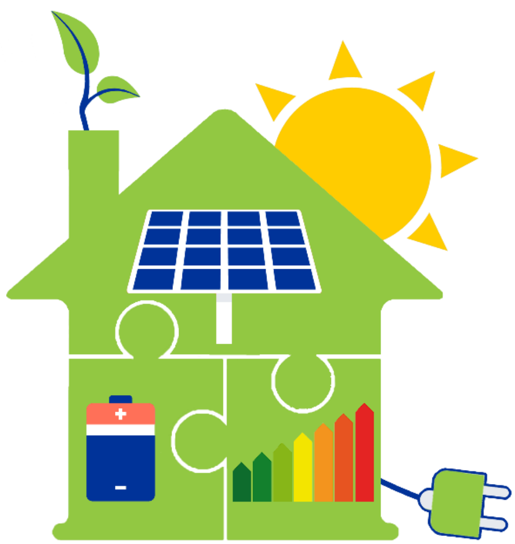
Interreg

EUROPEAN UNION

Balkan-Mediterranean

PV-ESTIA



Enhancing storage integration in buildings with Photovoltaics

PV-ESTIA

Specifications of pilots in each country and technical requirements

Deliverable 3.1

FOSS Research Centre for Sustainable Energy, University of Cyprus

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1. Project Summary

The Balkan Mediterranean (BM) region is facing the challenge of sustaining and increasing the growth of photovoltaic (PV) systems that is endangered by several barriers and their unpredictable nature. This is especially important in the built environment as member states are developing plans to increase the number of Nearly Zero Energy Buildings (NZEBs), which will most probably employ PVs, to reach their 2030 climate change targets. As the number of NZEBs increases, PV integration in the distribution grids of BM region will be very difficult, unless buildings become more grid-friendly and policies/regulations are suitably adapted. In the above context, the overall objective of the PV-ESTIA project is to enhance the penetration of PVs in the built environment. This will be achieved by using storage, which will transform the building into a more predictable power source. With the high solar potential of the BM region and the decreasing cost of PV and storage systems, such a solution is becoming cost-efficient. The project aims to change the way buildings with PVs are treated and conceptualise them as systems efficiently interacting with the grid. In addition, it aims to alleviate the above barriers and pave the way for unobstructed NZEB development.

2. Introduction

Through Work Package 3 (WP3), the technical requirements for PV and storage integration in the built environment were defined and the experimental pilot locations were selected, following a transparent procedure. The work included the definition of the exact technical characteristics of the pilot activities. The output outlines how each pilot will be implemented, taking into account local regulations and special technical requirements, to investigate potentials for a common context. Additionally, WP3 aims to identify the main barriers and opportunities that exist in the BM region. To achieve this objective, a comparative analysis of the current policies in the region related to PV integration in buildings and NZEBs was performed. Stakeholders' workshops and targeted meetings in each country provided valuable input. This phase run from the 1st of August 2017 until the 30th of April 2018.

In this report, the procedure of defining the technical requirements for PV and storage integration in the built environment and finalizing the experimental pilot locations of each participating country is presented. The different particularities of each region are identified in the process of analysing the pilot selection criteria and defining the features and characteristics of the experimental pilot activities. Taking into account the local regulations for each country, the developed selection procedure is analysed and the way each pilot will be implemented is justified.

3. Pilot assessment

PV-ESTIA targets to enhance the penetration of PVs in the built environment, which is endangered due to their volatile nature and by the limitations of the electrical distribution grids. Through the effective coupling between PV and Battery Storage System (BSS) technologies, PV-ESTIA aims to transform the buildings into controllable energy sources, thus making them grid-friendly and pave the way for the exploitation of NZEBs in the participating countries.

The experimental pilot sites of the project are categorized in two groups. The 1st group of pilots considers the implementation of hybrid PV+Storage installations in existing or new PV installations in all four participating countries (Cyprus, Greece, Bulgaria and FYROM). A public building was selected in Cyprus, Greece (both Thessaloniki and Kozani) and FYROM to host a PV+Storage system. Furthermore, PV+Storage systems will be installed in residential premises in Cyprus and Bulgaria in order to allow valid comparison between the two types of storage. The 2nd group of pilots concerns taking measurements from existing prosumer installations in Greece (both Thessaloniki and Kozani) and consumers in FYROM.

3.1 System configuration, battery technology and desirable features

There are three important decisions during the design of a PV+Storage system. The system configuration, the selected battery technology and finally, the features that the system is desired to support.

Two main configurations to integrate batteries with PV systems are available (Figure 1). The first is the AC-coupled system and is favourable since it can be easily fitted to existing PV systems. It consists of a PV inverter and a battery unit with an additional battery inverter responsible for charging/discharging the battery and it can be expanded to higher PV power or battery capacity by replacing the corresponding inverter. However, the need for two different inverters makes the installation difficult since many premises have limited available space. This system is named AC-coupled as both PV and battery inverters share a common AC bus. The second configuration is the Hybrid or DC-coupled system. The term hybrid is used since a single inverter integrates both PVs and the battery unit which are connected to a common DC bus. A DC-coupled system requires fewer components since the hybrid inverter is used instead of the PV and battery inverters, resulting in a lower unit cost. The round-trip efficiency is higher compared to the AC-coupled system but DC-coupled systems have limited expandability.

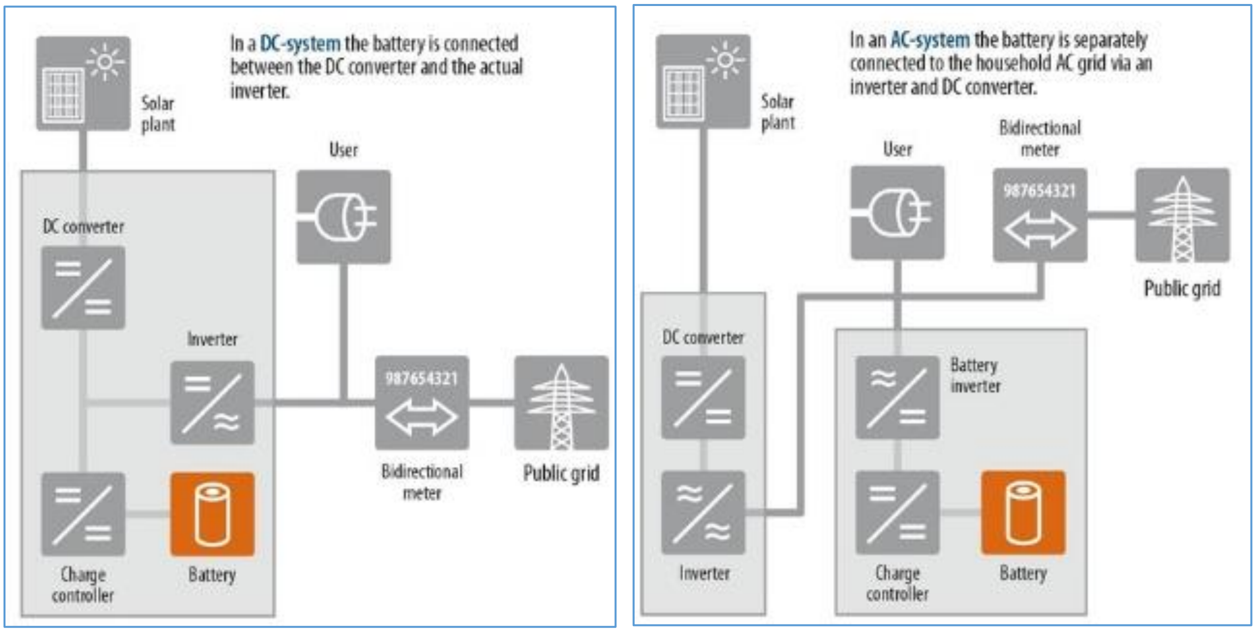

Figure 1: DC-coupled and AC-coupled configurations for PV+Storage systems

Regarding the battery technology of the PV+Storage system, Nickel Cadmium and Lead Acid batteries are considered as mature technologies and found many applications due to their low unit cost. However, their low energy density, low power output, high self-discharge rate and short lifetime make them incompatible for renewable applications. On the other hand, the Lithium-ion (Li-ion) technology has higher energy density, lower self-discharge rate, ability for regular deep cycles, long lifetime and requires low maintenance, properties that are suitable for lifelong PV applications. Yet, its comparatively high unit cost limits their widespread application at the moment.

Finally, the most important functionalities that must be fulfilled by the PV+Storage system are the self-consumption increase, peak load shaving, the support of one of the two configurations introduced above and finally, the compliance with the grid codes of each country. Some additional features include the backup operation, Time-of-Use (ToU) tariffs and Voltage and Frequency Control.

4. Specifications of pilots and technical requirements

In this section, the specifications of the selected pilots in each country are presented. The different specificities and criteria that have been taken into consideration for the selection process are presented for each country. Finally, the outputs from the procedure that indicate the pilot sites are introduced for each project partner.

4.1 Cyprus

4.1.1 Public system

The University of Cyprus (UCY) decided that the experimental pilot location for implementing the public PV+Storage installation in Nicosia is the New Nicosia Town Hall, which is currently under construction. It is located in the municipality of Nicosia with geographical coordinates 35°10'23.8"N, 33°21'57.2"E and an altitude of 254 m (Figure 2). The New Nicosia Town Hall is the first building in Cyprus in which all the required bioclimatic design principles have been implemented in order the building to be considered as a passive building. A passive building implies that it offers excellent comfort conditions and a healthy internal environment while consuming less than 30 kW of electricity for each m^2, instead of 150-400 kW in the case of conventional buildings.

More specifically, thermal insulation measures are used in the building envelope and the glazing to reduce the energy requirements of the building. Also, its construction allows storage of a high amount of heat in the building components and an optimal use of free cooling strategies (e.g. night-time natural ventilation).

Figure 2: Location of the New Nicosia Town Hall (under construction) and PV system siting (yellow)

A 12 kWp PV system has already been installed on the roof of the New Nicosia Town Hall with South orientation, covering 106 m^2 in total (Figure 3). However, it is not operational yet as the building is still under construction. The PV system is expected to generate about 60 kWh/day, covering a significant amount of the building's electricity consumption.

The PV system consists of:

- 46 PV modules x 260 Wp (rated power)
  Manufacturer LUXOR, model LX-260P, type polycrystalline silicon
  Dimensions 992x1640 mm, installation tilt angle 30°
- 1 inverter 12 kW (rated power)
  Manufacturer KOSTAL, model PIKO 12
  2 strings x 15 PV modules & 1 string x 16 PV modules

An AC-coupled 3-phase battery inverter and a storage system of about 20 kWh will be used and they will be installed in the PV inverter room, located on the roof (Figure 3).

