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Best practice in the implementation of qualification scheme for small-scale RES systems

Strategic Workshop
"Training and qualification of small-scale RES installers in Europe"
12th March, 2013
Brussels, Belgium

Dr. Stathis Tselepis, Director of PV Lab at CRES

INTELLIGENT ENERGY EUROPE

Outline

- ❖The development and dissemination of the PV training material by CRES
  - ▪Translation, adaptation and implementation of PV training materials
  - ▪Pilot Course
  - ▪1st training course
  - ▪2nd training course
- ❖Certification
  - ▪Description of the Certification Process
  - ▪Current state on Certification
  - ▪Next Steps towards article 14.3
  - ▪Certificarion progress
- ❖Conclusions

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Install+RES at CRES

❖Preparation and implementation of the pilot course was done by CRES at our premises in Pikermi.

❖The translation of the teaching materials, including the information materials, and the worksheets with and without the answers, were prepared by CRES.

❖The presentation during the workshops of the information materials was done mainly by Dr. Thanasi Giannadaki, according to the contract between Hellenic Association of Mechanical Engineers and CRES, with the assistance of CRES's scientific staff.

Info days and dissemination

- **Install+RES was presented at two workshops:**

1. **"Energy savings in the residential and industrial sectors" in Patras, Greece, 11 April 2011**
2. **"Photovoltaics and Environmental Technologies", in Patras, Greece, 16th May 2011**

- **Publication in the national magazine "RENEWABLE ENERGY MAGAZINE", March 2013**

"Install+RES: Training the trainers of small-scale Photovoltaic systems in buildings"

http://www.renewable-energy.gr/%CE%A0%CF%81%CE%BF%CE%B2%CE%BF%CE%BB%CE%AE%CE%AC%CF%81%CE%B8%CF%81%CE%BF%CF%85/tabid/134/ArticleId/397/.aspx

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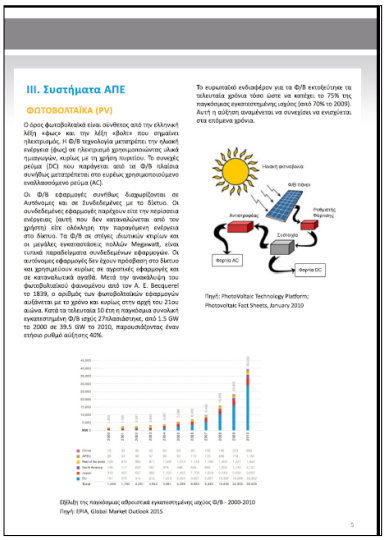
Install+RES PV Brochure



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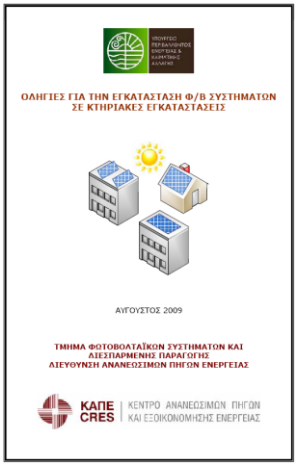
Technical installation guideline and Catalogue of PV Installers-Designers developed by CRES since 2009



http://www.cres.gr/kape/pdf/odigos_pv_systimaton.pdf

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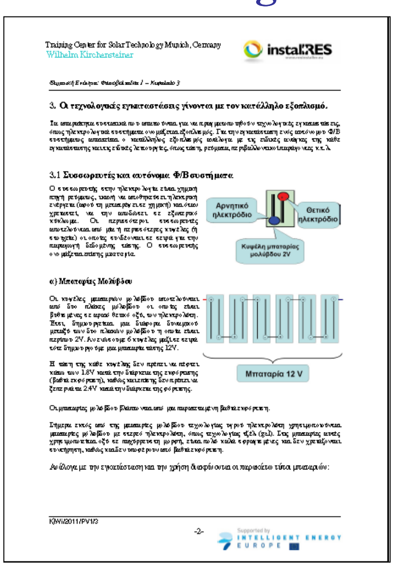
PV training material development by CRES

