



# POWERITY

Interreg Europe



European Union  
European Regional  
Development Fund

**Final Event**

**14 June 2023**

**Seville**

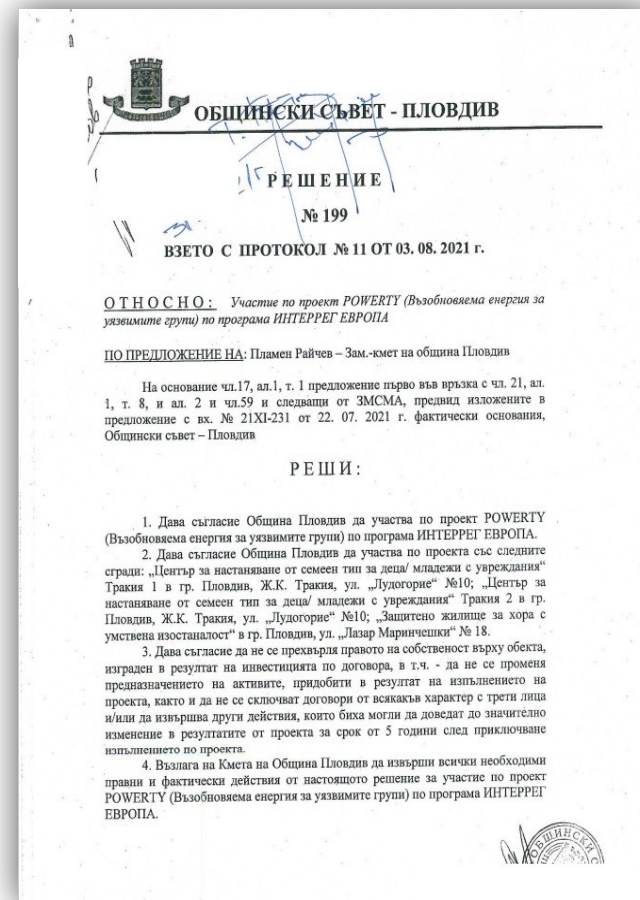
# Key renewable energy technologies, tools and methods that are best adapted to the vulnerable groups to improve their quality of life

- Technologies- PV+ storage, PVT, Solar thermal
- Methodology steps – problem diagnostic, action plan, execution
- Ongoing practices in Bulgaria related to the support of the most vulnerable groups are limited to the provision of short-term financial support without focusing on sustainability matters
- Lack of innovative practices - there is urgent need to establish innovative practices and protect end users through renewable energy
- PV+BESS systems are providing competitive renewable power to cover building needs.

# Pilot Action Bulgaria implementation phases

An agreement has been reached with the Municipality of Plovdiv to provide the pilot buildings

Municipality of Plovdiv to provide co-financing of 10 % of the pilot installations - officially voted in local Parliament



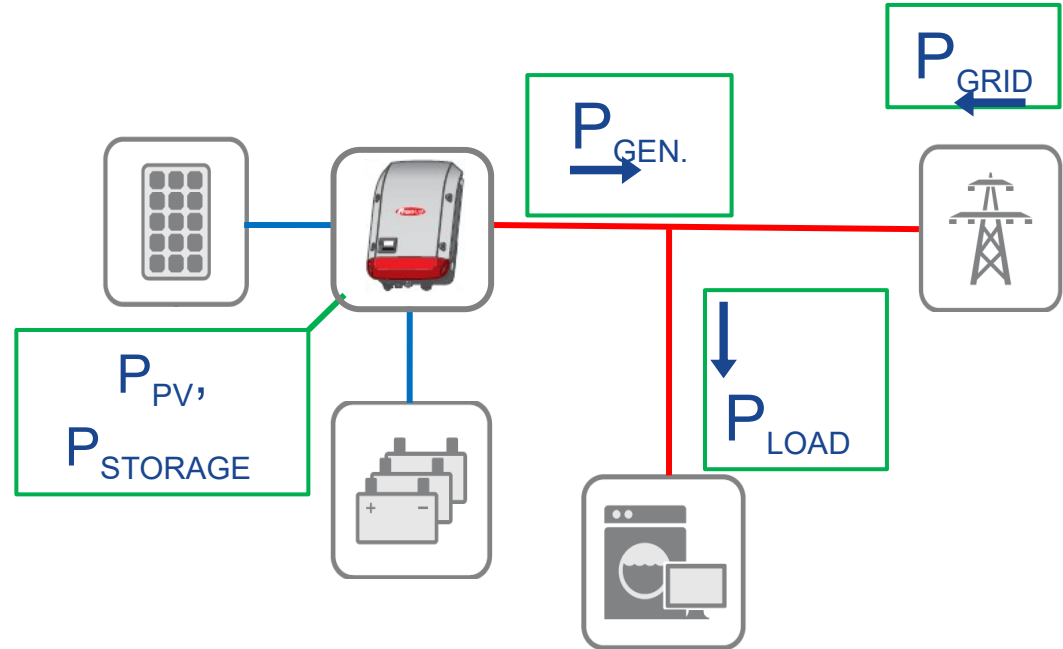
- 3 Pilot social centers are identified among a list of 7 buildings, all belonging to KSU “St. St. Constantine and Helena”- Plovdiv
- Buildings selection methodology was applied given POWERITY budget limitations and to achieve max. impact
- Energy class B, Buildings have external wall and roof insulation, HVAC systems for heating/cooling
- Preliminary training activities on the possible impact of PV+BESS



