Generalized Operational FLEXibility for Integrating Renewables in the Distribution Grid (GOFLEX)

D7.3 Report on the System Prototype Implemented in the Field – Use Case 1

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Executive Summary

The goal of the GOFLEX project is to demonstrate how much of the flexibility in energy consumption can be harvested at prosumer levels. There are three different types of prosumers: households with some standard electrical appliances and PV (and battery) or a single controllable load, buildings within the university campus and charging stations for electric vehicles. The GOFLEX system is tested in three different demonstration sites across Europe, representing different contexts. The implementation of the system prototypes in the demonstration site of Cyprus area is presented in this report. At the time of this report, corresponding to the Milestone 4 of the project, the representative systems of the different types were all installed and this demonstrates the proper operation in the field of the whole system. Over the next months, an expansion in the number of connected systems will be prosecuted:

- Direct Control: 5 prosumers with Smart Plugs. The direct control system is normally installed in a house and the controlled flexible loads can be the electrical heater, air-conditioning, water motor, etc.
- Home Energy Management Systems (HEMS): 23 homes in total will be engaged in GOFLEX.
- Building Energy Management Systems (BEMS): 10 Buildings within the UCY campus will be engaged as individual prosumers.
- Charging and Discharging Energy Management Systems (CDEMS): 1 charging station with discharging capability will be tested.
- Charging Energy Management Systems (CEMS): 4 CEMS are currently connected, encompassing 4 charging stations.

The report will present technical aspects of the prototype, as well as wider aspects, such as installation routines and challenges, interaction with local inhabitant/operator, information provided to the client, etc.

Document History

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List of Acronyms and Abbreviations

Abbreviation	Definition
BEMS	Building Energy Management System
CA	Consortium Agreement
CDEMS	Charging/discharging Energy Management System
CEMS	Charging Energy Management System
DOMS	Distribution Observability and Management System
DR	Demand Response
DSM	Demand Side Management
DSO	Distribution System Operator
EMS	Energy Management System
FEMS	Factory Energy Management System
FMAN	Flexibility Manager
FMAR	Flexibility Market
FOA	FlexOffer Agent
G2V	Grid to Vehicle
GA	Grant Agreement
GUI	Graphical User Interface
HEMS	Home Energy Management System
SP	Service Platform
UCY	University of Cyprus

1 Introduction

1.1 Purpose

The report D7.3 is the third deliverable of WP7. The aim of this document is to describe the installation of a prototype GOFLEX system at the Cyprus demonstration site and report on the implemented actions of Task 7.3 of the GOFLEX project. This report sets the adaptation and implementation status of the two use cases in Cyprus as of end-October 2018 (M24 milestone of the GOFLEX project).

In order to support and supplement the status reported, information about the implementation plans and the next steps are provided for both the University microgrid and the prosumers use case.

1.2 GOFLEX System

The GOFLEX system manages energy production and consumption at the local level, from the bottom up. In this way, consumers can participate actively in the future energy system by offering to be flexible in their energy production and/or consumption. In GOFLEX, end users of energy place offers to sell or activate discrete amounts of energy flexibility on a market. In the project demonstrations, the distribution system operator (DSO) accesses this flexibility by submitting a buy-offer to the market. Technology is also provided to for the DSO to automate and optimize use of flexibility in the grid. Figure 1 illustrates these concepts.

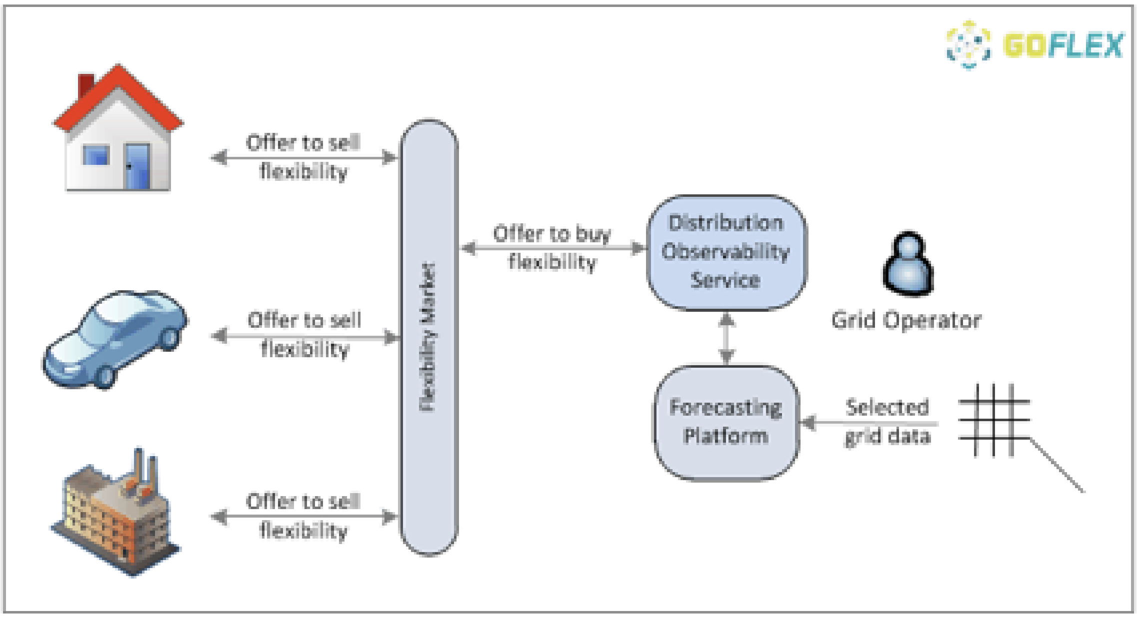

Figure 1 Illustration of GOFLEX Concept

Carrying out automatic trading of energy flexibility requires an integrated suite of technological components. Working from the bottom upwards, energy users such as factories, homes, and electric vehicles each require a suitable energy management system to physically control the energy loads that deliver flexibility. Thus a Factory Energy Management System (FEMS) controls factories and commercial buildings; a Home Energy Management System (HEMS) controls residential locations; a Charging Energy Management System (CEMS) controls electric vehicle charging stations; a Charging/Discharging Energy Management System (CDEMS) controls an electric vehicle capable of discharging to the grid. Other types of energy management system such as smart plugs or direct controls are also used. The energy management systems communicate available flexibility to a FlexOffer Agent (FOA). The role of the FOA is to transform information on available flexibility into a standard format and provide it to a centralized Flexibility Manager (FMAN). The FMAN places the offer on a Flexibility Market (FMAR) and receives notifications about whether the offer is accepted. When an offer is activated, the FMAN notifies the energy management system via the FOA. Collectively, the FMAR, FMAN, and FOA comprise an automatic trading platform (ATP). The DSO accesses energy flexibility by trading on the market. From the DSO side, a Distribution Observability and Management System (DOMS) receives grid data and forecasts from the Service Platform (SP). DOMS then optimizes where and when flexibility is needed to meet operational needs. The required flexibility is expressed as a buy-offer and sent to the trading platform. Figure 2 summarizes the technological components of GOFLEX systems.

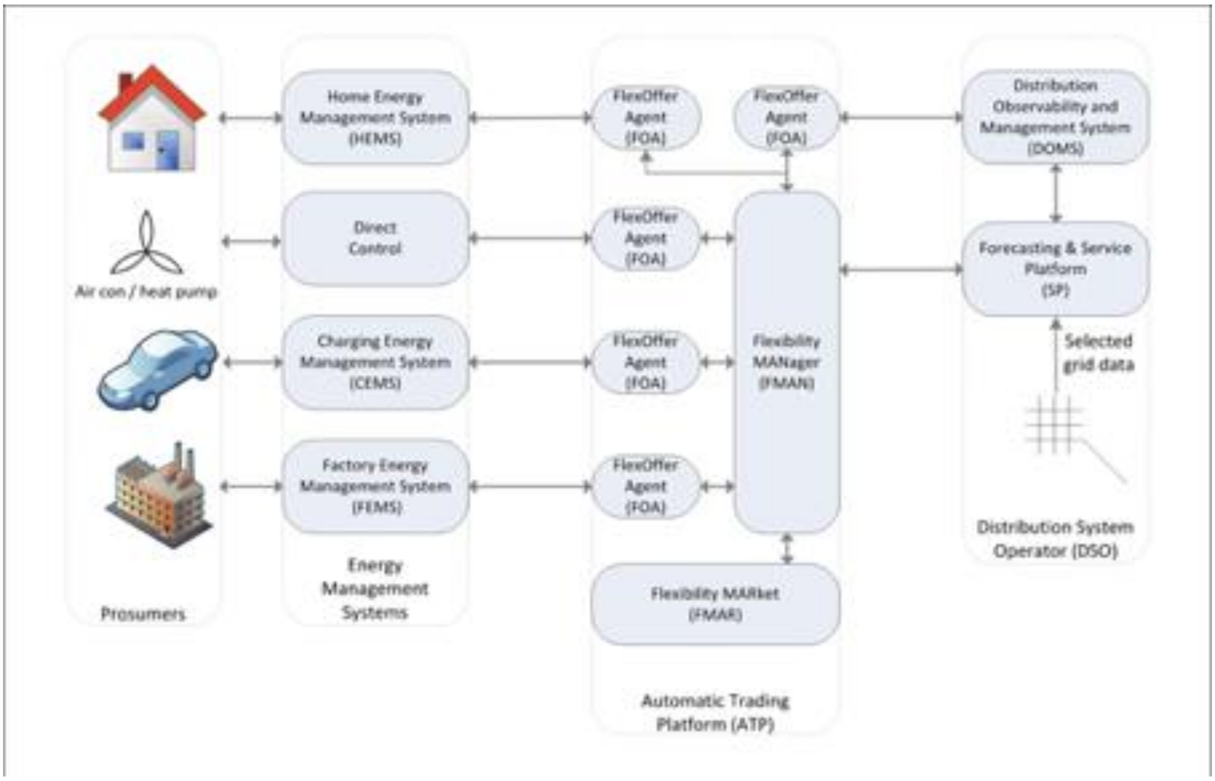

Figure 2 GOFLEX System Components

1.3 Related Documents

This document is related to the similar deliverables of the other demonstration sites of the project, namely D 8.3 and D 9.3. It is also directly related to Deliverables D7.1 and D7.2 of WP 7.

1.4 Document Structure

The structure of this document is as follows:

Section 2 summarizes the prosumer cases that are participating in the demonstration site of the Cyprus by trading mode and type of energy management system.

Section 3 focuses on the work steps that have been actually carried out to configure and/or install the different components of the prototype solutions.

Finally, Section 4 summarizes the deliverable by highlighting the implementation status of the two pilots and the next steps to be followed.

