated from the provinces of Overijssel and Noord-Brabant.

Province of Overijssel

Various local initiatives were particularly started in the province of Overijssel, supported by its provincial subsidy opportunities. The requirement was that at least 25 consumers or 15 companies would apply for a subsidy together. Solar panels were acquired through bottom-up, collective procurement projects in various municipalities. These projects benefitted from a provincial subsidy on the one hand and large-scale purchasing on the other hand, allowing consumers to acquire solar panels under very favourable conditions. The chance of actually being awarded a subsidy increased with the number of participants and installed power.

Province of Noord-Brabant

The province of Noord-Brabant stimulated the development of solar energy with a substantial investment, aimed at positioning this region at the top of solar energy technology and innovation in Europe. This ambition is shared among institutions, companies and the government. Three combined initiatives were awarded an investment of 48,7 mln. Euro; Solliance, KIC InnoEnergy and the FOM foundation. These initiatives are complementary to each other, although they were initiated separately. The investment is used to attract and start up additional research and knowledge development. Knowledge developed in institutions, laboratories and test facilities is made available to local companies, allowing them to apply and market this knowledge commercially. The goal is to increase the employment opportunities in this region, related to solar technology.

2.3.4 Building Integrated PV

In 2010 Dutch rail infrastructure operator ProRail has committed to using solar panels as much as possible when building a new train station. This commitment has led to 40.000 solar panels being installed on top of the roof of the platforms at Utrecht Central station. This assignment has a value of 32.5 million Euros and will be completed in 2012.

Figure 2-2: Solar panels are installed at Utrecht central station. (Source: www.duurzaammbo.nl)

The platform roofs, designed by Benthem Crouwel Architects and Movares, use solar cells integrated in glass (*Figure 2-2*). Furthermore the construction of a new public transportation terminal in Utrecht will lead to another 10.000 m^2 of the total 28.000 m^2 being covered with solar cells. This solar roof will become one of Europe's larger solar energy projects; it is for example larger than the solar roof of the Berlin central train station.

ProRail has also placed solar panels on the roof of the Rotterdam Central train station. These panels will deliver 10% of the total energy demand of the train station. The panels in Rotterdam are the same type as the ones used in the Utrecht Central station.

2.3.5 Other highlighted solar projects

Water Authority Velt & Vecht

The SDE subsidy of 2009 has in 2010 led to the installation of 256 kWp roof bound PV system in Water Authority Velt & Vecht. This system is the largest roof bound PV system in the Netherlands. The 1.400 installed Yingli solar panels together deliver 225.000 kWh electricity. Volker Wessels will measure the production of the solar panels over the next 15 years.

Train station Tilburg

On the Shed roofs of the historic NS-workshop in Tilburg VolkerWessels DEC has installed a PV installation of 189 kWp using the 2010 SDE subsidy. The systems produces 160.000 kWh annually which is enough to provide the electricity for 45 families.

Water Authority Hollands Noorderkwartier

The Water Authority Hollands Noorderkwartier has set out a tender at the end of 2011 for the installation of a 150 kWp PV system on top of their new office. The tender was won by Scheuten Solar, but the actual installation was delayed at the end of 2011 because of financial problems at Scheuten Solar.

2.3.6 Large Scale PV projects

In 2011 the first large scale PV projects have been delivered. Two projects were initiated at landfill locations in the east of the Netherlands. In Azewijn, close to Doetinchem, a 1,8 MWp solar park was built at former landfill location “De Reeven”. The solar park will deliver electricity for 550 houses.

Waste processor Twence has plans to build solar parks at their landfill locations in Hengelo, Zenderen and de Hof van Twente. A feasibility study at the start of 2012 will show if in it is possible to build the largest solar project in the Netherlands in this region. If feasible the solar panels will together deliver 7,5 MW electricity and deliver electricity to 2.000 houses.

2.3.7 Demonstration and field test programs

In the field of demonstration and field test, the Netherlands previously had 2 support schemes; the EOS – DEMO programme (market development support programme), and the UKP programme (tender programme, granting innovative sustainability projects that fit set criteria best).

Both of these programmes have been closed and no projects related to PV energy have been granted since 2009. As a result, there are no known examples of field demonstration or field test projects in the Netherlands for PV technology specifically. Current demonstrations and field test are focused primarily on associated technologies, like smart grids, that could include the use of PV. An example is PowerMatching City.

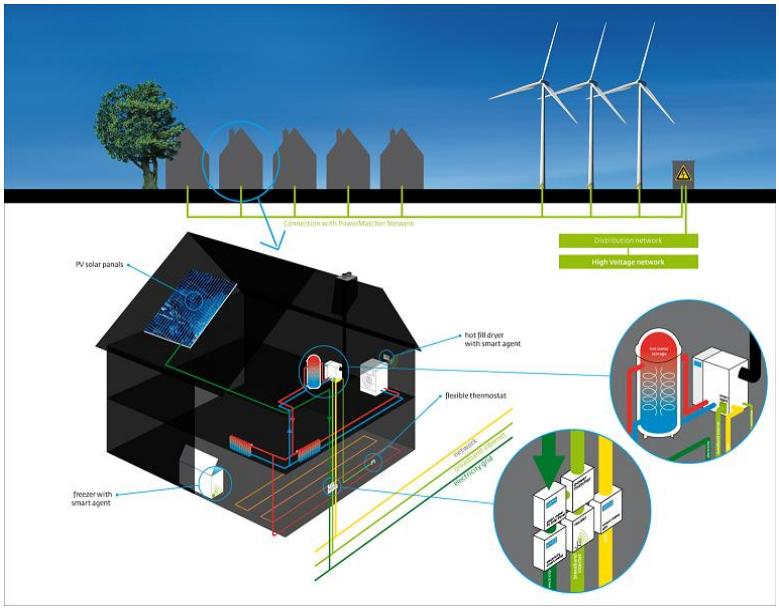
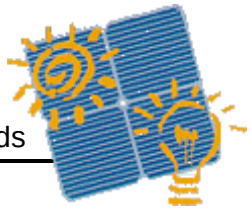


Figure 2-3: PowerMatching City concept (source: www.powermatchingcity.nl)



PowerMatching City

On the 4th of March 2011, “PowerMatching City” was opened. Consultancy company DNV KEMA Energy & Sustainability has created a living lab smart grid environment together with knowledge institute TNO (formerly the group involved was part of ECN), software company HUMIQ and utility Essent. PowerMatching City consists of 25 interconnected regular households in the town Hoogkerk, equipped with micro cogeneration units, hybrid heat pumps, PV-solar panels, smart appliances and electric vehicles. Additional power is produced by a wind farm and a gas turbine.

The goal of the first phase of this project was to develop a market model for a smart grid under normal operating condition. Currently a second phase is under development.

2.3.8 Net metering developments

Since 2004, net metering of electricity has been allowed by law in the Netherlands. For grid connections of 3 x 80A and less, users that generate electricity using renewable energy sources (mainly PV) are able to connect to the electric utility grid and to send electricity back to the grid at times when their generation exceeds their own use. In the past, this was limited to 3,000 kWh annually, while anyone exceeding this limit was not allowed to apply any net metering for that calendar year. The alternative settlement entailed a much lower compensation for all generated PV electricity.

In February 2011, the law was amended to allow for a 5,000 kWh limit on net metering, while the penalty for exceeding this limit was removed. Consumers can now take advantage of the full potential of larger PV systems, without the threat of a cost penalty.
Again, the electricity utilities took a double role with regard to net metering. On the one hand, they were obliged by law to deduct the grid-fed electricity from the purchased electricity before billing (net metering), therewith paying the full grid price, including energy tax and VAT for solar electricity. Many utilities object to this principle. On the other hand, some of them stimulated the realisation of solar energy by offering PV panels to customers or offer unlimited net metering. In paragraph 4.1.1, more information is provided on the effects of net metering in the Netherlands.