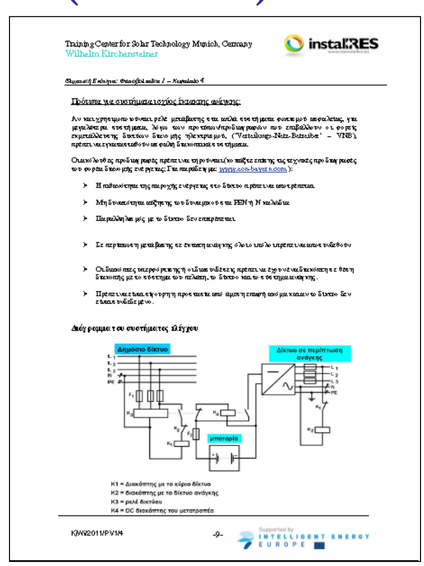
- Present the training material to a group of professional and technical experts in order to receive feedback about the appropriateness and the scope of the material for the target group

- Use the feedback to modify and imorove the PV training material in order to provide to the installer the capacity and the methodology to:

  - Select and combine in safety appropriate PV components for each project for efficient, reliable and longterm operation.

Greek translation and adaptation of the PV training materials (1st version)



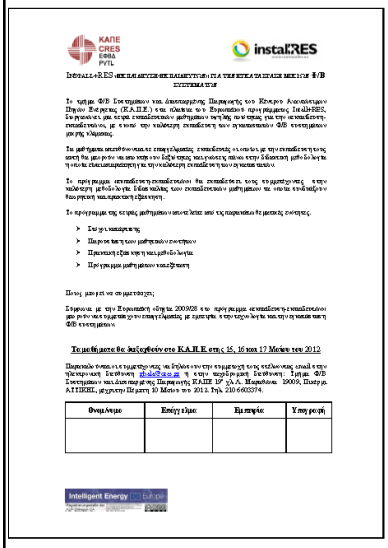


PV lab equipment procurement according to the translated PV training material

A Call for Tenders was issued for portable laboratory equipment for PV systems according to the PV training material provided by the Training Centre for Solar Technology in Munich.

Two companies participated in the Call for Tenders but the Tender was declared unsuccessful because both equipment suppliers failed to offer all the requested equipment.

Install+RES PV pilot course



Το μαθήμα θα διεξαχθεί στο Κ.Α.Π.Ε στις 15, 16 και 17 Μαΐου του 2012

Ονομ/νυμο	Επάγγ.τίτλος	Εμπειρία	Υπογραφή

Intelligent Energy Europe

The Install+RES "train the trainers" PV pilot course was held at CRES on 26 & 27 of March 2012.

Ten (10) participants were attending the pilot course.

The participants were invited from technical institutions and PV installation companies.

All participants were highly qualified. Some participants have had strong teaching background, some strong technical background and some strong PV installation background.

Install+RES PV pilot course

Giannadakis Thanasis	Professor at Technical University of Patra
Diamantis Odysseas	C.T.O. at HeliosRes Ltd
Kyritsis Tasos	PV researcher at CRES
Mathas Evaggelos	PV researcher at CRES
Mavromatakis Fotis	Professor at Technical University of Crete
Nikoletatos Jiannis	PV researcher CRES
Provolisianos Spiros	PV engineer at Extra Mile Ltd
Skouras Jiannis	PV engineer at AML/University of Patra
Tselepis Stathis	Head of PV Department at CRES
HalambalakisGeorgios	PV researcher at CRES
Hasapis Dimitris	Owner of D.C ENERGY LAB Ltd.

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PV pilot course feedback

- The Install+RES PV training materials were suitable for high-school education but not for professional installers.
  - More technical information was needed
  - Update the PV course material with the current commercial PV technology
  - Better presentation and justification of theoretical and technical concepts
- The theory must be in line with the lab equipment.
- It was necessary to make a complementary partial editing of the teaching materials as some errors of grammatical, logical and printing nature have been discovered.
- It was necessary to make a more complete adaptation to the international standards of the Greek legislation and conditions.

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Install+RES Training Course 1 (2nd version)

The 1st Install+RES PV training course was held at CRES on 15 & 16 of May 2012.

11 participants attended the course.

The participants were invited from technical institutions and PV installation companies.

