ENEA - RSE

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 Italy 2011

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Definitions, Symbols and Abbreviations

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

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

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

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

PV system: Set of interconnected elements such as PV modules, inverters that convert 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 euro (EUR)

PV support measures:

Enhanced 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 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 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
Net metering	allows PV customers to incur a zero charge when their electricity consumption is balanced by their PV generation, to be charged the applicable retail tariff when electricity is imported from the grid and to receive some remuneration for PV electricity exported to the grid
Net billing	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
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

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 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 22 participating countries are Australia (AUS), Austria (AUT), Canada (CAN), China (CHN), 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, the US Solar Electric Power Association and the US Solar Energy Industries Association are also members.

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

This report is related to the status and trends of PV power applications in Italy in 2008 and is intended for the use of IEA Photovoltaic Power System Programme experts. It has been prepared by:

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The authors are greatly indebted with several experts from ENEA, CESI, ENEL and PV Industries, who have supplied information on PV systems and components installed in Italy.

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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 Italy 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.

1 EXECUTIVE SUMMARY

The year 2011 has been characterized by an impressive growth of installations due the excellent investment conditions represented by the high incentive tariffs, alternate to "tumultuous" moments, caused by a series of institutional measures that introduced uncertainty and discontinuity for the entire market.

1.1 Installed PV power

PV power installed in Italy during 2011 sums to about **9 304.6 MWp**. Then the cumulative installed and operating power has reached **12 803 MWp**, with an increase around 266 % as respect to the previous year.

1.2 Costs & prices

The average system price decreased reaching a lower value of 2 €/W for large free standing applications while in the case of small rooftop the prices have recorded a wide spread ranging from 3 €/W to 3.4 €/W. The average module prices has reached the value of 0,8 €/W toward the end of 2011 while at the beginning of the year was around 1,2 €/W. For large volume orders has been reached the lowest value of 0,7 €/W.

1.3 PV production

The growth of the national PV industry has not been adequate to the installed capacity. By the end of 2011, the production of photovoltaic modules, both single and multi crystal technologies, amounted in fact to only 412 MW while the cells are mainly imported and only about 118 MW have been produced in Italy. In the case of inverter, about 50% of the installed apparatus have been produced in Italy.

1.4 Budgets for PV

Public and private budget for research and demonstration initiatives remains flat with respect to the previous years and very small (+0,2%) with respect to the budget of about 3 000 M€ allocated for promoting tariffs during 2010.

2 THE IMPLEMENTATION OF PV SYSTEMS

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.

For the purposes of this Italian report, **PV installations are included in the 2011 statistics if the PV modules were installed and commissioned between 1 January and 31 December 2011**.

2.1 Applications for photovoltaics

In Italy can be identified the following sectors of PV power system applications:

- Off-grid domestic systems: almost all the plants belonging to this application have been dismounted, being commissioned in the early eighties. As a consequence the total power still operating is next to zero.;
- Off-grid non-domestic applications: slowly, but constantly increasing roughly reach **10 MWp**;
- On-grid distributed systems ([1]):at the end of 2011 an amount of **4 208,7 MWp** has been counted for this application;
- On-grid centralized systems: growing up to **8 584,2 MWp** as cumulative installed power; this sector is now dominating with a share of over 67% Italy's cumulative installed power.

2.2 Total photovoltaic power installed

The PV power installed in the 4 sub-markets during 2011 is reported in Table 1.

Data of grid connected PV plants have been obtained by means of the database of the Manager of Energy Services (GSE), which manages the "Conto energia" Programme.

Moreover, the following data have been collected by authors among Italian PV operators through direct interviews:

1. Module and cell production data (obtained from the industrial operators and national publications).
2. Prices of PV systems and components (declared by the installers of the plant after plant construction)
3. The quantity of imported modules and inverter installed in 2011 (obtained from the industrial operators).

Uncertainty of production, import and cost data is around 20%.

[1] In this sector, PV plants with power not greater than 200 kWp are taken into account.

Table 1: PV power installed during calendar year 2011 in 4 sub-markets.

Sub-market/ application	off-grid domestic	off-grid non-domestic	grid-connected distributed	grid-connected centralized	Total
PV power installed in 2011 (MW)	**-**	**1**	**2 676,1**	**6 627,5**	**9 304,6**
Amount of CPV in the above (MW)		**-**	**0,06**	**-**	
Amount of PV in hybrid systems (MW)	-				

Table 2a: PV power and the broader national energy market.

