ODYSSEUS - OPEN DYNAMIC SYSTEM FOR HOLYSTIC ENERGY MANAGEMENT
A CASE PILOT FROM THE VIII MUNICIPALITY OF ROME

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Abstract

The paper presents the Odysseus Pilot executed in Rome. The Pilot objectives are: to obtain energy savings, reduction of energy wasting, reduction of CO_2 emissions, obtaining the energy surplus and the most efficient use of the energy excess.

Results are discussed highlighting the energy savings achievement using Odysseus solutions.

The 7 referring public buildings are located in The VIII Municipality of Roma Capitale. They are:

Ciliegio Rosa school;

Aquilone Colorato;

The Operational Unit of the eight Municipality of Rome;

Cesare Battisti school;

Institutional seat of the eight Municipality of Rome(complex building-building A and building B);

Monelli school ;

Livio Tempesta school;

We have different levels of energy nodes: 4 buildings are both energy generation and energy consumption nodes and 3 of them are energy consumption nodes; in fact, the energy is provided by the supply provider Acea and for 4 of them energy is also provided by their own PV Plant.

The energy consumption and generation of the 7 buildings is continuously monitored and measured by the meters installed in place that provide a detailed analysis of energy consumption, energy generation and energy wasting, gathering data on field.

Data are processed and analyzed by Odysseus tool. Odysseus recommends the most efficient solution to obtain the desired results suggesting the solution to obtain energy savings and the most efficient use of the energy in excess – replacement of fluorescent bulbs with led (identifying the number-zones-building)/ transferring energy surplus from one building to another identifying the energy demand/profile of the building to supply energy demand, without giving back the energy excess to the Acea grid or recharging the batteries of the electrical bicycles-simulating bidirectional energy flows through an independent grid of energy exchange -an integrated energy management system.

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Results will be discussed highlighting the energy savings achievement using Odysseus solutions.
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Aquilone Colorato school;
the Operational Unit of the eight Municipality of Rome ;

Cesare Battisti School;
the Institutional seat of the eight Municipality of Rome;
I Monelli school ;
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There are different levels of energy nodes: 4 buildings are both energy generation and energy consumption nodes and 3 are energy consumption nodes; in fact, from an electrical point of view, the current situation of the 7 buildings is that the energy is provided by the supply provider Acea Distribution and for 4 of them, energy is also provided by their PV Plant: Cesare Battisti School, the Institutional seat of the eight Municipality of Rome, I Monelli school, Livio Tempesta school .

The energy consumption and generation of the 7 referring public building, is continuously monitored and measured by the meters installed in the referring buildings and Odysseus provides, gathering data on field through a monitoring system – and processing them, a detailed analysis of energy consumption, energy generation and energy wasting, so Odysseus system gathers e-consumption and production data on field - and through the elaboration and analysis of the reported values of the electric energy consumption and production, ~~p~~proposes to the facility manager or decision maker the most efficient actions even if simulated, to obtain the desired results: the most efficient use of energy saved and/or in excess; e.g. the actions to put in place to reduce the energy consumption related to the type of building and compared to its the total area and to the number of occupants of the structure replacing bulb lamps with led lamps;

identifying the building to transfer the energy in excess satisfying the energy demand;

Recharging the batteries of the electric bicycles.

Through the monitoring system, and static data acquired, Odysseus describes the dynamic energy profile of buildings (dEpc) as an energy identity card and its needs;

The monitoring system and the suggested actions after the analysis of energy data by Odysseus consist in what described in the following table and The evaluation of energy savings opportunities is measured by the KPIs before(baseline period) and after (reporting period) the implementation of the suggested ECMs measures:

Which sensor measures the KPI'S	Odysseus ECM'S/Actions
BU1 – Cesare Battisti PV: measurement device of the energy generated by the P.V. M1: measurement device of the total energy consumed in BU1 KPIP1=(PV-M1)/PV; **BU3 – Livio Tempesta** PV1: measurement device of the energy generated by the P.V. section 1. PV2: measurement device of the energy generated by the P.V section 2. M1: measurement device of total energy consumed in	Actions: Simulated increase of photovoltaic power and reduction of total e-consumption through the simulated installation of LED lamps. Utilization of energy surplus to charge the batteries of the electrical bicycles.