Hatzopoulos Panagiotos	Manager of product development and customer support at Heliosphera S.A.
Kaponi Fotoni	Project Coordinator at Solar Cell Hellas
Kyritsis Tasos	PV researcher at CRES
Mpouroumas George	Electrical Engineer
Nikoletatos Jiannis	PV researcher at CRES
Rompotis Stilianos	ATKA Technical Production
Rikos Vagelis	PV researcher at CRES
Tselepis Stathis	Head of PV Department at CRES
Tsitses George	Manager ABB Ltd.
HalambalakisGeorgios	PV researcher at CRES




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Install+RES Training Course 1 Feedback

Workshop Feedback

- Editing of the teaching materials as some errors of grammatical, logical and printing nature have been discovered.

- ***After the improvements and the corrections from the pilot course, the theory still is not fulfilling the expectation of the workshop participants.***

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Preparation and implementation of completely new material for the 2nd training course

- ❖ Current PV technology and commercially available PV system components were used
- ❖ The theoretical material was in line with the new equipment
- ❖The material was addressing professional installers

Current PV lab equipment at CRES





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PV lab equipment at CRES

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The new PV training material

ΚΑΠΕ CRES ΕΦΒΔ PVTL | instalRES

Κεφάλαιο 1: Εισαγωγή στην Φωτοβολταϊκή Ενέργεια

Κεφάλαιο 1:

Εισαγωγή στην Φωτοβολταϊκή Ενέργεια

Περιεχόμενα 01

Intelligent Energy Europe -1-

ΚΑΠΕ CRES ΕΦΒΔ PVTL | instalRES

Κεφάλαιο 2: Φωτοβολταϊκή Τεχνολογία

Κεφάλαιο 2:

Φωτοβολταϊκή Τεχνολογία

Περιεχόμενα 01

Intelligent Energy Europe -1-

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The new PV training materials

Κεφάλαιο 3:

Το Φωτοβολταϊκό Πλαίσιο

Περιεχόμενα 01

-1-

Κεφάλαιο 4:

Φωτοβολταϊκά Συστήματα

Περιεχόμενα 01

-1-

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The new PV training material

Κεφάλαιο 5:

Εξοπλισμός Φωτοβολταϊκών Συστημάτων

Περιεχόμενα 01

-1-

Κεφάλαιο 6:

Εγκαταστaση Φ/Β συστηματων

Περιεχόμενα: 01

-1-

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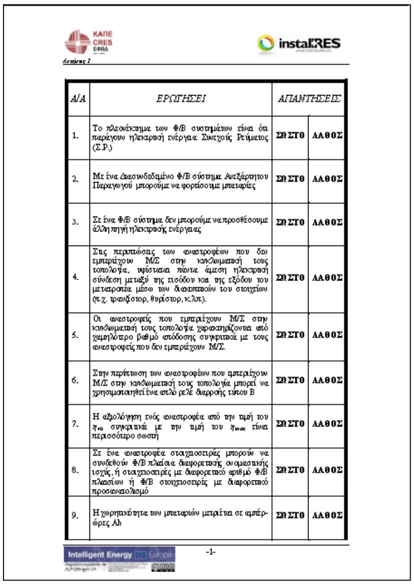
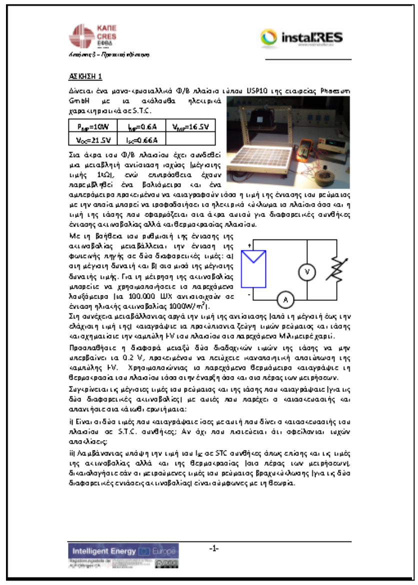
Questions and exercises for the examination