Total national (or regional) PV capacity (from Table 2) as a % of total national (or regional) electricity generation capacity	New (2011) PV capacity (from Table 1) as a % of new electricity generation capacity	Total PV electricity production as a % of total electricity consumption
PV capacity: **12 802,9 MW** electricity generation capacity: **96 000 MW** PV percentage: **13,3%**	New PV capacity: **9 304,6 MW** New electricity generation capacity: **6 000 MW** New PV percentage: **155 %**	PV production in 2011: **10 TWh** electricity production: **330 TWh** PV percentage: **3%**

A summary of the cumulative installed PV Power, from 1992-2011, broken down into four sub-markets is shown in Table 2.

Table 3: The cumulative installed PV power (kWp) in 4 sub-markets. (as at 31 December)

Sub-market/ application	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11
off-grid domestic	3 950	4 350	4 700	4 830	4 962	5 052	5 210	5 220	5 240	5 300	5 300	5 300	5 300	5 300	5 300	5 400	5 400	5 000	4 000	-
off-grid non-domestic	3 750	4 150	4 650	4 780	4 792	4 814	5 100	5 640	5 890	6 350	6 365	6 400	6 700	7 000	7 500	7 700	7 900	8 000	9 000	10 000
on-grid distributed	100	100	150	335	404	677	780	905	1 155	1 635	3 620	7 600	12 000	18 500	30 500	83 900	295 000	656 800	1 532 600	4 208 700
on-grid centralised	680	3 480	4 590	5 850	5 850	6 166	6 590	6 715	6 715	6 715	6 715	6 700	6 700	6 700	6 700	23 200	150 000	511 500	1 956 710	8 584 210
TOTAL	8 480	12 080	14 090	15 795	16 008	16 709	17 680	18 480	19 000	20 000	22 000	26 000	30 700	37 500	50 000	120 200	458 300	1 181 300	3 502 310	12 802 910

2.3 PV implementation highlights, major projects, demonstration and field test programmes

The national market stimulation initiative in operation during the year 2011 is represented by the “Conto energia” Programme.

In particular, during this year PV plants have been installed in the framework of the second third and fourth phase of the “Conto Energia” Programme:

- II phase: this phase has been characterized by the issue of the “Salva Alcoa“ decree that has extended the validity of the related tariffs from the end of 2010 to June 2011 for sworn declarations of construction completion recorded until 31 December 2010; in this phase resulted in setting in operation about 3650 MW;
- III phase: during the period of validity of this phase (from January 2011 to June 2011) has been installed a total power of 1550 MW
- IV phase: in the framework of the fourth phase, during 2011 about 76 150 plants corresponding to 4 100 MW have been installed.

2.4 Highlights of R&D

Research, development and demonstration activities on photovoltaic devices and systems are mainly conducted by ENEA (the Italian Agency for New Technology, Energy and the Environment) and RSE Spa, a research company owned by GSE (Manager of Energy Services). Additional contributions have been supplied by some Universities, CNR (the National Council for Scientific Research) and few private Laboratories.

ENEA is the main PV Research organization operating in Italy. Its most significant fields of interest regard: crystalline silicon, Cu_2O solar cells, microcrystalline Si devices, micromorph tandem solar cell as well as concentrators technologies.

RSE is carrying out activities in research and development on high efficiency single and triple junction solar cells (InGaP/InGaAs/Ge) for terrestrial and concentrator applications, in the frame of Italian electric system research programme RdS (Ricerca di Sistema) and in the European project “APOLLON”.

Furthermore, RSE is involved in components’ characterization and performance evaluation of PV innovative systems, as well as in research and demonstration activities for electrification of remote communities, again in the frame of the RdS programme.

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

The figures for the year 2010 on budgets from the public authorities for R&D, demonstration/field test programmes and market incentives (public subsidies, fiscal incentives) on the national/federal level, and on the state/regional level are given in Table 3

Table 4: Public budgets for R&D, demonstration/field test programmes and market incentives.

	R & D	Demo/Field test	Market incentives
National/federal	5,8 M€	0,2 M€	3 000 M€
State/regional			
Total	3 006 M€		

3 INDUSTRY AND GROWTH

3.1 Production of feedstocks, ingots and wafers

During the year 2011 no production of ingots has been performed in Italy.

Table 5: 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)
	Silicon feedstock	tonnes		
	sc-Si ingots.	tonnes		
	mc-Si ingots	tonnes		
LUX	sc-Si wafers	8 MW		
MEMC	mc-Si wafers	300 MW		

3.2 Production of photovoltaic cells and modules

In the year 2011, four producers of cells have been active in Italy: the historical producers of cells and modules, Helios Technology, Solsonica, Xgroup and Omnia Solar.

In total, the cells production in Italy sums to about 118 MW with a production capacity of 250 MW.