BU3 KPIP1=[(PV1+PV2)-M1]/(PV1+PV2) **BU5 – Institutional Seat building B** PV1: measurement device of the Energy generated by the P.V. section 1; PV2: measurement device of Energy generated by the P.V. section 2; M1: measurement device of total energy consumed in BU5 KPIP1=[(PV1+PV2)-M1]/(PV1+PV2) **BU6 – I Monelli** PV: measurement device of the energy generated by the P.V.; M1: measurement device of total energy consumed in BU1 KPIP1=(PV-M1)/PV.	
BU1 – Cesare Battisti M1=M2+M3+M4+M5: measurement device of total Energy consumed by BU1 M2: meter which measures the electricity consumed in the left side of the building by the following electrical loads: • light and driving force: Enfal Association • light and driving force: underground floor (refectory, ketboard, kitchen, boiler 1) • driving force: zone 1 ground floor, zone 1 first floor, zone 1 second floor, zone 1 third floor • light and driving force: the gym (ground floor) M3: meter which measures the electric Energy consumed on the left side of the building by the following electrical loads: • Light: zone 1 ground floor, zone 1 first floor, zone 1 second floor, zone 1 third floor and external (light). M4: meter which measures the electric Energy consumed on the right part of the building by the following electrical loads: • elevator2; • light and driving force: the Association; • driving force: zone 2 ground floor, zone 2 first floor, zone 2 second floor, zone 2 third floor, boiler 2, boiler 3 and pumps M5: meter which measures the electric Energy consumed on the right part of the building by the following electrical loads: • Light: zone 2 ground floor, zone 2 first floor, zone 2 second floor, zone 2 third floor and external (light) M6: meter which measures the electric Energy	Actions: reduction of total energy consumption through the simulated installation of LED lamps.

consumed by the left part of the building by the following electrical loads: • light and driving force: the Enfal Association M7: meter which measures the electric Energy consumed by the left part of the building by the following electrical loads: • light and driving force: underground floor (refectory, ket-board, kitchen, boiler 1) M8: meter which measures the electric Energy consumed by the left part of the building by the following electrical loads: • Light: zone 1 in ground floor M9: meter which measures the electric Energy consumed by the left part of the building by the following electrical loads: • Driving force ground floor zone 1 • Watering • Light and driving force gym M10: meter which measures the electric Energy consumed on the right part of the building by the following electrical loads: • Driving force ground floor zone 2 • Driving force ground floor refectory kindergarden • Rete LAN M11: meter which measures the electric Energy consumed on the right part of the building by the following electrical loads: • light ground floor zone 2 • light ground floor refectory kindergarden • external light M12: meter which measures the electric Energy consumed on the right part of the building by the following electrical loads: • light association • Driving force association **BU2 – UOT Sette Chiese** M1= measurement device of total electric energy (light + driving force) consumed by BU2 M2: measurement device of the electric Energy consumed by the air conditioning heat pump M1+M2: total electric Energy consumed by BU2 **BU3 – Livio Tempesta** M1: measurement device of total electric Energy consumed by BU3 M2: measurement device of total electric Energy by the Ground Floor. **BU4 – Institutional Seat building A** M1: measurement device of total energy consumed by	

BU4 M2: measurement device of electric energy by Anagrafe **BU5 – Institutional Seat building B** M1: measurement device of total energy consumed by BU5 M2: measurement device of electric energy of office lighting **BU6 – I Monelli** M1: measurement device of total electric energy consumed by BU6 M2: measurement device of the electric energy consumed for lighting. **BU7 – Ciliegio Rosa** M1: measurement device of total electric energy consumed by BU7 M2: measurement device of electric energy consumed by the laundry. **BU8 – Aquilone Colorato** M1: measurement device of total electric energy consumed by BU8 M2: measurement device of total electric Energy consumed by the laundry	
BU1 – Cesare Battisti PV: measurement device of the Energy generated by the P.V. **BU3 – Livio Tempesta** PV1: measurement device of the energy generated by the P.V. section 1. PV2: measurement device of the energy generated by the P.V. section 2. **BU5 – Institutional Seat building B** PV1: measurement device of the energy generated by the P.V. section 1. PV2: measurement device of the energy generated by the P.V. section 1. **BU6 – I Monelli** PV: measurement device of the Energy generated by the P.V.	Actions: simulated increase of the Power of Photovoltaic

