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INTRODUCTION

This manual is the result of the Leonardo da Vinci project titled: **IMPROVING VOCATIONAL EDUCATION IN THE CONSTRUCTION INDUSTRY SECTOR WITH THE AIM OF IDENTIFICATION AND RECOGNITION QUALIFICATIONS IN EUROPEAN UNION COUNTRIES 2008-1-PL1-LEO05-02059 (2008-2010)**.

Polish Association of Construction Industry Employers – Poland was the promoter of the project.
Partners of the project: Polish British Construction Partnership Sp. z o. o. – Poland, CREDIJ (Centre régional pour le développement la formation et l'insertion des jeunes) – France, University of Minho – Portugal, Ufficio Scolastico Provinciale di Venezia – Italy, Econometrica Ltd. – Greece, The Chartered Institute of Building – United Kingdom.

PROCONSTR is a project concerning developing an innovative program of vocational training based on eight selected construction professions for graduates from vocational schools technical secondary schools and employees who are professionally active and want to increase their skills.
The aim of the job modules is to promote ideas of regular vocational development, support activities leading to implementation of European tools concerning education and vocational training – equalisation of opportunities on European labour markets, intensification of co-operation among companies from construction sectors and social organisations in order to promote vocational development with reference to EQF and ECVET in Europe.
Moreover, the project's challenge is to make participants in the training sessions more aware of the requirement to increase their vocational qualifications with regular training sessions, as well as learning new techniques and technologies that are utilized in the construction industry and language education. Once these skills have been gained it will give them the opportunity of being employed across the whole territory of the European Union.

Unification of essential regulations of vocational qualifications in European Countries might simplify easy transfer of the most modern technologies as well as enabling common usage of knowledge and generating new employees that are able to meet the requirements of contemporary European market.

The nature of the training sessions is directed at men and women, with supporting efforts heading for equalisation to access vocational education and to ensure equality on the labour market, in this case, giving special consideration to the construction branch.

The outcome of the project is an innovative didactic resource for beneficiaries. Eight job modules were created on the basis of data and domestic markets available. The didactic materials were created with support of construction companies on national levels.

Job Module for Manson
Job Module for Carpenter
Job Module for Plumber
Job Module for Electrician
Job Module for Concrete builder
Job Module for Roofer
Job Module for HVAC worker
Job Module for Plasterer
Module for trainer

Each job module consists of two parts with the first part being theoretical, including the latest know-how concerning specific trades necessary for employees. The second part consists of training with appropriate examples set out in exercises based on chosen innovative aspects.

The project's creators hope that the final product might have a long-term influence which can be utilised successfully in vocational education throughout the European Union. Exploitation of unified course of vocational training sessions in all countries would result in the elimination of formal and informal barriers concerning an easy-flow of employees and equalize differences in professional qualification levels.
Equalization of qualifications between European countries would result in the effective exchange of experiences; simplify identification of different types of problems and the implementation of preventive means.

Conclusions drawn from the executed project could be used to create new training solutions as well as to prepare vocational education system reforms on a domestic level.

More information on project website: www.proconstr.eu.

INFORMATION ABOUT THE COURSE

Participants should have the following knowledge prior to attending this course:

- Knowledge of working both AC and DC circuits
- Reading and interpreting plans and specifications
- Reading and interpreting codes and standards
- Using basic mathematics

The following innovations will be learnt at the course:

- The safe installation of photovoltaic systems

The advantages of this modern technology are:

- Use of environmental friendly energy sources (photovoltaic installations)
- knowledge about using specific materials and techniques
- quality work improvement

As the participant, you will gain knowledge about safe installation and reliable work of photovoltaic, new skills and competences concerning dealing with these specific systems and techniques.

After the course you will be able to make a safe installation of photovoltaic. Moreover you will be able to apply this technology on your own.

As a participant you will receive a manual and CD full of didactic materials like ppt, pdf and vocabulary.

You will be asked to participate in the theoretical lectures (1 day) and practical workshops (2 days) conducted by a vocational trainer. Moreover you will gain knowledge on how to read and use additional materials included in this course.

Your knowledge will be tested/assessed by a trainer with use of a set of questions at the end of the course.

After completion of the course you will gain the **PROCONSTR CERTIFICATE**

CHAPTER I:

GENERAL CONSIDERATION CONCERNING CONSTRUCTION TRADES

The PROCONSTR project is intended for two main groups of construction workers i.e. qualified workers and medium-level technical supervisors. Eight trades covered by the project represent the main professions of the large cubature house building industry as well as the infrastructure industry such as: office buildings, hotels, commercial, cultural and sport centres, healthcare infrastructure and other public utility buildings. Experts in the fields covered by the project are also crucial for the single-family house building. They are equally important in the industrial and road construction sector.

Traditional trades like: concrete builder, carpenter, reinforced concrete builder, mason, roofer, and plumber are currently undergoing a dynamic evolution due to the technical progress in the construction field.

The common use of concrete pumps together with concrete mixers, as well as concrete mixes or a widespread application of chemical products in construction such as: self levelling floor compounds, resin and an important share of prefabricated reinforced-concrete elements used for ceiling construction or a common use of prefabricated reinforcement elements such as meshes and cages have an important influence on the change of traditional notion of a concrete and reinforced concrete builder, joining the two trades together in one, more universal trade of a reinforced concrete builder-concrete builder.

The widespread application of formworks and scaffoldings used on all types of construction sites has a decisive influence on the ongoing changes in the profile of the carpenter profession. Similarly, an exceptionally wide range of roof coverings and new methods of assembling them have a crucial impact on the modern definition of the profession of a roofer. Even more important changes are happening in the field of masonry, where masons have to have an excellent knowledge of all types of plasters and glues. The knowledge of an electric fitter has to cover a wide range of low current electric installations. A trade, which is undergoing particularly dynamic changes due to a huge progress in the field of air conditioning techniques, is the HVAC fitter.

An equally significant progress can also be seen in the field of sanitary techniques. A whole range of equipment is now available on the market that has not been used before. The use of internal or external materials made of epoxy resins, carbon fibres and other synthetic materials has already exceeded by percentage the use of traditional materials. The introduction of different types of plasters, dry walls or other wall elements like cardboards widens significantly the requirements relating to the trade of a plasterer.

Apart from technological changes which have influence on the profile of vocational trainings, it is impossible not to mention general requirements which have to be fulfilled by modern construction teams.

It is enough to mention:

- a significant shortening of the project implementation cycle,
- limiting the area of construction sites, particularly in urban agglomerations,
- the expansion of a vertical-building projects,
- the introduction of a top-down method, i.e. a simultaneous construction of both the underground and ground structures,
- carrying out the works in extreme weather conditions, due to the possibility of putting concrete layers at low as well as at high temperatures.

Nonetheless, the health and safety at work is the most important issue, relating to both the dynamics of changes in vocational profiles and strict requirements.

The expansion of the European Community favours the free movement of services in the construction sector. This also maintains the tendencies to create construction companies with international capital. It creates the necessity for the mobility of construction teams, which together with the high quality requirements constitutes an incentive for the unification of qualification of construction workers on the highest level in the whole Union. The above mentioned general remarks underline the importance of changes undergoing in the field of construction trades.

Good economic situation on the construction market affects the economy development substantially. Demand for residential housing, office space and infrastructural building grows up. Orders placed by investors motivate contractors to carry out their jobs and the contractors stimulate enterprises manufacturing building materials to maximize their production capacities; it enables quick completion of construction investments. Consequently, a system enabling stimulation of economies and decrease in the unemployment rate is launched.

When a market presents a demand for a quick and solid carrying out of investments, the most serious problem there is finding out a relevant contractor team consisting of high-class specialists knowing all secrets of a profession, who are trained at the latest methods and technologies used at the construction, in particular, at fields of their specialization.

JOB MODULE: ROOFER (SOLAR PHOTOVOLTAIC SYSTEMS INSTALLER ON ROOFS)

This module is common for electricians and roofers. Their action is complementary on the installation of photovoltaic panels, but in many cases, it is the same trade association which ensures the totality of the implementation (electrician OR roofer). It thus seems essential that the teaching exempted on the subject is identical for the 2 trade associations

Roofer– Job description (traditional profession)

The “man of the roofs” carries out or repairs the roofs of the apartment buildings or the houses (terrace or pitched roofs). He can install the thermo isolation under the roof. He can also achieve restoration works concerning bell-towers of churches, roofs and domes of historic buildings.

He is in relation with other workers of the construction sector (masons, electricians etc….) what requires having some knowledge on these trades.

The roofer works all the year and by any weather conditions on the roofs, generally squatted or knelt, in often uncomfortable positions. More than any other professional of the building sector, he must comply with the safety regulations.

The roofer can specialize in a material: slater, zinc worker (covers out of zinc and other materials such as copper or lead), tile maker, roofer specialist in monuments (bell-towers, domes). It can also become plumber zinc worker, revetisseur-etancheist (roofs and frontages).

He has to know the materials, the architectural styles specific to the area.