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.

Here photovoltaics score as the second highest topic with Dutch participation in absolute terms within the energy related programmes.

The Netherlands are also on the seventh position world wide of the highest ranked countries concerning patents for photovoltaics, see below.

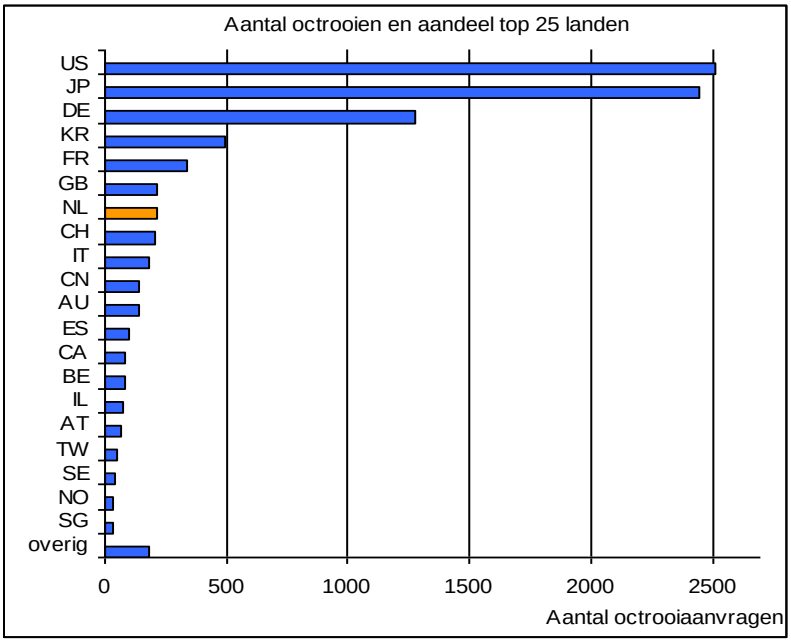


Figure 2.4.1 Position of strongest countries with PV patensts (source Dutch Patent Office based on EPO))

The Dutch share for PV over the period 1995 – 2009 is 2,4%, and somewhat lower than the Dutch average for other technology areas.

The next figure 2.4.2 show that despite the strong increase in patents over the last few years, the Dutch amount stays stable and in percentages is falling behind. The strong increase is largely due to number of patents from China and South Korea.

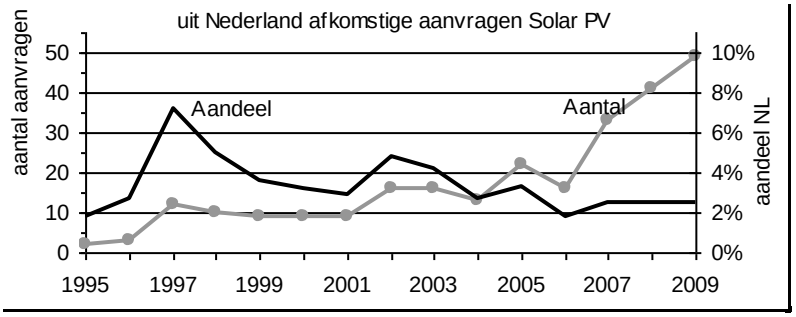


Figure 2.4.2. total number of patent requests and share of the Netherlands. (Source Dutch patent office)

Some highlights of the Dutch RTD activities in 2011:

FOM appoints two focus groups for fundamental energy research. The focus group under the leadership of Professor Kees Hummelen has the theme 'Next generation organic photovoltaics' and will be based at the University of Groningen. The focus group with the theme 'Light management in new photovoltaic materials' will be led by Professor Albert Polman at FOM Institute AMOLF in Amsterdam.. The focus groups will each have a budget of more than 5 million euros and accommodate about 30 researchers.

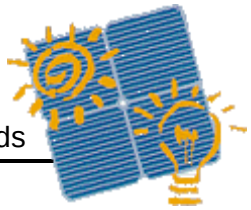
Light management in new photovoltaic materials research

AMOLF was awarded a 5.4 million euro grant from FOM to start a research program on 'Light management in new photovoltaic materials'. This enables the institute to start three new research groups investigating novel solar cells.

The central theme of the new program is 'light management': controlling the collection, guiding, concentration and conversion of light on the nanometre scale. The research program will focus on combining new materials and nanoscale geometries with the aim to realize solar cells that can convert sunlight into electrical current more efficiently and more cheaply.

The research will be carried out in cooperation with Utrecht University and the Energy Research Centre of the Netherlands (ECN). The programme will expand to up to thirty researchers in the coming years.

Next generation organic photovoltaics



Another 5.2 million euro grant was given to Kees van Hummelen and over the next 10 years this group shall carry out research that by 2020 should result in 'plastic' solar cells for widespread use in cheap and sustainable electricity generation. This ambition means that the yield, lifetime and cost price of the solar cells and the sustainability of the materials and processes used need considerable improvement.

The focus group shall work with Dutch knowledge institutes and industrial partners on the scaling up and preparations needed for large-scale production and use. The FOM focus group will be led by Professor Kees Hummelen and will consist of a multidisciplinary team of six physicists and chemists at the Zernike Institute for Advanced Materials at the University of Groningen.

Solar Fuels

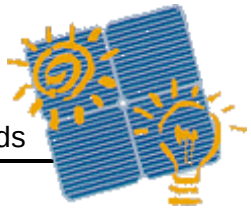
An interdisciplinary effort is made in the area of solar fuels and artificial photosynthesis. Several programs are under way and in february 2011, as part of the national program BioSolar Cells, 7 million euros were granted for several projects in this area, some including established names from the PV research community and some including newcomers to the field. One of these familiar names is prof. Richard van de Sanden who as become the director of the Dutch Institute for Fundamental Energy Research (**http://www.differ.nl/**). Source **http://www.fom.nl/live/nieuws/artikel.pag?objectnumber=140992**)

FLASH

STW has awarded 2.95 million euro to Professor Ruud Schropp and Utrecht University for the program Fundamentals and application of silicon heterojunction solar cells (FLASH). Industrial research partners will take care of co-financing. Goal of the program is development of cheap solar cells with high efficiency.

Solliance

Early 2011, an alliance between TNO, the Technical University of Eindhoven, Holst Centre, ECN and IMEC was formed for research and development in the field of thin film photovoltaic solar energy (PV). The initiative was named ‘Solliance’ and operates in the ELAT-region (Eindhoven-Leuven-Aachen triangle). Solliance’s ambition is to strengthen the position of the region as a world player in thin film PV and aims to create synergy among more than 250



researchers with this common goal. Solliance uses state-of-the-art infrastructure, alignment of research programs, and close cooperation with the solar business community to achieve its goal and is supported by the Dutch province of Northern Brabant.

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 Technical Universities of Eindhoven and Delft, the University of Groningen and the Radboud University of Nijmegen. In addition, the Technical University of Twente, the University of Amsterdam (UvA) and the University of Leiden research PV related issues, like plasmonic solar cells and artificial photosynthesis.

The University of Utrecht decided to discontinue its PV research in 2011. The related research group is being phased out. A new research group is being partly running out of the fund for the FLASH programme and will be moving to the Technical University of Eindhoven.