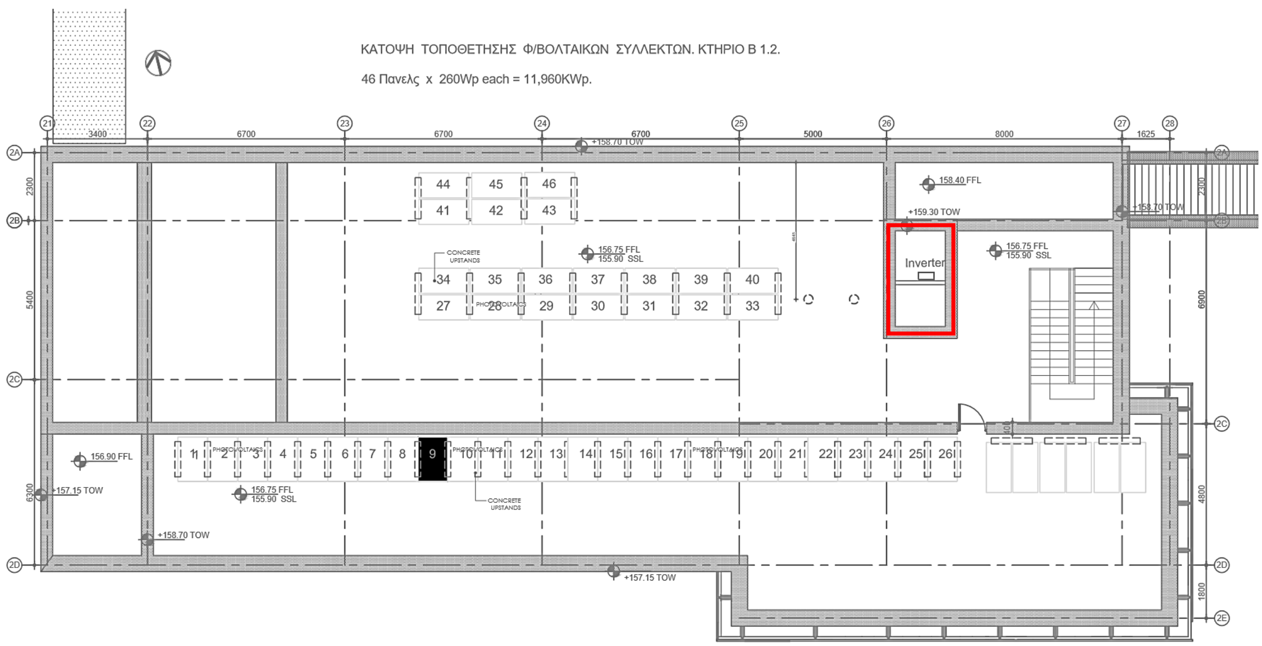

Figure 3: Top-view of the PV system design in the roof of the New Nicosia Town Hall and PV inverter room (red)

4.1.2 Residential systems

A methodology was followed to identify the residential pilot locations and it was of utmost importance to ensure the fairness and transparency of the selection process. Consequently, the main guiding principle that was taken into consideration during this phase included the homogeneous selection since all pilots had to be identified as an output of a common procedure. Additionally, the sites had to consist of new or existing residential prosumers under the Net-Metering scheme with a typical energy profile, ideally to have a balanced energy profile and the will to potentially optimise their self-consumption through the integration of a storage solution. Furthermore, these prosumers had to be aware about NZEBs and their premises had to preferably comply with the relevant technical and energy requirements for a building to qualify as NZEB. Finally, local specificities and technical requirements such as the maximum allowable system capacity, system connection, storage sizing and data collection availability were considered for the selection procedure and the finalisation of the technical solution. The Net-Metering scheme applied in Cyprus in 2013 and resulted to the rapid increase of the number of residential PV systems. Therefore, there is an urgent need to monitor and assess distributed generation without affecting grid stability. The deployment of storage in residential Net-Metering systems offers the capability to optimally control generation from distributed sources and to support grid operation, especially during peak demand periods.

The pilot site selection process fulfilled the requirements mentioned above, identified the different particularities in Cyprus and complied with the local regulations regarding permitted residential PV systems in Cyprus. According to the Electricity Authority of Cyprus (EAC), which is the Distribution System Operator (DSO) of Cyprus, eligible installations under the Net-Metering scheme are residential PV systems with maximum installed capacity of 4 kWp for single-phase (1-PH) systems and 5 kWp for three-phase (3-PH) systems. These systems are installed and tested according to DSO's Standards and Rules. Thus, the selection process was organized in close collaboration between UCY and EAC to coherently determine the pilots. The aim of the pilot demonstrations is to assist the development of the optimum PV and BSS Net-Metering model in order to achieve maximum self-consumption via the analysis of real data generated by the pilots. The storage sizing for the residential systems was estimated at 8.5-12 kWh and 8.5-15 kWh for 1-PH and 3-PH systems respectively.

The initial plan was to randomly select all five sites based on a record with already connected Net-Metering prosumers. However, considering the target of the PV-ESTIA project to assist the exploitation of NZEBs in the participating countries, additional parameters were considered to assess the selection of the prosumers. More specifically, the selected pilots have to preferably qualify as NZEBs from both design and constructional point of view, with reduced energy needs through the implementation of energy performance measures in the building envelope, such as the building orientation and thermal insulation and the use of energy efficient electrical appliances.

A custom procedure was developed that took the above requirements into consideration to maintain the transparency of the process and at the same time included additional parameters to fulfil all mandatory specifications for the residential solutions. An Expression of Interest process was developed to encourage prosumers to express their interest. A significant number of them with already installed PV systems of capacities between 3-5 kWp expressed their interest. The UCY in communication with the EAC contacted the selected prosumers and proceeds with the pilot audit process.

In order to eliminate any technical issues related to the system performance degradation, the existing PV installations were evaluated (in terms of daily energy yield, instantaneous current etc.). In addition, a visual inspection was carried out to ensure space sufficiency to accommodate the additional equipment of the proposed solution and to ensure proper ventilation and operating temperature of the BSS. The audit was performed in line with the selection criteria shown in Table 1, whilst a questionnaire that was prepared for the on-site inspection is included in the Appendix. The inspection requirements are mainly focused on space availability to facilitate typical equipment associated with the storage solution such as a Li-ion storage system, a hybrid inverter in the case of a DC-Coupled system or an additional battery inverter for the case of an AC-Coupled system. Also, the reduced energy demands of the premises through energy performance measures such as the building's thermal transmittance values (U-values) compared with conventional residential energy demands were also considered. Following the actual inspection of the sites, the evaluation process will conclude to the final five systems which will operate as pilot sites for the purposes of the PV-ESTIA project. Typical information collected during the actual inspection along with the map location of each pilot are presented in Table 2 and Figure 4 respectively.

A data collection system will be implemented by UCY to all selected installations. Recorded data will include PV production, electricity consumption of the premise, storage charging and discharging and other thermal energy and environmental parameters. Data recording will last for a period of 5 years. Internet connection should be available in order these data to be extracted to the University's server.

Table 1: Criteria for the pilot selection in Cyprus

Requirement	Fit criterion
NZEB relevance	a. Renewable energy production on-site (use of PVs) b. Building Energy Performance Certificate: Class A (minimum) c. Reduced energy consumption through thermal insulation solutions and features of the building envelope • Thermal transmittance of external walls < 0.4 W/(m^{2}K) • Thermal transmittance of roof < 0.4 W/(m^{2}K) • Thermal transmittance of windows < 2.25 W/(m^{2}K) • External shadings/Solar Water Heater • Efficient electrical appliances: Class A (minimum) d. Maximum primary energy consumption as calculated by the energy efficiency calculation methodology of a building: 100 kWh/m^2/year
Potential for self-consumption optimization of the participant	New or existing prosumer under Net-Metering scheme
System connection	1-PH or 3-PH
Inverter Location for DC-coupled system	a. Available space about 1.5 times the existing inverter to mount the new Hybrid Inverter (this is an approximation since the actual required space depends on inverter manufacturer) b. Enough space for batteries should be available (typical cabinet style battery dimensions HxWxD: 100x60x60 cm)

Inverter Location for AC-coupled system	a. Enough space to accommodate the Battery Inverter (assume the same size as the PV Inverter) b. The Battery Inverter location can be anywhere in the building, but ideally next to existing PV Inverter (need to consider wiring capacity if placed away from PV Inverter) c. Enough space for batteries should be available (typical cabinet style battery dimensions HxWxD: 100x60x60 cm)
Battery location/space	a. Location close to Battery/Hybrid Inverter b. Enough space (typical battery cabinet dimensions HxWxD: 100x60x60 cm)
Battery ventilation	Batteries will be sealed, mobile and electrically protected, even if no specific regulation exists. However, the following is a common practice to follow: a. No additional ventilation required if surrounding space is greater than 10 m^3 b. Ventilation is required if surrounding space is less than 10 m^3
Data Acquisition	a. Permission to access the electricity production and consumption data for a period of 5 years b. Internet access for provision of the production and consumption data to external servers
Non-technical requirements	a. Permission to access the system at any time for malfunction, adjustments, settings, etc. b. The systems will be used only for the purposes of the PV-ESTIA project

Table 2: General information of the pilot sites in Cyprus *(to be finalised)*

Map Position	Premise Type	PV System Capacity	Supply	Configuration
1	Typical household	3-5 kWp	1-PH or 3PH	AC or DC-coupled
2	Typical household	3-5 kWp	1-PH or 3PH	AC or DC-coupled
3	Typical household	3-5 kWp	1-PH or 3PH	AC or DC-coupled
4	Typical household	3-5 kWp	1-PH or 3PH	AC or DC-coupled
5	Typical household	3-5 kWp	1-PH or 3PH	AC or DC-coupled

Insert map

Figure 4: Selected residential pilot locations in Cyprus *(to be finalised)*

4.2 Greece

4.2.1 Public system in Thessaloniki

The Aristotle University of Thessaloniki (AUTH) selected as the experimental pilot location for implementing the public PV+Storage installation in Thessaloniki the AUTH Research Results Dissemination Centre (KEDEA), which is one of the newest buildings in the University Campus (Figure 5). It is located near Thessaloniki town centre, with geographical coordinates 40°37'35.57N, 22°57'44.07E and an altitude of 30 m. The building was designed in 2004, it was founded in 2006 and opened its doors for the first time in April 2011. The ground floor and underground floors form the AUTH RC Conference Centre and the three upper floors are used for the Research Committee offices. The Conference Centre has three modern auditoriums, exhibition space of 300 m^2 and public spaces ideal for hosting scientific conferences, symposiums and cultural events.

Figure 5: AUTH Research Results Dissemination Centre (KEDEA)

An important element of the architecture of the building is the characteristic red colour, which makes KEDEA a spatial reference point on the southern part of the University Campus. Although the building was designed and constructed according to the old Greek thermal insulation regulation, it has bioclimatic and energy efficient design with external shading systems, natural gas heating, controllable heating, ventilation and air-conditioning (HVAC) systems and a basic Building Management System (BMS). The addition of own production through PVs plus an electrical energy storage system, along with the extensive recording of the building partial electrical consumptions will bring the building energy performance a step closer to NZEB.

A PV system of at least 15 kWp will be installed on the roof of an adjacent building, consisting of 57 265 Wp polycrystalline silicon panels (3 arrays x 19 PV modules) and covering an area of about 150 m^2 (Figure 6), with South orientation and 30° inclination angle. The estimated electricity production is 21 MWh/year.

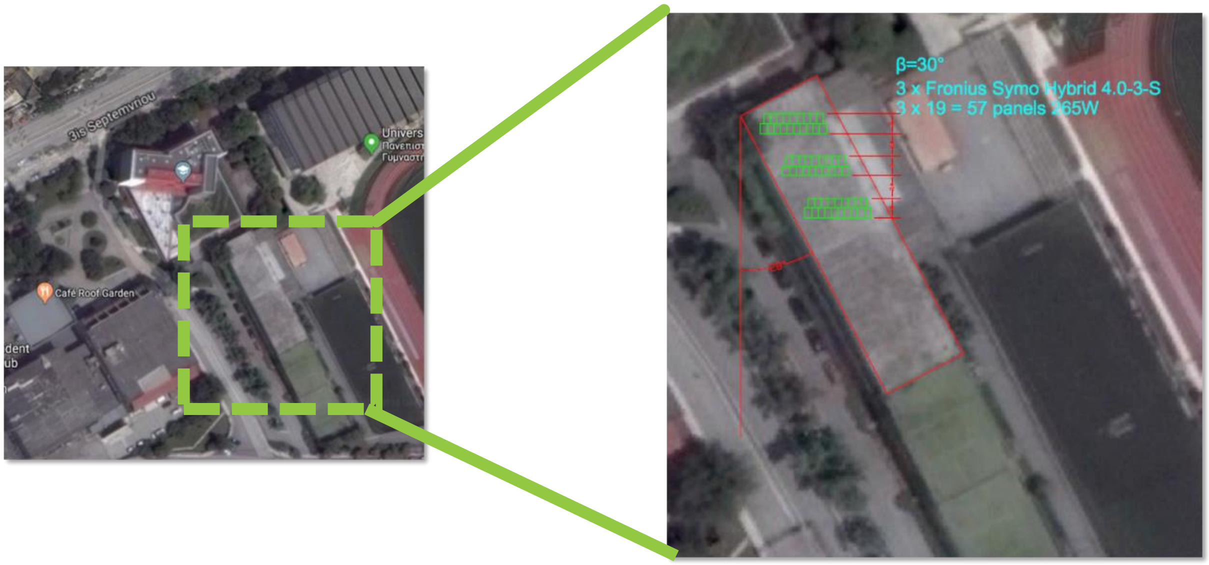

Figure 6: AUTH pilot PV installation site (3 arrays x 19 PV modules)

A DC-coupled system has been selected for increased system efficiency consisting of two or three Hybrid inverters (total 15 kW) together with an 18 kWh Li-ion battery system. Inverters and batteries will be installed in the central electricity room, next to the main electricity panel (Figure 7).