2 Prosumer Participation

The sections summarize prosumers participating in the demonstration by trading mode and type of energy management system. Include copies of information provided to prosumers.

The prosumers participating in the Cyprus pilot are classified in two categories, according to their use case:

University Microgrid (UCY) Use Case

i. 10 University Buildings can be distinguished as 10 individual prosumers inside the microgrid
ii. 1 CDEMS prosumer in the University Campus

Dispersed Prosumers Use Case

23 HEMS prosumers
4 CEMS prosumers
5 prosumers with Smart Plugs (Direct Load Control), provided by AAU

2.1 Direct trading prosumers

In direct trading mode, the FOA triggers an EMS (built-in or external xEMS). The EMS contains flexibility constraints imposed by the user comfort level, which if met the flex-offer is successfully traded and an adaptation schedule is decided and sent to the EMS. The direct trading mode is tested in both the University microgrid (BEMS and CDEMS) and the dispersed prosumers (HEMS and CEMS) use cases.

2.1.1 University Microgrid (BEMS)

The University of Cyprus (UCY) has set a target of becoming an energy optimal microgrid in the scope of improving the energy efficiency of the campus and its zero energy green objectives. In order to fulfil this objective, a centralised BEMS is currently being introduced in the built environment of the University as a mechanism to increase the energy efficiency of the campus, while maintaining the required comfort levels. This BEMS will also offer promising flexibility for Demand Side Management (DSM) and Demand Response (DR) within the scopes of GOFLEX project. Presently, each of the campus main buildings is equipped with a different Building Management System (BMS) that automatically monitors the electrical load demand and controls a range of building services, while smart meters have been installed in the campus for the efficient operation of the Microgrid infrastructure. Figure 3 shows the points of installation of the smart meters in regards with the electrical connection of the university campus. The smart meters can analytically measure several parameters, such as phase voltages, currents, frequency, active and reactive power etc., and are capable of communicating with the GOFLEX SP and DOMS.

The list of buildings that are going to be monitored by the BEMS system is presented in Table 1. For the initial demonstration phase of the implemented solution, 1 university building, using a Siemens Building Management System (BMS), will be controlled through the centralised BEMS. The fully operational version of the BEMS will enable the central monitoring and control of the individual BMS solutions of the campus, which come from 2 different vendors, namely Honeywell (5 existing BMS) and Siemens (1 existing BMS and 2 future BMS).

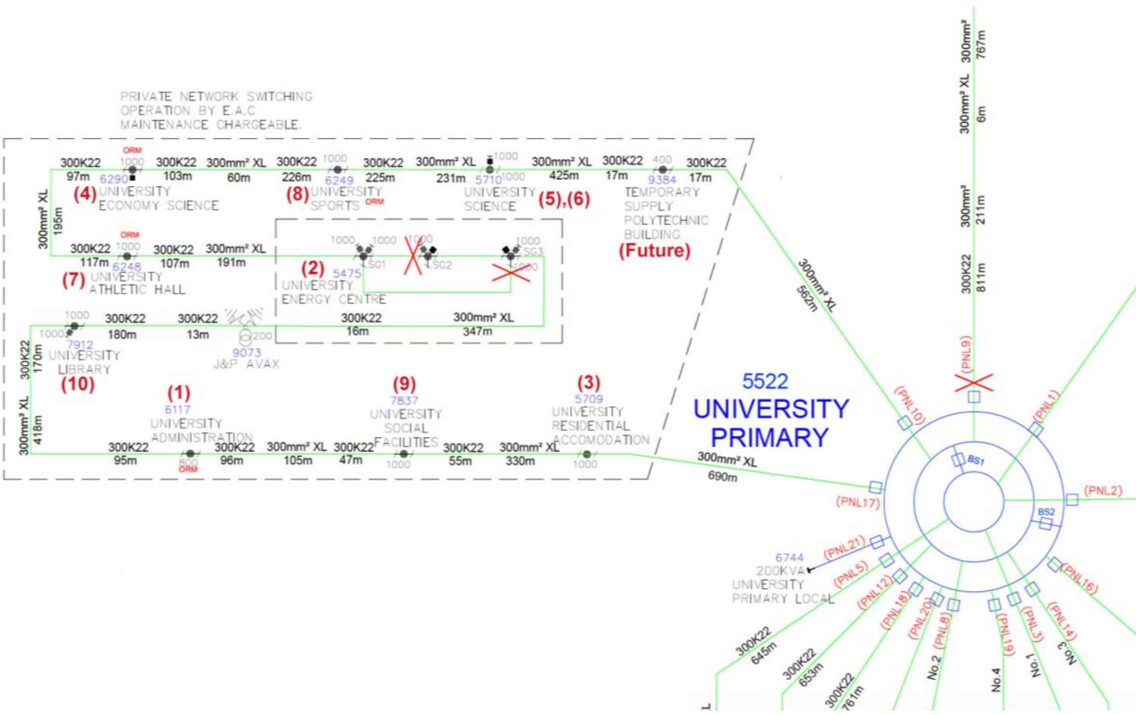

Figure 3 Installation points of the smart metering devices

Table 1 List of University buildings

Meter Nº	Building Name	Code
1	University Administration (ADM)	TRS-2
2	Energy Centre (ENC)	TRS-4
3	Student Hall	TRS-1
4	Faculty of Economics and Management (FEB)	TRS-14
5	Common Teaching Facilities (CTF) & Faculty of Pure and Applied Sciences (FST 01)	TRS-7_1
6	Faculty of Pure and Applied Sciences (FST 02)	TRS-7_2
7	Sports Facilities (SPF)	TRS-5
8	Sports Fields	TRS-6
9	Social Facilities (SFC)	TRS-11
10	Learning Resource Center (LRC)	TRS-3

2.1.2 Homes (HEMS)

The Home Energy Management System (HEMS), provided by Robotina, will be supplied to 23 prosumers. All selected prosumers own rooftop PV installations, while 3 of them also own a Battery Storage System. A HEMS with HW FOA approach will be implemented in the case of 20 prosumers, while 3 prosumers will utilize a HEMS with a SW FOA solution for their flexibility provision. The target is to manage the energy behaviour of the prosumers, control flexible loads and effectively activate DR potential by monitoring the households' local production, consumption and several environmental parameters. Through the HEMS, the prosumers will have the opportunity to control their loads by using the web-based application and provide the required flexibility to the DSO.

Visits to the prosumers' premises have already been completed, while the flexible loads that will be controlled by the integrated GOFLEX solution have already been identified and registered. Concrete implementation plans have been deployed for both representative and follower prosumer cases. These plans contain all information concerning the consumption and generation patterns of the participants, the selected flexible loads, as well as current topology and proposed installation plan. Potential DR flexibility in the case of Cyprus is mainly provided by white appliances (washing machines, dishwashers etc.) and air-conditioning units. The testing period of the GOFLEX solution will determine the DR potential and assess the long-term flexibility provision of these households. Table 2 presents the complete list of the selected representative and non-representative prosumers for the two variations of the HEMS GOFLEX solution.

Table 2 List of representative and non-representative dispersed prosumers in Cyprus

Representative Prosumers				
N^O		**Short Name or code name**	**Comments**	**Location**
1	7-PRE301	#301	HEMS+HW FOA	Nicosia
2	7-PRE035	#35	HEMS+SW FOA	Nicosia
Non-representative prosumers				
		Short Name or code name	**Reference representative prosumer**	
3	7-PRE191	#191	#301	Nicosia
4	7-PRE031	#31	#301	Nicosia
5	7-PRE239	#239	#301	Nicosia
6	7-PRE005	#5	#301	Larnaca
7	7-PRE243	#243	#301	Larnaca
8	7-PRE258	#258	#301	Nicosia
9	7-PRE053	#053	#301	Larnaca
10	7-PRE215	#215	#301	Nicosia
11	7-PRE209	#209	#301	Nicosia
12	7-PRE070	#70	#301	Larnaca
13	7-PRE181	#181	#301	Larnaca
14	7-PRE203	#203	#301	Larnaca
15	7-PRE253	#253	#301	Larnaca
16	7-PRE269	#269	#301	Nicosia
17	7-PRE271	#271	#35	Nicosia
18	7-PRE039	#39	#35	Nicosia
19	7-PRE095	#95	#301	Nicosia
20	7-PRE132	#132	#301	Larnaca
21	7-PRE194	#194	#301	Nicosia
22	7-PRE260	#260	#301	Nicosia
23	7-PRE302	#302	#301	Nicosia

2.1.3 Charging Stations (CEMS)

Four EAC-owned EV charging stations have been selected for the demonstration of the CEMS use case in Cyprus. All of the charging stations are located in public places and are directly connected to the grid. The charging system infrastructure is controlled and managed centrally by EAC and is able to monitor the charging of EVs throughout the duration of the charging. The stations use Mode 3 Type 2 charging with two-way communication between the vehicle and the charging station throughout the duration of the charging period, while the OCPP protocol is supported. In order to support flexibility of the charging Stations and align with the objectives of the project, EAC will replace its central charging points management system with ETREL's CEMS cloud solution and implement CEMS at 4 of the EV charging stations. The charging stations will be connected to ETREL CEMS via cellular mobile communication by using the OCPP protocol and will support the demand response functionality within the GOFLEX system by ensuring a dynamic load management and calculating the potential flexibility of the EV load charging in 15-minute periods, without compromising EV users' charging requirements.

2.1.4 Charging/discharging Stations (CDEMS)

The CDEMS use case for the Cyprus demo sites is going to be implemented in the University of Cyprus, and includes a semi-emulated solution for the operation of the charging/discharging operation of the EV.

As mentioned in the DoA of the CDEMS objectives "*Our goal is to integrate EVs as prosumers, either as a part of Home EMS (charging and discharging – called CDEMS) or on public/private parking area (only charging – called CEMS). For this, the charging infrastructure, EMSs at the prosumer level and trading interfaces will be further developed, adapted, and integrated. EVs will be treated as flexible loads with specific operation parameters*"

In the case of the University of Cyprus, three EV scooters with a battery capacity of 2.1 kWh each, will be used to demonstrate the CDEMS use case. The EVs will be integrated and demonstrated as part of a HEMS, which will be installed in the FOSS research centre premises. All individual EV charging loads will follow the requirements given by the higher level EMS.

As an EV with discharging option is not commercially available, the back-up option, as suggested by Robotina, was selected for the implementation of the CDEMS UCY use case. A battery storage unit with a 3kWh capacity is supplied by Robotina to the demo site. This battery unit will be used to emulate the EV CDEMS with the relevant EV use case features. The EV AC charger will be treated within HEMS as a flexible load. The configuration of the CDEMS use case in Cyprus is presented in Figure 4 (Option 2 to be implemented in GOFLEX).