According to the structure of the company, the roofer has to work within a team from 2 to 3 people. He is under the direct responsibility of the foreman, the site foreman. Later, he can apply for one of these functions.

b) The modertn profession

The modern roofer can:

Install of attics in livable part (bedroom or bathroom)

Know the Evolution of lifting gears and scaffoldings

Develop of work of maintenance-rehabilitation of the roofs and innovating architectures;

Know the evolution of the insulations which must not only allow the setting out of water, but also provide a function of thermo isolation, acoustic isolation, of lighting and equipment with automation (roof windows)
Know to use specific maintenance products
Create Green roofs
Install and maintain Solar Systems (such as Photovoltaik Systems)
Protect the Environment (recycling of waste)

Studies and training : Requirements to perform the profession

In France a worker who wants to perform the profession of roofer has to get a CAP (certificate d'aptitude professionnelle = certificate of professional ability).
This diploma is level V in the French NQF(national qualification framework), and level II EQF (European qualification framework)

Professional changes

The traditional trade still exists, but the Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings and the EU's climate change package which aims to ensure that the EU will achieve its climate targets by 2020:

- a 20% reduction in greenhouse gas emissions
- a 20% improvement in energy efficiency
- a 20% share for renewable energies in the EU energy mix

have changed the working context of the roofer in our country and in Europe.

Because of these new requirements which lead to save energy and to use more renewable energies, the the roofer profile has undergone different changes, additional to the traditional trade.
Health and security requirements, quality development (new labels), new technics, new materials lead to changes in the roofer's job profile and participate to the new apects and new additional skills necessary in the new contect.

Roofer’s technical-professional competence for installing P.V. Systems

- interpret arcitectural, mechanical and electrical plans and specifications (both AC and DC circuits)
- interpret codes and standards linked to photovoltaics
- identify points of measure on a photovoltaic system.
- visualize the scheme of the voltage across the chain of energy conversion.
- measure the representative quantities (U, P, ΔU, ...) on the whole chain of energy conversion.
- estimate the real losses on the whole chain of energy conversion.
- fit to health and security rrquirements while working

CHAPTER II

LEGAL BASIS OF PERFORMING PROFESSION IN EVERY PROJECT PARTNER COUNTRY

LEGAL BASIS IN FRANCE

1- Basic concepts: standards, DTU, Technical advice (*Avis Techniques)*

<u>1.1 Standards</u>: see: Standards and European directives (source: AFNOR)
French approved standards are mandatory for State and local government funded contracts. They are also recommended for privately funded contracts.
<u>1.2 DTUs</u> (Unified Technical Documents) are documents that contain technical rules relating to the execution of building works using traditional techniques. They are recognized and approved by construction professionals. They also provide a reference point for insurance experts and the courts. Failure to comply with DTUs may lead to the invalidation of warranties offered by insurance providers. DTUs specify standards for traditional construction methods and are considered the epitome of reference texts. They are intended for relevant state bodies as well as contractors (whether architects or general contractors), owners and other experts. They are authored by a committee advising on technical texts.
1.3. <u>Technical advice</u> is advice from a committee of experts specialising in relevant trades and the expected behaviours of materials, components or processes. They define the characteristics of any materials, components or processes involved, and give advice on their durability and suitability for use and how they comply with regulations.

2 - DTU

<u>2.1. Status of DTU</u>
The DTUs are established by a body created in 1958, the “Groupe de Coordination des Textes Techniques / Groupe DTU” (the “Coordinating Group of Technical Texts or Group DTU”).
In 1990, this group became the “Commission Générale de Normalisation du Bâtiment/DTU “(the General Committee for the Standardisation of Building / DTU) in order to integrate it into the French official system, which was necessary to comply with European technical harmonization (Eurocodes)

This means that the DTUs have become standards. The transformation took place gradually through the regulatory procedures that govern standardsation.

As a result, the DTU(s) now have one of the following statuses:

- Approved French standard (Norme française homologuée): this is a standard which has received official government approval, its technical value is recognized, and it plays an important role in the construction system;
- Experimental standard (Norme expérimentale): which is undergoes a period of probation before being confirmed or amended to become a certified French standard;
- Documentation booklet (Fascicule de documentation) : standard documents, essentially informative documents;
- DTU: the original form of the documents. Not part of the official standard system. In most cases DTU status is temporarily held in anticipation of its integration into the official standard system.

2.2. Private works

DTU is implemented following an agreement between the “maitre d’ouvrage” and the construction contractor. A DTU only commits the signatories, giving it a sense of obligation of contract.

Some standards and some French registered DTUs can be mandatorily enforced by regulatory decisions (often when safety-related).

2.3. Public works

The amended Decree of January 26, 1984 governs the application of French standards in contracts approved by the government, local authorities, public bodies etc., except in special cases as listed in the decree.

2.4. Composition of a DTU

A DTU may consist of the following documents:

- Technical specification clauses booklet (cahier des clauses techniques: CCT) which sets out the requirements for the selection and use of materials;
- Specification of special provisions booklet (cahier des clauses spéciales: CCS) which defines performance limits and obligations to other trades;
- Rules for calculating the structural design.

All these documents are contractual documents and must be adhered to. There are also other documents, such as memos and selection guides, which are useful for structural designs that are not intended to be imposed by contract.

Like ISO standards, the DTU(s) must be bought. They can be found on the CSTB website: http://boutique.cstb.fr/

(CSTB = centre scientifique et technique du bâtiment: scientific and technical center for construction)

DTUs and other required documents are listed on the CSTB website. There are specific DTUs for each profession : (see example for roofers on the next page)

http://boutique.cstb.fr/dyn/cstb/Upload/Fichiers/Liste_0310.pdf

Special legal basis linked to photovoltaics :

NF EN 60904-3 (C 57-323)	Photovoltaic devices - Part 3: Measurement principles for terrestrial solar devices photovoltaic (PV) for terrestrial use, including data for reference spectral irradiance
NF EN 61643-11 (C 61-740)	Low-voltage surge-Part 11: Surge protective devices connected to low voltage distribution systems - Requirements and tests
NF EN 61730-1 (C 57-111-1)	Qualification for safe operation of photovoltaic (PV) - Part 1: Requirements for construction
NF EN 61730-2 (C 57-111-2)	Qualification for safe operation of photovoltaic (PV) - Part 2: Requirements for tests
NF EN 62262 (C 20-015)	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
NF EN 62305-1 (C 17-100-1)	Protection against lightning - Part 1: General Principles
NF EN 62305-2 (C 17-100-2)	Protection against lightning - Part 2: Risk evaluation
NF EN 62305-3 (C 17-100-3)	Protection contre la foudre - Partie 3: Dommages physiques sur les structures et risques humains
NF C 14-100	Installations de branchement à basse tension
NF C 15-100	Installations électriques à basse tension
NF C 17-100	Protection against lightning - Protection of structures against lightning-Installation of Lightning Protection Systems
NF C 17-102	Protection against lightning-protection structures and open areas against lightning by lightning to boot device

UTE C 15-105	Practical Guide-Identification of cross-sections and choice of protection devices - Practical Methods
UTE C 15-443	Practical Guide - Protection of Electrical tensioncontre low overvoltages of atmospheric origin or due to switching. Selection and installation of lightning arresters
UTE C 17-100-2	Practical guide - Protection against lightning-Part 2: Risk Assessment
UTE C 17-108	Practical Guide - Simplified Analysis of lightning risk
DIN VDE 0126-1-1	Automatic disconnection device between a generator and low-voltage public network

HEALTH AND SAFETY

On building sites it is required by the coordinator of safety to have a general plan of coordination, the companies involved must create a PPSPS (Particular plan of safety and protection of health) valid for all workers on the building-site

PPSPS: Particular plan of safety and protection of health

Contents of the PPSPS

1. The name and address of the company, the address of the building site, the name and qualifications of the person in charge of the work.
2. The description of work and methods of work showing
    a) the company's specific risks and chosen means of prevention, taking into account any environmental constraints
    b) Work involving risks of interference arising from co-activity with other companies, mutual risks and the prevention methods available.
3. Procedures for observing any measures of general coordination defined by the coordinator.
4. Rules for hygiene and for workers' areas as laid out in the general coordination plan .
5. First aid organization of the company; including the medical equipment available, first-aiders and on site, measures for evacuating any injured persons, according to the general coordination plan

The descriptive part of the plan is the most important; it must be accompanied by a detailed analysis of the risks related to procedures, materials, devices and installations, the use of dangerous substances or preparations, and to circulation on site.

Plans or sketches drawn for the building site can effectively replace text. Photocopies of documents are to be avoided in general , except for private copies.

The plan can evolve and change, so it is always possible to modify any of the given procedures or preventive measures if the incurred risks are decreased or if the preventive measures give an equivalent guarantee.

LEGAL BASIS

Texts referring to the labor regulation:

- Principle of prevention articles R 230-1 with R 234-23
- General plan of coordination R 238-20 to R 238-36

Texts for the prevention and the safety of the workers:

- N° circular 6 DRT of April 18th, 2002 of the ministry for employment and solidarity
- Law N° 91-1414 of December 31st, 1991 published with the OJ N°5 of January 7th, 1992
- European directive 89/391/CEE of June 12th, 1989
- Decree 2001-1016 of November 5th, 2001 relating to the single document published in the 258 Olympics of the 11/7/01 page 17523.