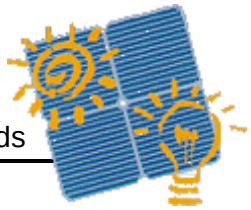
Furthermore three Universities of Applied Sciences (UAS) are active in PV RTD: Zuyd UAS (Hogeschool Zuyd te Rijswijk), Hanze UAS (Hanzehogeschool te Groningen) and the NHL UAS (NHL Hogeschool te Leeuwarden). Apart from these, the Netherlands count three institutes active in the field of PV research: ECN, TNO (including the Holst Centre), FOM-Amolf and KEMA.

2.4.2 Dutch companies

In the past, the Dutch solar companies have always been able to keep a significant, international position, despite their small numbers. The key to this has been ongoing innovation, in which Dutch companies typically have performed above the EU average. However in 2010 and 2011, the cell and manufacturers like Solland, Helianthos, Scheuten Solar, and Sunweb have been faced with fierce competition from Asian producers. The Module manufacturer Solar Modules holds it’s ground and focuses on new high efficiency technology for module manufacturing. Equipment suppliers are impacted less and remain in a strong position such as Tempress, Smitt Ovens and Rimas. OTB solar has been taken over by a Swiss company.

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

In 2011 policies for stimulation of field test and RTD programmes were temporarily on hold, while a new innovation policy was developed in consultation with the sector. STW and FOM



have granted three large long-term solar research programmes. In addition the SDE scheme was transformed into the SDE+ scheme. In the SDE+ scheme large scale (> 15 kWp) PV projects compete for funds with alternative renewable energy projects. Small scale PV is not subsidized in the SDE+, because those installations are under current market conditions profitable without subsidies. The budget for PV projects in the feed-in-tariff scheme declined from **143 M€ in 2009 to 93 M€ (SDE) in 2010** [6] **and 35 M€ (SDE+) in 2011** [7], while the subsidized capacity remained relatively constant as a result of rapid cost reductions.

The number of PV production sites continued to increase. However still a large part of all Dutch PV capacity, (2010 50.9 out of 131.4MW, see Table 2-2) 61%, is not participating in the green certificate scheme regulation, which is related to the SDE+, SDE and MEP scheme. MEP existed between 2003 and 2006, SDE existed between 2008-2010 and SDE+ since 2011. Coming years it is to be expected that more people will install PV without subsidy and therefore outside this certification scheme. It is to be expected that this percentage will grow.

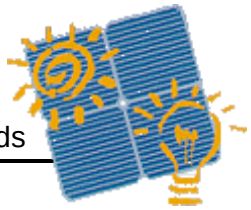
Table 2-2: Overview of Dutch solar PV green certificates (source: CertiQ)

	2009	2010	2011
Green NL certificates (per MWh solar)	6,567	10,704	22,141
% PV of total Green NL certificates	0.064%	0.1%	0.2%
Solar production sites for certificate scheme	3,817	6,634	9,054
% PV of total production sites for certificate scheme	75%	84%	87%
Combined capacity of solar production sites (MW_p)	18.0	31.6	50.9

The budget for both labour and profit tax incentive measures have also declined, but their absolute contribution is relatively small. Apart from the national budgets, several regions and

[6] Jaarbericht 2010, SDE en MEP. Agentschap NL, Ministerie van Economische Zaken, Landbouw en Innovatie.

[7] Tabellen stand van zaken SDE+ 2011, Agentschap NL, , Ministerie van Economische Zaken, Landbouw en Innovatie



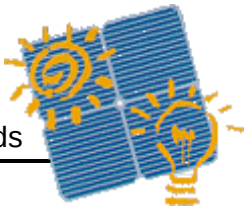
communities provided local investment subsidies. These are described in section 4.1.2.

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 feed-in-tariff for solar electricity produced by ≥ 15 kWp PV systems. Details 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. In 2011, Shell was no longer actively involved as their projects have been finished in 2010. No new projects were started in 2011. The programme aims at very fundamental and new research activities, like the 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. The 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 EOS program was closed at the end of 2010; no new projects were accepted in 2011.
- SBIR en IPZ: Small Business Innovation research, and integration PV are two instruments combined that have entered the second phase in 2011. By means of tendering in 2011 four parties are selected to continue their research and granted 2.3 MEuro. The next parties are selected:
    - Peer + Smart Energy Glass
    - Femtogrid, Femtogrid Solar System
    - Ballast Nedam, Modulair Solar Roof
    - Dimark Solar, Dimark Module



2.5.2 Stimulation through corporate 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 46 companies applied for hours in projects during 2011. In total 88 solar projects were identified to which 278,040 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 170 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. For investments of up to € 306.931, SME's were able to combine this with the KIA (Small-scale Investment Rebate). Both regulations allow a company to deduct either a set percentage or a fixed sum (KIA; depending on the size of the investment) of the PV investment costs from the company's net profit. At a tax rate over profit of 25%, this could result in a net financial advantage of 11% (EIA) plus 7% (KIA; upper limit) of the PV investment costs.

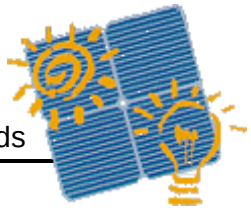


Table 2-3:*Overview of the public budgets for PV in the Netherlands in M€*

Instrument	2009 [M€]	2010 [M€]	2011 [M€]	Source:
National market stimulation				
SDE 2009-2010 / SDE+ (2011)	143	93	35	Jaarbericht 2011 SDE en MEP
EIA	1,54	3,52	n.a	Jaarbericht EIA 2009, 2010
KIA	n.a	n.a	n.a	
National RTD subsidies				
JSP	3,80	3,80	2,00	JSP Ann. Rep.
NWO (FOM)	0,60	3,2	10,6	FOM
STW	1,20	0	5,45	STW
EOS	5,45	3,62	0	NL Agency
NEO	0,28	0,00	0	NL Agency
LT	2,15	3,21	0	NL Agency
KTO	3,02	0,00	0	NL Agency
DEMO	0,00	0,41	0	NL Agency
SBIR	0,00	0,25	2,3	NL Agency
PID	3,12	2,23	n.a	NL Agency
RTD tax incentives [fte] 1				
WBSO	181 fte	197 fte	170 fte	NL Agency
Direct national RTD funding				
ECN	6,15	6,20	6	NL Agency
TNO	7,90	n.a	n.a	NAER – raw data
AMOLF	n.a	2,4	2,4	FOM
Indirect National market stimulation 2				
Net-metering	n.a	n.a	n.a	n.a

1 WBSO is a labour cost tax deduction subsidy. At the time of writing, only the labour hours, claimed by RTD performing companies were available.

2 Net-Metering is an indirect stimulation as kWh produced to the grid can be balanced out with the electricity price and added on this the normal energy-tax and added value tax. There are not publications yet on the exact number of this value.

The overall support programme for PV in the Netherlands is built up to support the development and introduction from the very first idea until implementation. Figure 2-4 shows how the different instruments support the different phases along the S-curve for market development of innovations. It is clearly visible that all national RTD instruments, such as EOS, NEO, LT, KTO, DEMO were cut., SBIR-IPZ were continued to the second phase. NWO has given a large long term grant to two large PV projects and STW has granted three solar projects. Therefore, fundamental research on PV does get an enormous boost. SDE subsidies have been decreased significantly.