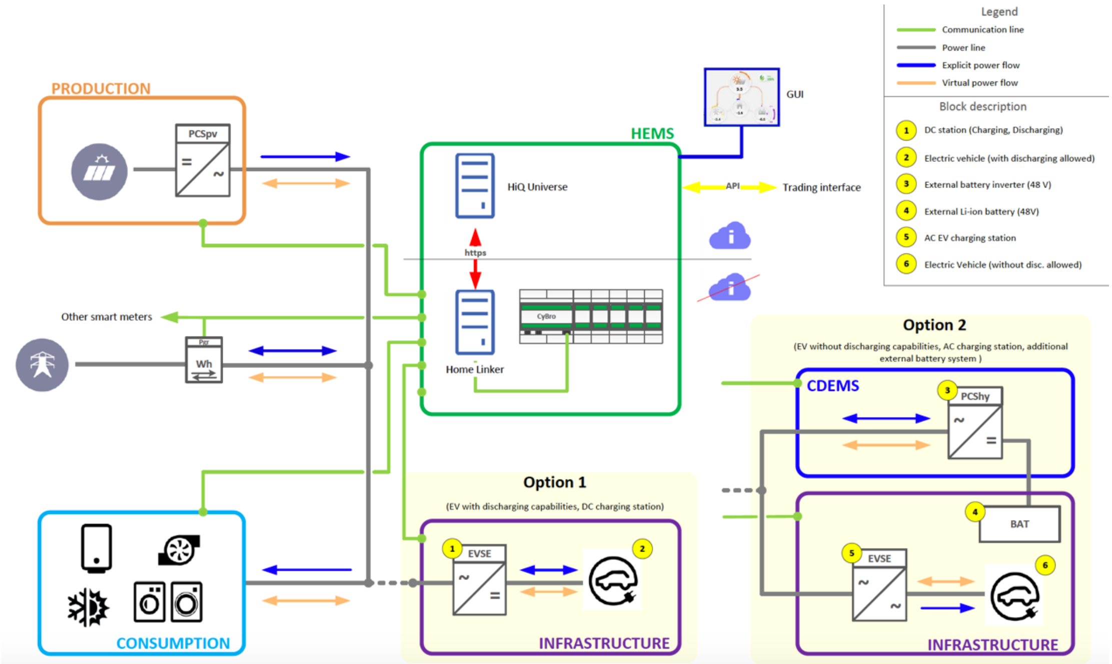

Figure 4 Configuration of the Option 2 CDEMS use case for Cyprus

2.2 Delegated trading prosumers

In the delegated trading mode, prosumers are able to delegate their flexibility trading activity to an aggregator, according to the local electricity market system operator or a pilot entity acting as an aggregator. All the metering data concerning consumption will be collected via smart wireless communication devices and directed through Flex Offer Agent (FOA) and FMAN to the ATP and cloud Service Platform. In the delegated trading mode, flex-offer price is pre-defined, depending on the agreed/ closed flexibility contract which sets flex-offer price depending on different parameters, such as number of flex-offers, number of energy units offered, time shifting from schedule etc. This Demand Response Flexibility scheme will enable users to optimize their energy profile and benefit from any left flexibility according to the needs of DSO. Therefore, the aim of this trading mode is to enable the DSO to better monitor and control the grid and to perform congestion management. In the Cyprus Demo site, the delegated trading mode is tested only in the dispersed prosumers use case.

2.2.1 Homes with Smart Plugs

5 residential prosumers have been selected and recruited to demonstrate the AAU Smart plug solution. Smart plugs, which are able to communicate with the central GOFLEX platform, are

used to control various flexible loads of the apartments. Typically, two energy-consuming appliances per household are selected as controllable/flexible loads. The controllable loads that will provide flexibility via the smart plugs are the following appliances:

- Washing Machines
- Clothes Dryers
- Dishwashers
- Freezers

Customers will be provided with both a mobile application (kasa tp-link) to monitor and control their appliances' operation, as well as a web application for the FOA to define their flexibility constraints and monitor their contract with the aggregator. The offered flexibility will be characterized by: number of flex-offers, number of energy units offered, time shifting from schedule The implemented solution will evaluate customer responsiveness in DR requests and investigate the flexibility potential of residential households without the use of an EMS.

2.2.2 Homes with Single Load Controllers

There are currently no prosumers engaged in this particular GOFLEX solution in the demo sites of Cyprus. Initially, it was expected that a total of 5 residential households would test the basic load control and flexibility trading functionalities provided by the Single Load Controller solution. However, the size of the Singe Load Cabinet and connectivity issues between the controllable loads and the cabinet have led to a difficulty in the engagement of prosumers for their participation in this particular delegated trading solution. Hence, it has been decided that this approach will not be tested in the case of residential prosumers in Cyprus.

3 Prototype Installation

3.1 Automatic Trading Platform

EAC has provided its own VMWare vSphere ESXi 6.5 infrastructure for the installation of Flexibility Manager (FMAR), Flexibility Market (FMAR) and the Software Flex Offer Agents(FOAs). The Virtual Machines have been provisioned as specified in the IT Systems Requirement Document provided by INEA. The provisioning for FMAN and FMAN has been implemented on the ESXi Host serving EAC's internal network for the increased security it provides. The provisioning for HEMS and CEMS FOA and a VPN/PROXY for handling the communication between the two zones has been implemented on the ESXi Host serving EAC's DMZ for unrestricted access to the internet and the hardware (HEMS and CEMS) that they need to communicate with.

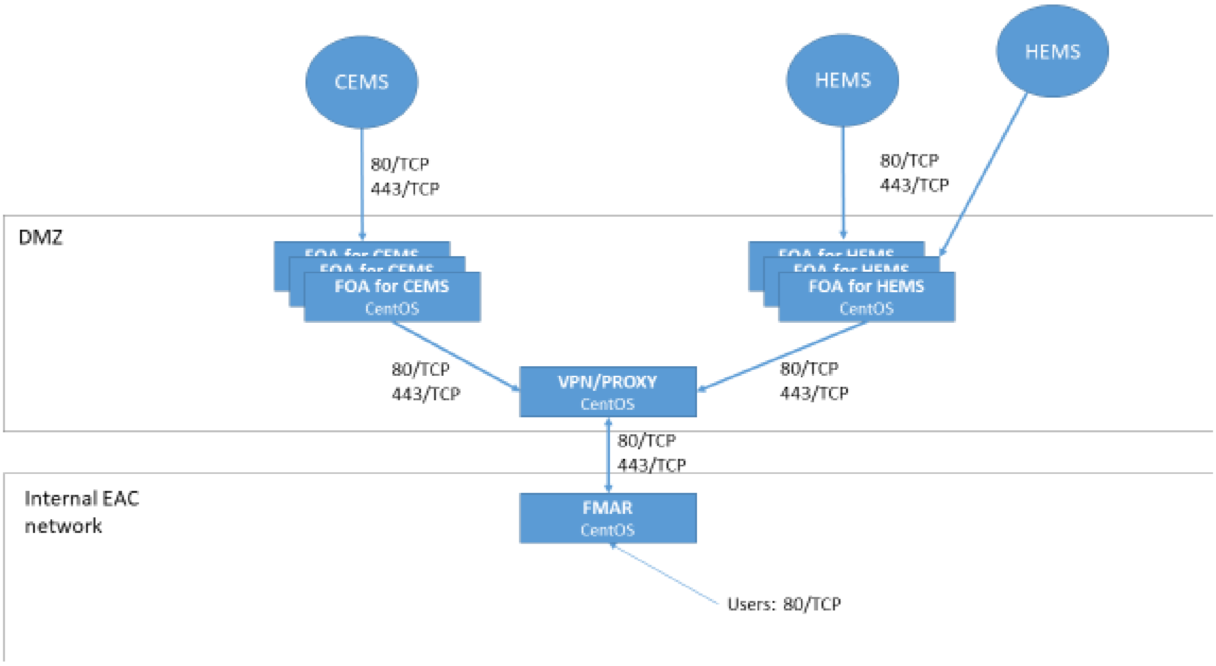

Figure 5 Virtual Machine Deployment and Communication Plan

3.1.1 Flexibility Manager (FMAN)

EAC's VMWare vSphere ESXi 6.5 host is ready to receive the Virtual machines containing FMAN for deployment on EAC's IT infrastructure.

3.1.2 Flexibility Market (FMAR)

EAC's VMWare vSphere ESXi 6.5 host is ready to receive the Virtual machines containing FMAR for deployment on EAC's IT infrastructure.

3.1.3 Flex Offer Agent (FOA)

No hardware FOA have been currently installed in the Cyprus use case. However, it is expected that there will be installations of 21 HW FOA (20 HW FOA at households plus 1 HW FOA for the CDEMS use case). Furthermore, there will be 3 use cases of residential prosumers, where software FOA will be hosted on cloud as part of the HEMS solution. EAC has provisioned computing resources (cores, RAM and Storage) as specified in the IT Systems Requirement Document for 8 Software FOAs

3 HEMS FOA Virtual Machines
4 CEMS FOA Virtual Machines
1 DOMS FOA Virtual Machine

EAC's VMWare vSphere ESXi 6.5 host is ready to receive the Virtual machines containing FMAR for deployment on EAC's IT infrastructure

In addition, a Software FOA will be demonstrated for the BEMS solution of the University microgrid.

3.2 Energy Management Systems

3.2.1 University Campus (BEMS)

The campus of University of Cyprus is participating in the GoFLEX project as a microgrid test case, taking into account its energy production and consumption mix. The campus of the University of Cyprus is located on the outskirts of east Nicosia, between Aglantzia and Athalassa and covers an area of approximately 1.2 square kilometers. The master plan of the University can be seen in Figure 6. In order to increase the overall efficiency of the current and future production and consumption units within the university microgrid, the controllability of the microgrid is being enhanced.

