IEA INTERNATIONAL ENERGY AGENCY

Forskningsrådet

National Survey Report of PV Power Applications in NORWAY 2014

PVPS

PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

Prepared by

Øystein Holm

TABLE OF CONTENTS

Foreword

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 member countries

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 participating countries and organisations can be found on the www.iea-pvps.org website.

The overall programme is headed by an Executive Committee composed of one representative from each participating country or organization, 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 promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. 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 country National Survey Report for the year 2014. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website www.iea-pvps.org also plays an important role in disseminating information arising from the programme, including national information.

1 INSTALLATION DATA

The PV power system market is defined as the market of all nationally installed (terrestrial) PV applications with a PV capacity of 40 W or more. A PV system consists of modules, inverters, batteries and all installation and control components for modules, inverters and batteries. Other applications such as small mobile devices are not considered in this report.

For the purposes of this report, **PV installations are included in the 2014 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2014, although commissioning may have taken place at a later date**.

1.1 Applications for Photovoltaics

2,2 MWp was installed totally in 2014 which is 3 times the volume installed in 2013. The market for PV in Norway reached a turning-point with more new capacity (1,4 MWp) of grid-connected systems than PV to off-grid applications (0,8 MWp). The main driver for the grid-connected segment is high environmental goals set by property developers who want buildings or operations to reduce their energy-use.

1.2 Total photovoltaic power installed

Table 1: PV power installed during calendar year 2014

AC			**MW installed in 2014 (mandatory)**	**MW installed in 2014 (optional)**	**AC or DC**
Grid-connected	BAPV	Residential		0,20	DC
		Commercial		0,80	DC
		Industrial		0,40	DC
	BIPV (if a specific legislation exists)	Residential			
		Commercial			
		Industrial			
	Ground-mounted	cSi and TF		N/A	
		CPV		N/A	
Off-grid		Residential			
		Other		0,80	DC
		Hybrid systems			
		Total	2,2		

Table 2: Data collection process:

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	N/A
Is the collection process done by an official body or a private company/Association?	Yes, by the private company Multiconsult on behalf of the Research Council of Norway
Link to official statistics (if this exists)	N/A
	N/A

Table 3: PV power and the broader national energy market.

MW for capacities and GWh for energy	2014 numbers	2013 numbers
Total power generation capacities (all technologies)	33 000	Approx. 30 000
Total power generation capacities (renewables including hydropower)	32 000	Approx. 30 000
Total electricity demand (= consumption)	126	129
New power generation capacities installed during the year (all technologies)	626	379
New power generation capacities installed during the year (renewables including hydropower)	626	379
Total PV electricity production in GWh	10,4	8,5
Total PV electricity production as a % of total electricity consumption	0,008	0,006

Table 4: Other informations

	2014 Numbers
Number of PV systems in operation in your country (a split per market segment is interesting)	**N/A**
Capacity of decommissioned PV systems during the year in MW	**N/A**
Total capacity connected to the low voltage distribution grid in MW	**1,4**
Total capacity connected to the medium voltage distribution grid in MW	**0**

Total capacity connected to the high voltage transmission grid in MW	**0**

Table 5: The cumulative installed PV power in 4 sub-markets.

Cumulative capasity per segment, kWp	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Stand-alone domestic	6440	6800	7150	7450	7780	8080	8400	8800	9250	9750	10497
Stand-alone non-domestic	375	377	390	410	430	450	470	490	510	530	602
Grid-connected distributed	75	75	128	132	132	132	192	192	192	292	1712
Grid-connected centralized											
Total, kWp	6890	7252	7668	7992	8342	8662	9062	9482	9952	10572	12811

1.3 Module prices

Table 6: Typical module prices for a number of years

Year							2014
Standard module price(s): Typical							N/A
Best price							N/A
PV module price for concentration (if relevant)							N/A

1.4 System prices

System prices collected from system suppliers serving the Norwegian market. The system prices show large variations, and the referred are average prices.