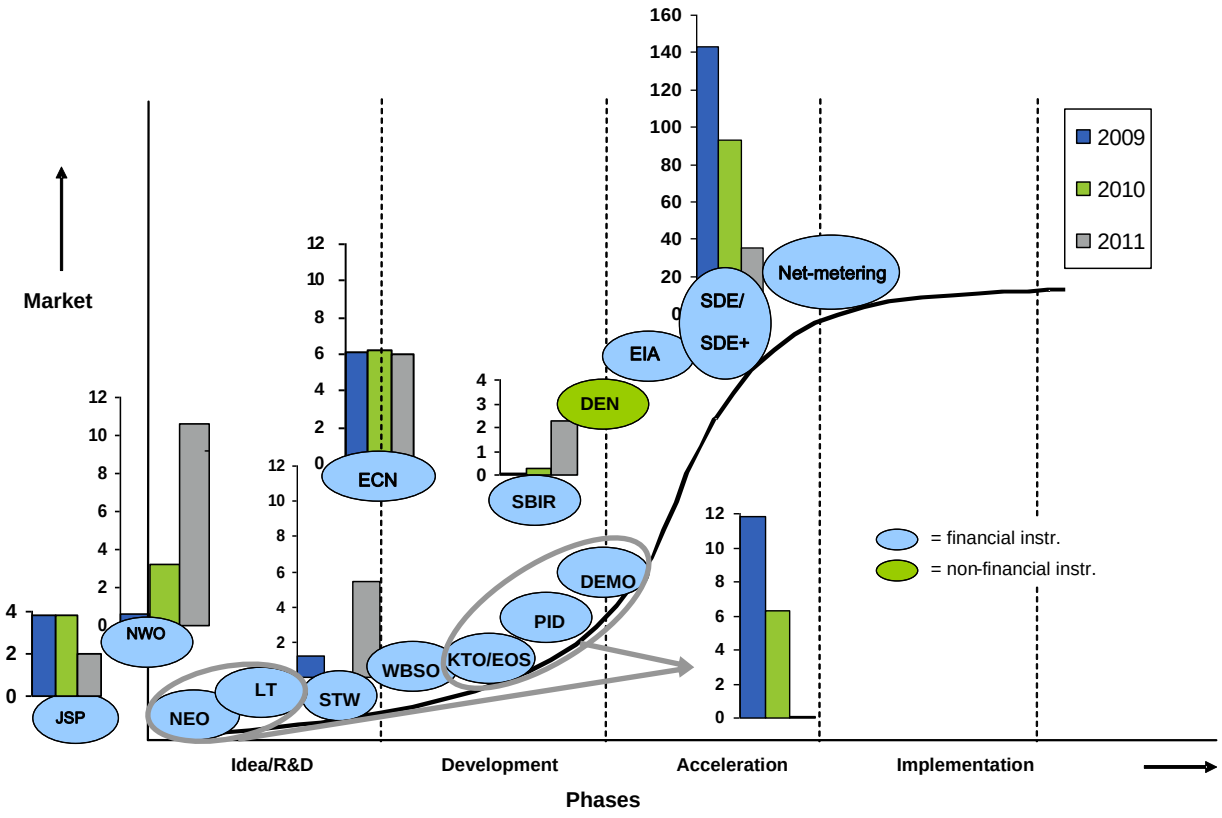
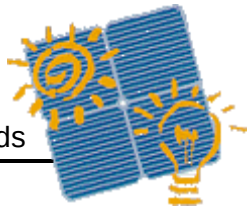


Figure 2-4: position of the different Dutch support instruments along the S-curve for market development of innovations.



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 were Solland Solar and Nuon Helianthos (flexible thin film) of which in 2011 Helianthos was only producing for demonstration projects, rather than large-scale commercial production. Nuon has been looking for investors to scale-up the production facilities for their innovative thin film technology In april 2012 a new formed group Hyet Solar, by entrepreneur Rombout Swamborn, has aquired Helianthos and will continue to develop the thin film production technology.

Due to fierce competition from PV producers in particularly China and Japan, the global prices for PV panels and cells have declined significantly over 2011. As a result, it has become increasingly difficult for western (USA and EU) and therefore also Dutch producers to compete and consolidate or increase market share. In the Netherlands, there have been virtually no investments in new production capacity for PV over 2010 and 2011. The credit crisis and recession are of course contributing to this effect.

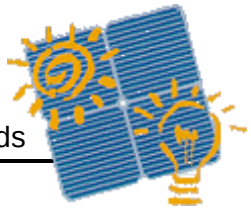
Dutch companies that have obtained severe difficulties are Solland Solar, Scheuten Solar, Sunweb and Helianthos. In addition Solar total was taken over by Rabobank, OTB was sold to a Swiss company and Alinement is looking for new financers as well. It appears that the equipment companies are more easily surviving the competition. Tempress, Smit Ovens, Solar Excel, Rimas are doing well. As well as Solar modules, that are targeting the market with higher efficiency modules.

Figure 3-1: Production line of crystalline PV modules by Solland Solar

The national facts and figures about the actual production of PV cells and modules have not been published for recent years, due to the low number of active companies. These numbers are considered confidential. Table 3-1 provides a trend until 2010 of the trade in solar modules in the Netherlands as published by the Dutch Central Bureau for Statistics. Figures for 2011 were not yet available at the time of writing of this report.

Table 3-1*: Production of PV modules and components is not published. Up to 2011 the trade data are provided. (Source: CBS, 06-06-2012).*

Topics	Trade in solar modules							
	Import	Produc-tion	Sales to installers				Export	Trade
			Total	Autono-mous 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	72 493	x
2010	x	x	20 682	291	768	19 623	117 665	x
2011	.	.	43 250	108	.	.	.	.



3.2 Module prices

Studies to module prices often lead to different values as the conditions that the studies apply may vary. Based on a market analysis conducted in October 2011, by order of NL Agency, the price of modules ranged from 1,11 to 4,70 €/W_p. The average price found for PV modules was 2,10 €/W_p[8]. Prices here are given for single modules only and including 19% tax. The majority of the systems are installed with mono or poly crystalline modules in the low price range.

After October 2011 to beginning of January, prices have been increasingly under pressure due to the module dumping of many Chinese suppliers. It is seen that module prices have dropped 10-30%[9].

3.3 Manufacturers and suppliers of other components

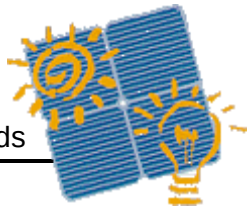
3.3.1 PV inverters

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 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. Exendis, another Dutch manufacturer of PV inverters, was taken over by Alfen in 2011. Alfen is originally a manufacturer of transformer substations and related technology, but also offers a number of ‘special products’, including chargers for electric vehicles, measuring equipment and, with the acquisition of Exendis, PV inverters. The SME Femtogrid has started to sell market products for smaller systems that solves the unequal power output of solar panels due to partial shading, a different orientation or module mismatch.

A market analysis by order of NL Agency was used to determine the inverter prices in the Netherlands. The average price found for inverters in (October) 2011, ranged from 0,17 €/W_p

[8] Sark, W.G.J.H.M. van, Muizebelt, P., Cace, J. (2011), Inventarisatie PV markt Nederland - Status Oktober 2011, Stichting Monitoring Zonnestroom, SMZ-2011-1, Utrecht.

[9] Ecofys field experience in the market.



for inverters around 10 kW to 0.87 €/W_p for inverters around 1 kW systems[8]. Prices are including 19% tax.

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 or maritime applications.

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.

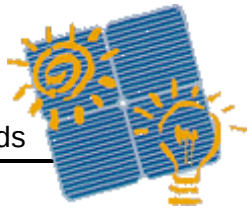
3.3.4 Support structures

The Dutch companies that offer dedicated support structures have grown and are often affiliated to German or Belgium companies and supply German or Belgium mounting systems.

Dutch mounting systems suppliers are:
Oskomera that offers complete solar rooftop systems as well as BIPV solutions. Such as Ubbink Solar that provides rooftop systems and BIPV solution developments such as the solarroof. In addition other Dutch companies that supply construction parts are: Centrosolar, Esdec, Energiebau, Van der Valk, Walraven, ClickFit, Sunbeam, Icopal, IBC-Solar and hafkon.