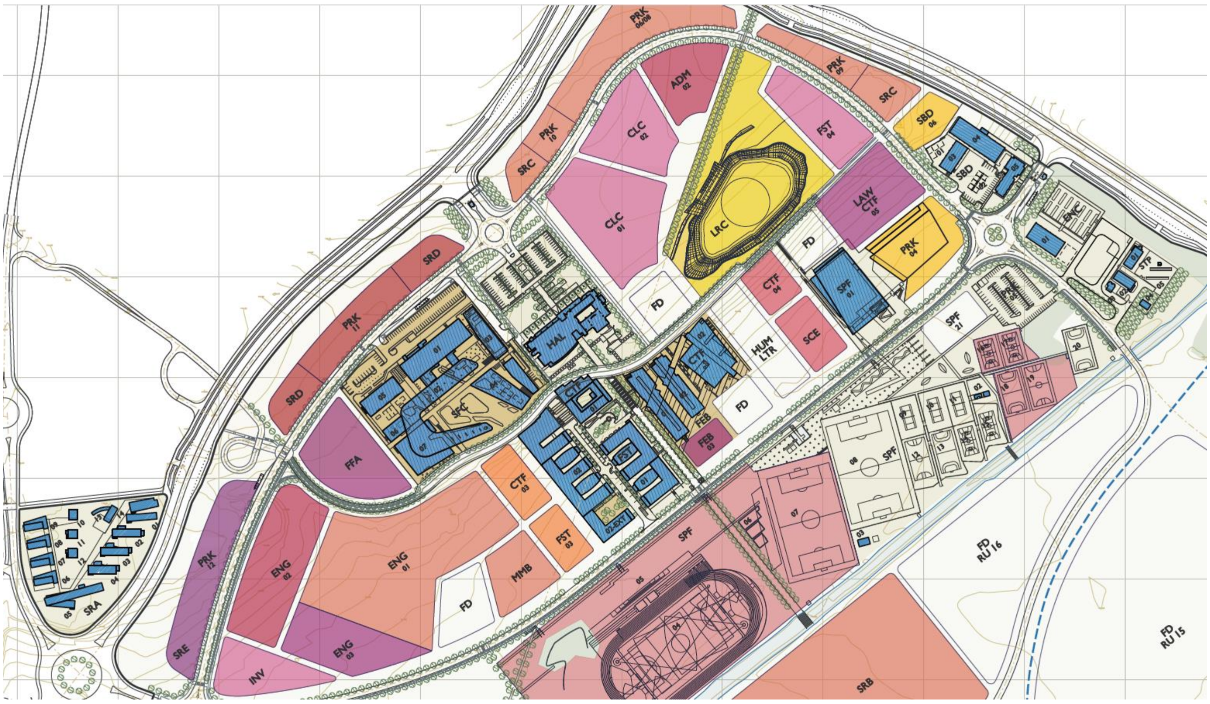

Figure 6 UCY master plan

Extensive hardware, software and engineering work has been done in the UCY in order to build the integrated BEMS solution, which will manage to connect the various different existing and future BMS systems into a singular central solution. This solution will be used for:

a. Centralized monitoring and analytics of several distributed BMS systems
b. Data capturing and monitoring from different sources, such as smart meters, temperature sensors, and BMS
c. Provision of a centralized hub for metering data exchange
d. Connection of the whole microgrid and the individual buildings as prosumers with BEMS into the GOFLEX project. Each individual building, and the microgrid as a whole will be able to offer and trade their flexibility to the DSO.

In the current operation of the Campus, the potential to harvest electric flexibility is mainly identified in the cooling system of the buildings.

As a building consists of a high number of components differing in characteristics and operation times, the BEMS needs normally this environment to be divided into multiple zones, e.g. office rooms, common areas, halls etc., with a set of energy demand and control variables. These energy demand and control variables should be configured initially by the Technical Services of the University. However, some level of control (e.g. temperature control) should be provided to the users of offices or classroom. The BEMS solution will be able to adequately and reliably configure and monitor these operations in each different zone of a particular building.

The following actions have been considered necessary for the efficient operation of the BEMS system within the integrated GOFLEX Solution:

- Acquisition, installation and configuration of smart meters to monitor the energy production of the campus

- Acquisition, installation and configuration of a PC server to ensure seamless connectivity with the GOFLEX prototype

- Installation and configuration of the centralised BEMS system

- Installation and configuration of FOA, FMAN, FMAR

- Interfacing between BEMS and FOA

- Configuration of data exchange interfaces and protocols. Definition of the relevant datasets (data exchange with GOFLEX Service Platform, DOMS, FOA, FMAN/FMAR)

- Test run and field testing of the implemented solution

A lot of progress has been made towards the implementation of the BEMS system and the system is expected to be up-and-running by the end of M24. Smart meters have bee acquired and installed in the relevant points. Installed smart meters in metering points of the UCY campus can be seen in in Figures 7 and 8. Table 3 presents the status of installation of the smart meters in the end of M23 (September 2018). Moreover, communication between the UCY server and the GOFLEX server has been tested successfully. Thus, there is no identified risk concerning the communication of the university control system with the SP, DOMS,FOA and FMAN/FMAR.

Presently, the main issue that has been identified is the lack of cooperation from the BMS suppliers and providers. As soon as the involvement of existing BMS integrators/providers is assured, the adaption and the programming of the individual BMS will be completed and the BEMS system will be ready to be tested.

Once the pending issue of the BMS integration into the platform is resolved, the whole operation of the system will be tested on-field, in order to assure that the BEMS solution is fully operational and in line with the GOFLEX project scopes.

Figure 7 Installed Smart Meters in the University campus

Figure 8 Installed Smart Meters in the University Campus

Table 3 Status of installation of University smart meters

Item No.	Distribution Board / Building	Code Name	Feeder	Seial No.	Status
1	PV Lab 2		Incomer	ME-1805A335-02	Installed
2	PV Lab 2		Chillers, Climatic	ME-1805A279-02	Installed
3	STP		PV Park	ME-1801C728-02	Installed
4	Student Halls	TRS1	Incomer	ME-1805A318-02	Installed
5	Administration Building Anastasios G. Leventis	TRS2	Incomer	ME-1804C200-02	Installed
6	Energy Centre	TRS4	Incomer	ME-1801C724-02	Installed
7	Energy Centre (Chillers 1 & 2)	TRS13a			To be installed
8	Energy Centre (Chillers 3 & 4)	TRS13b			To be installed
9	Energy Centre (Chillers 5 & 6)	TRS13c			To be installed
9	Energy Centre (Chillers 7 & 8)	TRS13d			To be installed
10	Athletic Hall	TRS5	Incomer	ME-1805B060-02	Installed
11	Athletic Center Sports Fields	TRS6	Incomer	ME-1801C730-02	Installed
12	Facilities for Science and Technology	TRS7	Incomer 1	ME-1085A133-02	Installed
13	Facilities for Science and Technology	TRS7	Incomer 2	ME-1804C089-02	Installed
14	Social Facilities Building	TRS11	Incomer	ME-1804C182-02	Installed
15	Faculty of Economics and Management	TRS14	Incomer	ME-1804C180-02	Installed
16	Library	TRS3	Incomer 1	ME-1707A311-02	To be installed
17	Library	TRS3	Incomer 2	ME-1801C736-02	To be installed

3.2.2 Homes (HEMS)

Individual visits to prosumer households have been completed during the past months in order to recruit potential participants in the GOFLEX project and identify flexible loads of the households. As mentioned above, 23 prosumers have been recruited for the demonstration of the HEMS use case in Cyprus. These prosumers are located in Larnaca and Nicosia districts. Iinstallations of the HEMS equipment at the two identified representative prosumers and currently ongoing. An indicative HEMS configuration can be seen in Figure 9, while Table 4 List of the HEMS components for the case of CyprusTable 4 presents the list of components that will be installed in the prosumers premises in order to enable the functionalities of the HEMS system.

10 shows the HEMS panel that will be installed in all prosumers households. The HEMS panel includes all the necessary components for the proper operation of the GOFLEX system.

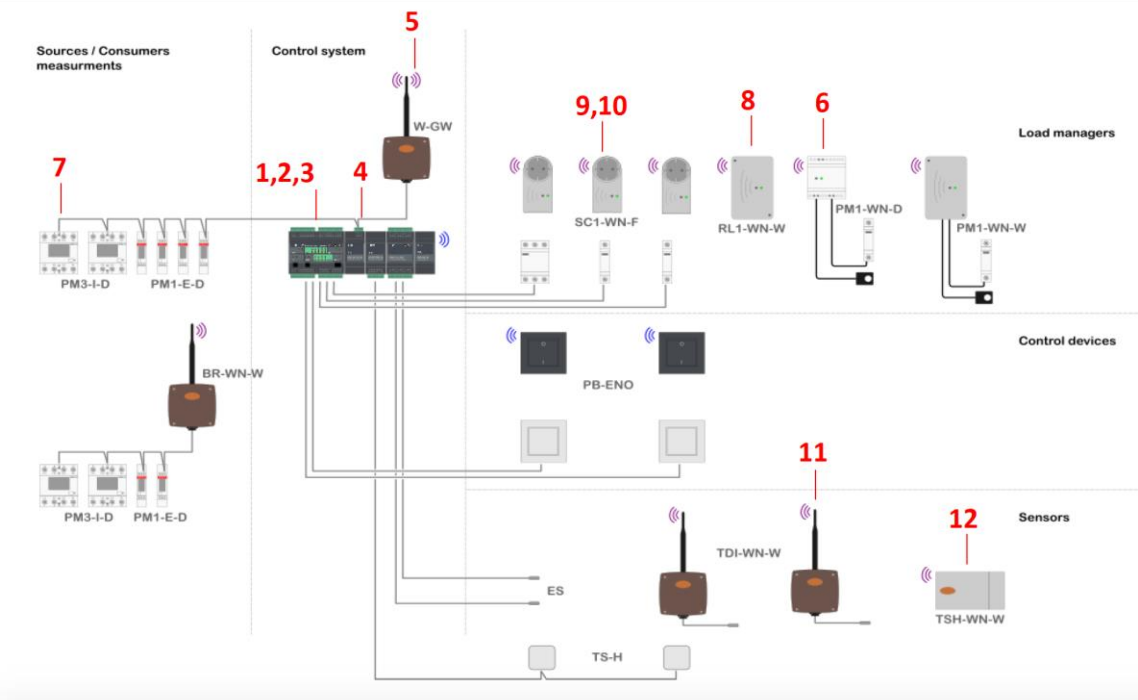

Figure 9 HEMS components and wiring configuration

Table 4 List of the HEMS components for the case of Cyprus

No.	Code Name	Part
1	PS-IQ	24VDC power supply
2	Home linker	IoT linker (local data storage, data en-cryption...)
3	HC-IQ-HEMS	HEMS controller
4	CAD-232-A2-IQ	RS232 to RS485 converter module
5	Wireless gateway	GW-WN-W
6	PM1-E-D	Bidirectional 1-phase power meter, Wired com
7	PM3-I-D	Bidirectional 3-phase power meter, Wired com
8	RL1-WN-W	Single-phase power relay and con-sumer measurement
9	SC1-WN-G	Wireless socket, UK type
10	TDI-WN-W	Wireless water temperature sensor
11	TSH-WN-W	Wireless room temperature & humid-ity sensor
12	HW CDEMS	CDEMS

13	HEMS CONFIGURATOR	End user GUI installed on local PC
14	HEMS WEB GUI (hiQ Universe)	End user GUI WEB account

Figure 10 HEMS controller installed in dedicated panel

Installation implementation plans of the two representative prosumers (HEMS with HW FOA and HEMS with SW FOA) are described in the following sections.