LEGAL BASIS IN GREECE

According to the Greek legislation all construction workers' professional activities are considered hazardous. So is, the profession of the Electrician – Roofer (PV installer) .

The major dangers are as follows:

- Falling from height
- Dropped tools or materials
- Incorrect use of equipment
- Fire
- Explosions
- Scalds

The legal framework for the PV installer profession covers the following sections:

1) Rules of preparing and undertaking the job
2) Health and safety regulations

The general rules for the Electrical installations are covered by:

P.D. 1073/81 art. 75,76,77,78,79,80,81,82,83,84

M.O. No 80225/19-11-1955,)

M.O. no 91184/3061/4-10-66)

Other rules are covered by:

1. Works near electrical wires
   P.D. 1073/81 art 78 par α, b, c, f, art 79
2. Works at height without scaffolds
   P.D. 778/80 art. 17
3. Works on scaffolds
   P.D.. 778/80 art. 9, 11
4. Works on roofs
   P.D. 778/80 art. 18, 19
4. Works in substations distribution
   Law 158/75

The health and safety regulations can be categorised as following:

- General regulations for health and safety
- Working at height using scaffolding and mobile platforms
- Protection from electrical shock
- Environment protection

Legislation referred to health and safety regulations:

P.D. 22/12/33 (I.G.G 406 A΄) "On security of workers using ladders"

P.D. 778/80 (I.G.G 193 A΄) "On security measures during building construction"

P.D.1073/81 (I.G.G. 260 A΄) "On security measures whilst performing tasks related to house building and engineering works"

L. 1396 (I.G.S 126 A΄) "Obligations of observance of security measures in structures"

L. 1430/84 (I.G.G. 49 A΄) "Ratification of the 62 International Employment contract, "As regards the safety provisions in the construction industry and resolving directly related issues"

L. 1568/85 (I.G.G. 177 A΄) "Health and safety of workers"

P.D.71/88 (I.G.G. 32 A΄) "Regulation for fire protection of buildings"

M.O. 9087 1004/96 (I.G.G 849 B΄) "Operational protection of outside workers exposed to the risk of ionizing radiation during their activities in controlled areas"

P.D.395/94 (I.G.G 220 A΄) "Minimum safety and health requirements for the use of work equipment by workers at work in compliance with directive 89/655 EU"

P.D. 396/94 (I.G.G 220 A΄) "Minimum safety and health requirements for the use by workers of personal protective equipment at work in compliance with the directive of the Council 89/656/EU"

P.D. 105/95 (I.G.G 67 A΄) “Minimum requirements for safety and health at work in compliance with directive 92/58/EU”
P.D.16/96 (I.G.G 10 A΄) “Minimum safety and health in the workplace in compliance with directive 89/654/EU”
P.D. 17/96 (I.G.G 11 A΄) “Measures to improve safety and health of workers at work in compliance with the instructions 89/391/EU and 91/383/EU”
P.D. 305/96 (I.G.G 212 A΄) “Minimum safety and health requirements at temporary or mobile construction sites in compliance with directive 92/57/EU”
P.D... 62/98 (I.G.G 67 A΄) “Measures for the protection of young people at work, in compliance with directive 94/33/EK”
M.O. 7568 F. 700. 1/96 (I.G.S 155 B΄) “Fire protection measures for hot works”
M.O. 130646/84 (I.G.G 154 B΄) “Security measures calendar”

Glossary:

L.: Law
P.D.: Presidential Decree
I.G.G.: Issue of Government’s Gazette
M.O.: Ministry ordinance

LEGAL BASIS IN ITALY

In Italy the plumbing profession is regulated by the same legislation. In particular, Decree 22/01/2008 regulates activities concerning the installation, conversion, enlargement and extraordinary maintenance of systems. The list of the activities is described in the Decree and includes also those relating to our profession. The act doesn’t deal with ordinary maintenance of systems and public systems such as the electricity distribution network, aqueducts, gas pipelines, or street lighting.
The activities of companies and workers in this sector are also regulated by Act 5/3/90 No. 46 “Safety regulations regarding the systems” and Decree 6/12/91 No. 447 which implements the previous law.
Other relevant Acts issued by the Government are: Decree 37/2008; Decree 412/93; Decree 192/05.
To perform work in this sector a company must submit a start-up declaration to the local Chamber of Commerce in order to be registered on the Companies Register.
The company, its’ owner or its’ partners must not be the subject of security or prevention measures or legal proceedings relating to the Mafia.

At least one Technical Manager (the owner or a partner) should be appointed to launch the company's activities.

A technical manager can work only in one company. Otherwise anyone who wants to work in the profession should meet one of the following technical-professional requirements:

- a degree in a specific technical subject (from a college of engineering, school of architecture, physical science, etc.)
- a secondary school diploma – second level with a sector-based specialisation, and a working period (of at least 2 years) in a company
- a qualification awarded by the Region or other authorized bodies and a working period (4 years) in a company
- employment with a company for a period (at least 3 years) as a "qualified worker" who performs installation, conversion, enlargement and maintenance of the systems. This period can also be worked in different companies.

According to Decree 37/2008 the company must issue a Conformity Declaration, which should be submitted to the Construction Counter Service of the Municipality where the system is located. The Municipality will send a copy of the declaration to the local Chamber of Commerce.

Important links:

- Ministry of Infrastructures and Transports: http://www.mit.gov.it/mit/site.php
- AEIT – Federazione Italiana Elettrotecnica, Elettronica, Automazione, Informatica e Telecomunicazione – Italian Federation: http://www.aei.it
- ANIE – Federazione Nazionale Imprese Elettroniche ed Elettrotecniche – National Association of Companies: http://www.anie.it
- CONFARTIGIANATO: www.confartigianato.it/elettricisti
- CEI – Comitato Elettrotecnico Italiano: http://www.ceiuni.it
- UNAE – Istituto Nazionale Qualificazione Imprese Installazione Impianti: http://www.unae.it
- ELETTRICO PLUS: http://www.elettricoplus.it

LEGAL BASIS IN POLAND

- Act dated 07.07.1994 – Building Act (Journal of Laws 2006 No. 156, item 1118 with subsequent amendments, Journal of Laws 2006 No. 170 item. 1217 and Journal of Laws 2006 No. 193 item 1430),

- Regulation of the Minister of Economy, Labour and Social Policy dated 15.12.2005 on basic requirements for electric equipment (Journal of Laws 2005 No. 259 item 2172)
- Regulation of the Minister of Transport and Building dated 27.12.2005 on assessments of conformity with basic requirements for electromagnetic compatibility and EMC marking (Journal of Laws 2005 No. 265 item 2227)
- Regulation of the Minister of Environment Protection dated 30.10.2003 on allowed electromagnetic field levels in environment and checking of the electromagnetic field level observance (Journal of Laws 192 item 1883)
- Act dated 10.04.1997 Energy Law (Journal of Laws 2006 Nr. 89 item 625 with subsequent amendments)
- Act dated 27.04.2001 Environment Protection Act (Journal of Laws 2006 No. 129 item 902 with subsequent amendments)
- Regulation of the Minister of Economy, Labour and Social Policy dated 28.04.2003 on detailed rules for checking of qualifications of equipment, installation and network operators (Journal of Laws 2003 No. 89 item 828 with subsequent amendments)

- Act dated 30.10.2002 on social work accident and occupational diseases (Journal of Laws 2002 No. 199 item 1673 with subsequent amendments),
- Regulation of the Minister of Labour and Social Policy dated 26.09.1997 on general industrial safety regulations (Journal of Laws 2003 No. 169 item 1650 with subsequent amendments),
- Act dated 24.08.1991 on fire protection (Journal of Laws 2002 No. 147 item 1229 with subsequent amendments)
- Regulation of the Minister of Economy and Labour dated 20.12.2004 on detailed requirements for network connections and operation (Journal of Laws 2005 No. 2 item 6)
- Regulation of the Minister of Economy dated 17.09.1999 on industrial safety of works at power equipment and systems (Journal of Laws 1999 No. 80 item 912)

LEGAL BASIS IN PORTUGAL

Labour Law: The Labour Code in Portugal is regulated by Law n. 7/2009 of 12th February. Further information regarding construction works contracts may be found in the Collective Work Contracts in the Construction Sector (*CCT, Contratos Colectivos de Trabalho para o Sector da Construção)* published by the Ministry for Labour and Social Solidarity in the Employment and Work Bulletin (*Boletim do Trabalho e Emprego)* n. 12 of 29th March 2009.

Standards for the Small and Middle-size Enterprises (SME): There are no specific regulations for SME. For the construction and real-estate companies there is a regulating entity (the Construction and Real Estate Institute -*in PT*, *Instituto da Construção e do Imobiliário, INCI*) and specific regulations concerning the admission and practice activity, namely:

- Decree-law n. 12/2004 of 9th January 2004 establishes the legal framework for the admission to and permanency in the construction activity;
- Decree n. 19/2004 of 10th January 2004 establishes the categories and subcategories related to the construction activity;
- Decree n. 21/2010 of 11th January 2010 establishes the value of the construction works according to the qualification categories of the building permit for 2010;
- Decree-law n. 211/2004 of 20th August 2004 regulates the real estate activity.