Α/Α	ΕΡΩΤΗΣΕΙ	ΑΠΑΝΤΗΣΕΙΣ	
1.	Το πλεονέκτημα των Φ/Β συστημάτων είναι ότι παράγουν ηλεκτρική ενέργεια Συνεχούς Ρεύματος (Σ.Ρ.)	ΣΩΣΤΟ	ΛΑΘΟΣ
2.	Με ένα Διασυνδεδεμένο Φ/Β σύστημα Ανεξάρτητου Παραγωγού μπορούμε να φορτίσουμε μπαταρίες	ΣΩΣΤΟ	ΛΑΘΟΣ
3.	Σε ένα Φ/Β σύστημα δεν μπορούμε να προσθέσουμε άλλη πηγή ηλεκτρικής ενέργειας	ΣΩΣΤΟ	ΛΑΘΟΣ
4.	Στις περιπτώσεις των αναστροφέων που δεν εμπεριέχουν Μ/Σ στην κυκλωματική τους τοπολογία, υφίσταται πάντα άμεση ηλεκτρική σύνδεση μεταξύ της εισόδου και της εξόδου του μετατροπέα μέσω των διακοπτικών του στοιχείων (π.χ. τρανζίστορ, θυρίστορ, κ.λπ).	ΣΩΣΤΟ	ΛΑΘΟΣ
5.	Οι αναστροφείς που εμπεριέχουν Μ/Σ στην κυκλωματική τους τοπολογία χαρακτηρίζονται από χαμηλότερο βαθμό απόδοσης συγκριτικά με τους αναστροφείς που δεν εμπεριέχουν Μ/Σ.	ΣΩΣΤΟ	ΛΑΘΟΣ
6.	Στην περίπτωση των αναστροφέων που εμπεριέχουν Μ/Σ στην κυκλωματική τους τοπολογία μπορεί να χρησιμοποιηθεί ένα απλό ρελέ διαρροής τύπου Β	ΣΩΣΤΟ	ΛΑΘΟΣ
7.	Η αξιολόγηση ενός αναστροφέα από την τιμή του η_{eu} συγκριτικά με την τιμή του η_{max} είναι περισσότερο σωστή	ΣΩΣΤΟ	ΛΑΘΟΣ
8.	Σε ένα αναστροφέα στοιχειοσειράς μπορούν να συνδεθούν Φ/Β πλαίσια διαφορετικής ονομαστικής ισχύς, ή στοιχειοσειρές με διαφορετικό αριθμό Φ/Β πλαισίων ή Φ/Β στοιχειοσειρές με διαφορετικό προσανατολισμό	ΣΩΣΤΟ	ΛΑΘΟΣ
9.	Η χωρητικότητα των μπαταριών μετριέται σε αμπέρ-ώρες Ah	ΣΩΣΤΟ	ΛΑΘΟΣ

-1-



ΑΣΚΗΣΗ 1

Δίνεται ένα μονο-κρυσταλλικό Φ/Β πλαίσιο τύπου USP10 της εταιρείας Phaesun GmbH με τα ακόλουθα ηλεκτρικά χαρακτηριστικά σε S.T.C.

P_{MP}=10W	I_{MP}=0.6A	V_{MP}=16.5V
V_{OC}=21.5V	I_{SC}=0.66A	

Στα άκρα του Φ/Β πλαισίου έχει συνδεθεί μια μεταβλητή αντίσταση ισχύος (μέγιστης τιμής 1kΩ), ενώ επιπρόσθετα έχουν παρεμβληθεί ένα βολτόμετρο και ένα αμπερόμετρο προκειμένου να καταγραφούν τόσο η τιμή της έντασης του ρεύματος με την οποία μπορεί να τροφοδοτήσει το ηλεκτρικό κύκλωμα το πλαίσιο όσο και η τιμή της τάσης που εφαρμόζεται στα άκρα αυτού για διαφορετικές συνθήκες έντασης ακτινοβολίας αλλά και θερμοκρασίας πλαισίου.

Με τη βοήθεια του ρυθμιστή της έντασης της ακτινοβολίας μεταβάλλεται την ένταση της φωτεινής πηγής σε δύο διαφορετικές τιμές: α) στη μέγιστη δυνατή και β) στο μισό της μέγιστης δυνατής τιμής. Για τη μέτρηση της ακτινοβολίας μπορείτε να χρησιμοποιήσετε τα παρεχόμενα λουξόμετρα (τα 100.000 LUX αντιστοιχούν σε ένταση ηλιακής ακτινοβολίας 1000W/m²).

Στη συνέχεια μεταβάλλοντας αργά την τιμή της αντίστασης (από τη μέγιστη έως την ελάχιστη τιμή της) καταγράψτε τα τουλάχιστον δέκα ζεύγη τιμών ρεύματος και τάσης και σχηματίστε την καμπύλη I-V του πλαισίου στο παρεχόμενο Μιλιμετρέ χαρτί.