3.2.2.1 HEMS with HW FOA Representative Prosumer

The selected representative household of the HEMS + HW FOA installation is a 3-floor building with PV installation of 3 kWp and a Battery Storage System of 9.8 kWh capacity.

A diagram of the household with the proposed Control and Communications Setup for the HEMS installation is presented in 11 and Figure . The flexible loads that will be managed and controlled by the HEMS system are an A/C unit and a Washing Machine/Dryer. These two particular loads are the most energy-consuming appliances of the household, while their operation can be deferred according to the needs of the DSO and the GOFLEX system, as long as operational constraints and user comfort levels are respected.

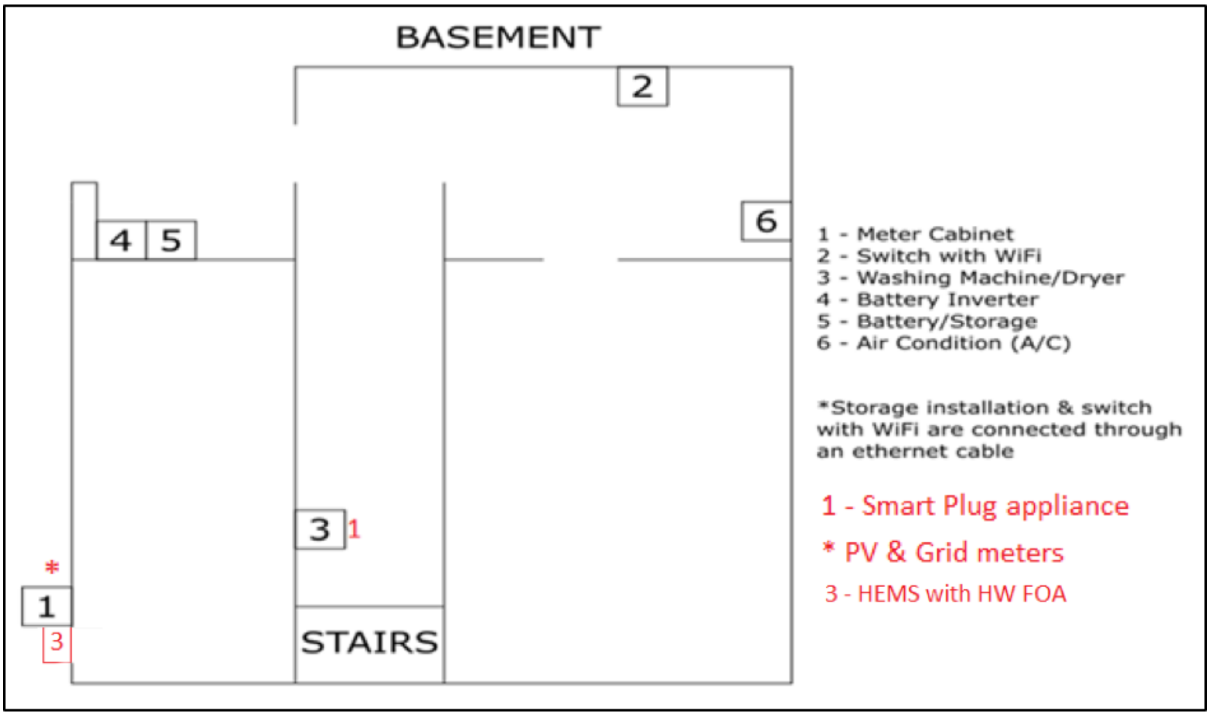

Figure 11 Proposed control setup of the basement of the household

The main issue of the installation of the HEMS system in this prosumer's household was the lack of space in the meter cabinet, which is located in the basement of the house. Due to this fact, the supplementary HEMS panel, including all the necessary equipment for the operation of the HEMS system with a HW FOA, will be installed right next to the meter cabinet. Two sub-meters will be installed in the cabinet in order to monitor PV production and household consumption respectively. Being positioned nearby, sub-meters will communicate directly with the HEMS, using wired connection.

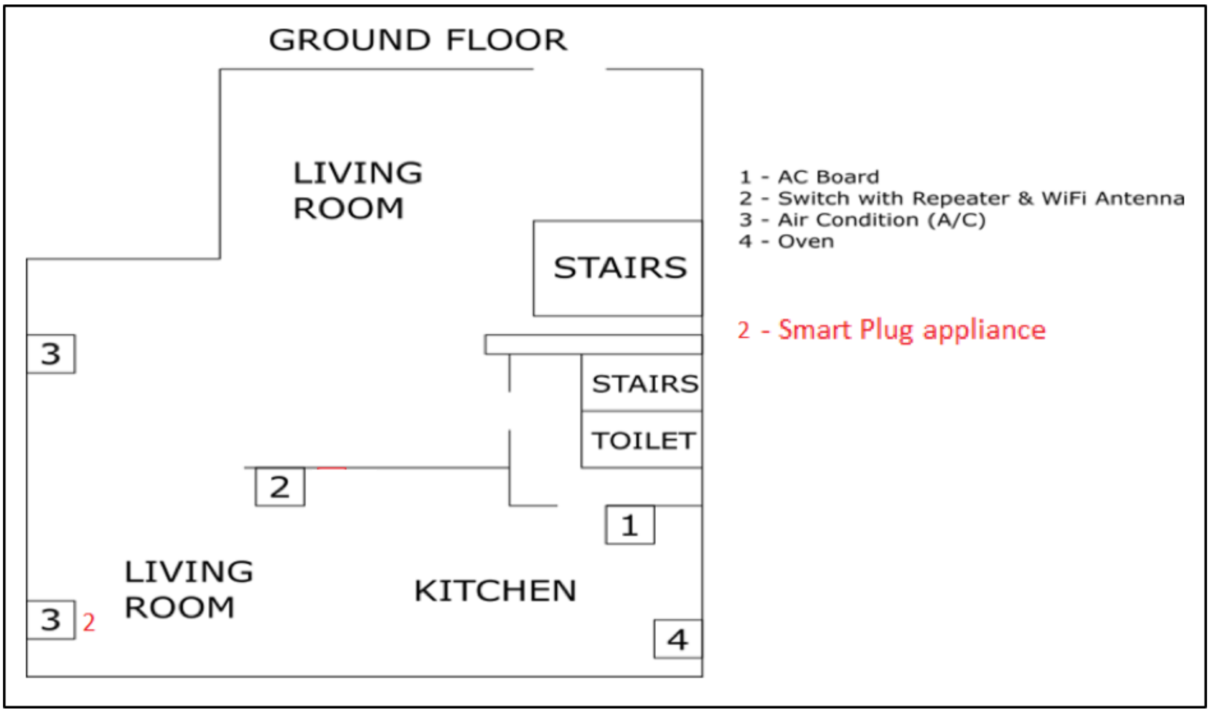

Figure 12 Proposed control setup of the ground floor of the household

Wi-Fi connectivity in this household is reliable enough (repeaters all over the house) for the wireless communication between HEMS and the indoor router. However, and in order to achieve reliable and seamless connectivity, PLC communication will be used. For this reason, a socket will be installed in the meter cabinet. This socket will be used for PLC communication (using PLC adapters in both the HEMS and the router's power supply, and Ethernet cables to attach the devices to the Powerline adapters) in order to achieve a seamless and more reliable communication.

Additionally, a 5 port Ethernet switch is required in order to connect the HEMS, FOA and IoT Linker devices with the router through the PLC adapters.

The HEMS will communicate wirelessly via ZigBee with the flexible/controllable loads. HEMS will communicate with the temperature sensor and the wireless relay of the A/C unit (located in the ground floor). Furthermore, a ZigBee plug will be used to control the washing machine/dryer, which is located in the basement. This particular ZigBee plug will also serve as a repeater for the ground floor's smart plug device.

The list of required materials for the proper installation and configuration of the HEMS system is presented in Table 5.

Table 5 Required equipment for the configuration of the HEMS device

S/N	Material / Device	Number of units	Provider
1	HEMS controller (CI-IQ-HEMS) with Zig-Bee gateway (GW-WN-W), power 24V supply (PS-IQ), IoT Linker (Cybro-Pi3), RS485 module and auxiliary parts/cables.	1	Robotina
2	INEA HW FOA IFB122 with WiFi module and auxiliary parts/cables	1	INEA
3	Bidirectional grid power consumption 1PH or 3PH wired meter (Model/Part Number: PM1-E-D or PM3-I-D)	1 x PM3-I-D	Robotina
4	Bidirectional PV power production 1PH or 3PH wired meter (Model/Part Number: PM1-E-D or PM3-I-D)	1 x PM1-E-D	Robotina
8	Smart Wireless Type G Plugs (Model/Part Number: SC1-WN-F)	1	Robotina
9	Smart Wireless Relay with cables (Model/Part Number: RL1-WN-W)	1	Robotina
10	Wireless (ZigBee) room temperature sensors (Model/Part Number: TSH-WN-W)	1	Robotina
13	PLC adapters	2	
14	5-port Ethernet Switch	1	

3.2.2.2 HEMS with SW FOA Representative Prosumer

The selected representative prosumer for the installation of the HEMS with SW FOA system is a household with a 3 kWp PV-system, located in Nicosia. A diagram of the household with the proposed Control and Communications Setup for the HEMS installation is presented in Figure 13. The flexible loads that will be managed and controlled by the HEMS system are the washing machine and the dishwasher. These white appliances are regularly used in the house and they can be easily controlled, while their operation can be deferred within a user-defined time-slot, in order to provide flexibility to the system.