Basics of construction standards: General Regulations of Urban Buildings (*in PT: Regulamento Geral de Edificações Urbanas, RGEU*) approved by Decree-law n. 38382 of 7th August 1951 (altered by Decree n. 38888 of 29th August 1952 and further revisions). A new version is foreseen to be published soon (*in PT: RGE*).

Basics of construction Works Contract: For general contracts, the Civil Code approved by Decree-law n. 47344/66 of 25th November 1966 (1st version) and for public contracts, the New National Public Procurement Code approved by Decree-Law nº 18/2008 of 29th January 2008 (modified by Decree-law n. 278/2009 of 2nd October and Decree-law n. 223/2009 of 11th September).

Health, Safety and Welfare Regulations: Decree 41821 of 11th August 1958 establishes the work safety regulations for building construction; Decree-law 441/91 of 14th November 1991 establishes the general principles for the promotion of Health, Hygiene & Safety at work (transposes Directive n.º 89/391/CEE of 12th June); Decree-law 273/2003 of 29th October revises the legal framework on Health and Safety conditions in the construction site (incorporating the minimum prescriptions required for temporary/mobile construction sites established by the Directive n.º 92/57/CEE of 24 June).

LEGAL BASIS IN THE UNITED KINGDOM

Generally, the laws governing health and safety relate to all construction activities and trades (including design) and are not industry specific. There are several Acts and Regulations.
Some of the principal Acts which deal with health, safety and welfare in construction are as follows:

– Health and Safety at Work etc. Act 1974

- Mines and Quarries Act 1954
- Factories Act 1961
- Offices, Shops and Railways Premises Act 1963
- Employers Liability Acts – various
- Control of Pollution Act 1989
- Highway Act 1980
- New Roads and Streetworks Act 1991
- Corporate Manslaughter and Corporate Homiside Act 2007

The fundamental Act governing health and safety in construction is the Health and safety at Work etc. Act 1974. The principal regulations of this Act which affect design and construction, are:

- Management of Health and Safety at Work Regulations 1999 amended 2006
- Construction (Design and Management) Regulations 2007 (known as the CDM Regulations)
- The Work at Height Regulations 2005 amended 2007.

Some other related regulations and guides are:

- Site Waste Management Plans Regulations 2008
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995
- The Control of Major Accident Hazards Regulations 1999 (COMAH) amended 2005
- The Chemicals (Hazard Information and Packaging for Supply) Regulations 2003 (CHIP 3)
- The Health and Safety (Display Screen Equipment) Regulations 1992
- COSHH (Control of Substances Hazardous to Health) Regulations 2002: Provision and Use of Work Equipment Regulations (PUWER 98)
- Lifting Operations and Lifting Equipment Regulations (LOLER 98)
- Personal Protective Equipment at Work Regulations 1992
- Signposts to the Health and Safety (Safety, Signs and Signals) Regulations 1996
- Control of Asbestos Regulations 2006

Some of the principal Acts and Regulations which deal with environment, are as follows:

- The Environmental Protection Act 1990
- Environment Act 1995
- The Clean Air Act 1993
- Radioactive Substances Act 1993

- The Control of Asbestos Regulations 2006
- The Ionising Radiation Regulation 1999
- The Control of Lead at Work Regulations 2002

The regulatory organisations are (according to the Environment Act 1995):

- The Environment Agency (in England and Wales)
- The Scottish Environmental Protection Agency (in Scotland)

CHAPTER III :
THE NEW CONTEXT

THE BUILDING SECTOR IN FRANCE, A CONTEXT IN FULL CHANGE

Evolutions of the activities and the professions in the building sector in France related to energy saving and environmental protection

The building sector is in the central issues on energy saving and on environmental protection because this sector focuses the great social and environmental stakes of the 21st century.

The rising environmental and societal concerns lead the governments to take into account multiple stakes: improvement of the accessibility of the residences, energy saving, reduction of gases with greenhouse effect, impact of the building on health.

The construction sector faces a gigantic societal stake in terms of city planning, architecture and sustainable development. Indeed, sustainable development implies not only to respect the environment but also to improve comfort of the inhabitants by saving energy and consequently to act on the buildings.

Planetary stakes with the French stakes concerning the building sector

The environmental awakening has become planetary. No one can be unaware of the impact of the human activity on the climate and on the life of planet and in particular the influence of the carbon dioxide emissions on the global warming and the increasing natural disasters.

The exploitation, the overexploitation of the basement, the grounds and the forests accelerate the risks of shortage of raw materials and energy, foodstuffs and drinking water on a world level. Environmental protection and the need for saving energy are not to prove any more.

In this field, France has begun to lag behind its European neighbors. Moreover it must fight against the “evil housing” by developing and improving housing stock at the quantitative and qualitative level. The housing needs remain dissatisfied; France counts SDF (Sans Domicile Fixe = homeless people) and badly accommodated. Many old residences remain unhealthy and unworthy; France can count 3000 dead per year because of the bad residences; a huge work to set to the security standards, to improve on health and comfort is necessary.

1. The sector of the French building and its evolutions

The building sector: a branch of increasing importance for the nation's economy and for employment.

Under the term of "Construction" all the activities of the building industry and public works are joined together. In 2005, the turnover of Construction amounted to nearly 170 billion Euros, including 119.3 billion Euros for the building industry and 50.6 billion for public works (See the "Contract of exploratory studies").

The building sector accounts for 1 300 000 assets (1 006 500 for the construction, 258 500 for public works) which means more than the third of salaried jobs in the industry. Consequently, mobilizing all the stakeholders in this sector on major social issues, on their skills development is meeting the challenge of sustainable development.

Several factors strongly impact the building sector:

- ***Laws resulting from French "Grenelle Environment Conference and Process" organize the change of the buildings and contribute to the development of the labels which will oblige the companies to reconsider their ways to build and renovate and to improve or standardize their practices.***
- ***New products, equipment as their implementation require new knowledge and know-how.***
- ***The requirement of measuring the energy performance of buildings and ensuring that performance oblige to think differently the design, the restoration and the management of the buildings; whole chain is involved: the manufacturer to the installer. The restructuring of jobs and skills will depend on the organization of the chain between manufacturer and installer.***
- ***Modify the energy supply imposes a new organization of business activity around the concept of global offer coordinated in time.***
- ***The obligation of results in terms of energy performance revives the requirement of quality on the building sites and a better communication between trades.***

And the tendency for the evolution of employment would be with is to break down barriers between jobs, to get some versatility and a better communication between trades.

By setting up a constraining lawful device, France has opened a vast project of improving the energy performance of the new and existing buildings

The laws resulting from "Grenelle Environment" organize the change of the building and contribute to the development of the labels which will oblige the companies to reconsider their way to build and to renovate.

"With over 68 million tones of oil equivalent consumed, or 123 million emitted tones of CO_2, that is to say 23% of the national emissions, the building sector is the biggest consumer of energy in France"

In France, the "Grenelle Environment" in particular targeted the priority to act for the reduction of consumption of energy by the building. For building professionals, this is a revolution because "Grenelle Environment" defines performance requirements and schedule.
"Grenelle Environment" set up a threefold challenge to 2020: 20% reduction in greenhouse gas emissions achieving 20% energy saving and development of 20% renewable energy.
The thermal regulations plan to reduce by four the CO2 emissions to 2050. If one estimates the energy consumption to approximately 240kwh per square meter and per year, in order to divide by four to 2050, the gas emissions with greenhouse effect, "Grenelle Environment" has planned to bring back the energy consumption of the existing buildings to the level of:

- 210 kwh/m^2/year in 2012,
- 150 kwh/m^2/ year in 2020
- 50 to 80 kwh/m^2/ year in 2050.

The government decided to face the major problem of the thermal leveling of the existing buildings, potentially the most accessible, which represent 3.5 billion square meters. According to the experts, the challenge is complex, with the diversity of the 32 million residence park: individual housing, collective housing divided between landlords, tenants of individuals, tenants of social public landlords
For the building sector, it is a huge building site which opens, supported by the community effort which ensures the solvency of the lowest income families with special aid and financial assistance for the public landlords.
In 40 years, we will have to renovate two thirds of the housing, which represents 500 billion jobs to 2050, which means 5 years of turnover of the building sector.

The changing regulatory framework leads to a proliferation of labels (HQE, THQE, Passive House, Effinergie....) and of charters.

Today, by adopting step HQE (Environmental High-quality) and THQF (Environmental Very High-quality), we have to build ecological, comfortable and to generate energy saving for the users.
The "climate 2004" plan clearly specifies the objectives of the thermal regulation applicable to the new buildings.

- A better energy performance in the new building (15% or over)
- A limitation of air-conditioning
- The control of the electricity demand.