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. Therefore, the results from a market analysis by order of NL Agency were used to determine the system price of PV in the Netherlands. The average



price found for PV systems in (October) 2011, ranged from 2,80 €/W_p for 600 W_p systems to 1,90 €/W_p for 50 kW_p systems[10]. Prices are including 19% tax and including installation.

Table 3-2: Systems prices of typical applications (Source: Sark, W.G.J.H.M. van, Muizebelt, P., Cace, J. (2011), Inventarisatie PV markt Nederland - Status Oktober 2011, Stichting Monitoring Zonnestroom, SMZ-2011-1, Utrecht).

	Small	Large
Roof-integrated	Not available	Not available
Roof mounted	2,40 – 2,80 €/W_p	1,90 – 2,10 €/W_p

It is seen that the price erosion at the end of the year has dropped prices from 10 up to 30%[11].

3.5 Labour places

The total of fte's in the PV-sector in 2011 is not available yet at the time of writing of this report. The Central Bureau of Statistics does not yet 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 2011 with in addition the turnover of the PV sector. Figures for 2011 were not yet available at the time of writing this report.

Table 3-3*: Facts of employment in the PV-sector in the Netherlands (source: CBS, 12-4-2012).*

	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	408 002
2009	588	56	x	x	332 401
2010	622	59	x	x	490 847
2011	.	.	.	.	.

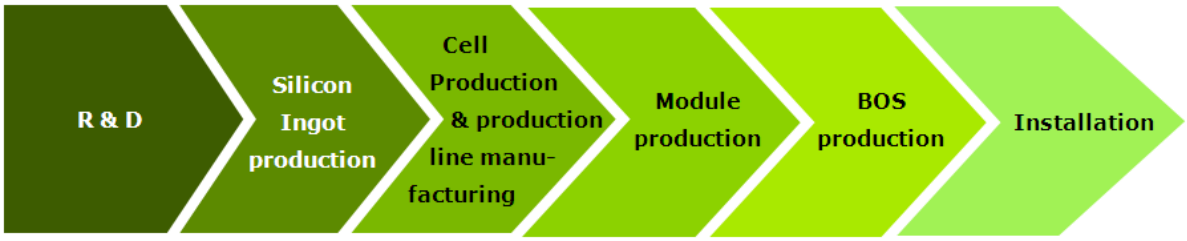
[10] Sark, W.G.J.H.M. van, Muizebelt, P., Cace, J. (2011), Inventarisatie PV markt Nederland - Status Oktober 2011, Stichting Monitoring Zonnestroom, SMZ-2011-1, Utrecht.

[11] Ecofys field experience in the market.

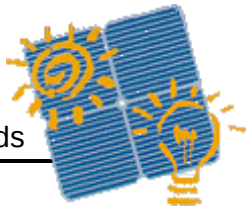
3.6 Value chains

Figure 3-2 shows where Dutch companies are active in the PV value chain for both crystalline based technologies. A large increase is seen in the installation sector.

Figure 3-2*: Crystalline silicon technology value chain.*



R&D		**Cell prod.**	**Module prod.**	**Inverters**	**Installation***
ECN		Solland Solar	Scheuten	Mastervolt	Agrisun
TNO		Sunweb	Solar modules Nederland	MG Electronics	Atama
Technical universities				Icopal	Awizon
AMOLF		**Production line manuf.**		Alfen	BAM
		OTB Solar			Besseling
		Tempress		**Mounting**	BP solar
		Smit Ovens		Klickfit	bureau Wilders
		Rimas		Walraven	CentroSolar
		Solar Excel		Van der Valk	eneco
				Nedap	Energie wonen
					Energie wonen
				Measuring equipment	Energieker
				Leiderdorp Instruments	E-On
				SolarCare	Esdec
				GPX	EVOO installatie technieks
				Qurrent	First energy
				Proxenergy	Green power
				Metsens	Greenchoice
					Hermans Techniek Energy BV

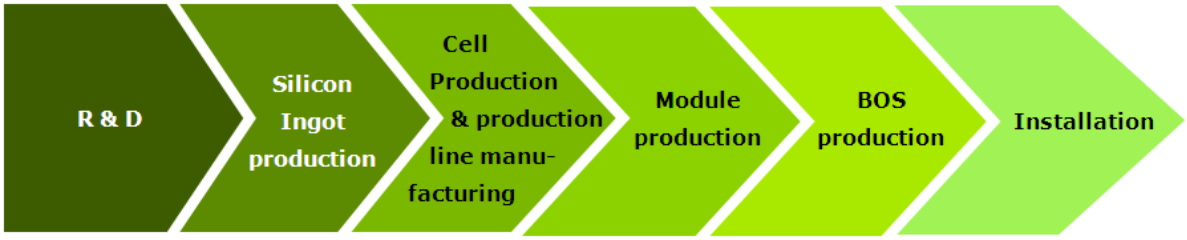


					IBC solar
					Nuon
					Oskomera
					Pfixx Solar
					Pure stroom
					Scheuten
					Schuco
					Solarclarity
					Solar-id
					Solarmodules
					SolarNova
					SolarNRG
					SunCatch
					SunCycle
					Techneco
					Tempus
					The Sun Factory
					Ubbink
					Volker Wessels
					Zizon
					Zonne-energiespecialist
					Zonnefabriek
					Zonnepanelen Gigant
					Zonnestroom
					ZonTech
					Zon-IQ

* The installation market is growing rapidly. This list is not intended to be complete, but show the main Dutch installers.

The Dutch PV value chain is also presented for thin film based technology. This is shown in Figure 3-3. Clearly visible are the strong universities and institutes that act in the top world level R&D field.

Figure 3-3*: Thin film technology value chain.*



R&D		Cell prod.	Module prod.	Inverters	Installation
ECN		Helianthos	Helianthos	Mastervolt	Centrosolar
TNO Technical				MG Electronics	
Universities Holst centre		**Production line manuf.**		Icopal Alfen	
AMOLF		Smit Ovens			
OM&T B.V.					

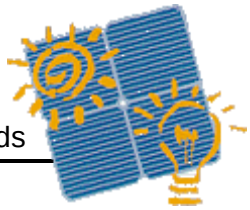
From the illustrations the conclusion can be drawn that there is currently more focus on thin film technology with regard to R&D.

The fastest growth is nonetheless found in the installation sub-sector. Due to the increasing (domestic) demand for PV-systems, the market for contractors installing these systems grew significantly in 2010 and 2011.

3.7 Business value

In 2011 the total business value of the PV capacity in the Netherlands can be estimated at several hundreds of millions of Euros. The value of the installed systems in 2011 can be estimated around 108 M€. In the calculation the yearly 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. As no data



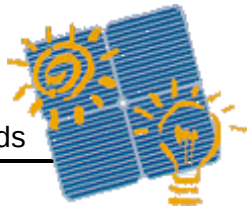
is available on import and stock change only the value of the export data is estimated. An average W_p prices is chosen indicative a price range and therefore value range of ± 20% can be assumed. Prices during the years are estimated from published EPIA data.[12]

Table 3-4 shows the estimated business value since 2004.