Figure 7: Inverters and storage asset installation room

Electric Energy Storage is introduced in Greek Codes recently, so the Greek market offers very limited selections for 3-PH Hybrid inverters. Currently only two companies offer 3-PH Hybrid inverters and do not provide functional integration of systems with multiple inverters. So the systems will be installed in parallel and each inverter will operate independently from the other. The number and the installed power of the inverters and the detailed configuration of the system will be designed according to the selected equipment following the relevant procurement procedure.

Project co-funded by the European Union and National Funds of the participating countries

For the connection of the system to the grid, AUTH will follow the procedure for a typical Net-Metering installation. After an application to the local DSO for technical approval, two contracts will be signed, one with the local DSO for technical and functional issues of the on-grid installation and one with the electricity supplier (Public Power Corporation S.A.) for the Net-Metering electricity calculations.

An extensive data collection system will be implemented by AUTH to both existing and new installations. Recorded data includes PV production, storage charging and discharging energy, electricity consumption of internal loads (auditoriums, offices, HVAC, pumps etc.) and also natural gas consumption and other thermal energy parameters. The analysis of the recorded and collected data will provide valuable information on the building energy behaviour, both thermal and electrical and will be used as input data for the design and tuning of the PV-ESTIA innovative management scheme.

All measurement equipment will have real time Ethernet communication capability, direct or through a gateway. They will be connected to a local switch router and through AUTH Intranet to Internet (Figure 8). A server in AUTH premises will be used for data collection management and a Virtual Private Network (VPN) will be used for private and safe communication with measurement equipment.

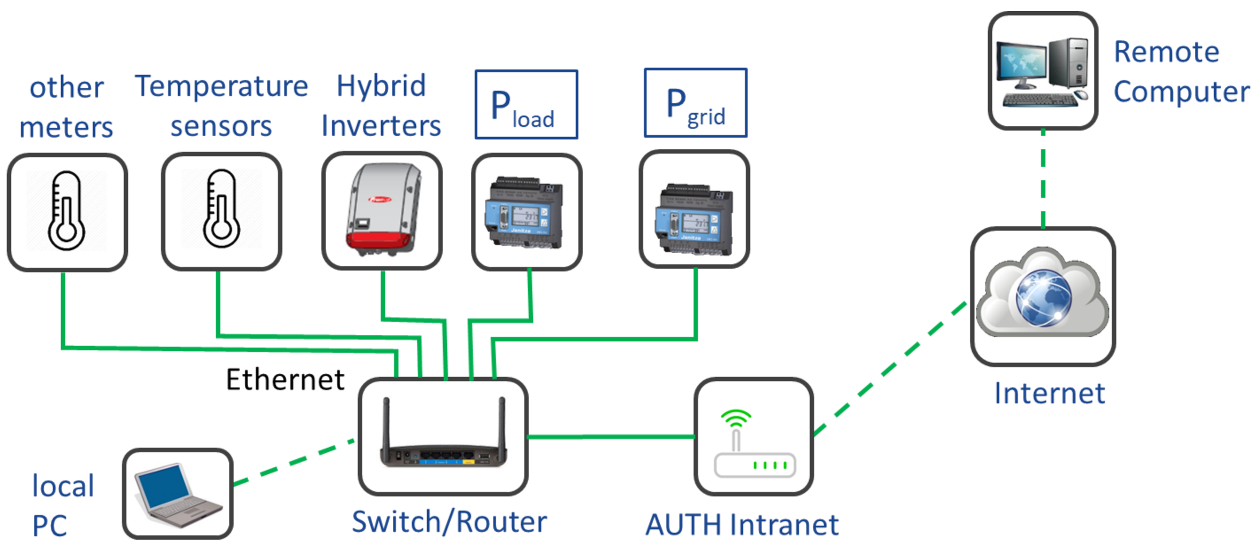

Figure 8: Data collection network

Electricity meters will store all measurements at short time intervals (1-min or less) in build-in memory. Once a day, the AUTH server will connect to the meters and collect all data to a local database. Data from inverters or meters without a build-in memory will be acquired by AUTH server at real-time and stored in the local database. After a post-proceeding to a predefined format, 15-min mean values will be uploaded to the central GR PV-ESTIA database.

Part of the collected data will be also illustrated to the public. A large display will be placed at the building entrance and it will inform the public about the building's current energy production and consumption, as well as other project details (Figure 9).

Figure 9: Photorealistic presentation of the project display screen at the building entrance

4.2.2 Residential prosumers in Thessaloniki

In the framework of WP3, AUTH aims to install metering systems for the collection of electrical data at several residential PV prosumers, located in the region of Thessaloniki. The target is to carefully select and monitor at least 20 residential prosumers with an already installed PV system. An open call for interest will be published by AUTH, both on press and online media. The call will remain stay open for a period of 20 days.

The applicants will be asked to provide information about building characteristics, PV system and electrical consumption data (Appendix). More specifically, the application form will require the following type of information:

- Building characteristics: location, floor area, type of use (e.g. dwelling, offices, combined use, etc.), building energy performance class (if available), year of construction, etc.
- PV system characteristics: nominal installed capacity, 1-PH or 3-PH, inverter type, PV panel characteristics, date of first operation, compensation policy (Net-Metering, Feed-in-Tariff), etc.
- Electrical consumption characteristics: contracted power (kVA), 1-PH or 3-PH, electrical loads used in the building, consumed energy during last years (three billing periods), etc.

After the collection of application forms, AUTH will choose the most suitable applicants in order to achieve a wide variety of prosumer types, concerning yearly consumption, PV compensation policy and building energy performance class. Finally, metering systems will be installed at the selected prosumers and data collection will begin. The collection of data will create a database of generation and consumption profiles for different types of residential PV prosumers in the metropolitan region of Thessaloniki.

4.2.3 Public system in Kozani

The experimental pilot location for implementing the public PV+Storage installation in Kozani was decided to be the dormitories building of the Western Macedonia University of Applied Sciences (TEIWM). The building is located about 2.5 km outside of the town of Kozani, with geographical coordinates 40°19'18.59N, 21°47'25.20E and an altitude of 720m (Figure 10). It was designed in 1980 according to a previous Greek thermal insulation regulation (valid from 1979 to 2010) and was constructed between 1984 and 1989. The building is located in a rural area and it consists of three identical wings. It is composed of 120 rooms and auxiliary rooms like kitchens and bathrooms.

Figure 10: Location of the TEIWM dormitories and PV system sitting (yellow)

A 20 kWp PV system will be installed on the roof of the middle wing, consisting of 84 260-270 Wp polycrystalline silicon panels (6 arrays x 14 PV modules) and covering an area of about 200 m^2 (Figure 11) with South-West orientation (38° from South) and 12° inclination angle following the roof's inclination, according to Greek building codes. The estimated electricity production is 24 MWh/year.

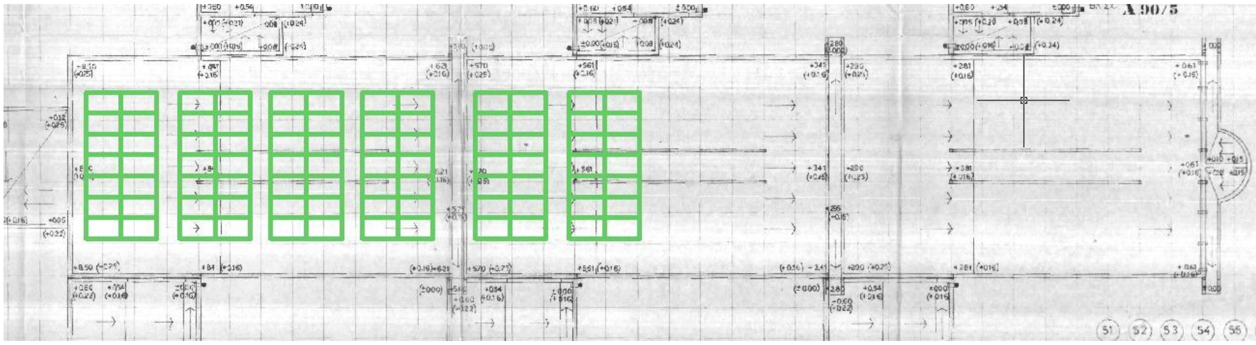

Figure 11: Top-view of the PV system in dormitories roof (6 arrays x 14 PV modules)

Three Hybrid 3-PH PV inverters-chargers and a storage system of 20 kWh will be used. Inverters and batteries will be installed in the storage room, just under the roof (Figure 12).

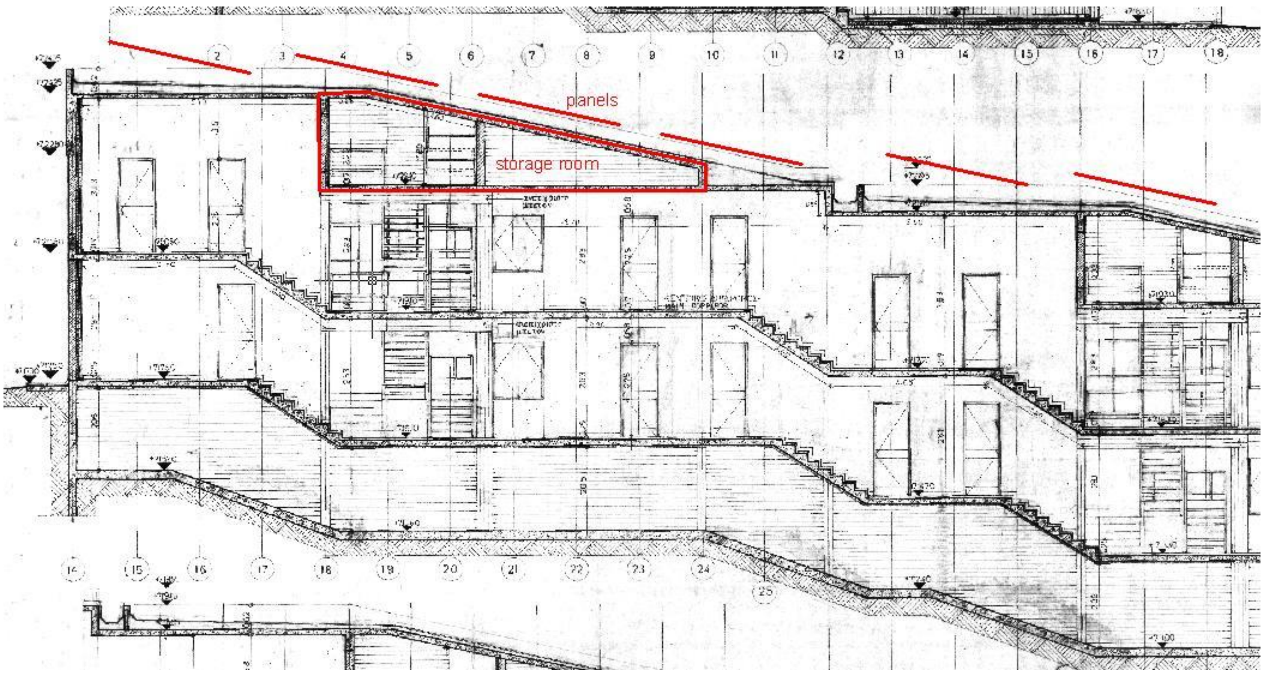

Figure 12: Section of the PV system in dormitories roof and storage room

The selection of the size, location and placement of the PV+Storage system was chosen in order to fulfil all regulations and authorities demands (building codes, Hellenic Electricity Distribution Network Operator regulation), required ventilation conditions, proximity to consumption and building's main switchboard.

An initial analysis of the electricity consumption of the dormitories building in 2017 revealed some interesting facts. As it can be seen in Figure 13, the consumption curve is almost an exact mirror of the PV production curve, with higher consumption during non-PV hours of the day both during summer and winter. Therefore, a storage system can be an appropriate solution to maximize self-consumption and limit the PV system's interaction with the grid.