Προσπαθήστε η διαφορά μεταξύ δύο διαδοχικών τιμών της τάσης να μην υπερβαίνει τα 0.2 V, προκειμένου να πετύχετε ικανοποιητική αποτύπωση της καμπύλης I-V. Χρησιμοποιώντας τα παρεχόμενα θερμόμετρα καταγράψτε τη θερμοκρασία του πλαισίου τόσο στην έναρξη όσο και στο πέρας των μετρήσεων.

Συγκρίνετε τις μέγιστες τιμές του ρεύματος και της τάσης που καταγράψατε (για τις δύο διαφορετικές ακτινοβολίες) με αυτές που παρέχει ο κατασκευαστής και απαντήστε στα κάτωθι ερωτήματα:

i) Είναι οι δύο τιμές που καταγράψατε ίσες με αυτή που δίνει ο κατασκευαστής του πλαισίου σε S.T.C. συνθήκες; Αν όχι που πιστεύετε ότι οφείλονται τυχόν αποκλίσεις;

ii) Λαμβάνοντας υπόψη την τιμή του I_{SC} σε STC συνθήκες όπως επίσης και τις τιμές της ακτινοβολίας αλλά και της θερμοκρασίας (στο πέρας των μετρήσεων), δικαιολογήστε εάν οι μετρούμενες τιμές του ρεύματος βραχυκύκλωσης (για τις δύο διαφορετικές εντάσεις ακτινοβολίας) είναι σύμφωνες με τη θεωρία.

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Install+RES 2nd PV Training Course

Manos Chatzidakis	Kaco
Elissavet Vandorou (ZISIS & KAPROS)	SMA
STELLA MAVROPOULOU	ABB
GEORGE TSITSES	ABB
THEODOROS VOGDANOS	ABB
VENETSANOS	DIMOULAS
PROTOGEROPOULOS	PHOENIX
AGGELOS KOSTANTINIDIS	EUROPA PROFIL ALOUMINO
THEODOROS LIVIS	EUROPA PROFIL ALOUMINO
PAPALAZAROU	ALUMIL
MYRTO KOSTANDINIDOY	DEMOKRITOS
ANDREAS TSAMIS	Engineer
KOSTAS KALLIVROUSIS	Engineer
PANAGIOTIS SARRIS	SARRIS ENERGY
ALEXANDROS PARLABANTZAS	XASAPIS
ARIS KALOGEROPOULOS	Embiria Consulting
ARIS GOUSKOS	Technical University of Crete
KANAKIS IOANNIS	Technical University of Crete
Theocharis Tsoutsos	Technical University of Crete
GIORGOS XRONOPOULOS	Engineer

The 2st Install+RES PV training course was held at CRES on 04, 05 & 06 of July 2012. 21 participants were attending the course.

The participants were invited from technical institutions and PV installation companies, as well as students from technical universities.

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Install+RES 2nd PV Training Course

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Participants to the 3 training courses for certification

42 in total

- **11 from the pilot course**
- **10 from the 1st training course**
- **21 from the 2nd training course**

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Certification or equivalent qualification schemes for small scale RES installers in Greece

- Small scale Biomass boilers and stoves
- Solar Photovoltaic
- Solar Thermal
- Shallow geothermal systems
- Heat pumps

➢ At present no **"official"** certification or equivalent qualification scheme (based on structured training and examination of the knowledge and skills acquired) exists for installers of small-scale RES systems in Greece.

➢ There is an administrative procedure (without training and examination) for the installers (plumbers, electricians, etc.) to get their necessary working permit according to their qualifications and from time to time installers may get the chance to participate in seminars organized by equipment manufacturers' staff for updating them on the use of their new products.