Table 7: **Turnkey Prices of Typical Applications – local currency**

Category/Size	Typical applications and brief details	NOK per W
OFF-GRID Up to 1 kW		60-100
OFF-GRID >1 kW		70-150
Grid-connected Rooftop up to 10 kW (residential)		20
Grid-connected Rooftop from 10 to 250 kW (commercial)		16
Grid-connected Rooftop above 250kW (industrial)		13
Grid-connected Ground-mounted above 1 MW		
Other category existing in your country (hybrid diesel-PV, hybrid with battery…)		

Table 8: National trends in system prices (current) for different applications – local currency

NOK/Wp					2011	2012	2013	2014
Residential PV systems < 10 KW					40-60	20-30	21	20
Commercial and industrial						15-20	15	16
Ground-mounted							12	13

1.5 Cost breakdown of PV installations (optional)

1.5.1 Residential PV System < 10 kW

Table 9: Cost breakdown for a residential PV system – local currency

Cost category	Average (NOK/W)	Low (local currency/W)	High (local currency/W)
Hardware			
Module	10,8		
Inverter	1,9		
Other (racking, wiring…)	3,7		
Soft costs			
Installation	3,6		
Customer Acquisition	Incl.		
Profit	Incl.		
Other (permitting, contracting, financing…)	N/A		
Subtotal Hardware	20		
Subtotal Soft costs	Incl.		
Total	20		

1.5.2 Utility-scale PV systems > 1 MW

Table 10: Cost breakdown for an utility-scale PV system – local currency

Cost Category	Average (local currency/W)	Low (local currency/W)	High (local currency/W)
Hardware			
Module	N/A		
Inverter	N/A		
Other (racking, wiring, etc.)	N/A		
Soft cost	N/A		
Installation Labor	N/A		
Customer acquisition	N/A		

Profit	N/A		
Other (contracting, permitting, financing etc.)	N/A		
Subtotal Hardware	N/A		
Subtotal - Soft cost	N/A		
Total Installed Cost	N/A		

1.6 Financial Parameters and programs (leasing…)

Table 11: PV financing scheme

Average Cost of capital per market segment	
N/A	

1.7 Additional Country information

Table 12: Country information

Retail Electricity Prices for households, NOK/kWh (inc.VAT)	0,7-1,0
Retail Electricity Prices for a commercial company, NOK/kWh (ex.VAT)	0,35-0,70
Retail Electricity Prices for an industrial company, NOK/kWh	0,35-0,70
Population at the end of 2014 (or latest known)	5 165 802
Country size (km^2)	323 772
Average PV yield (according to the current PV development in the country) in kWh/kWp	800
Name and market share of major electric utilities.	Grid owners: Hafslund Nett, Agder Energi Nett, Skagerak Nett, BKK Nett, Lyse Nett, Eidsiva Nett, Trondheim Energiverk Nett, NTE, Troms Kraft Nett Power Producers: Statkraft, E-Co, Hydro, Lyse Produksjon, NTE, Trønderenergi, EB

2 POLICY FRAMEWORK

This chapter describes the support policies aiming directly or indirectly to drive the development of PV. Direct support policies have a direct influence on PV development by incentivizing, simplifying, or defining adequate policies. Indirect support policies change the regulatory environment in a way that can push PV development.

2.1 Direct support policies

Table 13: PV support measures (summary table)

	On-going measures	Measures that commenced during 2014
Feed-in tariffs (gross / net?)	N/A	N/A
Capital subsidies for equipment or total cost	N/A	N/A
Green electricity schemes	N/A	N/A
PV-specific green electricity schemes	N/A	N/A
Renewable portfolio standards (RPS)	Renewable Electricity Certificates (RECS)	N/A
PV requirement in RPS	High entrance fee a barrier for PV. So far, no PV-plant is registered for RECS.	N/A
Investment funds for PV	N/A	N/A
Income tax credits	N/A	N/A
Prosumers' incentives (self-consumption, net-metering, net-billing…)	N/A	N/A
Commercial bank activities e.g. green mortgages promoting PV	N/A	N/A
Activities of electricity utility businesses	N/A	N/A
Sustainable building requirements	N/A	N/A

2.2 Direct Support measures

2.2.1 Support measures exiting in 2014

2.2.1.1 Description of support measures excluding prosumers, BIPV, and rural electrification

With nearly all power-production from hydropower, Norway has not defined any national goals when it comes to implementation of PV technology.