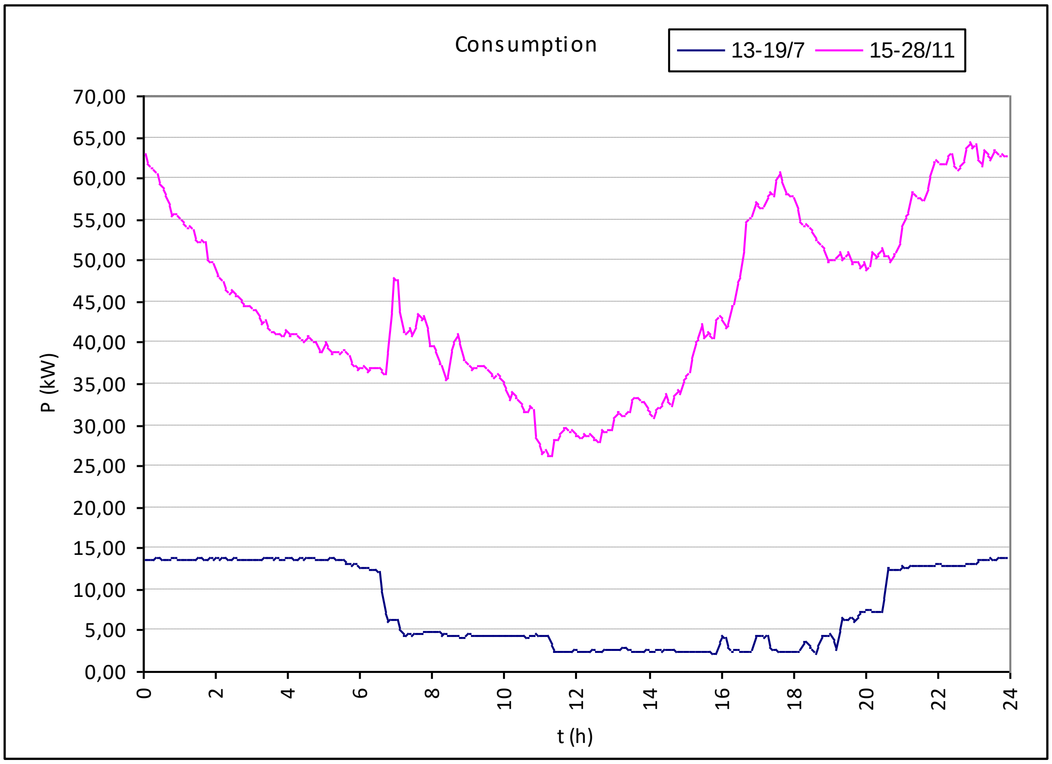

Figure 13: Consumption time-series of a typical summer and winter day (recorded data)

4.2.4 Residential prosumers in Kozani

The work programme includes the installation of metering systems for at least 10 prosumers with existing rooftop PV plants in the region of Western Macedonia. The rationale behind this is to collect a number of consumption and generation profiles of PV prosumers in the region. For that, an open call for interest was issued by the TEIWM on the 21/02/2018 through a press release. The announcement was sent to the regional electronic news media and blogs, reaching a wide coverage (at least 20 sites were recorded to publish the press release). The exact press release (in Greek) can be found in the Appendix.

The interested prosumers had to fill in an application form and reply back until 10/3/2018. At the end, 12 applications were received from PV prosumers mostly at the area of the city of Kozani and its suburbs. Figure 14 shows the rough location of each prosumer.

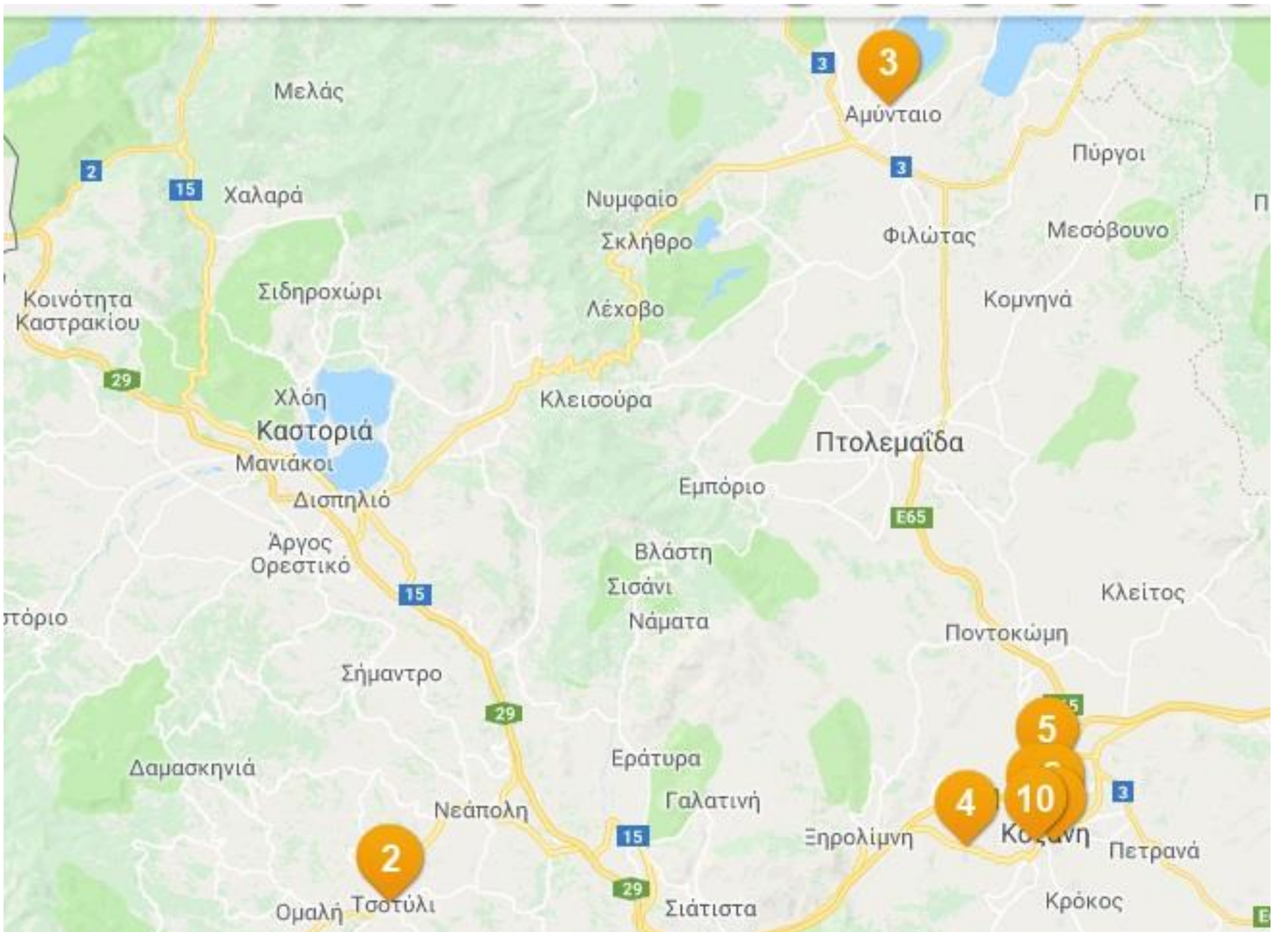

Figure 14: Locations of residential prosumers at the area of the city of Kozani

All prosumers have PV systems under the Feed-in-Tariff (FiT) scheme and became operational between 2010-2013. Only one installation is under the recent Net-Metering scheme, which was actually expected since very few such installations actually exist so far compared to the previous support scheme.

The smallest PV plant is 7.1 kWp while the largest is 13 kWp (the one under the Net-Metering scheme). The majority of the others are near 10 kWp, which was the maximum allowed capacity under the programme “PVs on roofs” that gave high FiTs to PV owners.

The intention is to actually satisfy all 12 applications, unless unforeseen circumstances arise. In the latter case, a “first-come, first-served” approach will be followed.

4.3 Bulgaria

4.3.1 Residential systems

The Energy Agency of Plovdiv (EAP) intends to establish five pilots in Bulgaria, consisting of a Hybrid inverter, a Li-ion Manganese Oxide battery ($LiFePO_4$) and AC/DC power generation metering units. A common selection procedure for all installations was followed in order to guarantee a fair and transparent process.

Currently, there is only one compensation policy for small-scale residential PV installations available in the country, namely the Feed-in Tariff (FiT) scheme. It is a policy mechanism designed to accelerate investment in renewable energy, where small-scale residential and non-residential PV installations are distinguished according to their capacity. Two different FiTs are available based on the system capacity. The first one regards PVs up to 5 kWp and the second one PVs from 5 kWp up to 30 kWp, with a compensation limit at the total yearly energy production of 1,261 kWh per kWp installed capacity for both system capacity ranges. The majority of the installed residential PV systems in Bulgaria are bound with long-term contracts (20 years) for directly selling and distributing renewable energy into the grid. Thus, those PV systems cannot be targeted as pilot locations, due to the actual impossibility for upgrading them with energy storage systems. Additionally, the current Law on Energy from Renewable Sources (18/07/2017) does not recognise energy storage and thus, energy storage systems. It only addresses the generation, purchase, transmission, distribution and taxation of the renewable energy, as well as the accession rules of an energy production system.

The different criteria set by the EAP allowed current and new prosumers to join the project. However, based on the above and considering that the majority of the residential PV systems in Bulgaria are established through the FiT mechanism, it was certain that the best cases will be the newly established systems, more specifically PV systems that will be established simultaneously with project progress. Win-win collaboration with the future prosumers had to be set, where the prosumer should be ready to implement the PV systems by themselves in the timeframe between May until July 2018.

It is also very important that all current national requirements are met by the future prosumers. EAP guided all prosumers on how to follow each step required by the national circumstances. For instance although, the planned PV systems will have the ability not to be charged with energy from the grid and also not to discharge energy to the grid, all pilots should follow a DSO application procedure examining the accession conditions of the requested PV system. Consequently, this document is followed by an installation permit request, which has to be issued by the local Municipality.

All steps that have to be followed by the future prosumers before the actual pilot implementation takes place are described as follows:

1. Pass Law on Condominium - obtain documented approval stating owners with total ideal parts of the building higher than 50% agree on establishment of a PV installation in the building (roof)
2. Complete an application to the DSO in order to examine the conditions for accession of the requested PV system - the application briefly describes the project concept and includes the number of documents
3. Obtain official construction assessment stating that the building will withstand the load to be implemented
4. Technical design project
5. Building permission application and official permission from the Regional municipality
6. Installation implementation

In order to comply with the requirements set, each pilot is requested to have a balanced ratio between electricity consumption and production and the will to optimise its self-consumption through the integration of a storage solution. Considering that all pilots will be newly established, EAP guided all prosumers on how to achieve their best performance and what should be the optimal PV capacity installed, considering that an energy storage system will be also implemented. Additionally, these prosumers had to be aware about NZEBs and their premises had to preferably comply with the relevant technical and energy requirements for a building to qualify as an NZEB or at least, to have an up-to-date heating system – heat pump for those heated on electricity (W2W, A2A, A2W, etc.) or biomass pellet boiler/stove with efficiency above >87%. In order to have a broader picture and to achieve better consumption and production analyses for the PV-ESTIA purposes, the best case scenario will be a mixture of prosumers using both heating methods. Ideally these are prosumers who will install a PV system with total capacity between 2.5-5 kWp, where both 1-PH systems and 3-PH systems are eligible.

Furthermore, ownership and data acquisition issues were considered very important and each pilot had to comply with them. The EAP through the PV-ESTIA project will remain the owner and will have the ability to operate the systems for at least 5 years. Each pilot is also obliged to provide access to the data from the electricity generation and electricity consumption for a period of 5 years. Internet connection should be available in order for consumption and production data to be extracted to external servers. Finally, local specificities and technical requirements such as the maximum allowable system capacity, system connection, storage sizing and data collection availability were considered for the selection procedure and the finalisation of the technical solutions.