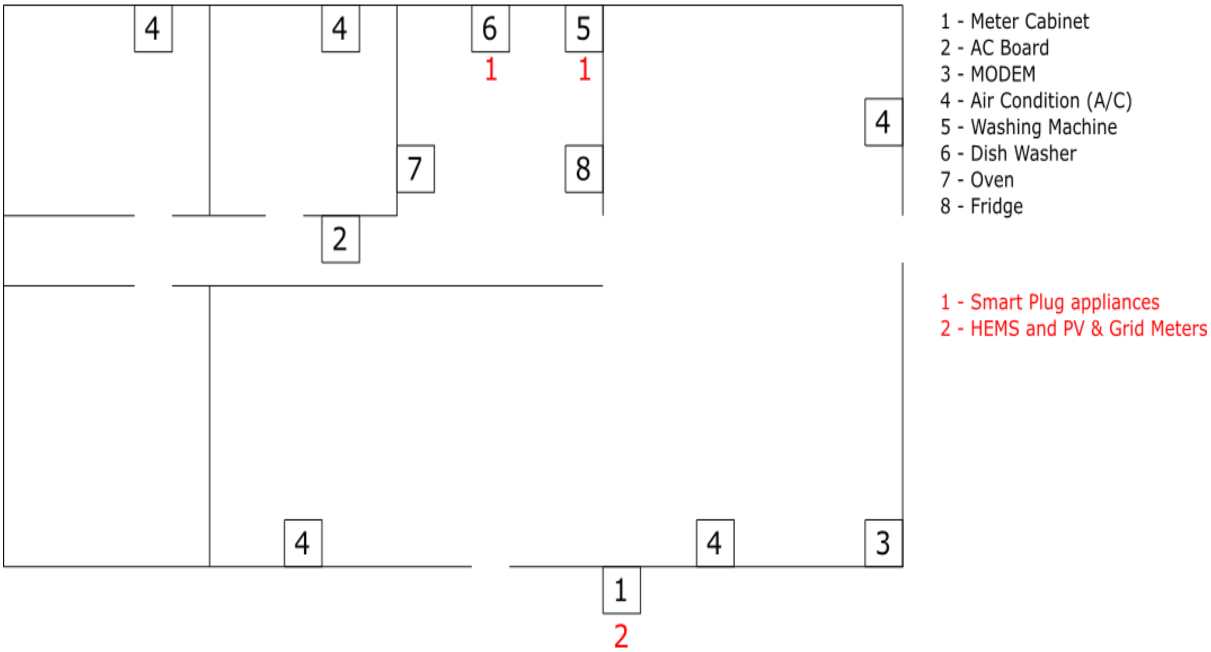

Figure 13 Proposed control setup of the household

As in the previous case, the HEMS cabinet has been installed right next to the Meter Cabinet, as shown in Figure

Additionally, two sub-meters have been be installed in the cabinet in order to monitor PV production and household consumption respectively. Being positioned nearby, sub-meters communicate directly with the HEMS, using wired connection.

Wi-Fi connectivity in this household is reliable enough for the wireless communication between HEMS and the indoor router. However, in order to achieve seamless connectivity, PLC communication is used. For this reason, a socket has been installed in the meter cabinet. This socket is used for PLC communication, using PLC adapters in both the HEMS and the router's power supply, and Ethernet cables to attach the devices to the Powerline adapters, in order to achieve a more reliable communication method.

Additionally, a 3 port Ethernet switch has been used to connect the HEMS and the IoT Linker with the router through the PLC adapters. Finally, the HEMS communicates with the flexible/controllable loads using ZigBee Smart Plugs, provided by Robotina. ZigBee reliability and coverage is currently assessed.

The list of required materials for the proper installation and configuration of the HEMS system is presented in Table 6.

Table 6 Required equipment for the configuration of the HEMS device

S/N	MATERIAL/DEVICE	Number of units	PROVIDER
1	HEMS controller (CI-IQ-HEMS) with Zig-Bee gateway (GW-WN-W), power 24V supply (PS-IQ), IoT Linker (Cybro-Pi3), RS485 module and auxiliary parts/cables.	**1**	**Robotina**
3	Grid power consumption wired 1PH meter with optional CT or cables (Model/Part Number: PM1-WN-D or W)	**1**	**Robotina**
4	PV power production wired 1PH meter with optional CT or cables (Model/Part Number: PM1-WN-D or W)	**1**	**Robotina**
5	Smart Wireless Type G Plugs (Model/Part Number: SC1-WN-F)	**2**	**Robotina**
10	PLC adapters	**2**	
11	3-port Ethernet switch	**1**	

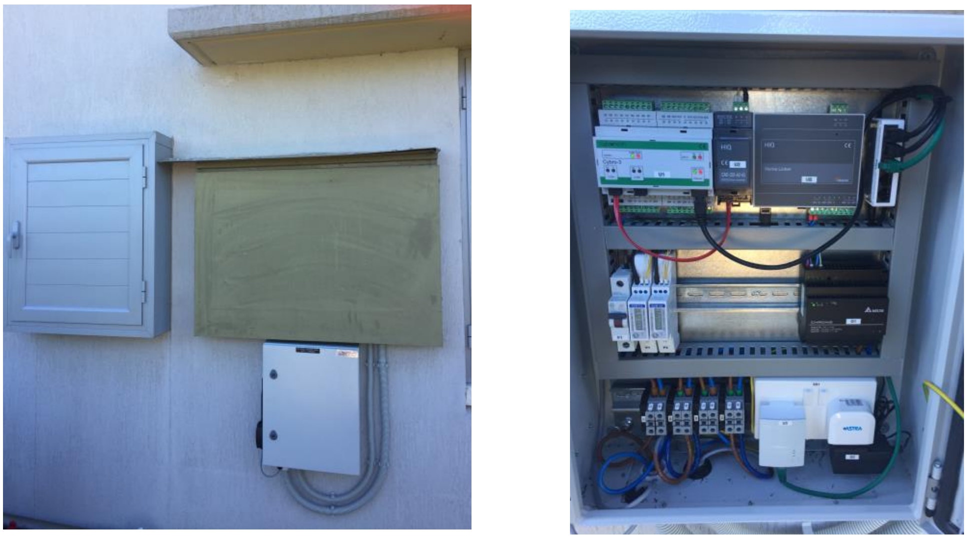

Figure 14 HEMS controller installed in dedicated panel at 7-PRE035

3.2.3 Charging Stations (CEMS)

As previously mentioned, EAC(DSO) has decided to procure ETREL's Ocean Cloud Instance (OCI) for the Central Charging Stations Management System and is currently testing communications for the integration of the first charging stations to the OCI and the Ocean Web platform application. CEMS will be provided within OCI as a separate module.

3.2.4 Charging/Discharging Stations (CDEMS)

The CDEMS use case for the Cyprus demo site is implemented within the University Microgrid. A HEMS device will be installed in the FOSS Research Centre Premises, while a smart plug device will be used to monitor the energy consumption and control the charging operation of the EV. A 3 KWh battery pack, provided by Robotina, will be used to emulate the discharging (G2V) operation of the EV. Installation, configuration and trial operation of the CDEMS system is expected to be completed by the end of M24.

3.2.5 Smart Plugs

The five prosumers that will use the Smart Plugs delegated-trading solution have been identified and recruited. All participating households are equipped with a PV-system, while their power generation and consumption is monitored by smart meters (providing data in 15-min intervals). In this type of solution, the Smart plug communicates with the GOFLEX system through the cloud. A mobile application, as well as a web-based Graphical User Interface (GUI) are provided to the user. Figure 15 shows the main application page with integrated plugs while Figure 16 shows the FOA web application "Devices" page. In this way, the user is allowed to effectively and efficiently analyse, monitor, trade, and shape his available flexibility in near real-time.

Figure 15 kasa tp-link mobile application main page

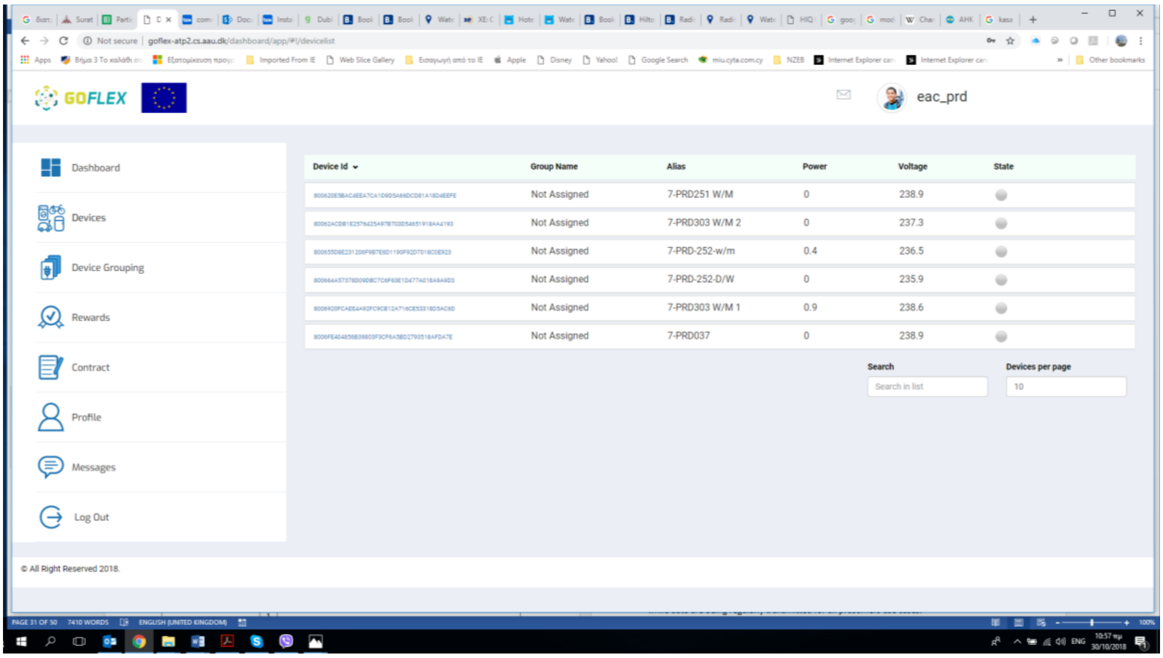

Figure 16 FOA web application "Devices page"

Four out of five installations of this particular solution have already completed. The installation implementation plan of the representative prosumer is summarized in the following section.

3.2.5.1 Smart Plug Representative Prosumer

The selected representative prosumer for the installation of the Smart Plugs solution is a household with a 3 kWp PV-system, located in Nicosia district. A diagram of the household with the proposed Control and Communications Setup for the installation is presented in Figure 17. The flexible loads that will be monitored and controlled by the Smart Plug Appliances are the washing machine and the dishwasher.