Further 7 companies assembling and encapsulating standard or tailor-made and especially designed modules can be found in Italy. During 2011, the module production of all 11 companies sums to about 413 MW with a capacity around 882 MWp.

Total PV cell and module manufacture together with production capacity information is summarised in Table 5 below.

Table 6: Production and production capacity information for 2011 (source: Politecnico di Milano)

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					
Solsonica	sc-Si, mc-Si	25	95	40	150
Helios Technology	sc-Si, mc-Si	40	40	60	57
Omnia Solar	sc-Si, mc-Si	8		10	
X-Group	sc-Si, mc-Si	45	40	140	100
MX Group	sc-Si, mc-Si		73		180
Solon	sc-Si, mc-Si		40.5		95
Moncada Solar	sc-Si, mc-Si		40		100
Renergies	sc-Si, mc-Si		30		45
Brandoni	sc-Si, mc-Si		27		55
Eosolare	sc-Si, mc-Si		15		50
Solar Green Energy	sc-Si, mc-Si		12		50
Total		***118***	***412,5***	***250***	***882***

Additional information:

a) The manufacturers, that produce modules, purchase cells on the international market. As a consequence a total of 294,5 MW of cells have been imported. The other manufacturers that produce cells and modules from wafer have exported 190 MW of wafers, taking into account that 308 MW have been produced in Italy.

b) Taking into account that only 412,5 MW of modules have been produced in Italy during 2011, the other 8891 MW have been imported.

3.3 Module prices

In Table 6 are shown the a module prices (excluding VAT/TVA/sales tax) and the best prices achieved. In particular, the typical prices derive from an average of price at the beginning (1.2 €/W) and at the end of the year (0.8 €/W). The best price are the lowest ones and regard import products at the end of 2011 (for Crystalline silicon modules from China).

Table 7: Typical module prices for a number of years

Year	1993	2000	2003	2005	2007	2008	2009	2010	2011
Standard module price(s): Typical	4,65	4,13	3,5	3,6	3,8	3,3	2,2	1,5	1,0 (*)
Best price			3,1	3,2	3	2,2	1,6	1,2	0,7 (*)
PV module price for concentration									

(*) Crystalline silicon modules

3.4 Manufacturers and suppliers of other components

In Italy, 7 companies manufacture inverters for on-grid and off-grid applications. The most important of them are Power One Italy, Elettronica Santerno, Aros, Siel, Answer Drivers, Astrid Energy and Fimer: During 2011, these companies have produced about 4500 MW of inverter while their production capacity is around 8000 MW. Taking into account that during 2011 have been installed over 9300 MW, a total power of 4800 MW has been imported.

As far as the prices of inverter an average value of 180-220 €/kW has been obtained on a sample large size apparatus. In the case of small size inverter the typical prices range from 330 €/kW to 400 €/kW.

3.5 System prices

Table 7 gives turnkey prices per W (excluding VAT/TVA/sales tax) for the various categories of installation. Prices do not include recurring charges after installation such as battery replacement or operation and maintenance. Additional costs incurred due to the remoteness of the site or special installation requirements have not been included. The prices reported indicate a range of all known prices.

Additional information regarding national trends in the turnkey prices of selected applications are reported in Table 7a.

Table 8: **Turnkey Prices of Typical Applications**

Category/Size	Typical applications and brief details	Current prices per W
OFF-GRID Up to 1 kW	Street light	5 – 7 €
OFF-GRID >1 kW		
GRID-CONNECTED Specific case	1-5 kW roof-mounted system	3 – 3,4 €
GRID-CONNECTED up to 10 kW		
GRID-CONNECTED >10 kW	100 kW on industrial building	2,5 - 3 €
GRID – CONNECTED (utility-scale plant, if relevant)	1 MW on ground	2 – 2,5 €

Table 7a: National trends in system prices (EUR) for small roof-mounted system (*2-3 kW*)

YEAR	1998	2000	2002	2004	2005	2007	2008	2009	2010	2011
Price /W:	9,3	7,75	7,5	6,8	7.0	6.5	6.0	4.5	4.0	3.2

3.6 Labour places

Full time labour places in the following activities during the year 2011 are:

a) Public research and development (not including private companies): **250**

b) Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D: **10 000**

c) All other, including electricity companies, installation companies induced labour, etc.: **44 000**

d) Utilities and government: **750**

Provide an estimate of labour places in the following (where these are mainly involved with PV):

a) Public research and development (not including private companies);

b) Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D;

c) All other, including within electricity companies, installation companies etc.