Thus, a selection process of those who guarantee fulfilment of the requirements and regulations mentioned above was organized in order to coherently determine the pilots. The aim of the pilot demonstrations is to assist the development of the optimum model in order to achieve maximum self-consumption via the analysis of real data generated by the pilots. The optimum storage sizing for the residential systems was estimated between 7-10 kWh.

An Expression of Interest process was developed to encourage prosumers to express their interest. In order to eliminate any possible technical issues, a technical audit of each pilot was carried out to ensure space sufficiency to accommodate the required equipment and to ensure proper ventilation and operating temperature levels will be met. The audit was performed in line with the selection criteria described in Table 3. The inspection requirements were mainly focused on space availability for the Li-ion storage system and the Hybrid inverter and NZEB relevance of the building. The heating system installation type was also considered.

Table 3: Criteria for the pilot selection in Bulgaria

Requirement	Fit criterion
Potential for self-consumption optimization of the participant	New or existing system prosumers independent from the FiT Scheme
PV presence	a. PV system with installed capacity between 2.5-5 kWp b. Deadline for establishment of the new PV system: May - July 2018
Possible building types	a. Residential single/multifamily buildings b. Small office buildings
NZEB relevance	a. Requirement for full self-consumption of the produced PV energy b. Balanced ratio between the production of electricity and consumption c. Available heating system: • Heat pump (W2W, A2A, other) • Biomass with COP>87%
Smart metering possibilities	Possibility to install AC/DC metering
Documentation for news prosumers	a. Able to obtain permission from the local DSO b. Able to obtain construction assessment c. Able to obtain PV building permit
System connection	1-PH or 3-PH
Inverter/battery location/space	a. Practical opportunity to install battery and (new) inverter (provide the necessary space) b. Battery/Hybrid Inverter to be installed in closed premises (rooms) with relatively constant temperature c. Working temperature limitations to be met (0 ^{o}C - 25 ^{o}C) d. Proper distance between the Battery and the Hybrid Inverter (to be installed close to each other)
Battery ventilation	a. Proper conditions are met for normal operation of the battery b. Ventilation provision (when necessary)
Ownership	EAP remains the owner of the systems for 5 years
Data Acquisition	a. Obligation to access the data from the production of electricity and electricity consumption for a period of 5 years b. Internet presence for provision of the consumption and production data to external servers
Non-technical requirements	a. Obligation to access the system at any time for malfunction, adjustments, settings, etc. b. Obligation to protect the equipment for a minimum of 5 years from the date of granting c. Responsibility d. The systems will be used only for the purposes of the PV-ESTIA project

Following the actual inspection of the sites, the evaluation process concluded on the final five systems, which will operate as pilot sites for the purposes of the PV-ESTIA project. Typical information collected during the actual inspection along with the map location of each pilot are presented in Table 4 and Figures 15 and 16 respectively. Figures 17 and 18 illustrate the design of the Hybrid system to be implemented.

Each of the five new Hybrid PV systems to be installed will consist of:

- 10 or 12 PV modules x 270 Wp (rated power)
  Manufacturer BOVIET SOLAR, CSUN SOLAR or JA SOLAR
- 1 Hybrid inverter 5 kW
  5,000 W input; 4,600 W AC output; 97.6% max efficiency
  Including Wi-Fi monitoring and Battery Management Unit
- Lithium Iron Phosphate battery system consisted of 4 x 2.4 kWh per single module
  Nominal Voltage 48V, Nominal Capacity 50Ah
  Dimensions 440x410x90 mm, >6000 cycles at 80% DoD

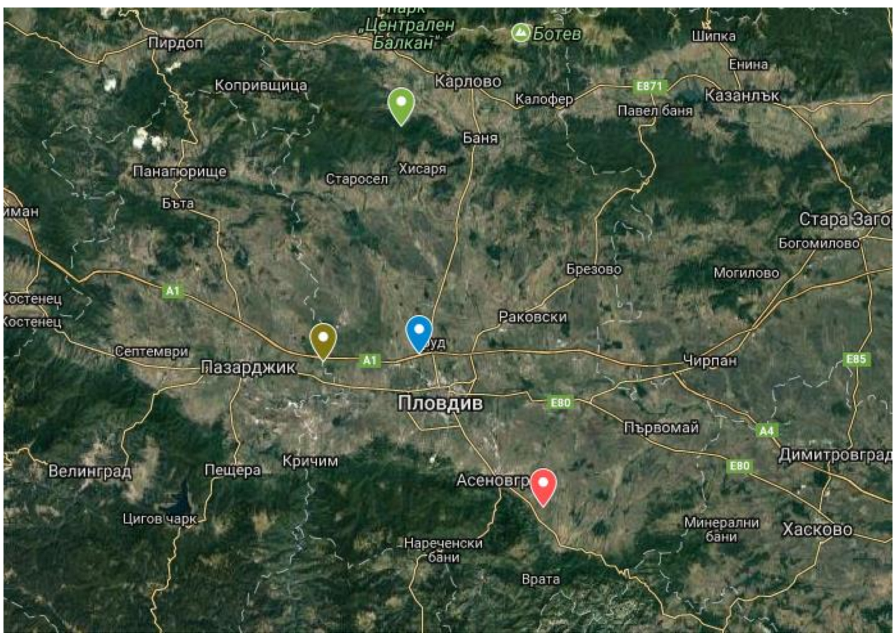

Figure 15: Selected pilot locations in Bulgaria

Figure 16: Roof photos from selected pilots in Bulgaria

Table 4: General information of the pilot sites in Bulgaria

Map Position	Premise Type	PV System Capacity	Supply	Configuration
1	Typical household	2.70	1-PH	DC-coupled
2	Typical household	2.70	1-PH	DC-coupled
3	Typical household	3	1-PH	DC-coupled
4	Typical household	3	1-PH	DC-coupled
5	Single house	3	3-PH	DC-coupled

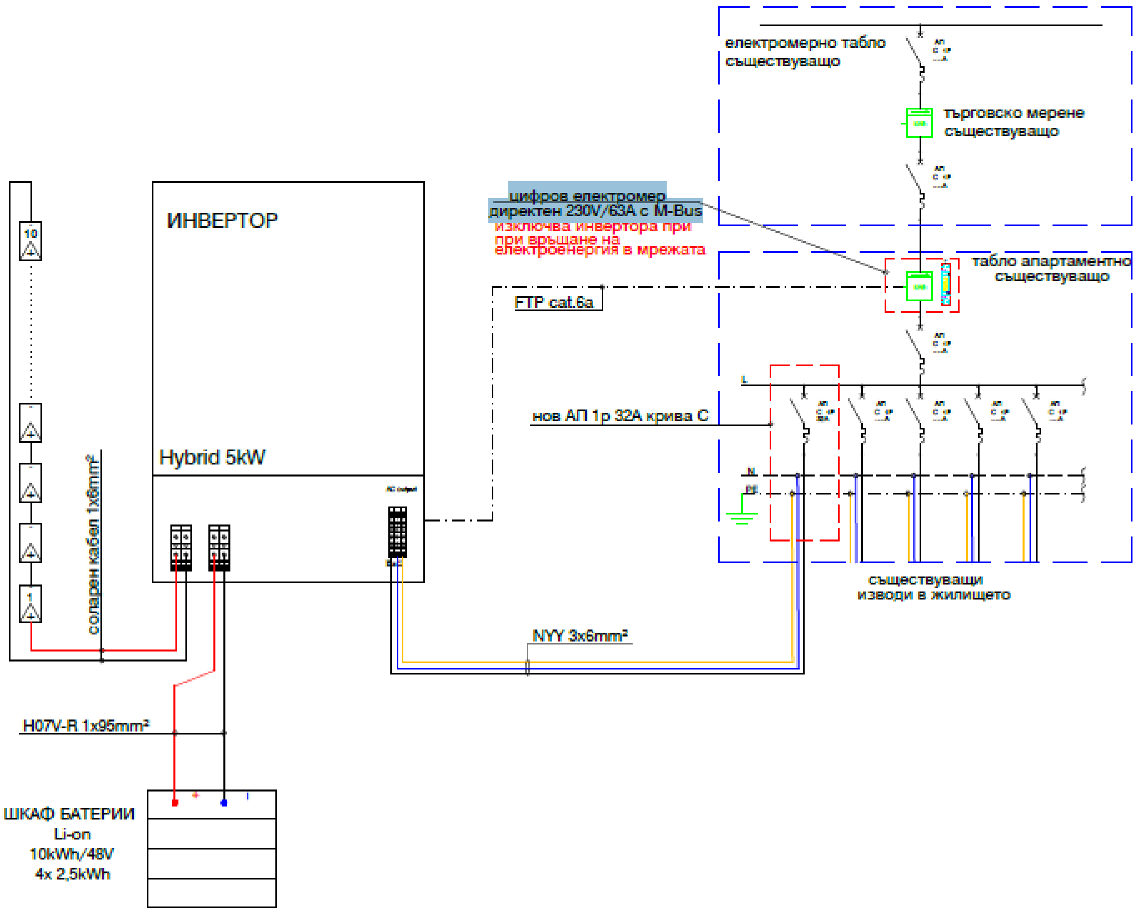

Figure 17: System design of the proposed DC-coupled PV+Storage system

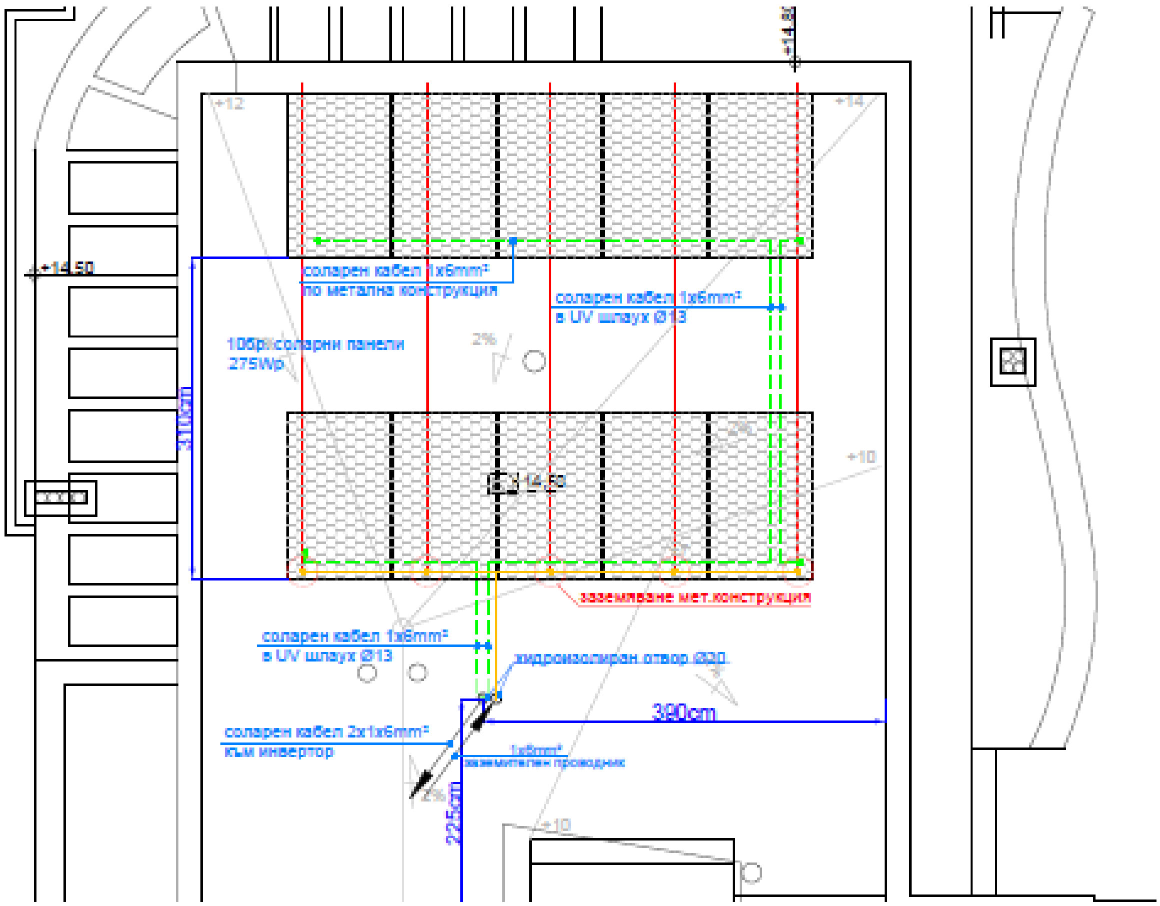

Figure 18: Rooftop PV system design at one of the selected pilots

4.4 FYROM

4.4.1 Public system

UKIM-FEIT decided that the Hybrid PV+Storage system will be installed at the Faculty of Electrical Engineering and Information Technologies of the University, in Skopje. The project is in line with the Faculty's efforts to deploy the most up-to-date technologies, as well as the efforts to supply its energy consumption in a sustainable manner.