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Certification of attendance

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Certificate of Attendance

This is to certified that

_____

has successfully completed the

Training course for installers of small-scale Photovoltaic systems in buildings

July 2011

_____

Dr. E. Tselepis
Director of PV Lab at CRES

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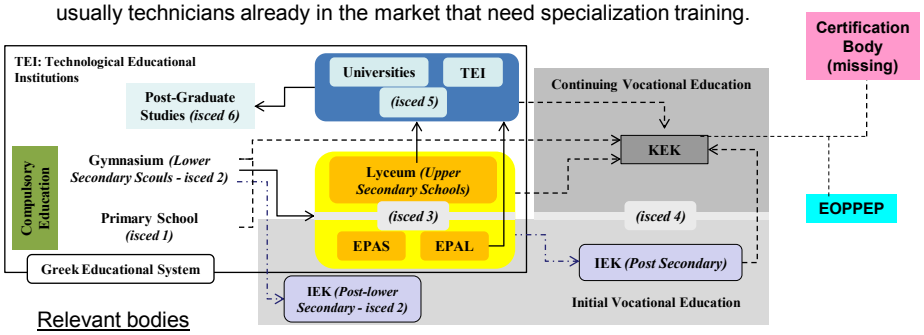
Description of the Certification Process

- The Certification process already in place in Greece for **all technical professions** (not specifically for RES system installers) is shown in the schematic diagram below. In our case, the focus is on the right top part of the diagram (grey shaded), as the installers are usually technicians already in the market that need specialization training.



Relevant bodies

- Vocational Training Centres (KEKs): Public and private sector agencies that organise continuing VET programs, focusing on combining theoretical and practical training.
- The National Organisation for the Certification of Qualifications and Vocational Guidance (EOPPEP), is responsible to define the "professional profiles" of KEKs and provide accreditation to KEK.

Current state on Certification

- As already mentioned, the certification procedure itself has not been defined in Greece (yet).
- What can be mentioned is that – as this is an obligation arising from the RES Directive – all possible considerations will be made in order for the certificates issued in Greece to be recognisable in the other EU Member States.
- Among the other things, the recognition process that will be used for the certification awarded by other MS (in accordance to Annex IV criteria) has to be examined and decided on European level.

Next Steps towards article 14.3 (of RES Directive) implementation

- Continuation and finalisation of the discussions started between the YPEKA (which is responsible for the transposition of the RES Directive into the Greek legislation) and EOPPEP, which is the body repsonsible for all issues related to certification of qualifications/skills in Greece (under the auspices of the Greek Ministry of Education & Religious Affairs, Civilization & Athletics).

- Set up the structure of the certification process („who is going to do what, and when...“)

- Clarification of the „governance“ (i.e. which will be the body responsible for carrying out the examinations and issue the certificates) and recognition of the certification process.

Certificarion progress

➢The intention of the Ministry of Environment, Energy and Climatic Change (YPEKA) is to create a program on certification and carry it forward to the Operational Programme "Environment and Sustainable Development 2007-2013” for funding. According to the ministry, the support and contribution of CRES in this action is necessary.

➢A Presidential Decree is in preparation from the ministry of Development with the collaboration of the Ministry of Environment, Energy and Climatic Change in order to determine the specialization and conditions for issuing an appropriate license for exercising implementation, maintenance, repair and operation of electrical installations and other related activities, including Photovoltaic systems on buildings.

Certificarion progress

➢Within the Presidential Decree (P.D.), as professional activities of specialization “A”, are defined, amongst others, those exercised in electrical installations following the national standard of the Hellenic Body for Standardisation, ELOT HD 384, which is harmonized with the relevant CENELEC and IEC standards.

➢In a draft version of the P.D., it is foreseen that the documents providing objective evidence of the requirements are the following:

- The education Degree
- The Certificate of Attendance of specific vocational training programs
- The Certificate of Attendance and successful completion after examination of a training program in small scale solar photovoltaic systems.

Conclusions

❖The PV training material was translated, adapted and implemented in Greek and according Greek, European and International standards and experience

❖New training material was developed and current PV technology and commercially available PV system components were introduced according to the feedback of the pilot and 1st training course participants

❖In total 42 participants were certified for attendance

❖Certification: Steps towards a national certification body have been made…Things are moving slowly…Still more to do

❖Our experience: The installers and the companies welcomed with great enthusiasm the install+RES PV training courses organized by CRES

Thank you for your attention

I would like to thank the scientific staff of CRES for their efforts and devotion in the preparation of the PV training material:

Dr. Georgios Halambalakis, Dr. Anastasios Kyritsis, Mr. John Nikoletatos, Mr. Vagelis Mathas, Dr. Vagelis Rikos

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