## Hybrid of PV plus Battery Energy Storage System in social housing

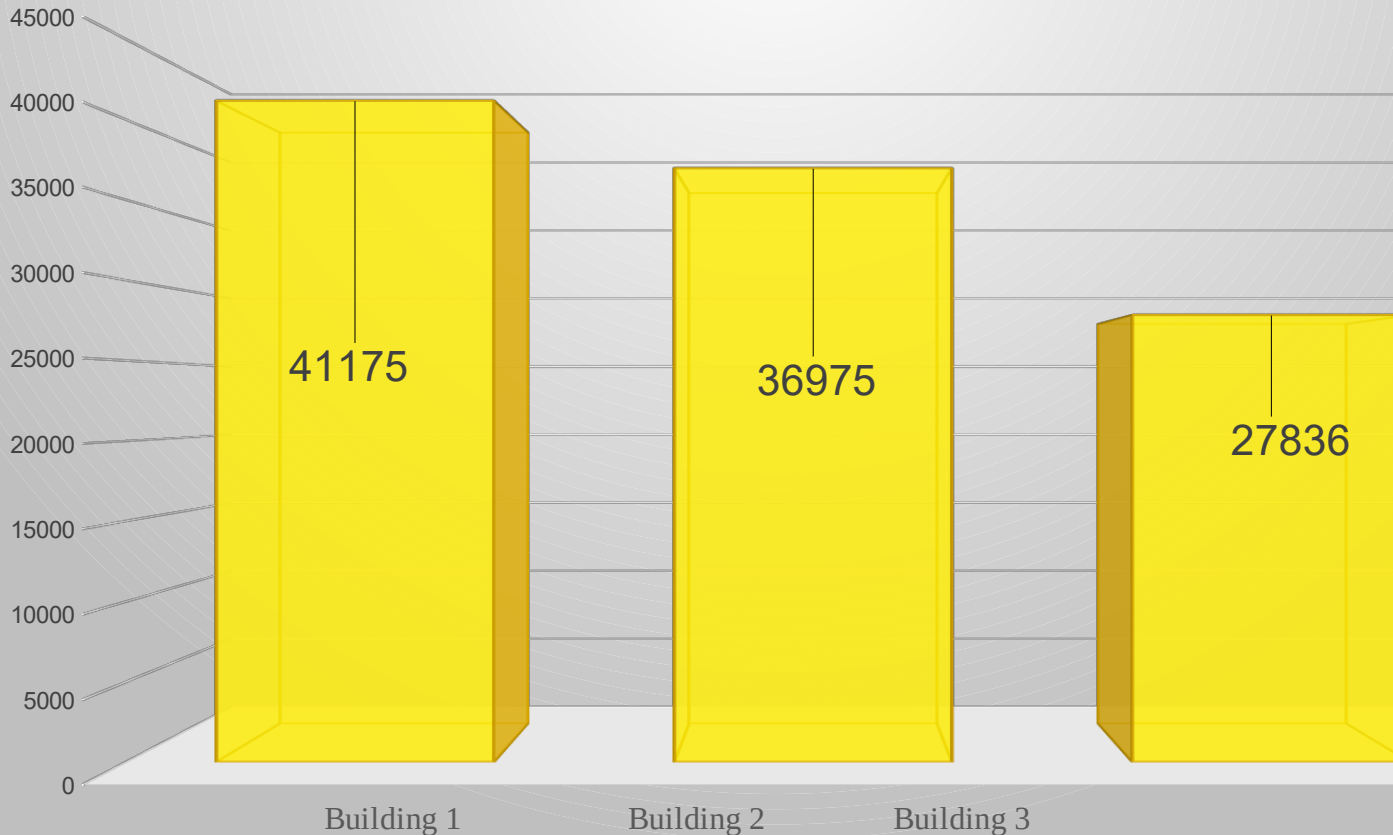
The project tests the impact of innovative hybrid of **PV plus Battery Energy Storage System (PV+BESS)** within 3 social building

- as a possible solution pilot buildings (consumers) to achieve significant share of **renewable self-consumption and self-sufficiency**
- to decrease on-site electricity bills, further contributing to the decarbonisation of the energy system.