The buildings of the Faculty of Electrical Engineering and Information Technologies are located in Skopje, in the Municipality Karposh 2 with geographical coordinates 21.408043°E, 42.004478°N and an altitude of 254 m. The PV system will be installed on the roof of the laboratory building (Figure 19).

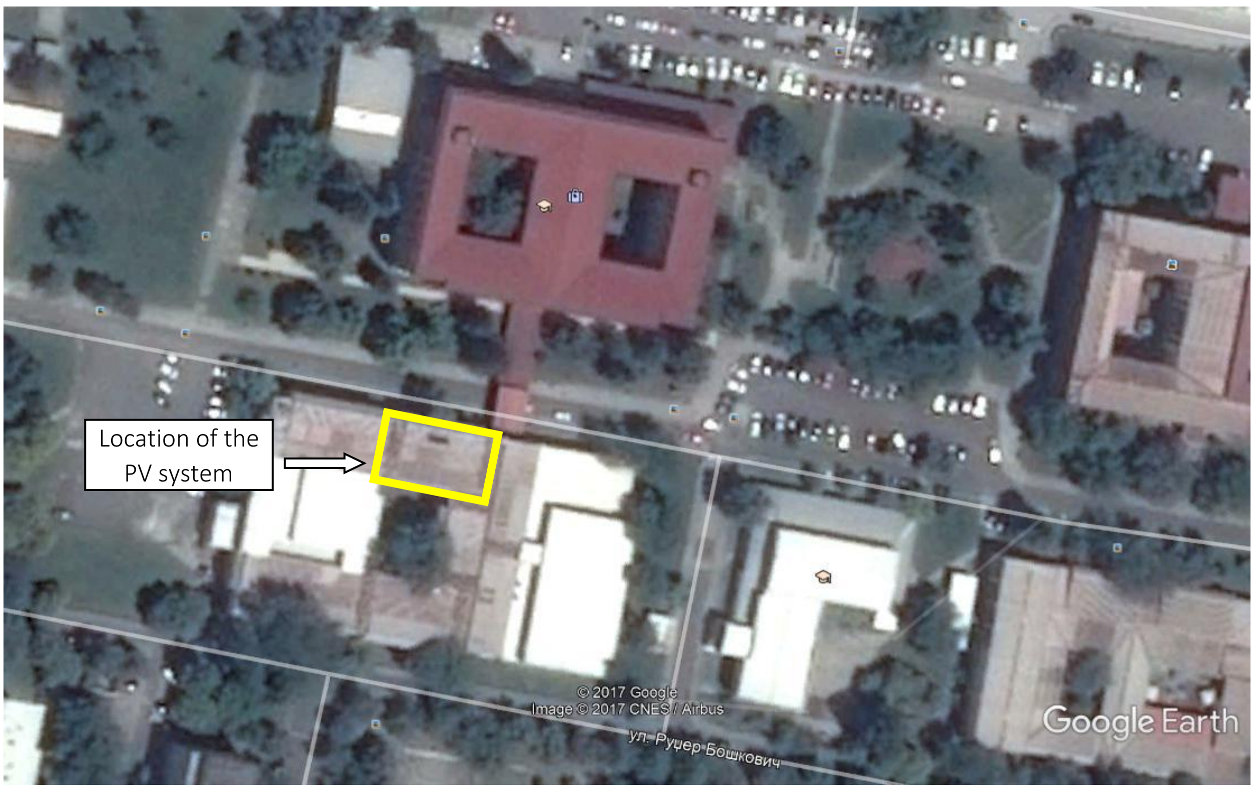

Figure 19: Location of the PV system on the roof of the laboratory building

The main components of the PV system are the 10.26 kWp PV generator with the corresponding inverter and a storage battery with an at least 7 kWh capacity. The inverter, storage battery and instrumentation with the equipment related to monitoring and control of the whole system will be purchased from the project budget of PV-ESTIA that is allocated to UKIM-FEIT. In addition, the 10.26 kWp PV generator will be purchased by the own budget of the Faculty of Electrical Engineering and Information Technologies, as an added value to the PV-ESTIA project.

More specifically, the PV+Storage system will consist of:

- 36 PV modules x 285 Wp (rated power)
  Manufacturer Canadian Solar, type CS6K-285P, monocrystalline silicon
  Module efficiency 17.41%
  Dimensions 1650x992 mm, installation tilt angle 30o
- 1 inverter (3 x 3.3 kW, 3-PH)
  Manufacturer SUNLOGICAL
- 1 Lithium Titanate battery system 9.108 kWh (rated capacity)
  TYPE LTO 66260-55AH,
  Nominal Voltage 55.2 V, Nominal Capacity 165 Ah, 30,000 cycles
  The storage system is consisted of three cylindrical batteries, each with a nominal capacity of 55 Ah and dimensions 66 mm x 260 mm

The PV modules will be situated on a corrugated metal sheet roof of the building and they will be placed on metal-aluminium bearing structures (Figure 20).

Figure 20: Roof where the PV panels will be placed and the bearing construction

The PV modules will be placed in landscape position at a tilt angle of 30° with respect to the horizontal surface. The orientation of the panels coincides with that of the building and has an azimuth of 10° towards West (South-West orientation) (Figure 21).

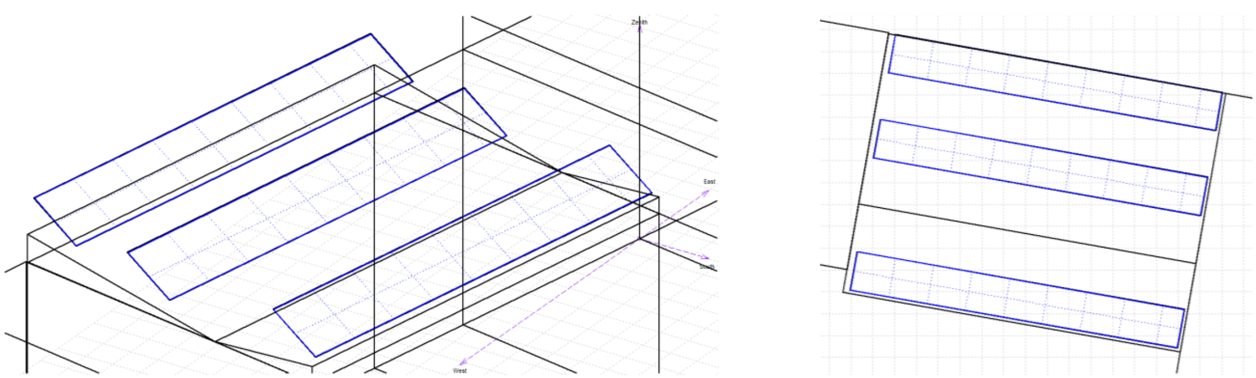

Figure 21: Structure and placement of PV panels

4.4.2 Residential consumers

The second pilot project of UKIM-FEIT in PV-ESTIA aims to collect the electricity consumption measurements in 20 households. The goal is to develop an understanding of the general consumption pattern of individual consumers by analysing their load curves. This data could be used later as input in the analysis related to the integration of PV+ESS systems in buildings.

For the needs of the second pilot project the technical specifications of the following four different energy monitors were analysed:

- SOMMY EW9T
- SOMMY EW9L
- Janitza UMG 96 RM-CBM
- Efergy Engage hub

The SOMMY EW9T intelligent power meter is a programmable power meter device (Figure 22). This device is able to continuously measure 3-PH voltage, current, active power, reactive power, apparent power, active energy, reactive energy, power factor and frequency. It also measures true RMS values of the electrical quantities and has the ability to perform harmonic analysis. The EW9T device has a possibility for bidirectional measurement of active and reactive power. The device is constructed so there are multiple input and output ports.

The second proposed instrument is SOMMY EW9L digital power meter (Figure 22). The device is similar to EW9T, but the overall specifications and the accuracy of the device are of lower level, thus justifying the lower price. This power meter can measure 3-PH voltages and currents, active, reactive and apparent power, as well as active and reactive energy. Active and reactive energy measurement can be performed in two directions.

The third analysed device is Janitza UMG 96 RM-CBM (Figure 22). It can be used to measure 3-PH voltages and currents, active, reactive and apparent power, active and reactive energy, power factor and frequency. Accuracy levels for voltage and current measurement are 0.2 %.

Figure 22: SOMMY EW9T intelligent power meter, SOMMY EW9L power meter and Janitza UMG 96 RM power meter respectively

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Many of the problems that might occur in the implementation of the mentioned devices can be encountered by the Efergy Engage hub monitor. The Engage hub online energy monitor is the cheapest device of all analysed devices. Its main advantage, apart from the low price, is the possibility of direct data transmission via WLAN and home router. The data measured can be observed in real time on any smartphone, tablet or computer. Another crucial advantage, as can be seen from the technical specifications, is the possibility of measuring high currents directly, without having to use a current transformer. The elements of this monitoring device are illustrated on Figure 23. This device uses three current sensor clamps mounted on the phase conductors. The measured data is wirelessly transmitted via energy transmitters connected to the hub station. The hub station is connected to a local internet router via an Ethernet cable (Figure 24).

Figure 23: Engage hub online energy monitor

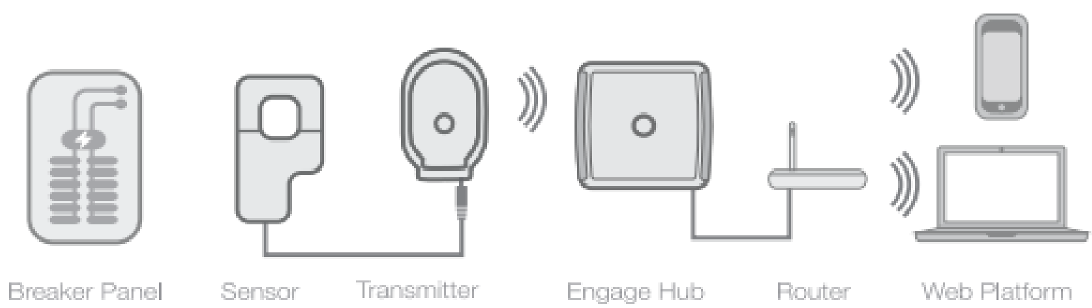

Figure 24: Operating scheme of the Efergy Engage hub

The technical parameters of this power monitoring device are:

- Voltage sensor range varies from 110 V to 300 V
- Current sensor range varies from 50 mA to 95 A per phase
- Transmission range up to 50 m
- Transmission time in intervals of 10 s (default), 15 s and 20 s

Using the application provided for the purpose of energy monitoring, the user is able to monitor the energy consumption in real time. Subsequently the costs, as well as diagrams of daily, monthly or previous energy consumptions in a different time periods can be accessed.

The comparison of the main characteristics of the analysed devices is given in Table 5.

Table 5: Comparison of technical specifications of the analysed devices

Measuring device / **Technical data**	**Sommy EW9T**	**Sommy EW9L**	**Janitza UMG 96 RM-CBM**	**Engage hub online energy monitor**
3-PH measurements	Yes	Yes	Yes	Yes
Voltage and current accuracy	0.2 %	0.5 %	0.2 %	Not available
Power accuracy	0.5 %	0.5 %	0. 5 %	Not available
Energy accuracy	0.5 %/1 %	0.5 %/1 %	0.5 %	Not available
Communication	RS 485	RS 485	RS485/USB	WLAN/Ethernet
Flash disc memory	No	No	Yes	No
Price	200-275 €	115-150 €	320-550 €	125 €

A publically announced call for participation will be issued through web, social networks, etc. to allow households to express their interest to participate in the pilot project. After the expression of interest, the UKIM-FEIT project team will provide the households:

- Invitation letters
- Application forms/contract and information packs
- Questionnaire for relevant energy data of the premises

In order to avoid technical difficulties regarding the implementation of the measuring equipment, a custom selection process has been created. It aims to evaluate each household’s ability to accommodate the measuring equipment and to provide uninterrupted measurement throughout the lifetime of project. The selection process is designed to facilitate a transparent and fair selection of the 20 households.