Table 3-4 *Indicative estimation of the PV business value in the Netherlands. (source: CBS, 31-05-2012).*

Year	Import of PV products [MW]	Export of PV products (panels) [MW]	Change in stocks [MW]	Price panel* [€/Wp]	Total export** [M€]
2004	13,2	9,8	n.a.	2,9	28
2005	23,7	20,9	n.a.	3,1	65
2006	25,1	22,1	n.a.	3,1	69
2007	n.a.	34	n.a.	2,7	92
2008	n.a.	64,1	n.a.	2,3	147
2009	n.a.	72,5	n.a.	1,7	123
2010	n.a.	117,7	n.a.	1,6	188
2011	n.a.	n.a.	n.a.	1,2	n.a.
Total	**62**	**341**	**n.a.**		**713**
Year	**Yearly installed capacity [MW]**	**Price system* [€/Wp]**	**Total value [M€]**	**Added value Installation *** [€/Wp]**	**Total value installation*** [M€]**
2004	3,6	5,3	19	11	4
2005	1,7	5,8	10	12	2
2006	1,5	5,6	8	11	2
2007	1,4	5,6	8	11	2
2008	4,4	5,6	25	11	5
2009	10,7	3,8	41	8	8
2010	20,7	3	62	6	12
2011	43,3	2,5	108	5	22
Total	**87,3**		**281**		**56**
* Prices estimated from EPIA data					
** Only value of export is calculated as other data is missing					
*** Average 20% is added value of installation and profit by Dutch installers					

[12] www.EPIA.org

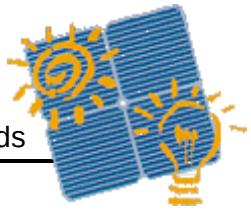


4 FRAMEWORK FOR DEPLOYMENT (NON-TECHNICAL FACTORS)

Table 4-1 lists the main support measures for PV during 2011. Further details on new initiatives are provided below.

Table 4-1*: PV support measures*

Support measure	Ongoing measures	Measures that commenced during 2010-2011
Feed-in tariff	- MEP measure until 2006; 10 year duration - SDE (Promotion of Renewable Energy Production) until 2010; 15 year duration: • Small (1-15 kWp) • Large (15 - 100 kWp)	- SDE+ commenced in 2011.
Direct capital subsidies	.	Regional: • up to €1.00 per Wp with a maximum of € 50,000 per system • € 500 subsidy for investment in solar energy and insulation for dwellings. Differentiated per province.
PV-specific green electricity schemes		One utility offered 5,000 of their customers solar energy from PV-systems on their own roofs.
Renewable portfolio standards (RPS)	None	
PV requirement in RPS	None	
Investment funds for PV	"Groen Beleggen" (Green investments) is a 1.3% tax benefit for investments in renewable energy. Any renewable energy system can apply. It was decided to phase out this measurement in 3 year, starting in 2011 (a 1% benefit remains for 2011).	
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 law for private grid connections up to 5,000 kWh/yr (balancing). This means that if more electricity is being fed into the system than being used, a utility is then not obliged to balance, which results in a higher income per kWh. Some utilities do not apply any limit.
Net billing		All suppliers are obliged by law to pay a reasonable tariff for electricity fed into the grid. This is typically set to 70% of the commodity price. Transport costs are deducted separately from the returns of the solar energy producer.
Commercial bank activities	Several banks provide Green Mortgages (ASN, Triodos, ING, Rabobank, Fortis). These all offer 1-2% discount on market interest rates. The max. amount of mortgage under these beneficial conditions is €34,034.	
Electricity utility activities	No specific subsidies available through utilities. Some suppliers apply feed-in tariff constructions / benefits. Additionally, PV-systems are offered in package-deals with energy contracts.	
Sustainable building requirements	PV provides points for the required building energy performance coefficient.	



4.1 Description of new support measures introduced in 2011

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.

- In 2011 a new policy framework for innovation was developed in which sustainable energy has been given an important role in the liberalised market. The new framework covers:
    - Creation of topsectors including a topteam energy. This topteam advises how the energy sector is able to compete on the worldmarket. The topteam has created innovation contracts for the different themes with the sector under which solar-PV has a role. The solar-PV 'innovation table' has strongly included and gathered the small and medium scale business sector. At the end of the year in December the contours became clear of the new innovation contract that will replace the subsidy scheme for R&D in the Netherlands. This is a public-private partnership with shared funding that will ensure a closer connection between research, development and market deployment, and a more effective employment of available funds. The innovation contract focuses on three main program lines: PV systems and applications, wafer-based silicon PV technologies and thin film PV technologies.
- A second new policy item in 2011 covers the use of green deals with companies and local initiatives. In green deals the government focuses on interaction and participation from bottom up. In 2011 5 green deals relating to Solar-PV are signed.

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 is not awarded to new systems anymore.

The successor of the MEP subsidy was the SDE subsidy. The SDE bridges the gap between the costs of renewable energy and conventional energy during 12 or 15 years. On awarding the SDE subsidy, the cost of renewable energy (per kWh) was determined. The gap with conventional energy is calculated annually, based on the average electricity price over the relevant year. The gap is limited to the difference between the cost of renewable energy and a set lower limit for conventional energy. This is illustrated in Figure 4-1.

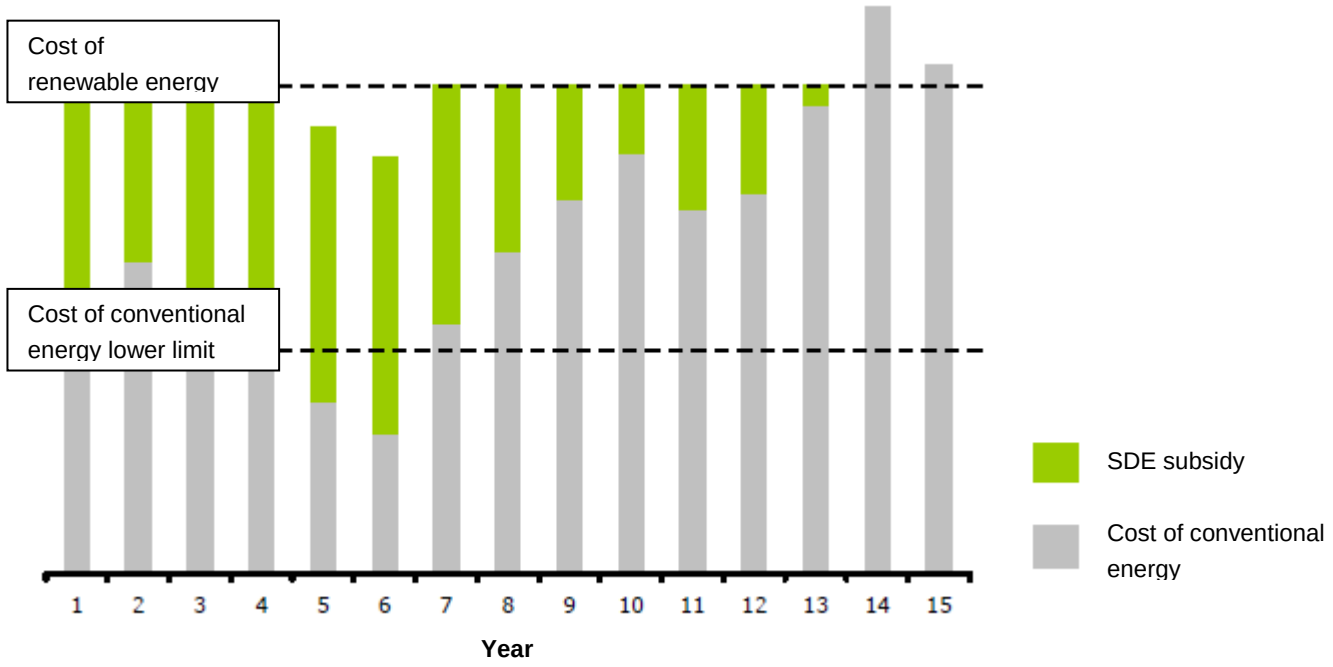


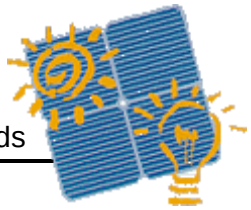
Figure 4-1: SDE subsidy mechanism.