Energy consumption and load patterns are studied for each building

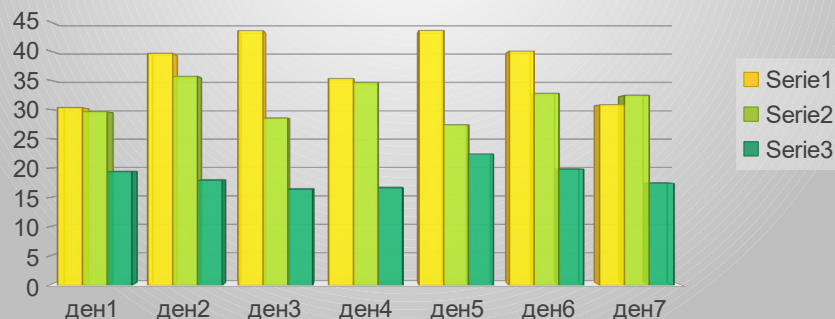
## Annual electricity consumption



To design installed capacities daily and hourly load patterns are studied for each building

Analysis of night electrical loads between (19.00 - 9.00)

### Daily consumptions in August



30.08.2021 19:00	3.862	1.650	1.072
30.08.2021 20:00	4.815	4.252	0.802
30.08.2021 21:00	3.915	4.095	2.272
30.08.2021 22:00	3.832	2.610	3.465
30.08.2021 23:00	2.910	1.252	0.840
31.08.2021 00:00	1.088	1.110	0.690
31.08.2021 01:00	1.500	1.012	0.735
31.08.2021 02:00	3.435	3.000	0.615
31.08.2021 03:00	1.028	2.738	0.592
31.08.2021 04:00	1.042	0.728	0.578
31.08.2021 05:00	3.728	0.735	0.518
31.08.2021 06:00	1.162	1.035	3.352
31.08.2021 07:00	0.975	2.805	1.732
31.08.2021 08:00	2.738	2.580	0.630

Day 1	30.278	29.602	19.364
Day 2	39.555	35.656	17.893
Day 3	43.418	28.524	16.342
Day 3	35.241	34.612	16.589
Day 5	43.448	27.382	22.382
Day 6	39.938	32.722	19.807
Day 7	30.781	32.393	17.369
AVERAGE	37.5	31.6	18.5

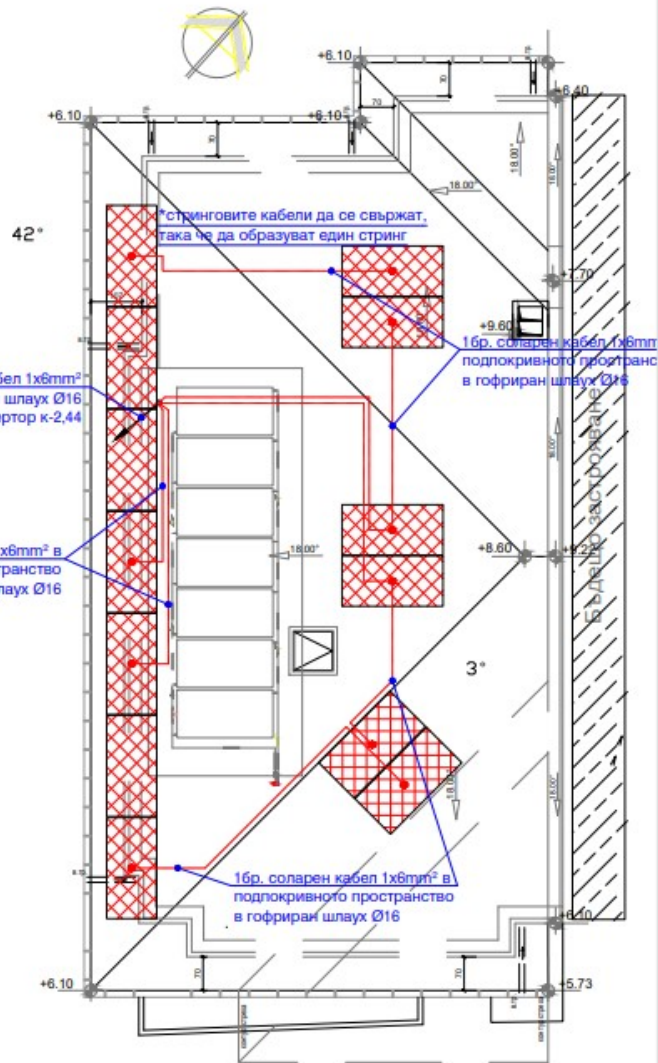
**Building 1:** Installed power 9,9 kWp and battery capacity 34.80 kWh