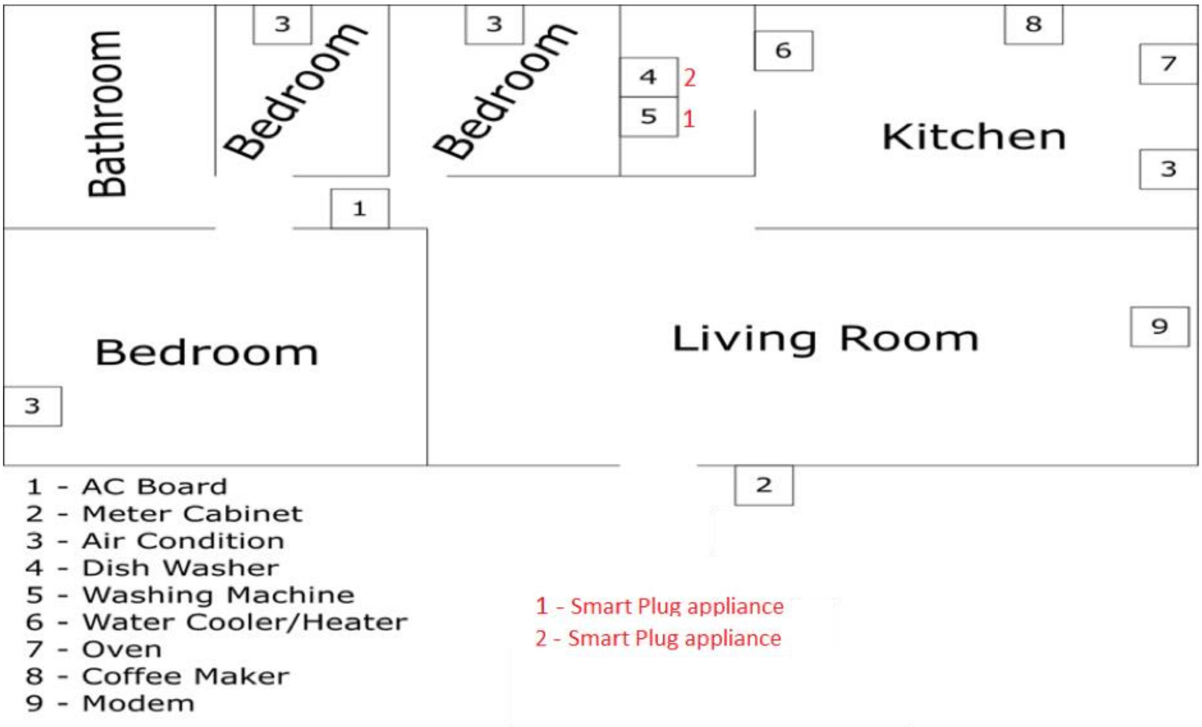

Figure 17 Proposed Control Setup of the household

The household has reliable Wi-Fi connectivity; thus, the communication with the GOFLEX system is expected to be seamless.

The list of required materials for the proper installation and configuration of smart plugs is presented in Table 7.

Table 7 Required equipment for the configuration of the Smart Plug Solution

S/N	MATERIAL/DEVICE	NoS.	PROVIDER
9	Wireless TP-LINK smart type-G plugs	2	AAU

3.2.6 Single Load Controller

As mentioned above, there will be no installation of single load controllers in the households of prosumers, due to reasons of limited applicability of the solution in typical Cypriot residences.

3.3 Distribution Observability and Management System (DOMS)

The operation of the DOMS for the Cyprus use case focuses mainly on assessing grid congestion issues for the DSO. A FOA at the DSO will be responsible to monitor the grid's state and generate flexibility requests to the ATP platform.

An AMQP client to reside in EAC as part of the DSO FOA, will run automatically the various data requests to the DOMS, e.g. state variables and economic parameters. Other data requests may be a list of relevant prosumers and transfer cost. The results of the above communication are screened as output of the DSO FOA interface.

DOMS in turn, retrieves all required parameters from the SP. Communication between DOMS and SP is implemented automatically via other python scripts, namely client.py and goflexapi.py and concern meter association topology to external client requests, meter data retrieval, and meter energy forecasts.

For the case of DSO, the relevant metering points and grid data have already been identified, while datasets are being regularly transmitted for all prosumers use cases, as described in paragraph 3.4

3.4 Cloud Service Platform (SP)

EAC and FOSS have identified the necessary data that will be transmitted to the Service Platform. Required sensor data are gathered for the cases of the microgrid and the domestic prosumers, while regular transmission of data to the SP has already been tested successfully. Communication with the SP is achieved via mqtt_client.py and goflexsubmitapi.py files, while an anonymisation process is performed to provide improved data protection.

In cooperation with IBM, EAC identified five types of information for retrieval and transmission to DOMS. These are divided in two main categories, Grid Data and Prosumer data as follows:

1. Load (current) measurements of the MV feeders supplying the prosumers and the pertinent substations's transformer load (apparent power), bus-section current and busbar segment voltage. These measurements will be automatically retrieved from the National Control Centre/SCADA every five minutes with minute granularity.
2. Measurements from the prosumers' smart meters:
    a. Instantaneous and profile voltage for single-phase prosumers
    b. Instantaneous voltage for three-phase prosumers
    c. Energy import-export profile for single-phase prosumers
    d. Energy import-export profile for three-phase prosumers

A temporal resolution of fifteen-minutes was decided for all types of information. The relevant data sources reside in two different locations on EAC's network. EAC has created a program that gathers grid data every five minutes and stores the data in a CSV file. There is one CSV file for every 24-hour period. The same data format (CSV) and 24-hour period has been implemented for the prosumer data. The prosumer data is exported every fifteen minutes from EAC's Meridian Smart Meter Software in a CSV file.

A Virtual Machine (GoflexSRV) was created to centralize the data gathering and transmission process. The Python code prototype (mqtt_client.py) that IBM created for reading, formatting and transmitting DOMS data to the Service Platform was installed on GoflexSRV. This code was then modified by IBM to the specific requirements of EAC's data streams and the transmission protocol used by IBM (MQTT). A configuration file that contains the specification for the CSV format of each data source was created.

The mqtt_client.py must run with a set of parameters for successful completion. Here is an example python command with all required parameters for prosumers' load profile data:

```
python mqtt_client.py --broker=de-cyprus-mqtt-config1.json --dir="x:\GOFLEX
prosumers\Load_Profile_csv" --pattern=L*.csv --state=state-EnergyPro-
files.json --flavour=1 --batch=10 --max=500
```

This can be run from the command line (windows or linux) and all output will be directed to the terminal.

Parameter	Example	Description
`broker`	`--broker=de-cyprus-mqtt-config1.json`	A json file that contains all the required information to connect to the IBM Service Platform MQTT Broker. This file will be supplied to you by IBM and it should be Read Only.
`dir`	`--dir="x:\GOFLEX prosumers\Load_Profile_csv"`	The source directory where the files are located
`pattern`	`--pattern=L*.csv`	The filenames we are looking for in the source directory. In this case CSV files starting with a capital L
`state`	`--state=state-EnergyProfiles.json`	A json file containing the last file read and the last line processed in this file. You can name this as you like. The file will be automatically created the first time that you successfully run mqtt_client.py for a specific flavor and will be subsequently updated at every run.
`flavour`	`--flavour=1`	The parsing rules that mqtt_client.py will use to extract the information we are looking for from a CSV file
`batch`	`--batch=10`	How many parsed lines extracted from a CSV file will be sent with every MQTT message. A bigger batch number means that fewer MQTT messages will be set to the Service Platform per file.
`max`	`--max=500`	The maximum number of lines that will be processed by mqtt_client.py per file per run. When the program is run it will process any number of files but it will stop at the first file that it encounters that has more than *max* lines of data (in the example it is 500)
`Verbose`	`--v`	**Optional**. Changes the logging level to Verbose and all program actions will be logged. This is for development and testing purposes.

3.4.1 Task Scheduling for Data Transmission to Service Platform

Scheduling of the five data ingestion tasks was implemented with the Windows Scheduler. Every task is run in fifteen-minute intervals.

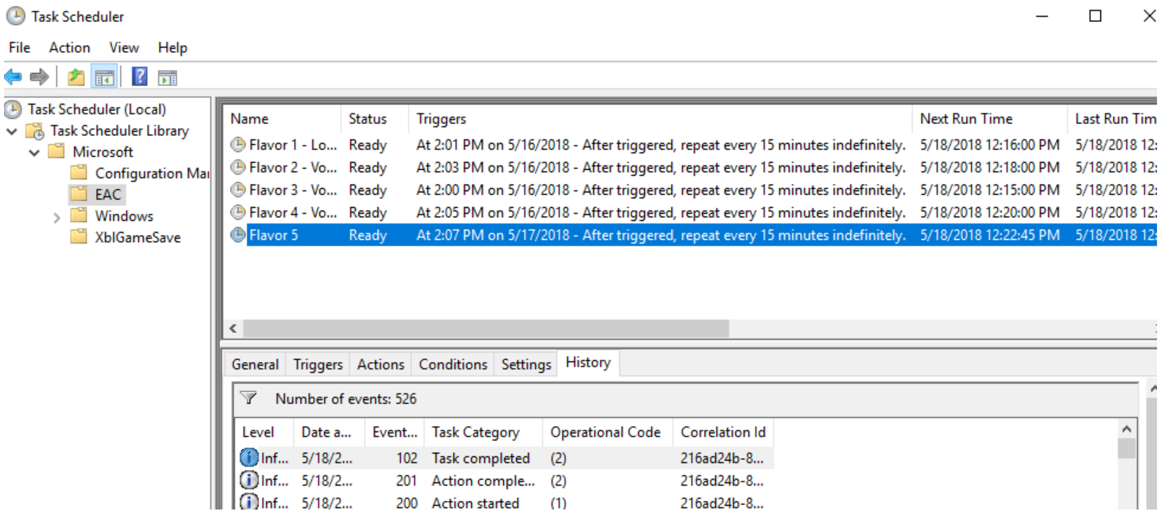

Figure 18 Task Scheduler for Data Transmission

Each task runs a batch file that contains all the necessary commands for connection to the data source locations and the command for the execution of mqtt_client.py. The batch file, in its simplest form should contain one line as below:

```
python mqtt_client.py --broker=de-cyprus-mqtt-config1.json --dir="x:\GOFLEX prosumers\Voltage_Inst+Prof_1PH" --pattern=V*.csv --state=state-f2.json --flavour=2 --batch=10  --max=500 >> f2.log
```

The only addition to the command is `>> f2.log` that redirects the output to a log file.

The complete version of the script for a windows machine should be similar to the following:

```
cd \Users\Administrator\samples\eac_mqtt
if not exist x:\ (
net use x: \\172.23.0.XX\exported_files /user:meridiansrv\goflex G0flxx3xDR
)
python mqtt_client.py --broker=de-cyprus-mqtt-config1.json --dir="x:\GOFLEX prosumers\Voltage_Inst+Prof_1PH"  --pattern=V*.csv  --state=state-f3.json  --flavour=3 --batch=10  --max=500 >> f3.log
```

Test data has been successfully transmitted to the Service Platform for the past six months.

4 Conclusions

This document has described how each GOFLEX system will be transitioned into a specific operational system. In the case of Cyprus, the document contains an overview of the implemented solutions in Cyprus, provides the state of art of electrical and communication installation, and describes critical issues and difficulties that have arisen.

The recruitment and installation period has been quite challenging for the demo sites of Cyprus. However, representative prosumers of all the direct-trading and delegated-trading prosumers have been recruited and the installations are currently on track. Thus, the pilot phase and the trial operation of each particular GOFLEX solution is ready to be initiated, while any pending installation is expected to be completed by M26.