The green bars represent the SDE subsidy; the subsidy is maximised because of the lower limit that was set for conventional energy. If the cost of conventional energy rises above the cost of the renewable energy developed under this scheme, the SDE subsidy ultimately declines to zero.

In 2010, the scheme was divided into two trenches: small systems: 0,6 – 15 kW and medium sized systems: 15 – 100 kW. The total budget subsidised 20 MW (69 M€) of small systems and 5 MW (24 M€) of medium sized systems, leading to a total budget of 93 M€. The scheme was not opened again in 2011.

The SDE is a Feed-in-Tariff scheme, subsidising the additional production costs with respect to electricity from the grid. In 2010 the prices per kWh were 47,4 €ct/kWh for small installations (1-15 kWp) and 43,0 €ct/kWh for large systems (15-100 kWp). The SDE paid the difference between the calculated average grid price and the set cost of a solar kWh. For Small installations:

- cost of solar electricity: € 0,47
- price of grid electricity: € 0,22
- uneconomic top € 0,25



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 following year and is based on the actual average cost of grid electricity of the year before. The subsidy is granted for 15 years.

In 2011, the SDE subsidy was succeeded by the SDE+ programme. A number of changes were made in comparison to the SDE subsidy. The most important changes are:

- The introduction of one, general budget. This budget is not distributed over various technologies, but instead all technologies are competing for budget;
- The scheme is opened in five separate phases, in which the subsidy per unit of energy increases with each phase;
- A cap was introduced for the cost of renewable energy. This cap was set to 15 €ct/kWh.

The SDE+ was not granted to PV-installations of < 15 kW_p or installations with ≥ 15 kW_p that were connected to the grid with a connection allowing net metering. Nonetheless, 35 M€ was awarded to investments in PV-systems over 2011.

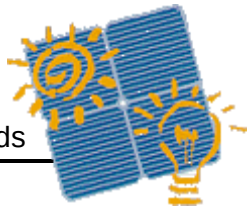
Figure 4-2: Distribution of the total granted power of PV-panels in the SDE and SDE+ granted (not installed) in 2011 showing the Dutch communities in total W_p (source: Agency NL).

4.1.2 Capital subsidies

On a national level direct capital subsidies are not provided. Apart from the national feed-in schemes, several provinces and local authorities organise regional support schemes for PV. Table 4-2 provides an indication of subsidies that were granted to install PV-systems.

Table 4-2*: Capital subsidies in several Dutch provinces*

Province	Subsidy	Comment
Overijssel	0,4 €/Wp, available 3,5 Meuro	Farmers were stimulated to remove asbestos from their stable roofs and install PV-panels afterwards.
Limburg	30% of the purchase & installation costs	Consumers were stimulated to tender for a subsidy on the investment costs of PV-systems.
Utrecht	Meer Met Minder (500-950 €)	A Subsidy for decreasing the energy label of a living. PV is one example to reduce your energy label, isolating the living is also



		included in this scheme.
Noord-Brabant	Meer Met Minder (500-950 €)	A Subsidy for decreasing the energy label of a living. PV is one example to reduce your energy label, isolating the living is also included in this scheme.

Apart from the regional support schemes, several local communities provide support for implementation.

4.1.3 Electricity utility activities

No specific subsidies are available through utilities. However, they sometimes offer turn-key PV-systems in package deals with an energy contract. Additionally, some utilities offer additional net metering, beyond the mandatory limit of 5,000 kWh annually (Greenchoice, Atoomstroom).
Finally, Greenchoice has offered 5,000 of its customers a leased PV-system to generate their own electricity for a fixed electricity price, in combination with a long-term energy contract with Greenchoice. After 20 years of use, the panels are owned by the customer.

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 consumed. The REB tariff is dependant on the total annual energy consumption of the user. The tariffs are shown in Table 4-3 for 2010 and 2011.

Table 4-3: Regulating Energy Tax tarrifs.

Electricity (per kWh)	**2010**	**2011**
0 – 10,000 kWh	€ 0.1114	€ 0.1121
10,000 – 50,000 kWh	€ 0.0406	€ 0.0408
50,000 - 10 mln. kWh	€ 0.0108	€ 0.0109
> 10 mln. Non-profit	€ 0.0010	€ 0.0010
> 10 mln. For profit	€ 0.0005	€ 0.0005

The application of these offset tariffs, dependant on total energy consumption, has a significant effect on the impact of net metering. For energy users consuming 10,000 kWh per year or less, the electricity is on average more expensive than for larger users. Due to this, more money is saved by using electricity generated with a local PV-system. Figure 4-3 illustrates the resulting price difference between consumers, SMEs and large (industrial) users.

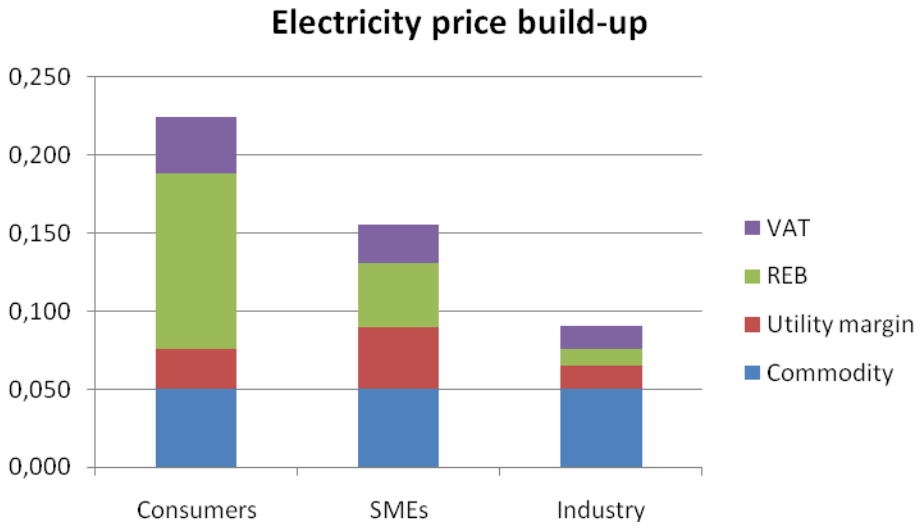
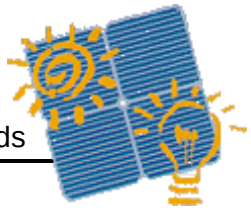


Figure 4-3: Indicative 2011 build-up of Electricity prices.

Particularly consumers and other small electricity consumers pay a substantial amount of REB per kWh. SMEs and other medium users pay much less, while the effect of the REB is very small on the electricity prices of large users.

Consumers are compensated for this, by means of a lump sum discount (‘heffingskorting’) on the REB. The same discount applies to all electricity connections, regardless of the annual consumption. The REB discount was € 379.16 (including VAT) for 2011; this is negligible for industrial users, but it compensates most of the REB for consumers.

If electricity is being generated by an own PV-installation, consumers can feed this electricity back to the grid. Up to a threshold of 5,000 kWh, net metering is applied. The customers do not only earn the cost of electricity, but also save the REB (and VAT) costs. The REB discount is a lump sum and can be applied nonetheless. As a result, net metering provides a



substantial tax discount for consumers. Grid parity is achieved in several segments in the Netherlands, mainly due to this tax benefit.

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 Mechanism (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. A large part of the Dutch international cooperation is through agencies such as the World Bank.