**Building 2:** Installed power 9,9 kWp and battery capacity 34.80 kWh

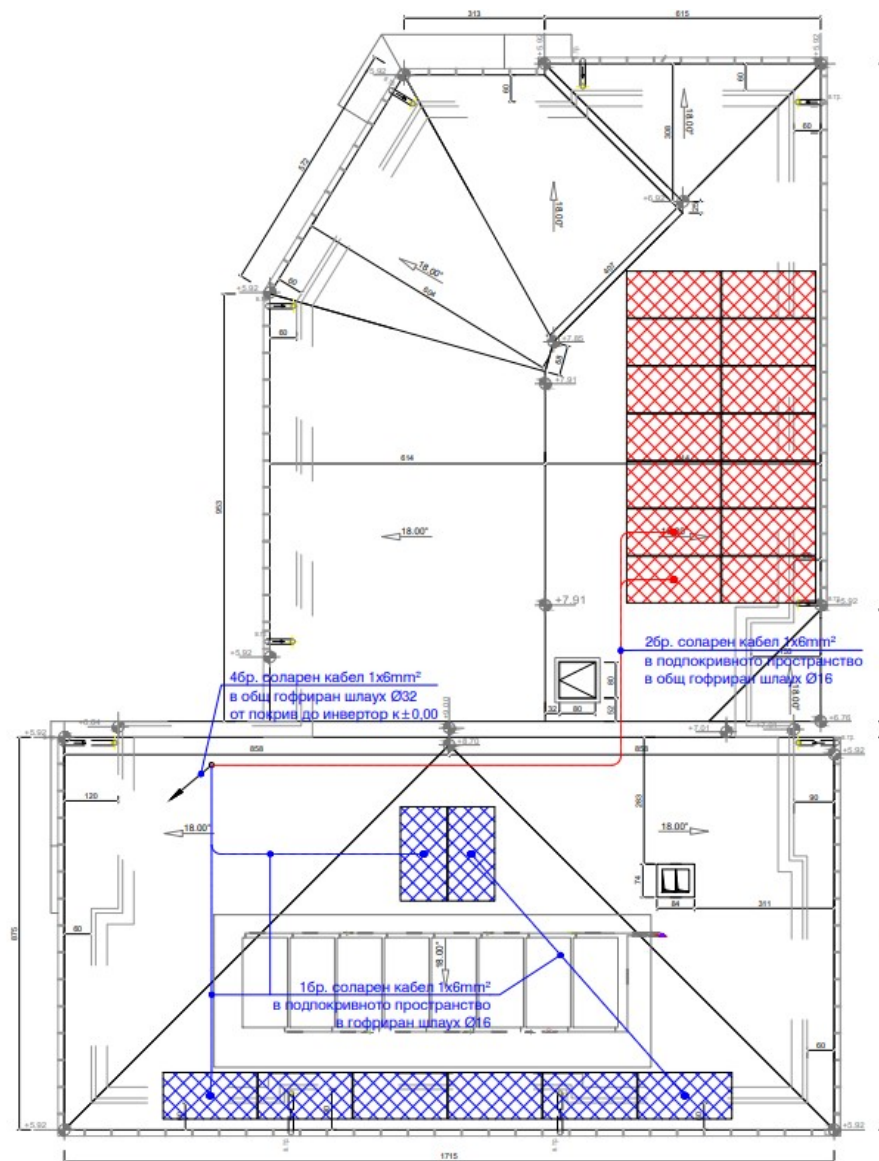
- **Building 3:** Installed power 5,85 kWp and battery capacity 11.60 kWh