Appendix

Project Title: ***Generalized Operational FLEXibility for Integrating Renewables in the Distribution Grid (GOFLEX)***

INSTALLATION PROJECT DOCUMENTATION

Version *0.3*

21/06/2018

INTRODUCTION

GOFLEX Project develops a trading flexibility market open to all potential players of the market, either implicitly or explicitly. The GOFLEX platform is also open to support multiple roles and processes based on the vertically structured Harmonized Electricity Market model in Europe. GOFLEX incorporates a more flexible energy system at the local level, facilitating the target of 100% RES penetration. Flexibility is the alternative option to costly grid reinforcements and upgrades or RES curtailments. In addition, the problems are solved locally and with the right cost, as the platform provides dynamic pricing of flexibilities. Generators, prosumers, DSM Operators, Energy Suppliers, BRPs, DSOs, Aggregators, Microgrid Operators and Energy Communities will be enabled to aggregate and trade load flexibilities. GOFLEX technology is an integrated platform of hardware and software building blocks which can be applied individually or as whole technology solution, depending on the needs of the related market actors, offering a cost effective use of various business cases for the players. GOFLEX is focusing on the development of high technical readiness level (TRL) solutions and will ensure scalability and feasibility beyond the project.

The integrated solution will offer a number of energy optimization solutions for different types of users in Cyprus, including residential prosumers, some of them also with electrical storage installed, and electric vehicle charging stations. These users will be equipped with the required software and hardware building blocks to help them optimize their energy profile and spare flexibility which will be traded to a trading platform. This flexibility, if traded successfully, will be applied via smart controllers installed at the users' premises.

There are two main use cases for the Cyprus DSO. The first one refers to DSO Congestion Management where the local DSO will take advantage of users' flexibility[1], namely residential prosumers, EV charging stations and the university microgrid to relieve grid congestion when required. The DSO will set the reimbursement offer for the flexibility offered by the users according to its business scenario. Prosumers will be offered two major trading modes, either direct or delegated. In the direct trading mode, prosumers will be able to actively compete each other while offering their Demand Response flexibility. In the delegated trading mode, prosumers will be able to delegate their flexibility trading activity to an aggregator, according to the local electricity market system operator or a pilot entity acting as an aggregator. All the metering data concerning production and consumption (and storage in some cases) will be collected via smart wireless communication devices and directed through Flex Offer Agent (FOA) to the Cloud-based Service Platform. This Demand Response Flexibility scheme will enable users to optimize their energy profile and benefit from any left flexibility according to the needs of DSO. Therefore, the DSO will be allowed to better monitor and control the grid and to perform congestion management.

[1] Via a Balancing Responsible Party which is actually a DSO entity in the Cyprus case, as there's only a single DSO

For each case, the role of the Balancing Responsible Party (BRP) is assigned, as an intermediate level for trading flexibility between the prosumers and the DSO. Home Energy Management Systems (HEMS) will be installed at the premises of 26 prosumers with 3kWp rooftop PV system (4 of them have also 9.8kWh storage system) for optimizing the user's energy profile before directly offering flexibility to the BRP. Another 10 prosumers will offer their individual loads flexibility through a BRP playing the role of an aggregator before trading the formed flexibilities to the BRP. Also, 5 Charging/Discharging Stations for Electric Vehicles

will be incorporated in the Demand Response Flexibility scheme, offering flexibility to the grid when needed. The Charging/Discharging EMS, will better monitor and control the power availability and demand through smart charging/discharging scheduling.

PURPOSE

The document describes how each pilot system will be transitioned into a specific operational system. The document contains, an overview of the user information and energy profile, the current state of electrical and communication installation, an analysis of the potential flexible loads and a proposed action plan with the target flexibility setup. Then, a bill of materials is constructed according to the action plan and an implementation schedule with set responsibilities among the solution providers and system integrator. Finally, the document is signed by the solution providers and system integrator responsible persons.

The document's main target is to act as a hands-on manual, mutually agreed between pertinent partners, for the implementation of each flexible user.

Also, the agreement signed between the system integrator and the user is annexed.

PROSUMER CURRENT PROFILE

Date of Visit(s):

Prosumer’s Name:

Prosumer’s Number:

Address:

Type of building:

ELECTRICAL DATA

Electrical Energy Consumption

Average daily consumption (kWh)	Average monthly consumption in Winter (kWh)	Average monthly consumption in Summer (kWh)	Average yearly consumption (kWh)	Remarks

PV Energy Production

Installed PV Capacity (kW)	Average yearly production (kWh)	Remarks

Energy Storage (if present)

Type of unit	Storage Capacity (kWh)	Max charging/discharging power (kW)	Energy Management (Y/N)	Manufacturer	Remarks
Batteries					

EXISTING SMART POWER/ENERGY MEASURING DEVICES

Measuring Point	Type of Device (1ph/3ph)	Meter Model	Location	S/N-Name	Remarks
Grid					
PV System					

EXISTING COMMUNICATIONS DEVICES

Wi-Fi Modem Existence (Y/N)	Provider-Model	Location	Relocation possible? (Y/N)	Remarks

CURRENT ELECTRICAL AND COMMUNICATIONS SETUP

[drawing]

PROSUMER GOFLEX PROFILE

HOUSEHOLD FLEXIBLE LOADS

S/N	Type of load	Supply interface (socket/heater switch)	Single load on circuit (Y/N)	Control permitted by user (Y/N)	Control device required (smart plug/wireless relay/temp sensor)	Shifting possibility (Y/N)	Remarks	
1	**Air Conditioner – Cooling/Heating**						Continuation of cycle is supported? (Y/N)	
							Window switch/digital input is available? (Y/N)	
							Timer is available? (Y/N)	
							Indicate room if more than one	
2	**Washing machine**						Continuation of cy-	

S/N	Type of load	Supply interface (socket/heater switch)	Single load on circuit (Y/N)	Control permitted by user (Y/N)	Control device required (smart plug/wireless relay/temp sensor)	Shifting possibility (Y/N)	Remarks	
							cle is supported? (Y/N)	
							Timer is available? (Y/N)	
3	**Dishwasher**						Continuation of cycle is supported? (Y/N)	
							Timer is available? (Y/N)	
4	**Clothes Dryer**						Continuation of cycle is supported? (Y/N)	
							Timer is available? (Y/N)	
5	**Water boiler**							
6	**Oven/ cooker**						Timer is available? (Y/N)	

S/N	Type of load	Supply interface (socket/heater switch)	Single load on circuit (Y/N)	Control permitted by user (Y/N)	Control device required (smart plug/wireless relay/temp sensor)	Shifting possibility (Y/N)	Remarks
7	**Freezer**						
8	**Space heater**						
9	**Water cooler/heater**						
10	**Pool water pump**						
11	**Irrigation system pump**						
12	**Coffee maker**						
13	**Any other appliance that ideally operates regularly or on automatic cycle or with a time-schedule (e.g. dehumidifier,**						

S/N	Type of load	Supply interface (socket/heater switch)	Single load on circuit (Y/N)	Control permitted by user (Y/N)	Control device required (smart plug/wireless relay/temp sensor)	Shifting possibility (Y/N)	Remarks
	wine preservator)						

USER CATEGORIZATION (√ appropriately)

DIRECT TRADING	
1A. HEMS AND INEA HW FOA	

OR

DELEGATED TRADING	
2A. DELEGATED TRADING (AAU SW and Smart Plugs)	
2B. DELEGATED TRADING (INEA IFB controller in cabinet and SW FOA)	

APPLIANCES TO BE CONTROLLED	
S/N	
S/N	
…	

ALTERNATIVE OPTIONS						
PRIORITY 1	USER CATEGORIZATION	e.g. 2B	APPLICANCES TO BE CONTROLLED (S/N)		REMARKS (indicate details: e.g. location of HEMS, INEA cabinet)	
PRIORITY 2	USER CATEGORIZATION		APPLICANCES TO BE CONTROLLED (S/N)		REMARKS (indicate details: e.g. location of HEMS, INEA cabinet)	
..						

PROPOSED CONTROL AND COMMUNICATIONS SETUP

[drawing]

BILL OF MATERIALS REQUIRED

S/N	MATERIAL/DEVICE	NoS.	PROVIDER	REQUIRED DELIVERY DATE	PERSON RESPONSIBLE

1	HEMS controller (CI-IQ-HEMS) with Zig-Bee gateway (GW-WN-W), power 24V supply (PS-IQ), IoT Linker (Cybro-Pi3), RS485 module and auxiliary parts/cables.		**Robotina**		
2	INEA HW FOA IFB122 with WiFi module and auxiliary parts/cables		**INEA**		
3	Grid power consumption 1PH or 3PH meter with ZigBee and optional CT or cables (Model/Part Number: PM1-WN-D or W)		**Robotina**		
4	PV power production 1PH or 3PH meter with ZigBee and optional CT or cables (Model/Part Number: PM1-WN-D or W)		**Robotina**		
5	Smart Wireless Type G Plugs (Model/Part Number: SC1-WN-F)		**Robotina**		
6	Smart Wireless Relay with cables (Model/Part Number: RL1-WN-W)		**Robotina**		

7	Wireless (ZigBee) room temperature sensors (Model/Part Number: TSH-WN-W)		**Robotina**		
8	INEA's prototype cabinet with IFB controller, relay, power supply, meter and other auxiliary parts/cables.		**INEA**		
9	Wireless TP-LINK smart type-G plugs		**AAU**		

5 IMPLEMENTATION ACTION PLAN

This section provides a sequence of tasks required from initiation to completion of installation and commissioning.

The overall implementation should not exceed 30/04/2018 for representative users and 31/07/2018 for the other users.

MAJOR TASKS

Task No.	Description	Responsible entity	Due by	Completed (Y/N)	Date of Completion	Remarks
T1	Installation Project Documentation finalized and signed	EAC/Solution Providers				

Task No.	Description	Responsible entity	Due by	Completed (Y/N)	Date of Completion	Remarks
T2	Training for installation/setup/commissioning personnel	Solution Providers/EAC				
T3	Materials/devices delivery	Solution Providers				
T4	Installation, configuration and setup (HW&SW)	EAC/Solution Providers				
T5	Commissioning	EAC/Solution Providers				

DESIGN-INSTALLATION-COMMISSIONING PERSONNEL

The persons responsible for the implementation are the following:

Name	Partner	Role	Remarks

		Solution provider	
		System Integrator	
		Installation-Setup	
		Commissioning	

Solution providers' and demo site manager installation project documentation agreement:

For ETREL Name: Signature: Date:	For ROBOTINA Name: Signature: Date:
For INEA Name: Signature:	For AAU Name: Signature:

Date:	Date:
For EAC Name: Signature: Date:	