Enova SF, a public agency owned by the Ministry of Petroleum and Energy, was established in 2001 as an instrument to improve energy system efficiency and increase renewable energy production. Enova offers support schemes in the areas in which the greatest effect in the form of saved, converted, or generated clean energy can be achieved. Since the introduction of the el-certificate market Enova only supports new power generation technologies, i.e. demonstration projects including immature technologies or technologies new to the Norwegian market. New renewable power generation capacity from wind and hydropower will receive support from the el-certificate market. This is a bilateral agreement and common market for Renewable Electricity Certificates (RECS) between Norway and Sweden it was established in 2012, but it is not effective for PV. The RECS-market has a

minimum entrance fee of NOK 15000,- (~1850 €) which is an effective barrier for small PV-systems. RECS are traded with floating prices and is at the moment worth 0,14 NOK/kWh (~2 €c/kWh).

Some of the projects that Enova supported under the demonstration support program in 2014 was so-called "plus energy buildings" or "Zero Emmission Buildings" in which the use of PV was a central part of the concept.

In the end of 2014 Enova announced a new support-scheme to be effective from Jan 1st 2015 which includes right-based support for a range of energy efficient technologies including PV (ref. 2.2.3 below)

2.2.1.2 Prosumers' development measures

Self-consumption is allowed for residential plants under the 'Plus-customer scheme' (Plusskundeordningen) provided that the customer is a net consumer of electricity on a yearly basis. At the moment the scheme is voluntary for the utilities, hence they can decide whether to offer to pay the customers or not. The Plus-customer scheme is under revision at the moment and a new possibly compulsory scheme is expected to be implemented in the near future.

Under this scheme the utilities handles the transactions related to the power fed to the grid from distributed micro-generators as PV-systems. PV-electricity fed to the grid is compensated by the current spot-price. Excess electricity fed in to the grid is charged energy charge based on marginal losses. This charge could be even positive or negative (+/- 1,8 cEu/kWh).

2.2.1.3 BIPV development measures

Environmental qualities or aspects seem to become an increasingly important market parameter for actors in the Norwegian building and construction sector. Enova has a strong focus on energy efficient buildings and in 2014 a new support for buildings with energy efficiency requirements beyond "passive standard" has been released. BIPV and innovative energy solutions can be included in projects which can obtain support for a portion (normally in the range 20-50%) of the extra cost for energy qualities beyond the required building standard.

2.2.1.4 Rural electrification measures

N/A

2.2.1.5 Other measures including decentralized storage and demand response measures

N/A

2.2.2 Support measures phased out in 2014

N/A

2.2.3 New support measures implemented in 2014

A new incentive scheme which included PV was communicated to the press by the end of 2014 only covers private households from the beginning of 2015. The support is limited to 10 000 NOK plus 1250 NOK/kWp, up to a maximal capacity of 15 kWp. The result of this mechanism means real investment support in the range 10-20% of the system cost.

The Norwegian Solar Energy Association among several stakeholders has said that at least 40% investment support is necessary to stimulate significant market growth.

For households in Oslo the climate-fund of the municipality of Oslo announced a limited demonstration-project with 40% investments support for PV. The budget for this project was limited to 2 mill.NOK.

2.2.4 Measures currently discussed but not implemented yet

N/A

2.2.5 Financing and cost of support measures

Enova is financed via funds allocated from the Energy Fund. These funds must be used in as cost effective way as possible in order to achieve the goals that the authority sets.

The Energy Fund is financed via a small additional charge to electricity bills of 0,01 NOK/kWh. In addition, the Energy Fund has been allocated the proceeds from "The “Green Fund for Climate, Renewable Energy and Energy Efficiency Measures”. The Green Fund’s capital this year is 35 Billion NOK, however further funds will be added in the course of next years. 5 Billion NOK will be added in 2014 and 2015.

Renewable Electricity Certificates (RECS) is also financed by a small additional charge to electricity bills which with the current RECS-prices gives a surcharge in the range of 0,017-0,021 NOK/kWh (including VAT) according to NVE.