**In total – 25.6 kWp PV + 81,2 kWh BESS**





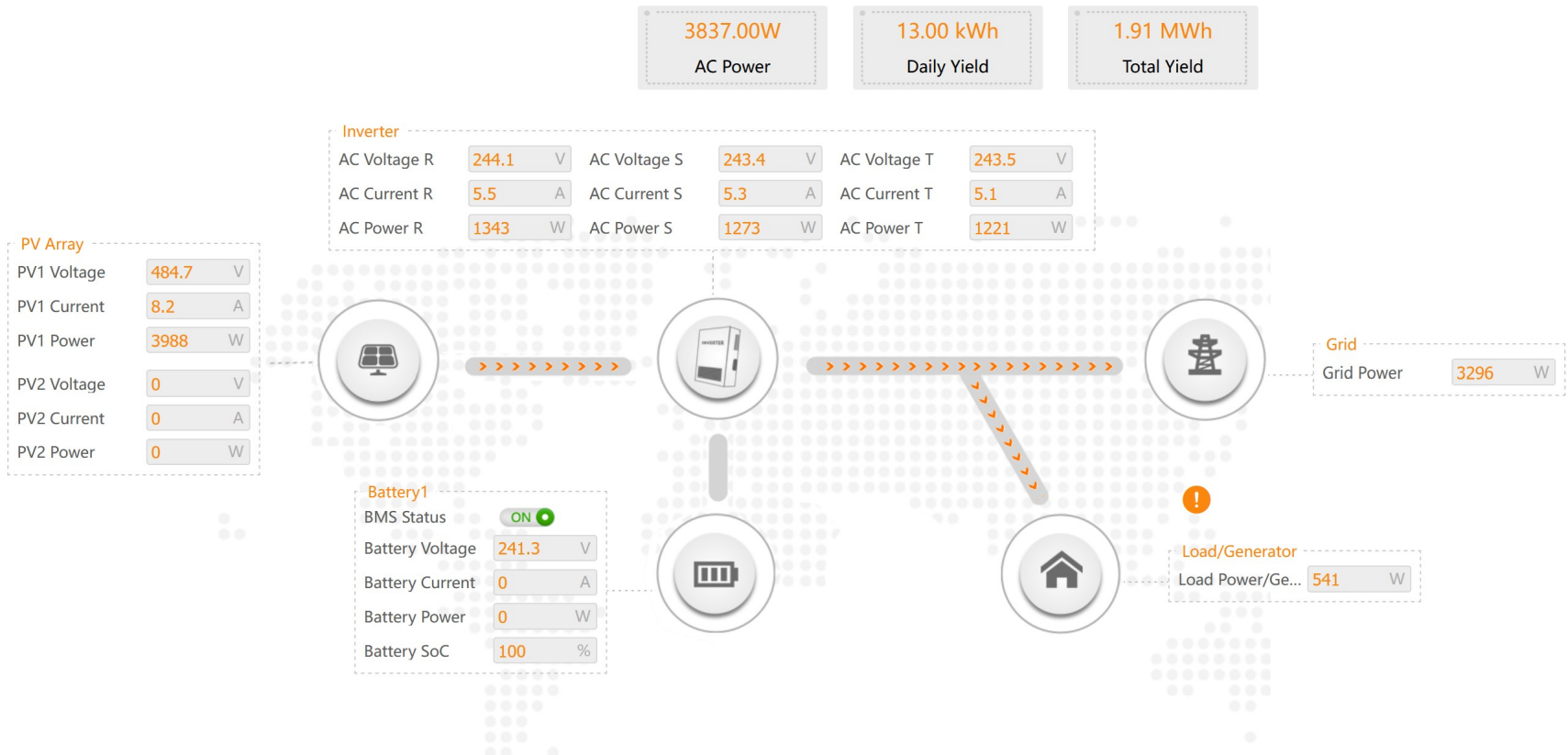
2бр. в общ



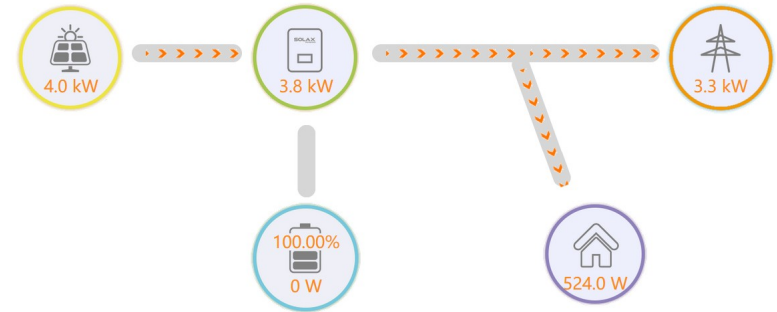
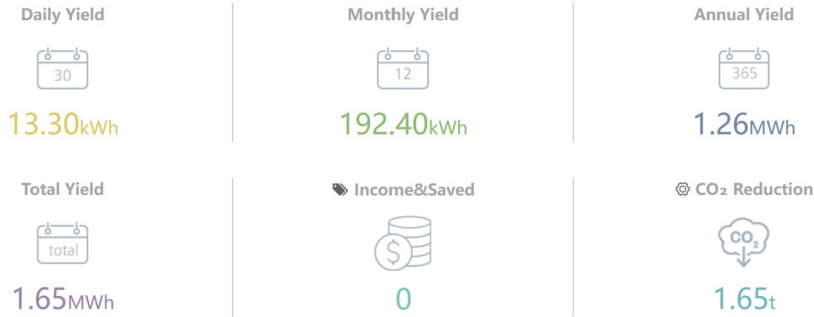
# Pilot Action Bulgaria – the installations



## Hybrid of PV plus Battery Energy Storage System in social housing



## Hybrid of PV plus Battery Energy Storage System in social housing

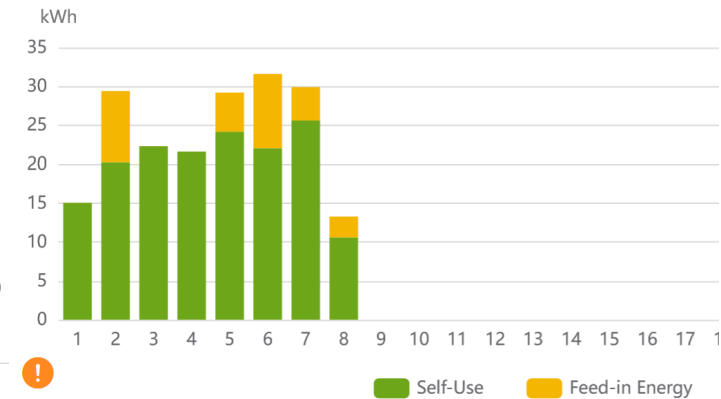
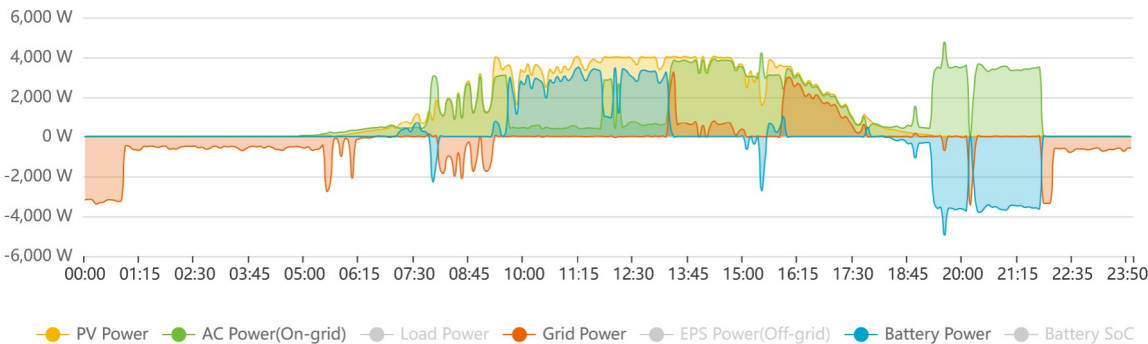