Three types of standards frame construction activity: thermo isolation, energy performance and indoor climate.
According to Jocelyne Blaser, responsible for the structural engineering policy at the Regional management of the equipment, the creation of new imposed standards "will create

emulation for the professionals of the building. They will use different materials, think construction differently, manage the thermal bridge, and integrate vegetation and the environment…" (See InffoFlash supplement n°730).

2. The building sector is preparing the change of its jobs

The professionals agree to say that all the trades are or will be concerned with the evolutions.
As Alain Kokosowski, President of the CREDIJ and Paul Kalck, researcher in the Research and Studies Center on Qualifications (CEREQ) "Grenelle Environment makes new trades and new skills emerge", "the professionals of the building have to work out answers which will define contours of a new construction, with many repercussions on employment and qualification".
Let us analyze how the trades, the knowledge, the know-how are impacted by the changes in the sector.
Starting from the central idea that the companies and the craftsmen become "the renovating energy people of tomorrow and the holders of a global offer", we tried to analyze the strategic choices of these actors on the market and the problems to which these actors must find solutions before considering the impact on the jobs and skills.
Generally, the energy performance requirements involve improving energy products, equipments and their implementations; new know-how develops as well.
Currently, the building sector develops the use of innovating and natural products in substitution with the derivative products of fossil energies. Frames of wood, steel, concrete or composite, and elements of factory prefabricated panels with exterior insulation should replace the concrete.
The techniques to create energy saving buildings exist, but most of them are experimental, and it is necessary to go towards an industrial scale…
It is considered essential to check that the techniques available today are adequate to complete the necessary work. "We believe that manufacturers are pushing the search for more efficient equipment and probably less expensive to run. This should take five years, necessary duration to fix the techniques and to make legal adjustments. It will be necessary to work on two important subjects: measuring the energy performance of the buildings and improve of the knowledge on the existing park; the guarantee of the energy performance without which the builders and the landlords will not make investments."
The requirement of measuring the energy performance of buildings and ensuring that performance oblige to think differently the design, the restoration and the management of the buildings; whole chain is involved: the manufacturer to the installer. The restructuring

of jobs and skills will depend on the organization of the chain between manufacturer and installer.

What will the new organization of the chain be: which are the axes which are emerging (industrialization, specialization of the craftsman-setters by product or networking craftsmen)?

Craftsmen constitute a key interlocutor of the chain which goes from the supplier of products and equipment, to the customer. The transformation of the built framework, the installation of energy and thermal solutions imply to mobilize all the actors of the chain: fitters and companies.

Manufacturers, in order to shorten the completion periods, develop strategies for product-services which encroach on the traditional handcraft activity. All the professional practices will be modified. New jobs will rise (especially in the restoration) and the borders between the trades will move. The building sector's best interest is to take the turn, or else the industrialists will be tempted to train their setters to ensure a perfect implementation alerts Françoise Vaysse, journalist at the Monitor of Public Works and Building.

The SMEs gather and get organized, facing the groups of manufacturers. A study of the CSTB (Centre Scientifique et Technique du Bâtiment) says that groups of manufacturers will want to organize and reach the final customer; it implies the creation of a consortium associated with a manufacturer and the transfer of margins resulting from installation of materials to large groups. The development of industrialization could be done with the detriment to the craft industry: the fitters would choose to specialize on a product or equipment.

In reaction, SMEs would try to preserve their knowledge and know-how as craftsmen and would resist in being organized. In some areas one observes an emergence of new practices of regrouping in craftsmen's cooperatives of purchase, of creation of craftsmen associative networks (according to the study of the CSTB).

The need to propose an offer of diversified energy on the market will structure the approach of the companies around the concept of comprehensive solutions, coordinated in time.

The rising cost of energy drives the development of a global offer of the energy operators which structure the market of the building. EDF (Electricité de France) offers diversified energy (gas, electricity, solar…) designed with a package of equipment (heat pumps, solar panels…) which allow reaching the expected energy performance. As a result, consumers wait for comprehensive advice from the fitters. Therefore, the company must deal directly with the individual's requests for new technologies and give an appropriate answer.

The result of the investigation made by CSTB and ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie) about renewable energy confirms that craftsmen are now in a more important transversal process because they must submit a package which ensures the coupling of different energy productions. Furthermore, they must take into account the habitat (buildings, ventilation) to answer energy saving questions.

In addition to the financial support of the State near the individuals with the lowest incomes, the experts of the "Grenelle Environment" recommended a better information and awareness of individuals as well as the deployment of a quality offer from the professionals of the building sector: comprehensive solutions, loops of innovations and experience feedbacks between the research and development and practical implementation (See Les Echos, March 20, 2008 - Michel Octernaud folder: Landlords).

The committee of the "Grenelle Environment" also recommends the creation of a zero-interest loan designed for homeowner inhabitants and for landlords' backers to finance the heavy rehabilitations. The financing relies on a bunch of ambitious coordinated work. In apartment buildings, the central idea is to require the owners to implement a coordinated package such as insulation of the roofs, boiler change, and installation of programmers by spreading out the constraint of time.

A requirement increased as regards to quality: the obligation of result in terms of energy performance revives the requirement of quality on the building sites and a better communication between trades.

Paul Kalck thinks that building professionals have to deal with customers' increasingly demands: "customers are better informed on preventive maintenance, and more sensitive to the need to save energy and to spare natural resources".

Paul Kalck underlines the fact that "the companies must adapt to the new contexts, expect new skills from their employees: lawful technological survey, strict compliance of procedures, development of capacity of self-checking of carried out work…".

Because of technical innovations, of the increasing requirement for quality, of the need for comprehensive solutions, the supervision of construction sites becomes more constraining and should help to contribute "to develop a better communication between the professionals who will have to work more synergistically". (See Jocelyne Blaser).

The impact on employment: breaking down barriers between jobs, to get some versatility?

For lack of complete analysis on the jobs and skills, we will approach some examples that seem to go towards the development of the communication between the trades and a decompartmentalisation between some trades.

Improving management of energy consumptions goes through the use of home automation.

In selecting home automation materials, a comprehensive view of the interactions between the trades is required. Craftsmen must find all together solutions to achieve the operating scenarios of intended technical installations.

For the installation of solar systems, trades interfere: for example, the roofer or the tile setter has to have notions on hydraulics.

For the heating fitters, the traditional plumber is likely to die because it must at the same time control new technologies and develop versatility in electricity-heating-cooling". According to Jocelyne Blaser, the plumber, for example, will not deal any more only with boilers, but also with insulation. This trade association will have an advisor role in thermal rehabilitation".

CHAPTER IV:
NEW SOLUTIONS

The photovoltaic effect was discovered in 1839 by the French Alexandre Becquerel . It refers to the ability of some materials to convert sunlight into electricity. PV is thus classified among renewable energy as it uses solar radiation when it works.
The amount of photovoltaic energy is directly proportional to the surface exposed to sunlight, allowing facilities to "map": the area with modules. The photovoltaic panels can spread over a few cm2, feeding a calculator, to hundreds of thousands of m2 plant floor. The plant size can be modified by simple addition or removal of modules.

The photovoltaic effect is a real alternative to traditional electricity generation and it doesn't cause nuisance nor impact on the environment: no noise, no emission of gas, no smell ...
Besides the cost of investment, the access to energy resources is free. The pannels have a lifespan approaching 30 years, so the economic balance is predictable.
The impact of a photovoltaic system on the environment is limited to the visua aspectsl, because at the end of teir life, the modules can be recovered, recycled and re-used, so the final waste and resulting pollution is minimal.
So, the environmental impact of photovoltaics is extremely limited compared to other energy sources.

The French "Grenelle Environnement" says we have to build all new buildings including "positive energy" in 2020. This point has a strong impact on photovoltaics use in future construction projects. At that date, the PV industry is expected to have highly developed and the manufacturing cost of photovoltaic panels should have considerably dropped, so the cost of electricity should be near that of the public grid. The aid and support of the state which are now incentives for setting up this type of installation would therefore become unnecessary.

Materials

Three general technical areas — crystalline silicon, films, and modules — are discussed, with further levels of detail provided within the discussions.
Crystalline silicon technology is advancing through research of materials, devices and processes. With improved starting material, we can produce better solar devices. With improved devices, we can increase efficiencies and decrease fabrication costs, and with improved processes, we also reduce costs.

Thin Films of special photovoltaic materials produce solar cells with relatively high conversion efficiencies, but use much less material than crystalline silicon cells. We will discuss the following key materials or technologies: amorphous silicon (a-Si), copper indium diselenide (CIS) and its alloys, cadmium telluride (CdTe), and thin films using a multijunction design.

PV modules are optimised to improve performance beyond present limits. To optimise the modules, we must know and control technical details such as doping profiles, morphology, short-range order, stoichiometry, and process uniformity. Research also helps to decrease the costs of module manufacturing.

Specific PV system components may include a DC-AC power inverter, battery bank, system and battery controller, auxiliary energy sources, and sometimes the specified electrical load (appliances). In addition, an assortment of balance-of-system hardware, including wiring, over-current, surge protection and disconnect devices, and other power processing equipment may be included. The following diagram illustrates the relationship of individual components.