2.3 Indirect policy issues

All households will get new smart (two-ways) energy meters installed within 2019. The new meters will register the consumption on an hourly basis and communicate metering data automatically to the system operator. The customer will get access to clear information of power consumption and prices and the meters can also enable additional functionality and services. Differentiated power distribution tariffs are proposed also for households, but not implemented yet.

2.3.1 International policies affecting the use of PV Power Systems

N/A

2.3.2 The introduction of any favourable environmental regulations

N/A

2.3.3 Policies relating to externalities of conventional energy

N/A

2.3.4 Taxes on pollution (e.g. carbon tax)

N/A

2.3.5 National policies and programmes to promote the use of PV in foreign non-IEA countries

Norway is one of the countries that are testing Result-Based Financing (http://www.norad.no/en/toolspublications/publications/2015/experiences-with-results-based-payments-in-norwegian-development-aid/)in the energy-sector through support to the Clean Development Mechanism (CDM), with the GetFit-programme in Uganda (http://www.getfit-uganda.org/) and Energy+ (http://www.osloenergyforall2011.no/energy.cfm).

3 HIGHLIGHTS OF R&D

3.1 Highlights of R&D

The Norwegian Research Council (NRC) funds industry oriented research, basic research and socio-economic research within the energy field, including renewable energy sources.

The total NRC-funds for PV-related R&D projects were appr. 76 MNOK (8,6 MEURO) for 2014. Most of the R&D projects are focused on the silicon chain from feedstock to solar cells research, but also related to fundamental material research and production processes. A growing supply business is also filling out the portfolio of projects.

The Norwegian Research Centre for Solar Cell Technology has completed it's fifth year of operation (www.solarunited.no). Leading national research groups and industrial partners in PV technology participate in the centre. In 2014, the 14 centre partners were CleanSi, Dynatec, Elkem Solar, IFE, Mosaic Solutions, Norsun, Norwegian Crystals, NTNU, the Quartz Corporation, REC Silicon, REC Solar, Semilab, SINTEF and the University of Oslo.

The research activities were originally grouped into six work packages, five of which involve competence-building: mono- and multi-crystalline silicon, next-generation modelling tools for crystallizing silicon, solar-cell and solar panel technology, new materials for next-generation solar cells, and new characterization methods. The sixth is a value-chain project that will apply the findings of the other five work packages to produce working solar cell prototypes. A seventh work package was added in 2014 and the focus of this WP is the production of solar grade silicon. The center has excellent lab facilities for this type of research and it includes equipment for free-space reactors, rotating reactors and fluidized bed reactors. The total Centre budget is 374 MNOK over the duration of the Centre (2009–2017).

There are six main R&D groups in the universities and institute sector of Norway:

- IFE (Institute for Energy Technology): Focus on polysilicon production, silicon solar cell design, production and characterization and investigations of the effect of material quality upon solar cell performance. A solar cell laboratory at IFE contains a dedicated line for producing silicon-based solar cells. Additionally, a characterization laboratory and a polysilicon production lab, featuring three different furnace technologies have been established.

- University of Oslo (UiO), Faculty of Mathematics and Natural Sciences: The Centre for Materials Science and Nanotechology (SMN) is coordinating the activities within materials science, micro- and nanotechnology.

- NTNU (Norwegian University of Science and Technology) Trondheim: Focuses on production and characterization of solar grade silicon as well as next generation solar cell technology

- SINTEF Trondheim and Oslo: Focus on silicon feedstock, refining, crystallisation, sawing and material characterisation.

- NMBU (Norwegian University of Life Sciences): Focus on fundamental studies of materials for PV applications and assessment of PV performance in high-latitude environments.

- Agder University (UiA): Research on silicon feedstock with Elkem. Renewable Energy demonstration facility with PV-systems, solar heat collectors, heat pump, heat storage and electrolyser for research on hybrid systems.

- Norut (Northern Research Institute Narvik): Development of silicon based solar cells and includes the whole production chain from casting of silicon to solar cell modules. Testing of PV-systems under arctic conditions.