BU1 – Cesare Battisti PV: measurement device of the Energy generated by the P.V. M1: measurement device of total Energy consumed by BU1 **BU2 – UOT Sette Chiese** M1= measurement device of total electric energy (light + driving force) consumed by BU2 **BU3 – Livio Tempesta** PV1: measurement device of the energy generated by the P.V. section 1. PV2: measurement device of the energy generated by the P.V. section 2. M1: measurement device of total Energy consumed by BU3 **BU4 – Institutional Seat building A** M1: measurement device of total Energy consumed by BU4 **BU5 – Institutional Seat building B** PV1: measurement device of the energy generated by the P.V. section 1. PV2: measurement device of the energy generated by the P.V. section 1. M1: measurement device of total energy consumed by BU5 **BU6 – I Monelli** PV: measurement device of the energy generated by the P.V. M1: measurement device of total energy consumed by BU1 **BU7 – Ciliegio Rosa** M1: measurement device of total eneròy consumed by BU7 **BU8 – Aquilone Colorato** M1: measurement device of total energy consumed by BU7	Odysseus tool: simulation of a network for the more efficient distribution of solar energy: i.e. to transfer energy from energy generation nodes to energy consumption nodes;

So Odysseus is an important tool that supports the decision maker suggesting, through the monitoring system and the dEPC, the more efficient actions to generate energy saving opportunities:

Odysseus recommends, through the analysis and elaboration of the monitoring system data, the most efficient solution to obtain the desired results to archive energy savings, to avoid waste of energy, to reduce CO2 emissions, aiming to obtain the energy surplus and suggesting the most efficient use of the energy in excess (energy saving opportunities).

Odysseus analyses the reported values (data) of the electricity consumption and the production of the electric energy and also analyses the values of the electricity consumption even measured by the other meters and send data in real time to the portal of Odysseus.

The evaluation of energy savings opportunities is measured by the KPIs before(baseline period) and after (reporting period) the implementation of the suggested measures.

Odysseus analysis proposes the actions (decision support to the facility manager or the energy manager), even if simulated (dEPC that describes the energy profile of the building), in order to reduce energy consumption and to obtain the electric energy in excess.

These recommended actions consist in:

- replacing fluorescent lamps with LED lamps (Odysseus suggests the more efficient actions (ECMs): replacing bulb lamps with led lamps, the optimal and right number of lamps, the power of them and the areas/zones of the building where to install the Led lamps and the alternative results of the actions, the compared scenarios and related energy savings, costs and benefits) in some areas of the building, with the prediction of mechanisms of automatic lights-off and / or of illumination reduction depending on the external light and increasing the power of the photovoltaic plant.

- transferring the energy excess from one building to another (depending and measuring energy needs demand) to supply its energy demand, at least during the holidays when schools are closed, without giving back the energy in excess to the Acea grid,

- recharging with the energy inn excess, the batteries of the electrical bicycles reducing Co2 impact;

- simulating bidirectional energy flows for energy generation and energy consumption through a desired independent grid of energy exchange(an integrated energy management system) that manages the energy surplus in the most efficient way satisfying the energy demand of the other buildings, smartly integrating the actions of all users that are connected.

Odysseus solutions offer to the decision maker the most efficient way to obtain energy savings, reduction of energy wasting, reduction of CO2 emissions, the energy surplus obtained, the most efficient use of the energy excess in order to understand the goodness of the actions.

The conclusion will report the results of the application of the tools developed in Odysseus which include dynamic energy profiling of buildings and an Urban Energy Management system which are necessary for managing energy flows

Odysseus analyses the reported values (data) of the electricity consumption and the production of the electric energy and also analyses the values of the electricity consumption even measured by the other meters and send in real time to the portal of Odysseus. Odysseus analysis proposes the actions (decision support to the facility manager or the energy manager), even if simulated (dEPC and energy profile of the building), in order to reduce energy consumption and to increase the electric energy generated. These actions may consist in replacing fluorescent lamps with LED lamps (Odysseus suggests the more efficient actions (ECMs): replacing bulb lamps with led lamps, the number of lamps, the power of them and the areas of the building where to install the Led lamps and the alternative results of the actions, the compared scenarios and related energy savings, costs and benefits) in some areas of the building, with the prediction of mechanisms of automatic lights-off and / or of illumination reduction depending on the external light and increasing the power of the photovoltaic plant.

The key tools are:

The monitoring system

The dEPC

The analysis of Odysseus tools

The comparison of results before and after the implementations of Odysseus recommended actions and the measure of the results by the KPIs.

Attached the schools and the consumption/monitoring system/tools.