A set of information, provided in Table 6, will be collected for each involved household in order to assess whether or not a particular household is suitable for the pilot project (Appendix).

Table 6: Criteria for the pilot selection in FYROM

Requirement	Fit criterion
Building data	a. Apartment/house b. Floor area (m^2) c. Location of measuring unit (main switchboard/individual switchboard) d. Height of one floor (m) e. Distance from switchboard to router (m) f. Wi-Fi availability g. Spatial requirements for installing the measuring equipment
Total electricity demand of electrical equipment	a. System connection (1-PH/3-PH) b. Disaggregated evaluation of the rated power of all electrical equipment in the households c. Evaluation of the total power of the electrical equipment
Solar thermal data	a. Technical specification of the solar thermal collector b. Collector area (m^2) c. System capacity (litres)

A household will not be able to participate in the project if it cannot accommodate the measuring equipment. In order to meet this requirement, it must provide access to the switchboard, a suitable location for placement of the equipment and to have a Wi-Fi connection. Households with a reliable Wi-Fi connection and smaller distance from the switchboard to the internet router are deemed more suitable since this will increase the availability of the measured data. Evaluation of the rated power of the installed electrical equipment will be performed when gathering the household data. Finally, households with solar thermal collectors will enable an overview of the differences in load patterns among consumers with such systems and consumers without them. It should be noted that although this is a preferred criterion, it is not a priority for a household to participate in the pilot. The interested households should agree about:

- The monitoring system that will be installed free of charge during the project's lifetime and will be used at least 3 years after the conclusion of the project
- Sharing the privacy/confidentiality of the collected data based on a contract issued project team of UKIM for guaranteed confidentiality of data
- Accepting the project team's activities to inform/educate the users how to use the monitoring devices, support, inform and advice homeowners and to incorporate their feedback/expectations

5. Conclusions

In this report, the procedure of identifying the different particularities that had to be taken into account for the development of the pilot selection criteria in each country is outlined. The technical requirements for PV and storage integration in the built environment were defined. Furthermore, specifications of the pilot sites of all participating partners are presented and the desirable features of the experimental pilot activities are introduced.

Appendix

UCY (Cyprus)

Expression of interest and characteristics of pilot locations | PV-ESTIA Project

FOSS Research Centre for Sustainable Energy — Interreg Balkan-Mediterranean PV-ESTIA — University of Cyprus

ΕΚΔΗΛΩΣΗ ΕΝΔΙΑΦΕΡΟΝΤΟΣ ΚΑΙ ΕΠΙΘΕΩΡΗΣΗ ΧΩΡΟΥ ΚΑΤΑΝΑΛΩΤΩΝ

1. ΣΤΟΙΧΕΙΑ ΚΑΤΑΝΑΛΩΤΗ

Ονοματεπώνυμο: ....

Διεύθυνση: .... **Πόλη:** .... **Τ.Κ.:** ....

Τηλέφωνο: ....

Ηλ.διεύθυνση: ....

2. ΠΛΗΡΟΦΟΡΙΕΣ ΕΓΚΑΤΑΣΤΑΣΗΣ

2.1 Γενικές Πληροφορίες ΦΒ συστήματος

Εγκατεστημένη Ισχύς: 3 kW / 4 kW / 5 kW **Παροχή:** 1-PH / 3-PH

Κατασκευαστής ΦΒ πλαισίων: ....

Τεχνολογία ΦΒ πλαισίων: mono-cSi / poly-cSi Άλλο: ....

Εταιρεία και έτος εγκατάστασης συστήματος: ....

Χώρος εγκατάστασης ΦΒ συστήματος: Οροφή Άλλο: ....

Τρόπος Διάταξης και Στήριξης ΦΒ πλαισίων: ....

2.2 Πληροφορίες αντιστροφέα ΦΒ

Κατασκευαστής: .... **Ισχύς:** ....

Μοντέλο: .... **Συνδεσιμότητα:** ....

Παραγωγή (ενδεικτικές μετρήσεις από περασμένους μήνες):

1) .... 2) .... 3) ....

3. ΑΝΑΓΚΑΙΕΣ ΑΠΑΙΤΗΣΕΙΣ ΓΙΑ ΕΓΚΑΤΑΣΤΑΣΗ ΝΕΟΥ ΣΥΣΤΗΜΑΤΟΣ

3.1 Σύστημα DC-Coupled

Διαθέσιμος χώρος στο σημείο εγκατάστασης του αντιστροφέα ΦΒ (για αντικατάσταση του υφιστάμενου αντιστροφέα με Hybrid αντιστροφέα)

*Ενδεικτικές Διαστάσεις Hybrid αντιστροφέα 3KW (HxWxD): 650x450x210 mm

Διαθέσιμος χώρος: ....

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Expression of interest and characteristics of pilot locations | PV-ESTIA Project

FOSS Research Centre for Sustainable Energy | Interreg Balkan-Mediterranean PV-ESTIA | University of Cyprus

3.2 Σύστημα AC-Coupled παράλληλα του υφιστάμενου αντιστροφέα ΦΒ [1]

Διαθέσιμος χώρος περιμετρικά του υφιστάμενου συστήματος για εγκατάσταση επιπλέον αντιστροφέα (Battery inverter)

*Ενδεικτικές διαστάσεις Battery inverter 2.5KW (HxWxD): 400x500x150 mm

Διαθέσιμος χώρος: ....

Απόσταση από υφιστάμενη εγκατάσταση: ....

3.3 Σύστημα αποθήκευσης ενέργειας (ESS)[1]

Διαθέσιμος χώρος για εγκατάσταση συστήματος ESS. Ιδανικά η εγκατάσταση τέτοιου συστήματος πρέπει να γίνεται το δυνατό πλησιέστερα του αντίστοιχου αντιστροφέα (Hybrid or Battery inverter) για μείωση των ωμικών απωλειών

*Ενδεικτικές διαστάσεις 10 kWh Lithium-ion ESS (HxWxD): 1000x600x620 mm

Τοποθεσία εγκατάστασης ESS: Indoor / Garage Άλλο: ....

Διαθέσιμος χώρος: ....

Απόσταση ESS από αντιστροφέα για:

α) Σύστημα DC-Coupled: ....

β) Σύστημα AC-Coupled: ....

[1] Σε περίπτωση επιλογής AC-Coupled συστήματος, η εγκατάσταση του battery inverter και του ESS πρέπει να γίνεται στον ίδιο χώρο. Πιο συγκεκριμένα, η ιδανική περίπτωση εγκατάστασης είναι σε ένα κλειστό δωμάτιο με τον κατάλληλο εξαερισμό πλησίον του αντιστροφέα ΦΒ

4. ΛΟΙΠΕΣ ΠΛΗΡΟΦΟΡΙΕΣ

- Διαθέσιμος χώρος εγκατάστασης επιπλέον μετρητή. Ο μετρητής αυτός θα έχει επικοινωνία με το σύστημα διαχείρισης ενέργειας (EMS) έτσι ώστε επιτρέπεται η ανατροφοδότηση των πληροφοριών σχετικά με την εισερχόμενη και παραγόμενη ενέργεια
  *Ενδεικτικές διαστάσεις (HxWxD): 90x75x70 mm

  Σημειώσεις: .... ☐

- Διαθέσιμη σύνδεση στο διαδίκτυο. Στο σημείο εγκατάστασης πρέπει να υπάρχει εύκολη σύνδεση στο διαδίκτυο μέσω Ethernet ή/και Wi-fi για να γίνεται εύκολη επίβλεψη του συστήματος καθώς και η αλλαγή των ρυθμίσεων του συστήματος διαχείρισης ενέργειας (EMS) σε πραγματικό χρόνο (realtime)

  Σημειώσεις: .... ☐

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Expression of interest and characteristics of pilot locations | PV-ESTIA Project

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5. ΣΥΣΧΕΤΙΣΗ ΜΕ ΚΤΗΡΙΑ ΣΧΕΔΟΝ ΜΗΔΕΝΙΚΗΣ ΚΑΤΑΝΑΛΩΣΗΣ ΕΝΕΡΓΕΙΑΣ (NZEBs)

Πιστοποιητικό Ενεργειακής Απόδοσης κτηρίου: Κατηγορία Α Άλλο: ....

Μέτρα θερμομόνωσης/Μέσος Συντελεστής Θερμοπερατότητας

- **Κέλυφος κτηρίου (κολόνες, τοιχία):** .... W/m²K
  ....
- **Οριζόντια στοιχεία (οροφή, δάπεδα):** .... W/m²K
  ....
- **Κουφώματα (πόρτες, παράθυρα):** .... W/m²K
  ....

Συστήματα σκίασης: Ναι / Όχι

Θερμοσίφωνας για ΖΝΧ: Ναι / Όχι

Μέγιστη κατανάλωση πρωτογενούς ενέργειας για κτήρια που χρησιμοποιούνται ως κατοικίες όπως αυτή υπολογίζεται από την μεθοδολογία υπολογισμού ενεργειακής απόδοσης κτιρίου: .... kWh/m²/έτος

Επιπλέον Σημειώσεις

....

....

....

....

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AUTH (Thessaloniki, Greece)

ΑΡΙΣΤΟΤΕΛΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΟΝΙΚΗΣ
ΤΜΗΜΑ ΗΛΕΚΤΡΟΛΟΓΩΝ ΜΗΧΑΝΙΚΩΝ ΚΑΙ ΜΗΧΑΝΙΚΩΝ ΥΠΟΛΟΓΙΣΤΩΝ
ΕΡΓΑΣΤΗΡΙΟ ΣΥΣΤΗΜΑΤΩΝ ΗΛΕΚΤΡΙΚΗΣ ΕΝΕΡΓΕΙΑΣ
Καθ. Γρηγόρης Παπαγιάννης

Interreg Balkan-Mediterranean PV-ESTIA

«PV-ESTIA - Επαυξάνοντας την αποθήκευση ενέργειας σε κτίρια με φωτοβολταϊκά»

Εκδήλωση ενδιαφέροντος

1. Στοιχεία Επικοινωνίας

Ονοματεπώνυμο	
Διεύθυνση	
Πόλη – Ταχ. Κώδικας	
Email	
Τηλέφωνο σταθερό	
Τηλέφωνο κινητό	

2. Περιγραφή εγκατάστασης

Διεύθυνση ______________________________

Περιοχή ______________________________

Χρήση κτιρίου ______________________________

Εμβαδό κτιρίου ________ m^2

Έτος κατασκευής __________ (εάν είναι γνωστό)

Περίοδος κατασκευής

Πριν το 1980	1980-1989	1990-1999	2000-2009	Μετά το 2010

Τύπος κουφωμάτων *(σημειώστε όλες τις κατηγορίες που υπάρχουν)*

Μεταλλικά	Συνθετικά	Ξύλινα

Μονό τζάμι	Διπλό τζάμι

Τρόπος θέρμανσης

Κεντρική θέρμανση	Ατομική θέρμανση

Πηγή ενέργειας

Πετρέλαιο	Φυσικό αέριο	Ηλεκτρικό ρεύμα	Βιομάζα

Τύπος θέρμανσης

Καλοριφέρ νερού	Αντλίες θερμότητας	Θερμοπομποί/ Θερμοσυσσωρευτές	Τζάκι/ Σόμπα	Άλλο

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Interreg
Balkan-Mediterranean
PV-ESTIA

2. Περιγραφή εγκατάστασης (συνέχεια)

Ζεστό νερό χρήσης *(σημειώστε όλες τις κατηγορίες που υπάρχουν)*

Ηλεκτρικός θερμοσίφωνας	
Boiler στο κύκλωμα θέρμανσης	
Καυστήρας αερίου με εναλλάκτη ροής	
Ηλιακός Θερμοσίφωνας	
Άλλο –περιγραφή:	

Πρόσθετες πληροφορίες για την εγκατάσταση:

____

____

3. Εγκατάσταση παραγωγής από φωτοβολταϊκά (ΦΒ)

Θέση εγκατάστασης: ____

Καθεστώς Λειτουργίας

Σταθερής απόδοσης: ☐ Ενεργειακός συμψηφισμός (net-metering): ☐

Τεχνικά στοιχεία εγκατάστασης παραγωγής

Ονομαστική ισχύς (kWp)	
Αριθμός φάσεων	
Αντιστροφέας (κατασκευαστής, τύπος)	
ΦΒ Πάνελ (αριθμός, ισχύς, τύπος)	
Ημερομηνία έναρξης λειτουργίας	

4. Ηλεκτρική εγκατάσταση

Αριθμός φάσεων	Συμφωνημένη ισχύς (KVA)	Διατομή παροχής (mm^2)

Πρόσθετες πληροφορίες για το είδος και το μέγεθος των ηλεκτρικών φορτίων::

____

____

5. Ηλεκτρική κατανάλωση (εκτίμηση σε kWh, προαιρετικά, αν είναι διαθέσιμες)

Ετήσια	Μηνιαία χειμώνα	Μηνιαία καλοκαίρι

Η εκδήλωση ενδιαφέροντος πρέπει να υποβληθεί μέχρι **<u>15 Ιουνίου 2018</u>** ηλεκτρονικά στο grigoris@eng.auth.gr ή με fax στο 2310996356.