Power

< 2023-06-07

Energy Diagram

Yield



## Building 1 & 2: Estimated Total PV power generation from 9,9 kWp = 14,7 MWh

### Summary

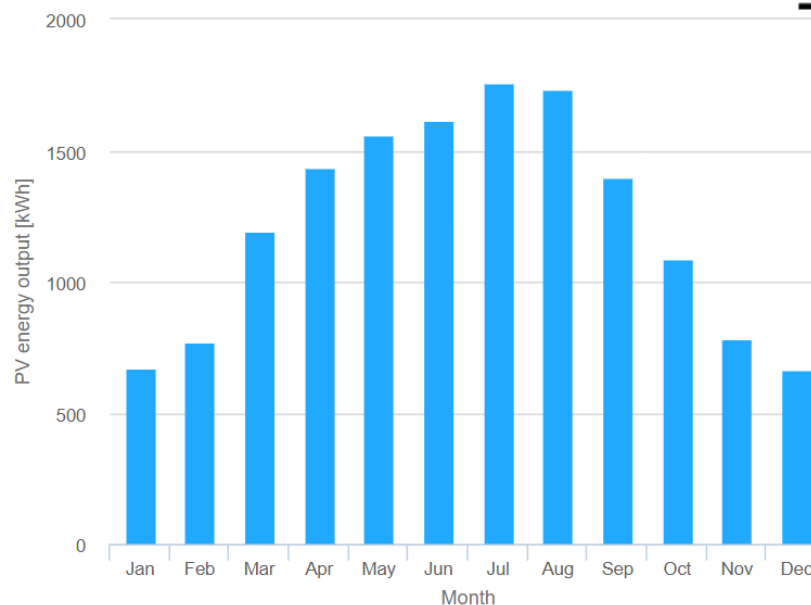
#### Provided inputs:

Location [Lat/Lon]:	42.142,24.753
Horizon:	Calculated
Database used:	PVGIS-SARAH2
PV technology:	Crystalline silicon
PV installed [kWp]:	10
System loss [%]:	4

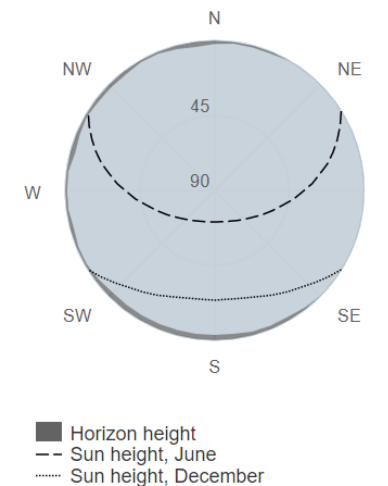
#### Simulation outputs:

Slope angle [°]:	22
Azimuth angle [°]:	0
Yearly PV energy production [kWh]:	14677.69
Yearly in-plane irradiation [kWh/m <sup>2</sup> ]:	1692.09
Year-to-year variability [kWh]:	715.15
Changes in output due to:	
Angle of incidence [%]:	-2.85
Spectral effects [%]:	0.81
Temperature and low irradiance [%]:	-7.74
Total loss [%]:	-13.26

### Monthly energy output from fix-angle PV system



### Outline of horizon



## Building 3: Estimated Total PV power generation from 5.8 kWp = 8,5 MWh

### Summary

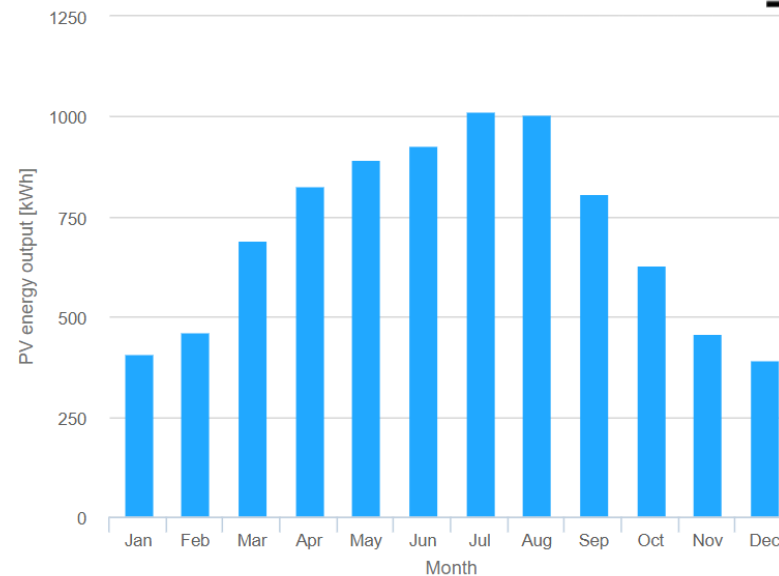
#### Provided inputs:

Location [Lat/Lon]:	42.138,24.745
Horizon:	Calculated
Database used:	PVGIS-SARAH2
PV technology:	Crystalline silicon
PV installed [kWp]:	5.8
System loss [%]:	4