CHAPTER V :
TRAINING

1. Aims of training

The purpose of this training is the safe installation and reliable operation of photovoltaic systems, interconnected with the central electric network AC mains. The training focuse mainly on planning and delivery of electrical installation.

The main objective was to inform stakeholders to adopt practices that contribute to the joint and addresses the installation and safe operation of the Building interconnected photovoltaic systems. Taking into account that the installed power plants close to consumers during the long period of operation, highlighted the need for high quality design and installation of these power plants to ensure the safety of users of the Greek Power System and the proper and safe operation of the Greek Power Systems.

2. Contents of training part

<u>Content:</u>

<u>I - THEORICAL PART</u>

I. General information

I.1) "new" renewable sources of electricity

I.2) Of other interesting renewable sources in certain "privileged" places

I.3) Examples of photovoltaic systems connected to the network (with the wire of the sun)

I.4) Growth of the photovoltaic field

I.5) Solar Radiation on our planet and in France

II. Solar energy

II.1) Atmospheric effect

II.2) Other factors

III. Photovoltaic solar energy

III.1) Operation of a PV cell

III.2) Manufacture of a PV cell statement

III.3) Yield of a cell

III.4) Photovoltaic modules

III.5) Composition of a photovoltaic system (PV)

IV. Types of systems

IV.1) Isolated or autonomous System

IV.2) System connected to the electrical supply network

V. Stage of design of a photovoltaic installation

STAGE 1: Determine the total electric consumption.

STAGE 2: Evaluate the solar resource.

STAGE 3: Define the type of systems to be installed

STAGE 4: Determine the photovoltaic power necessary for the installation.

STAGE 5: Ddetermine the capacity of the battery

STAGE 6: Determine the size of the regulator

STAGE 7: Determine the power of the inverter

STAGE 8: Determine wiring and protections

STAGE 9: Consider the real losses of the whole system

VI. Architectural aspect and integration of the frame

VII. Appendices:

VII.1) Graphs

VII.2) Protection against the electromagnetic interfaces

VII.3) Principle diagrams of a PV installation

II - PRACTICAL PART

I. The market, the resources

II. Calculations for the dimensioning of the photovoltaic system to set up

I.1)The various factors

I.2) Elements of calculation - formulas

III. Assembly of the panels

III - ASSESSMENT

The trainer will give you the test ot the end of the module

3. Some basis on Photovoltaïcs

SOLAR ENERGY

With particular thanks to

- Mr Réda Farah, Inspecteur au Rectorat de Paris
- The European project IEE« ENERGYpath »
- The French "Centre National de Ressources en Génie Electrique "

INTRODUCTION

Of all forms of renewable energy, solar radiation is the most important and the most abundant. Throughout history the sun has been one of the main sources of energy used by mankind to produce heat, whether directly or indirectly, natural or artificial. This is called solar thermal energy. More recently, space programmes in the 1950s led to the development of another way of using solar power: solar photovoltaic, which directly converts solar radiation into electricity.

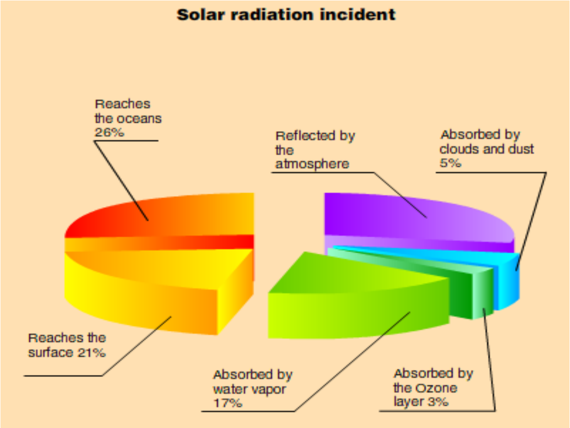
The Sun

The planet receives about 5.4 x 10^{24} J of energy from the sun each year – 4500 times the amount consumed. Despite its abundance the use of solar radiation is limited by three factors. These are the intensity of the radiation reaching the Earth (the amount of energy per unit of time and area), the daily and annual cycles (night and day, and seasons) and the climatic conditions (hours of sun per year) in each region.

In general the term '*solar radiation*' refers to the overall value of radiation, i.e., the amount of energy received by a unit of area at a specific moment of time (measured in W/m^2. These values normally refer to the energy that arrives directly from the sun (direct radiation) plus the energy that is diffused by the atmosphere and radiated by other parts of the sky (**diffuse radiation***).

Losses in the atmosphere due to reflection, absorption and dispersion reduce the amount of solar radiation reaching the Earth by 30%. As a result the intensity of radiation reaching the Earth's surface is about 1000 W/m^2. The amount actually received depends on climate.

Solar power technologies can be classified in a number of ways.



Direct or Indirect

In general, direct solar power involves a single transformation of sunlight which results in a usable form of energy.

- Sunlight hits a photovoltaic cell creating electricity.
- Sunlight warms a thermal mass.
- Sunlight strikes a solar sail on a space craft and is converted directly into a force on the sail which causes motion of the craft.
- Sunlight strikes a light mill and causes the vanes to rotate as mechanical energy (little practical application has yet been found for this effect).
- In a direct solar water heater the water heated in the collector is used in the domestic water system.
- In general, indirect solar power involves multiple transformations of sunlight which result in a usable form of energy.
- Vegetation uses photosynthesis to convert solar energy to chemical energy. The resulting biomass may be burned directly to produce heat and electricity or processed into ethanol, methane, hydrogen and others biofuels.
- Hydroelectric dams and wind turbines are powered by solar energy through its interaction with the Earth's atmosphere and the resulting weather phenomena.
- Ocean thermal energy production uses the thermal gradients present across ocean depths to generate power. These temperature differences are produced by sunlight.
- Fossil fuels are ultimately derived from solar energy captured by vegetation in the geolical past.
- In an indirect solar water heater the fluid heated in the collector transfers its heat through a heat exchanger to a separate domestic water system.

Solar Thermoelectric Technology.

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Pasive or Active

This distinction is made in the context of building construction and building services engineering.

Passive solar systems use non-mechanical techniques of capturing, converting and distributing sunlight into usable outputs such as heating, lighting or ventilation. These techniques include selecting materials with favorable thermal properties, designing spaces that naturally circulate air and referencing the position of a building to the sun.

- Passive solar water heaters use a thermosiphon to circulate fluid.

– A Trombe wall circulates air by natural circulation and acts as a thermal mass which absorbs heat during the day and radiates heat at night.
– Clerestory windows, light shelves, skylights and light tubes can be used among other daylighting techniques to illuminate a building's interior.
– Passive solar water distillers may use capillary action to pump water

Passive solar water distillers may use capillary action to pump water.
Active solar systems use electrical and mechanical components such as photovoltaic panels, pumps and fans to process sunlight into usable outputs.

Solar Thermoelectric Plant.

Concentrating or non-concentrating

Concentrating solar power (CSP) systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam capable of producing high temperatures and correspondingly high thermodynamic efficiencies. Concentrating solar is generally associated with solar thermal applications but concentrating photovoltaic (CPV) applications exist as well and these technologies also exhibit improved efficiencies. CSP systems require direct insulation to operate properly. Concentrating solar power systems vary in the way they track the sun and focus light.
Non-concentrating photovoltaic and solar thermal systems do not concentrate sunlight. While the maximum attainable temperatures (200 °C) and thermodynamic efficiencies are lower, these systems offer simplicity of design and have the ability to effectively utilize diffuse insulation. Flat-plate thermal and photovoltaic panels are representatives of this technology.

Photovoltaic solar plate.

TECHNOLOGY DESCRIPTION

There are two basic types of solar energy installations: those used to produce thermal energy (mainly for hot water and heating) and those that convert solar radiation into electricity (photovoltaic technology).

Finally it must be considered the possibility of making more general use of solar radiation in buildings. This method of using solar energy is called bioclimatic architecture. It takes daylight and the local climate into account when designing new dwellings.

Different types of technology:

- **Solar Thermal energy**
- **Solar Photovoltaic energy**
- **Solar Thermoelectric energy**

Solar energy.

SOLAR PHOTOVOLTAIC ENERGY

Solar photovoltaic energy is light converted into electricity using solar cells. It provides economic and environmental benefits. It is a limitless form of energy, clean, silent and environment-friendly. Furthermore it is available everywhere.
Solar photovoltaic electricity generation is very much a recent and close-to-state-of the-art renewable energy technology. Until recently, their use has been limited because of high manufacturing costs.

TECHNOLOGY DESCRIPTION

The solar cell

A solar cell is a semiconductor in which a permanent electric field has been artificially created. When exposed to the sun, the electrons circulate and an electric current is set up between the two faces of the cell. Many different types of semiconductors are used to make solar photovoltaic cells but the dominant one so far is silicon (mono-crystalline, poly-crystalline or amorphous). Suitably doped (contaminated artificially) by a specific substance such as phosphorous, silicon forms a semiconductor layer called "n" (with an excess negative charge). Alternatively, if it is doped with other substances, such as boron, it forms a layer called "p" (with an excess positive charge). The union of these two layers (the p-n junction), furnished with suitable electrical contacts, causes an electric current to appear when one layer is illuminated by the sun – thus forming a solar cell.