4.3 Standards and codes

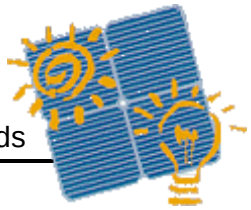
4.3.1 Technical regulations for PV plant construction and operation

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.



- Branche organization Uneto VNI and Hollands Solar are developing and improving the guideline solar-energy for installation from 2005 and a certification training for solar installation is planned to launch mid 2012..

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. Table 4-3 and Table 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 4-4: Relevant standards 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
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

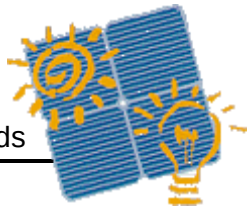
Table 4-5: Relevant standards for PV in the built environment

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

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. It is expected that this standard will be finalised in 2012.

Since a period of small activity in development of quality guidelines and standards since 2010 and 2011 there is awareness again on this topic. For one it is decided to develop NVN7250 and include research to waterproofing solar systems and wind tunnel research for determination of wind factors. Secondly as mentioned a training and certification for installation is being developed.



HIGHLIGHTS AND PROSPECTS

4.4 Key aspects of PV deployment and production in the Netherlands during 2011

2010 and 2011 have again been eventful for the PV-sector in the Netherlands. Costs have dropped rapidly and small scale systems have become profitable. Therefore the subsidy for small scale systems was finalised. The market for small to medium sized PV-installations genuinely took off in 2011. The declining investment costs of PV-systems have led to near grid parity in numerous cases and as a result the public interest in PV grew tremendously in recent years. This was demonstrated by many public interest and commercial initiatives, starting collective purchasing tenders. These resulted in large orders at very low prices.

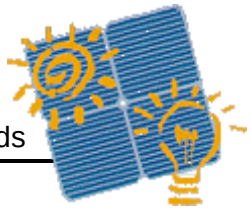
The industry has received in 2011 fierce competition from Asian competitors and lower margins. As a result, investments in additional capacity were hampered and mainly the cell production companies are struggling to expand or consolidate their market shares and moving their focus areas.

An increasing number of companies and local initiatives entered the PV market for installation activities and project development. The manufacturing industry stays strong and has a clear international outlook, with strong European, Asian and American ties, the contractors have mainly been focused on the growing domestic market and neighbouring countries like France, Germany and the UK.

Holland Solar is the Dutch Solar branch organization and has seen there members increased of the last two years from 71 members in 2009 tot 99 in 2011. Currently there are over 100 members.. Activities that the solar branch have set themselves for the future are:

- Education and spreading information
- Strengthen the political lobby in developing a stronger sustainable solar policy
- Promoting of solar awareness campaigns, like European Solar Days.
- Organizing events such as Solar city of the year competition.

Activities are focussed on broadening the solar energy application and developing of a quality brand.



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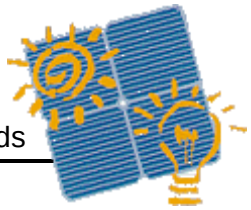
4.5 Prospects for future

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

Helianthos is still working on the development of 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 and applied in pilot projects. The main focus of Nuon has however shifted to finding a suitable investor to scale-up the process effectively. In april 2012 a new formed group Hyet Solar, by entrepreneur Rombout Swamborn, has aquired Helianthos and will continue to develop the thin film production technology.
The thin film knowledge accumulated in the Netherlands will provide a fertile soil for further ventures.

4.5.2 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 R&D infrastructure in the Netherlands is well developed and research is productive and of high quality in international perspective; this is illustrated by a number of new research projects and networks that have been initiated in the past years (e.g. Solliance, FOM foundation).
The Netherlands has had a nearly complete value chain for several PV technologies for some time. The Dutch equipment manufacturing companies have expanded until recently, despite of the small home market and focus strongly on emerging markets. The cells and module manufacturers also rely heavily on exports and have been caught up in the global consolidation in the sector. In 2011 the installed capacity nationally has taken off as a result of the drop in system prices.and jobs are being generated in this part of the value chain.
Although the general perception of PV is very positive and expectations of the future potential is very high, PV still has to prove itself as a competitive energy source outside the small systems retail market. Medium sized system are increasing on public buildings and in the agricultural sector and this will aid the general acceptance and possible raise the interest of new companies with specific business cases. The innovation system analysis still shows the relatively weakness of the advocacy coalitions in the specific Dutch political landscape.



4.5.3 National subsidy versus bottom-up initiatives

In 2011, the SDE+ scheme has been limited to large scale PV-systems. Moreover, PV projects now have to compete with other renewable energy technologies in order to acquire funding. The most cost-efficient projects are rewarded subsidy first. The 2011 applications have shown that large-scale PV-systems are still viable in competition to other technologies.

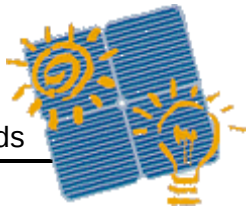
Furthermore, a host of new initiatives for the implementation of solar power that are independent of governmental subsidies have been set up. The “Wij Willen Zon” (We want sun) foundation was one of the firsts to aim at buying large amounts of solar panels so that the price per panel is reduced. At present, there are many similar initiatives in the Netherlands. Additionally, lease-back constructions and cooperative organisational structures are used to allow people to become the (partial) owners of solar panels and/or use solar energy without making large investments. These bottom-up initiatives represent a clear new trend in the Netherlands; the start of subsidy independent implementation of solar power.

4.5.4 PV value chain

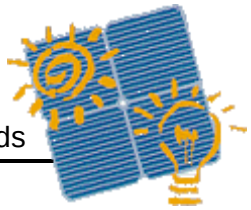
As stated above research in the Netherlands is very well developed and of high quality also from an international point of view. New networks are created to further increase the alignment and speed of development of research activities. These include the Joint Solar Programme (FOM, Shell, Nuon, CW) and 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 equipment supply industry (OTB Solar, Tempress, Smit Ovens).

Vast amount of the Dutch PV turnover comprises export, while the market in the Netherlands in 2011 is starting to grow, this mainly account for the installation of systems. The production sector is relatively modest in size. Furthermore the current price competition from Asian suppliers gives stress on the Dutch cell and module suppliers. This counts as well for the export market. While the equipment suppliers still have good running businesses as they supply also to Asian suppliers. Thus, focus in the Netherlands is currently mainly on R&D activities and the supply industry in the PV value chain, installation business starts to grow. 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. 2011 has shown to be a year with bankruptcy for



some suppliers in US and Germany. It is expected that with the current prices the production will move more to the Asian countries. However most Chinese companies are also showing losses and the current price level will not be sustainable for all of them. The Asian countries will remain the main producers in the nearby future due to scale benefits and the financial backing. The Netherlands are expected to play an important role in the supply of manufacturing machines. However, there are indications that production of PV modules is moving back to 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. An example of this is the continuing good growing business of Solar Modules Nederland.



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. The reader is advised to do their own research for more detailed data.

1) retail electricity prices:
   household: ca. € 0,22 depending on the utility
   small business: ca. € 0,16 depending on the utility
   large business: by contract
   The difference between the different tariff groups is partly caused by the difference in energy tax (REB).

2) typical household electricity consumption ~ 3,300 kWh per year (source: Nibud, 07-05-2012).

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 – € 32,500 per year (source: CBS, 07-05-2012)

5) typical mortgage interest rate 5.6% average 20 year mortgages (source: 'Hypotheekshop.nl', 07-05-2012)

6) voltage:

Household :	50 Hz, 230 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, although distribution company Stedin and utility Eneco are still an integrated company. The Netherlands is one of the most progressive countries regarding unbundling.

8) price of diesel fuel per litre: € 1.51 depending on company and region (source, United Consumers 12-4-2012)

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