3.2 Public budgets for market stimulation, demonstration / field test programmes and R&D

Table 14: Public budgets for R&D, demonstration/field test programmes and market incentives.

	R & D	Demo/Field test
National/federal	76	
State/regional		2
Total	78	

4 INDUSTRY

4.1 Production of feedstocks, ingots and wafers (crystalline silicon industry)

Elkem Solar is based on the so called metallurgical route; Elkem Solar has invested in a silicon production plant in Kristiansand in southern Norway. With a design capacity of 6 000 tons of solar grade silicon per year, the plant started to ramp up production during 2009. The production technology is now tested and verified, and according to Elkem, it enables the company to produce silicon with just 1/4 of the energy consumption compared with traditional technology.

Following a standstill during 2012 and 2013 Elkem Solar started up its production of solar grade silicon in 2014. Through the year the production has been ramped up and it now runs on 100 % of the capacity. Furthermore, Elkem Solar has plans to expand the capacity to 7 500 t/y.

Norwegian Crystals was established in the former REC Wafer production facility for mono crystals in Glomfjord. The capacity of the factory is approximately 200 MW/y and is still ramping up. At end of the year they were running at 100 % capacity, and there are plans to expand the production capacity to 350 MW. The main product of Norwegian Crystals is mono crystalline silicon blocks for the international market, but they can also deliver high efficiency modules produced abroad.

NorSun manufactures high performance monocrystalline silicon ingots and wafers at its plant in Årdalstangen in the western part of Norway. Annual production capacity of monocrystalline silicon ingot blocks at the company's facility in Norway is around 1000 MT or 350 MWp of corresponding solar cell power. Around 800 MT of these silicon ingot blocks are processed further at the company's facility in Norway into monocrystalline silicon wafers of around 280 MWp of corresponding solar cell power. In 2014/2015, market conditions have improved and the factory was running at full capacity while a number of cost reduction improvements were implemented.

Table 15: Production information for the year for silicon feedstock, ingot and wafer producers

Manufacturers (or total national production)	Process & technology	Total Production	Product destination (if known)	Price (if known)
Elkem Solar	Silicon feedstock	6000 tonnes		
Norwegian Crystals	sc-Si ingots.	350 tonnes		
Norsun	sc-Si ingots	1000 tonnes		
Norsun	sc-Si wafers	280 MW		

Describe briefly the overseas activities of any key companies also operating in other countries.

4.2 Production of photovoltaic cells and modules (including TF and CPV)

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. A company may also be involved in the production of ingots, wafers or the processing of cells, in addition to fabricating the modules with frames, junction boxes etc. The manufacturing of modules may only be counted to a country if the encapsulation takes place in that country.

There are no module production in Norway.

Total PV cell and module manufacture together with production capacity information is summarised in Table 9 below.

N/A

Table 16: Production and production capacity information for 2014

Cell/Module manufacturer (or total national production)	**Technology** (sc-Si, mc-Si, a-Si, CdTe)	**Total Production (MW)**		**Maximum production capacity (MW/yr)**	
		Cell	Module	Cell	Module
Wafer-based PV manufactures					
1		a		b	
2		c	d	e	f
3 etc					
Total					
Thin film manufacturers					
1		x	*x*	y	*y*
2					
Cells for concentration					
1		g		h	
TOTALS		**a+c+x+g**	**d+x**	**b+e+y+h**	**f+y**

4.3 Manufacturers and suppliers of other components

Eltek is a world leader in high-efficiency power electronics and energy conversion. - See more at: http://www.eltek.com/detail.epl?cat=23290#sthash.I2qknDhu.dpuf

5 PV IN THE ECONOMY

5.1 Labour places

Table 17: Estimated PV-related labour places in 2014

On behalf of the Ministery of Petroleum and Energy, the Norwegian labour and income from the renewable energy sector was analysed by Multiconsult and Analyse&Strategi in 2014; The report can be downloaded here: https://www.regjeringen.no/no/aktuelt/fornybar-rapport/id2403119/

Research and development (not including companies)	62
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	
Distributors of PV products	
System and installation companies	688
Electricity utility businesses and government	
Other	24
Total = 774	