The rated power of these cells is usually measured in picoWatts (pW), which is the voltage the cell generates under a standard radiation density of 1,000 W/m^2. For example, an installation of 10 pW will supply 10 W of power from 1,000 W/m^2 of radiation. The surface area of a normal single cell is about 75 cm^2 and has a power rating of 2.5 W. This means that with 1,000 W/m^2 of radiation it generates about 2 A of current at 0.5 V.
A number of cells can be combined in a photovoltaic panel to obtain a voltage that can be used by a typical low voltage device. These panels usually contain between 36 and 72 cells and produce direct current at 12 or 24 V and between 80 and 190 pW of power.
In the northern hemisphere panels must face south, inclined at an angle that depends on the latitude and time of year.

Other components of a solar photovoltaic system are:

The Solar Panel

This is a module that generates a direct electrical current through the interconnection of photovoltaic cells which are encapsulated and mounted in a frame.

Inverter

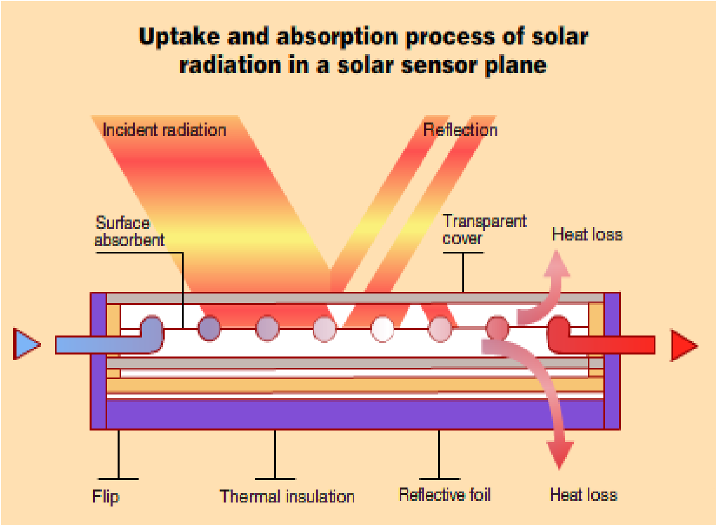
This transforms the direct current (at 12 or 24 Volts) generated by the photovoltaic installation into alternating current for use with typical appliances in grid-isolated installations or for adding energy to the grid (in the case of grid-connected installations).

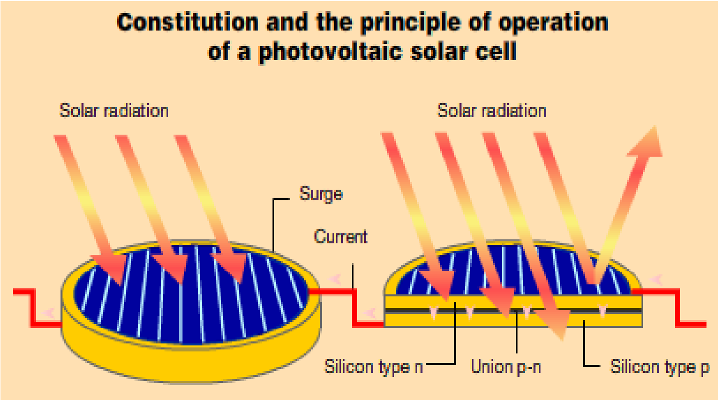
Battery

Batteries are only used in installations that are not connected to the grid. Generally they are accumulators with long discharge times.

Controller

In grid-isolated installations, this protects the accumulators from overloading and excessive discharge. If the batteries are overcharged it cuts off the current and short circuits the panels. In the event of excessive discharge, it warns the user via an alarm or cuts off supply if the drain continues.





APPLICATIONS

Solar photovoltaic systems can be divided into two groups:

A) Systems not connected to the power grid

There are areas where access to the national power grid is impossible or very expensive and solar energy is used as the local supply. In these cases it is not necessary to install a power line to the point where the electricity is required and this associated cost is avoided. Typical applications are as follows:

- Electricity for dwellings that are some distance from the power grid.
- Farming (pumping of water, irrigation systems, illumination of greenhouses and livestock in winter, etc).
- Signage and communications (sea and air navigation, highway lighting, relay stations, etc)
- Street lighting (streets, monuments, bus shelters, etc).
- Water purification plants.

B) Systems connected to the power grid

CURRENT SITUATION

In 2003, worldwide production of solar cells increased by 32%. Between 2000 and 2004, the increase in worldwide solar energy capacity was an annualized 60%. 2005 was expected to see large growth again, but shortages of refined silicon have been hampering production worldwide. Analysts have predicted similar supply problems from 2007.

Photovoltaïcs power installed in European Union *(statistics EurObserv'ER)*				
Country	2006 MWc	2007 MWc	Total power 2007 MWc	Installed power Wc/capita
Allemagne	833,0	1.103,0	3.846,0	46,5
Espagne	115,1	340,8	515,8	11,7
Italie	12,5	50,2	100,2	1,7
Pays-Bas	1,5	2,3	55,0	3,3
Portugal	0,4	14,3	17,9	1,7
France (métro)	7,6	12,8	46,7 (+ DOM)	0,8
Autriche	1,5	3,0	28,6	3,5
Royaume-Uni	3,4	3,4	17,7	0,3
Grèce	1,2	2,5	9,2	0,8
TOTAL UE	981,4	1.541,2	4.689,5	8,5

SOLAR THERMOELECTRIC ENERGY

INTRODUCTION

Solar thermoelectric technology generates electricity in a similar fashion to a conventional thermal power station using a Ranking Cycle (steam turbine and alternator). The only difference is the thermal source. Instead of burning fossil fuels, a fluid is heated by concentrating the suns rays.

TECHNOLOGY DESCRIPTION

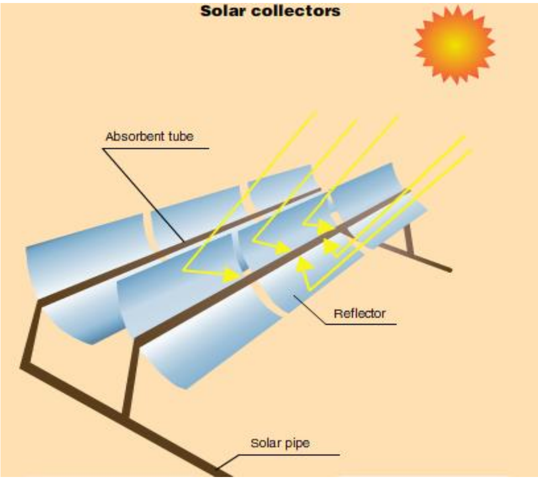
At present there are three main systems of thermoelectric technology:

Parabolic trough collectors:

radiation is concentrated by a reflecting surface shaped like a parabolic trough, onto a tube located along the focal axis of the collector. A fluid (oil) flows through the tube to a reverse-flow heat exchanger where it heats water, generating steam. This is then used to drive the turbine. The turbine shaft is connected to an alternator, which produces the electricity. The position of the sun is usually followed using one axis and the concentration factor is 30-80. It is also possible to use a thermal storage system (with chemical salts), which will prolong the hours of operation

Power towers:
radiation is concentrated by heliostats which focus the sun's rays on an absorbing surface at the top of a tower. The fluid which circulates over or behind this surface cools it by convection and transfers the thermal energy to a device where it generates steam. The rest of the cycle is the same as the conventional steam cycle. The position of the sun is usually tracked using two axes and the concentration factor is 200-1000.

Dish and Stirling engine:
a parabolic dish concentrates radiation on a surface located at the focal point. This surface coincides with the hot cylinder of a Stirling engine. The position of the sun is usually tracked using two axes and the concentration factor is 1000- 4000.



Thermo electric technology is there, waiting for the right investment to produce large amount of electricity. The unique obstacle is the geographical limitation / confinement because productivity is related to latitude and climatology of the places, that is why world areas as the southwest of United States, Central and South America, Africa, Near East, Mediterranean Europe, Iran, Pakistan, desert areas of India, Russian Federation, China and Australia are the ones with better expectations.
Spain is for its size and latitude, the European country with more possibilities in solar energy, in this sense thermo electrical energy is one of the future options in the energy sector.

According to Greenpeace "the exploitation of less than the 1% of the thermal solar power would be enough to stabilize the World climate thanks to massive reductions of CO_2".
This technique can be also used for industrial processes or for industrial climatization, although nowadays researches, focused on the optimization of industrial equipments to combine with this system, are still being developed.
The authorities should deal with solar thermoelectric power plants like any other power generation project. They include those in charge of the environment, culture (in the event of possible archaeological remains) and public works (licence for non-urban land and public interest). River basin authorities, gas and power utility companies, ecological interest groups, etc, can also play a role.