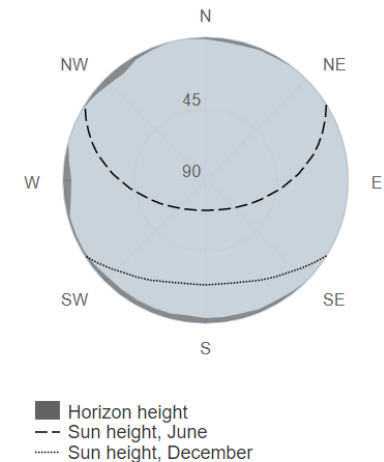
#### Simulation outputs:

Slope angle [°]:	22
Azimuth angle [°]:	0
Yearly PV energy production [kWh]:	8508.21
Yearly in-plane irradiation [kWh/m <sup>2</sup> ]:	1690.11
Year-to-year variability [kWh]:	432.44
Changes in output due to:	
Angle of incidence [%]:	-2.86
Spectral effects [%]:	0.82
Temperature and low irradiance [%]:	-7.68
Total loss [%]:	-13.2

### Monthly energy output from fix-angle PV system



### Outline of horizon



## B1: PV power generated 14,7 MWh

- direct consumption & BESS 12.1 MWh
- Excess to the grid 2.6 MWh
- ~ 30 % of self-sufficiency

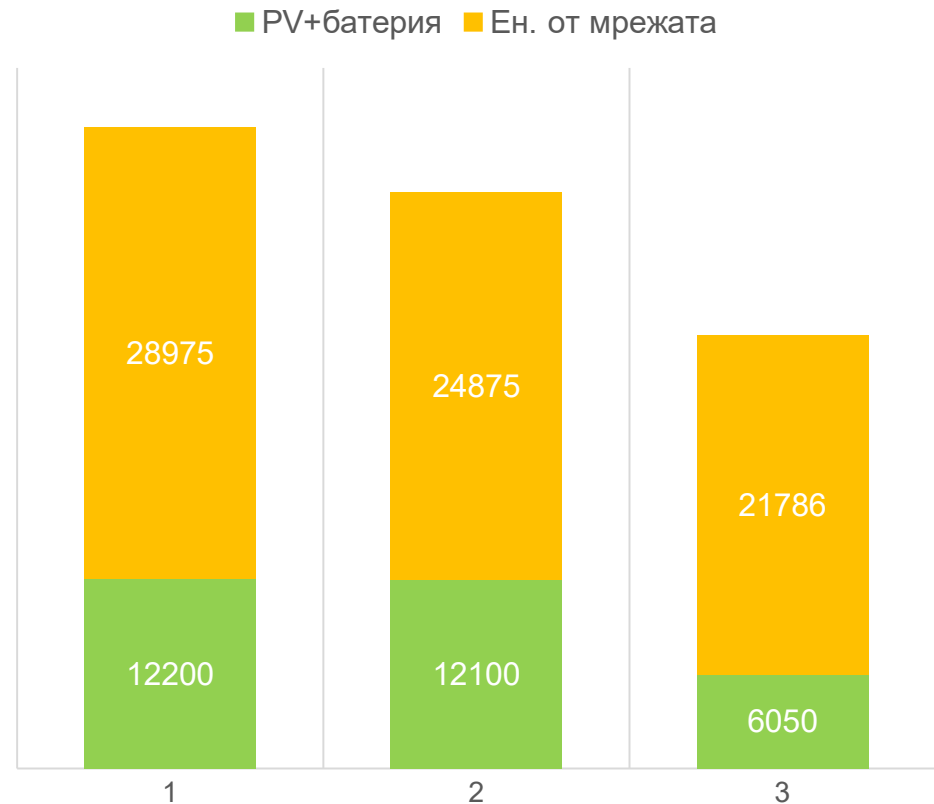
## B2: PV power generated 14,7 MWh

- direct consumption & BESS 12.1 MWh
- Excess to the grid 2.6 MWh
- ~ 30 % of self-sufficiency

## B3: PV power generated 8.5 MWh

- direct consumption & BESS 6.1 MWh
- Excess to the grid 2.4 MWh
- ~ 22 % of self-sufficiency