Project co-funded by the European Union and National Funds of the participating countries

TEIWM (Kozani, Greece)

Κεντρο Τεχνολογικης Ερευνας Δυτικης Μακεδονιας

ΚΕΝΤΡΟ ΤΕΧΝΟΛΟΓΙΚΗΣ ΕΡΕΥΝΑΣ ΔΥΤΙΚΗΣ ΜΑΚΕΔΟΝΙΑΣ
ΤΜΗΜΑ ΗΛΕΚΤΡΟΛΟΓΩΝ ΜΗΧΑΝΙΚΩΝ Τ.Ε. , ΤΕΙΔΜ
ΕΡΓΑΣΤΗΡΙΟ ΗΛΕΚΤΡΙΚΗΣ ΙΣΧΥΟΣ
«PV-ESTIA: Επαυξάνοντας την αποθήκευση ενέργειας σε κτίρια με φωτοβολταϊκά»

Εκδήλωση Ενδιαφέροντος

ELECTRIC POWER LABORATORY - TEIWM

1. Στοιχεία Επικοινωνίας	
Ονοματεπώνυμο	
Διεύθυνση	
Πόλη – Ταχ. Κώδικας	
Email	
Τηλέφωνο σταθερό	
Τηλέφωνο κινητό	

2. Περιγραφή Εγκατάστασης

Διεύθυνση ____________________

Περιοχή ____________________

Χρήση κτιρίου ____________________

Εμβαδό κτιρίου ______m2

3. Εγκατάσταση παραγωγής από φωτοβολταϊκά:

Θέση εγκατάστασης : ____________________

Κατηγορία εγκατάστασης : ☐ σταθερής απόδοσης ☐ ενεργειακός συμψηφισμός

Ονομαστική ισχύς (kWp)	Αρ. φάσεων	Αντιστροφέας (κατασκ. -τύπος)	Φωτοβολταϊκά πάνελ (Αριθμός – ισχύς – τύπος)	Ημερομ. Έναρξης λειτουργίας

4. Ηλεκτρική εγκατάσταση

Αρ. φάσεων	Συμφωνημένη ισχύς (kVA)	Διατομή Παροχής (mm^2)

Πληροφορίες για το είδος και το μέγεθος των ηλεκτρικών φορτίων :

____

____

5. Ηλεκτρικές καταναλώσεις (εκτίμηση σε kWh – προαιρετικά αν είναι διαθέσιμες)

Ετήσια	Μηνιαία χειμώνα	Μηνιαία καλοκαίρι

Η εκδήλωση ενδιαφέροντος πρέπει να υποβληθεί μέχρι **10 Μαρτίου 2018** ηλεκτρονικά στο gchristo@teiwm.gr

Interreg Balkan-Mediterranean PV-ESTIA

Project co-financed by the European Regional Development Fund

EAP (Bulgaria)

Expression of interest - PV-ESTIA Project

ЕНЕРГИЙНА АГЕНЦИЯ ПЛОВДИВ ENERGY AGENCY OF PLOVDIV

Interreg Balkan-Mediterranean PV-ESTIA

ЗАЯВЛЕНИЕ ЗА ИНТЕРЕС

ЗА УЧАСТИЕ В ПРОЕКТ PV ESTIA

1. ОБЩИ ДАННИ НА КАНДИДАТА:

- Име: ....
- Адрес: ....
- Населено място: ....
- Телефон: ....
- Електронна поща: ....

2. КАКВА Е ВАШАТА КАТЕГОРИЯ СГРАДА
   - А) Жилищна
   - Б) Офис
   - С) Друга, моля отбележете.................................

3. ПЛАНИРАТЕ ЛИ ДА ИЗГРАДИТЕ ФОТОВОЛТАИЧНА ИНСТАЛАЦИЯ ПРЕЗ СЛЕДВАЩИТЕ 6 МЕСЕЦА (до ЮЛИ, 2018г.)
   - Да
   - Не

Ако, да с какъв приблизителен капацитет.. kWp

4. КАКВА Е ВАШАТА ГОДИШНА КОНСУМАЦИЯ НА ЕНЕРГИЯ?
   - Консумация на енергия .... лв.год.
   - Консумация на енергия .... kWh /год.

5. КАКЪВ Е ИЗПОЛЗВАНИЯТ ОТ ВАС МЕТОД ЗА ОТОПЛЕНИЕ?

Expression of interest - PV-ESTIA Project

Моля, срещу съответният метод да отбележете вид на отоплителното съоръжение, година на производство и КПД.

- Отопление с електроенергия: ………………………… КПД………….. %
- Отопление с биомаса: ……………………………………. КПД………….. %
- Друг метод: ………………………………………………… КПД………….. %

6. КЪМ КОЙ ЕНЕРГИЕН КЛАС ПРИНАДЛЕЖИ ВАШАТА СГРАДА?

Моля, отбележете……..

- Какъв е коефициентът на преминаване през външните стени: ………………… W/m²K
- Какъв е коефициентът на преминаване през покривната конструкция: ……… W/m²K
- Какъв е коефициентът на преминаване през дограмите: ………………… W/m²K

7. РАЗПОЛАГАТЕ ЛИ С ПОДХОДЯЩО/ОТДЕЛНО ПРОСТРАНСТВО ЗА ИНСТАЛИРАНЕ НА СИСТЕМА ЗА СЪХРАНЕНИЕ НА ЕНЕРГИЯ И ИНВЕРТОР?
   - Да
   - Не
   - Ако да, с какви размери: ………….. m ………….. m ………… m²

8. РАЗПОЛАГАТЕ ЛИ С ПОДХОДЯЩО/ОТДЕЛНО ПРОСТРАНСТВО В КОЕТО СЕ ПОДДЪРЖА ТЕМПЕРАТУРА В ПОРЯДЪКА НА 0 – 25 °C?
   - Да (климатизира се)
   - Не (не се климатизира)
   - Ако да, каква е температурата през лятото? ………………… °C
   - Ако да, каква е температурата през зимата? ………………… °C

9. СЪГЛАСНИ ЛИ СТЕ СЪС СЛЕДНИТЕ УСЛОВИЯ
   - Енергийна Агенция - Пловдив остава собственик на системата (батерия + инвертор) в продължение на 5 години
   - Ще осигурите достъп до данни от производството на електроенергия и електроенергия за период от 5 години
   - Ще осигурите интернет достъп с цел пренос на данни до външен сървър относно потреблението и производството във вашето домакинство
   - Ще осигурите достъп до системата по всяко време за неизправност, настройки, настройки и др.

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- Ще осигурите защита на оборудването за минимум 5 години от датата на предоставяне
- Ще сте отговорни към предаденото оборудване
- Съгласни сте, ще предоставените системи ще се използват само за целите на проекта PV-ESTIA

10. ГАРАНТИРАТЕ ЛИ, ЧЕ ВАШАТА ПОКРИВНА КОНСТРУКЦИЯ ЩЕ ПОНЕСЕ НАТОВАРВАНЕТО ОТ ЗАЛОЖЕНАТА ФОТОВОЛТАИЧНА ИНСТАЛАЦИЯ ?
    - Да
    - Не

11. ГАРАНТИРАТЕ ЛИ, ЧЕ ЩЕ ПРЕМИНЕТЕ ПРЕЗ ПРОЦЕДУРА ПО ИСКАНЕ ЗА РАЗРЕШЕНИЕ ЗА ИЗГРАЖДАНЕ НА СИСТЕМА ОТ ФОТОВОЛТАИЦИ И СИСТЕМА ЗА СЪХРАНЕНИЕ НА ЕНЕРГИЯ ?
    - Да
    - Не

Дата:..

Кандидат:..

Подпис: ....

UKIM-FEIT (FYROM)

Interreg
Balkan-Mediterranean
PV-ESTIA

Изразување на интерес за учество во пилот проект во рамки на проектот PV-ESTIA

1. **ИНФОРМАЦИИ ЗА ДОМАЌИНСТВОТО**

Име и презиме:...

Адреса:.. **Град:**..

Телефон:..

E-mail:..

2. **ИНФОРМАЦИИ ЗА ОБЈЕКТОТ**

- **Изведбата на инсталацијата на мерната опрема зависи од типот на објект, неговата површина, пристапноста до разводната табла и безжична интернет врска.**

Тип на објект:

Стан.................................. ☐

Куќа.................................. ☐

Површина:........................ m^2

Локација на мерен уред:

Главна разводна табла............. ☐ Индивидуална разводна табла......... ☐

Висина на спрат:............................ m

Број на спратови од разводна табла до потрошувач:...................

Задоволува просторни критериуми за поставување на мерен уред: Да / Не

*индикативни димензии (HxWxD): 84x80x27 mm

Интернет врска

Пристап до безжична интернет врска: Да / Не

Растојание од мерен уред до рутер:.................. m

Interreg
Balkan-Mediterranean
PV-ESTIA

3. **ЕЛЕКТРИЧНИ УРЕДИ ВО ДОМАЌИНСТВОТО**

- **Проценка на вкупната моќност на сите електрични уреди во домаќинството.**

Потрошувач	Моќност (kW)
Електричен бојлер во купатило	
Електричен бојлер во кујна	
Шпорет	
Фрижидер	
Други уреди во кујна (тостер, блендер)	
Клима уред	
Електрична греалка	
Осветлување	
Машина за перење	
Телевизор и озвучување	
Компјутери	
Други потрошувачи	
ВКУПНО	

4. **СОПСТВЕНО ПРОИЗВОДСТВО НА ЕНЕРГИЈА**

- **Технички карактеристики на технологии производство на енергија. Овие податоци (Се пополнува ако е инсталирана соодветната опрема)**

Фотоволтаичен генератор:
Вид на модули: mono-Si / poly-Si / друго Врска: 1 PH / 3 PH
Моќност.............................. kW
Тип на инвертор:...
Капацитет на систем за складирање на енергија:... Ah

Соларен термален колектор
Површина на колектор:................m^2
Капацитет:.......................................литри

5. **ЗАБЕЛЕШКИ**

....
....
....
....
....

PARTNERS

ARISTOTLE UNIVERSITY OF THESSALONIKI - DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

TECHNOLOGICAL RESEARCH CENTRE OF WESTERN MACEDONIA

UNIVERSITY OF CYPRUS - FOSS RESEARCH CENTRE FOR SUSTAINABLE ENERGY

ELECTRICITY AUTHORITY OF CYPRUS (DSO)

ENERGY AGENCY OF PLOVDIV

FACULTY OF ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGIES OF SS. CYRIL AND METHODIUS, UNIVERSITY IN SKOPJE

OBSERVER PARTNER:
MINISTRY OF ENVIRONMENT AND ENERGY - DIRECTORATE FOR RENEWABLES AND ELECTRICITY

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