Environmental Aspects

The main repercussions on the environment are the visual impact and occupation of land, which can be significant for very large installations. This occupation of land may affect the flora and fauna on and around the site

Comparison of solar thermal technologies

	Cylinders parabolics	Central tower	Disc/engine
Size (MW)	30	10	0,005
Temperature operation	390 ºC	565 ºC	750 ºC
State trading	Commercial	Demonstration	Prototypes
Technological risk	low	half	high
Investment (€/kW)	3.702	4.074	11.659
O&M (€/MWh)	9,26 €	6,49 €	18,63 €

Source: 'Overview of Solar Thermal Technologies'. Department of energy's

Thermoelectric Solar Technology

The development and large-scale implementation of solar energy, whether thermal or photovoltaic, contributes to the preservation of the environment and to an improvement in the quality of life in urban or rural areas in the following ways:

- Solar installations produce energy from resources that are renewable and available around the world. Therefore they help to avoid the depletion of fossil-fuel reserves.
- They do not produce noise or smoke; they do not require sophisticated safety precautions and they do not produce waste that is difficult to treat or dispose of.
- They do not generate emissions such as CO2, SO2 and NOx which are produced by conventional power stations and therefore they contribute to the goals of the Kyoto Protocol on the reduction of greenhouse gases.
- The centres of production can be closer to the centres of consumption. This reduces the need for large transmission infrastructure (such as power lines) and the associated environmental impact.
- The energy from the sun is virtually free after the initial cost has been recovered.
- Depending on the utilization of energy, paybacks can be very short when compared to the cost of common energy sources used.
- Facilities can operate with little maintenance or intervention after initial setup.
- Solar electric generation is economically competitive where grid connection or fuel transport is difficult, costly or impossible. Examples include satellites, island communities, remote locations and ocean vessels.

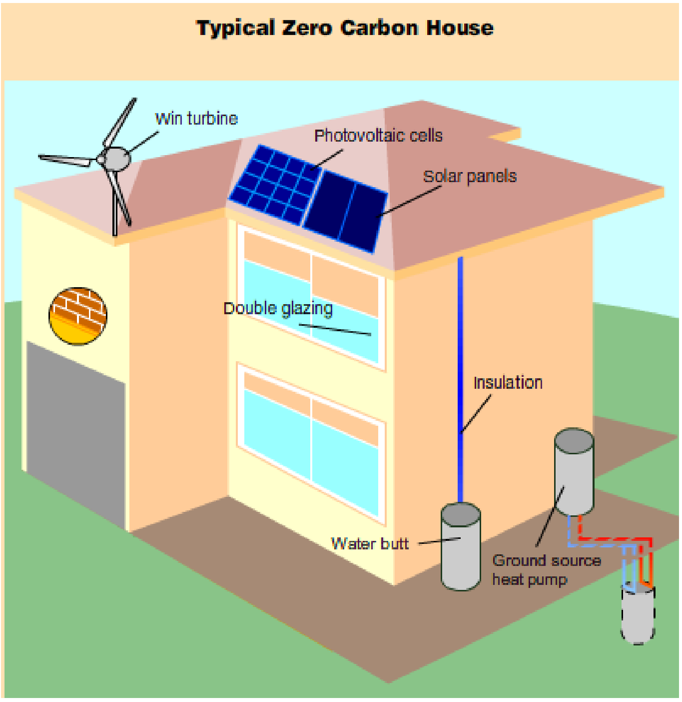
Nonetheless, although they have positive aspects, it should not be forgotten that solar installations, like any other type, must apply a series of criteria to minimise environmental impacts:

- One important aspect of both thermal and photovoltaic installations is that in most cases they can form part of a building. The visual impact of the exposed parts of the installation (the collectors) must be minimised whether the building is old or new. This is done by integrating these components with the building's structure.

– In the case of solar photovoltaic installations that are not connected to the grid and use storage batteries, it is important to ensure tracking, collection and proper treatment of these at the end of their life cycle. They contain substances that are very harmful to the environment.

ZERO CARBON HOUSING

In the consultation document 'Building a Greener Future', the government's views on the importance of moving to zero carbon housing. By 2016 it is hoped that all new homes built will be zero carbon and will include those that use some form of distributed energy (locally produced energy, such as that from renewables). By 2016, if housing supply ambitions are met, there will be an additional 200,000 homes every year, the majority of which will be newly-built, zero carbon properties



CONCLUSIONS REGARDING WHOLE JOB MODULE

Solar photovoltaics can and should play an important role within a sustainable energy system of the future. Solar photovoltaics (PV) is one of the key technologies to generate decentralised electricity for private households around the world, and the technology is on its way. The market has grown by more than 40 % each year for almost one decade now and the industry is investing large sums for building more production facilities each year.

USEFULL RESOURCES

Website links

1. Centre for Renewable Energy Sources (CRES) www.cres.gr/kape/index_eng.htm
2. *Objectives and Task Analysis for the Solar Photovoltaic System Installer,* North American Board of Certified Energy Practitioners®: www.nabcep.org
3. *Code of Federal Regulations,* Chapter 29 Part 1926 - Safety and Health Regulations for Construction, Occupational Safety and Health Administration: www.osha.gov
4. *Electrical Safety in the Workplace,* NFPA 70E, National Fire Protection Association: www.nfpa.org
5. *Photovoltaic Systems, 2007,* by Jim Dunlop. ISBN 978-0-8269-1287-9, National Joint Apprenticeship and Training Committee and American Technical Publishers: www.jimdunlopsolar.com
6. *Photovoltaic's Design and Installation Manual,* 2007. ISBN 978-0-86571-520-2, Solar Energy International: www. solarenergy. org
7. *Photovoltaic Power Systems and the 2005 National Electrical Code: Suggested Practices,* February 2005, by John Wiles. SAND2005-0342, New Mexico State University/Southwest Technology Development Institute and Sandia
8. National Laboratories: www. sandia. gov/pv
9. *Roofing Construction and Estimating, 6th Printing,* 2006. ISBN 978-1-57218-007-9, Craftsman Book Company: www. craftsman-book. com
10. *Photovoltaic Systems Engineering, 2nd Edition,* 2004, by Roger Messenger and Jerry Ventre. ISBN 0-8493-1793-2, CRC Press LLC: www.crcpress.com
11. *Soares Book on Grounding and Bonding, 10th Edition,* 2008, ISBN 1-890659-47-9. International Association of Electrical Inspectors: www.iaei.org
12. *A Guide to Photovoltaic System Design and Installation,* by Bill Brooks. California Energy Commission Consultant Report 500-01-020, June 2001: http://www.energy.ca.gov/reports/2001-09-04 500-01-020.PDF

11. *Battery Service Manual, 12th Edition,* Battery Council International: www.batterycouncil.org
12. *Stand-Alone Photovoltaic Systems: A Handbook of Recommended Design Practices,*

SAND87-7023, Sandia National Laboratories:
http://www.sandia.gov/pv/docs/PDF/Stand%20Alone.pdf

13. *Maintenance and Operation of Stand-Alone Photovoltaic Systems*, Sandia National laboratories: http://www.sandia.gov/pv/docs/PDF/98TLREF13.pdf
14. *Working Safely with Photovoltaic Systems*, January 1999, Sandia National Laboratories:
15. http://www.sandia.gov/pv/docs/PDF/workingsafely.pdf
16. Solar America Board for Codes and Standards: www.solarabcs.org
17. National Renewable Energy Laboratory Website: www.nrel.gov
18. Sandia National Laboratories Photovoltaics Website: http://photovoltaics.sandia.gov/
19. Southwest Technology Development Institute, PV Codes and Standards Website by John Wiles:
20. http://www.nmsu.edu/~tdi/Photovoltaics/Codes-Stds/Codes-Stds.html
21. Interstate Renewable Energy Council Website: www.irecusa.org
22. *IAEI News*, International Association of Electrical Inspectors, http://magazine.iaei.org
23. PHOTON International Magazine : www.photon-magazine.com/
24. Home Power Magazine: www.homepower.com
25. Solar Pro Magazine: www.solarprofessional.com

EUROPEAN

1. **EERA** European Energy Research Alliance www.eera-set.eu/
2. **TREN** The Directorate - General for Energy and Transport europa.eu/comm/dgs/energy_transport/index_en.html
3. **Eurostat** europa.eu/comm/eurostat/
4. **ADEME** Agence de l'Environnement et de la Maitrise de l'Energie www.ademe.fr
5. **ADENE** Agencia para a Energia www.adene.pt/
6. **DEA** Danish Energy Agency www.ens.dk

7. **Enea** Ente per le Nuove Tecnologie l'Energia e l'Ambiente www.enea.it
8. **EVA** Energieverwertungsagentu www.eva.ac.at
9. **FES** Future Energy Solutions www.future-energy-solutions.com
10. **IDEA** Instituto para la Diversificacion y Ahorro de la Energia www.idae.es
11. **IEC** Irish Energy Centre www.irish-energy.ie
12. **IFE** Institute for Energy Technology www.ife.no
13. **NOVEM** Netherlands Agency for Energy and the Environment www.novem.nl