Table 9: Estimated PV-related labour places in 2011

Research and development (not including companies)	250
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	
Distributors of PV products	
System and installation companies	54 000
Electricity utility businesses and government	750
Other	
Total	55 000

3.7 Business value

An estimate of the value of PV business in Italy by the Gross Domestic Product approach is reported in table 9, taking into account

the imported volumes of:

- PV modules: 8 890 MW
- inverters: 5 300 MW
- cells: 295 MW

And the exported volumes of:

- inverters: 500 MW
- wafer: 190 MW

Table 10: Value of PV business

Sub-market	**Capacity installed *in 2011* (MW)**	**Price per W** *(from table 7)*	**Value M€**	**Totals**
Off-grid domestic				
Off-grid non-domestic	**1**	**6**	*6*	
Grid-connected distributed	**2676,1**	**3**	*8 028*	
Grid-connected centralized	**6627,5**	**2,5**	*16 569*	
				24 603
Export of PV products *(including information from Tables 4 & 5)*				*226*
Change in stocks held *(including information from Tables 4 & 5)*				
Import of PV products *(including information from Tables 4 & 5)*				*9769*
Value of PV business				***15 060***

4 FRAMEWORK FOR DEPLOYMENT (NON-TECHNICAL FACTORS)

If not already covered in section 2.2, please identify and give a brief description of any support measures from Table 10 that have been launched or identified in your country during 2011 (or early 2012). Please indicate whether the measures were in place at the national, regional (state) or local levels.

- Please indicate here if local content policies have been enacted in concert with any of the support measures listed below. If so, please elaborate briefly.

Table 10 lists the main support measures (definitions at start of guidelines) for PV during 2011. Further details on these are to be provided on the following pages.

Table 11: PV support measures

	On-going measures	Measures that commenced during 2011
Enhanced feed-in tariffs (gross / net?)		0,38 €/kWh 1-3 kW on building (June 2011) 0,17 €/kWh centralized on ground (December 2011)
Capital subsidies for equipment or total cost		
Green electricity schemes	9 c€/kWh added to feed-in tariff	
PV-specific green electricity schemes		
Renewable portfolio standards (RPS)		
PV requirement in RPS		
Investment funds for PV		
Income tax credits		
Net metering		
Net billing	Up to 200 kW	
Commercial bank activities e.g. green mortgages promoting PV		
Activities of electricity utility businesses		
Sustainable building requirements		

4.1 Indirect policy issues

Policy initiatives that may influence the implementation of PV power systems in Italy:

a) A new decree on renewable energies

b) A new decree for PV plants (the fifth “conto energia”, expected in the second part of the year 2012) that will redefine the maximum expense to support the tariffs of the PV plants.

4.2 Standards and codes

At international level, Italy has actively participated to the works on new and revised standards carried out within both IEC and CENELEC working groups. In this contest, the Technical Secretariat of CENELEC TC 82, is managed by the Italian Electrotechnical Committee (CEI).

AT national level, during 2011, the Technical Committee 82 of CEI has updated the guide for the design, installation and test of PV plants connected to low and medium voltage grid (CEI 82-25).

5 HIGHLIGHTS AND PROSPECTS

During 2011 have been highlighted two main barriers that could break the growth of the photovoltaic market in Italy:

1. the electric grid is going to become not adequate in some regions of south Italy, where the installed power of wind turbines and photovoltaic power stations is almost the same order of magnitude of peak load.
2. at the end of 2011, the annual cost for the incentive tariffs has reached 5 500 M€ and is quickly reaching the limit of 6 000 M€ fixed by the fourth phase of the “Conto Energia” Programme; the fifth phase of Conto energia will probably fix the limit to 6 500 M€ or at least to 6 750 M€; when that limit will be reached, the photovoltaic won’t be incentivate any more in Italy.

ANNEX A: COUNTRY INFORMATION

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

Source of the information: author's estimate.

1) retail electricity prices - household, commercial, public institution
   a. household (17,5 c€/kWh)
   b. commercial, public institution (18 c€/kWh)

2) typical household electricity consumption (kWh): 2 700 kWh

3) typical metering arrangements and tariff structures for electricity customers tariffs include a fixed charge, a demand charge (€/kW) and an energy charge (cent €/kWh) with several tiers

4) typical household income: 35 000 €

5) typical mortgage interest rate: 7%

6) voltage (household, typical electricity distribution network): 230 Vac

7) electricity industry structure and ownership; private owned or municipal

8) price of diesel fuel: 170 c€/l

9) typical values of kWh / kW for PV systems in parts of your country.
   a. North 1000 -1200 kWh / kWp
   b. South 1300 -1500 kWh / kWp