5.2 Business value

Table 18: Value of PV business

Sub-market	**Capacity installed *in 2014* (MW)**	**Price per W** *(from table 7)*	**Value**	**Totals**
	X	*Y*	*a = X x Y x 1 000 000*	
Off-grid	**0,8**	**70-150**	*56-120 000 000*	
Grid-connected residental	**0,2**	**20**	*4 000 000*	
Grid-connected commercial	**0,8**	**16**	*12 800 000*	
Grid-connected Industrial	**0,4**	**13**	5 200 000	*78-142 000 000*
Export of PV products				*e*
Change in stocks held				*f*
Import of PV products				*g*
Value of PV business				***a+b+c+d+e+f-g***

If possible, please provide some brief comment on the industry value chain in your country or provide references to articles, reports dealing with this topic.

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

Short description of the electricity industry landscape. Norwegian Water Resources and Energy Directorate (NVE) is responsible for managing domestic energy resources, and is also the national regulatory authority for the electricity sector.	The Norwegian power sector is characterised by a large number of stakeholders within different areas of activity. The sector is organised around generation, grid and trading of power. Public bodies are considerable owners in the sector; for example, about 90 per cent of Norwegian hydropower production is owned by public entities.

6.2 Interest from electricity utility businesses

None of the utilities showed any interest in PV for the domestic market during 2014.

6.3 Interest from municipalities and local governments

Oslo is member of C40 (http://www.c40.org/) and has already in place sound solutions and a strong political focus, positioning the city among the most ambitious. Oslo's strategy promotion of electrical vehicles, collective transport, and combination of waste material-recycling and waste-to-energy solutions have created most interest internationally. The municipality of Oslo implemented a demonstration-project for PV with 40% subsidy of the system cost with a total budget of 2 mill.NOK.

7 STANDARDS AND CODES

The grid codes are decided by each individual grid owner, but several of the Norwegian grid owners have applied codes similar to what we find in Germany. Some grid owners denies PV-systems to be connected until the new measuring devices have been installed, i.e. until 2019.

There are no particular standards for PV in Norway, but IEC-standards are often used. In some cases VDE-standards are applied.

8 HIGHLIGHTS AND PROSPECTS

The Norwegian Government has adopted a “technology neutral” strategy for increased production of renewable energy. There are no particular targets for solar power.

Definitions, Symbols and Abbreviations

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

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

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

Rated power: Amount of power produced by a PV module or array under STC, written as W.

PV system: Set of interconnected elements such as PV modules, inverters that convert d.c. current of the modules into a.c. current, storage batteries and all installation and control components with a PV power capacity of 40 W or more.

CPV: Concentrating PV

Hybrid system: A system combining PV generation with another generation source, such as diesel, hydro, wind.

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, electricity utility businesses 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 NOK.

PV support measures:

Feed-in tariff	an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility business) at a rate per kWh that may be higher or lower 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 business, usually at a premium price
PV-specific green electricity schemes	allows customers to purchase green electricity based on PV electricity from the electricity utility business, usually at a premium price
Renewable portfolio standards (RPS)	a mandated requirement that the electricity utility business (often the electricity retailer) source a portion of their electricity supplies from renewable energies
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

Compensation schemes (self-consumption, net-metering, net-billing…)	These schemes allow consumers to reduce their electricity bill thanks to PV production valuation. The schemes must be detailed in order to better understand if we are facing self-consumption schemes (electricity consumed in real-time is not accounted and not invoiced) or net-billing schemes (the electricity taken from the grid and the electricity fed into the grid are tracked separately, and the electricity account is reconciled over a billing cycle). The compensation for both the electricity self-consumed and injected into the grid should be detailed. Net-metering schemes are specific since they allows PV customers to incur a zero charge when their electricity consumption is exactly balanced by their PV generation, while being charged the applicable retail tariff when their consumption exceeds generation and receiving some remuneration for excess electricity exported to the grid
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
Activities of electricity utility businesses	includes 'green power' schemes allowing customers to purchase green electricity, operation of large-scale (utility-scale) 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