## SELF-SUFFICIENCY SHARE



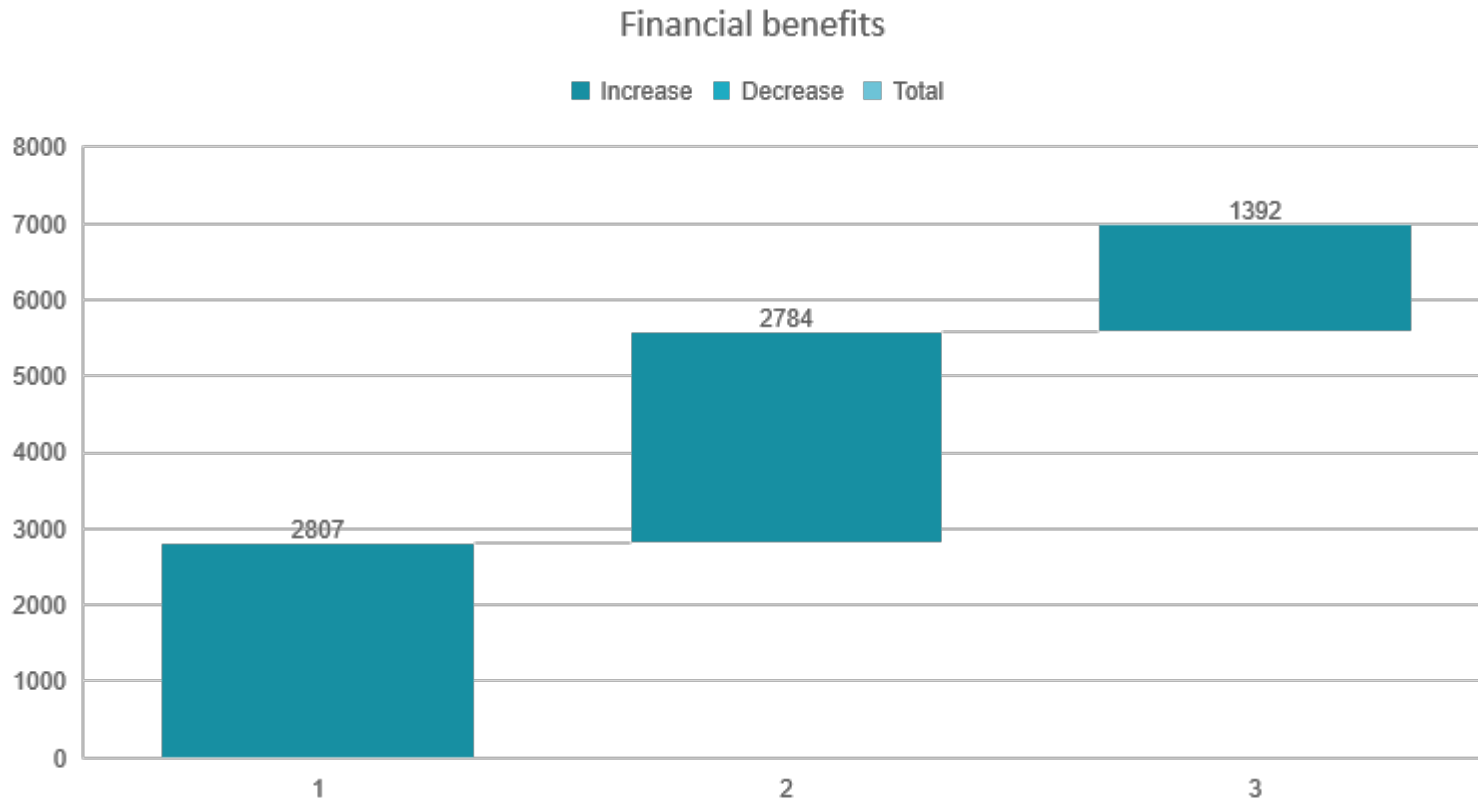
Additional estimated impact from implementation of the practice:

- Social buildings with reduced electricity costs – 3
- Renewable energy produced – 37.65 MWh/year
- Self-consumed renewable energy – 30.35 MWh/year ~ 80 % of self-consumed RE
- Excess power 7.3 MWh/year
- CO2 avoided -30.83 t/year
- Potential direct financial savings– 6980 €/year / 230 €/ MWh
- Further profit from excess power - 670 €/year / 92 €/ MWh
- Total savings 7650 €/year
- Investment **€55,100 without VAT** (€ 6500 funding of the Municipality)
- Payback 7.2 years



# Pilot Action Bulgaria – FINANCIAL IMPACT

- Total financial savings € 7650 without VAT / year.
- Investment **55,100 without VAT** (€ 6500 funding of the Municipality)
- Payback period 7.2 years



- National legislation still lacks simplified procedures for PV construction permission and connection of a power plant to the electricity distribution network
- In some cases, even small installations, such procedures could take several months (up to 3-÷6 months) and is backed up with bureaucracy
- Local distribution companies and grid operators are not very cooperative with regards to prosumers even in case of vulnerable groups

- new set-up of the city energy systems and planning for new energy efficiency measures in the public buildings
- proved valuable, novel experience for the users
- proved significant energy reduction results and facilitated for further improvement of their energy status
- Demonstration of a solution to an urgent problem -the sharp increase of the energy prices that puts tension on buildings with high number of vulnerable consumers
- long- term support with a focus on sustainability matters
- emphasizes the need of innovative practices to protect end users through renewable energy

- **Data and performance monitoring** including energy generation and storage, grid consumption, to validate results and benefits
- **Evaluation of impact** – this deals with **technical data analyses, environmental analyses**, such as **CO<sub>2</sub> emissions avoidance, economic results**, such as the reduction of the energy bills and social acceptance and vulnerability changes status, such the **decreased energy costs**.
- Final step - **Facilitate Municipal programme** for installing PVs for self-consumption and Battery Energy Storage systems (BESSs) in social buildings



# POWERITY

Interreg Europe



European Union  
European Regional  
Development Fund

Thank you!  
Angelina Tomova  
Energy Agency of Plovdiv  
e-mail: [angelina.tomova@eap-save.eu](mailto:angelina.tomova@eap-save.eu)