

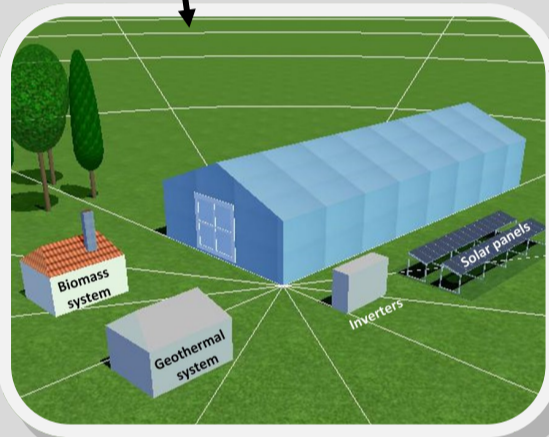
Analysis and Optimization of a Geothermal, Biomass, Solar Hybrid System: An Application of PV*Sol Software

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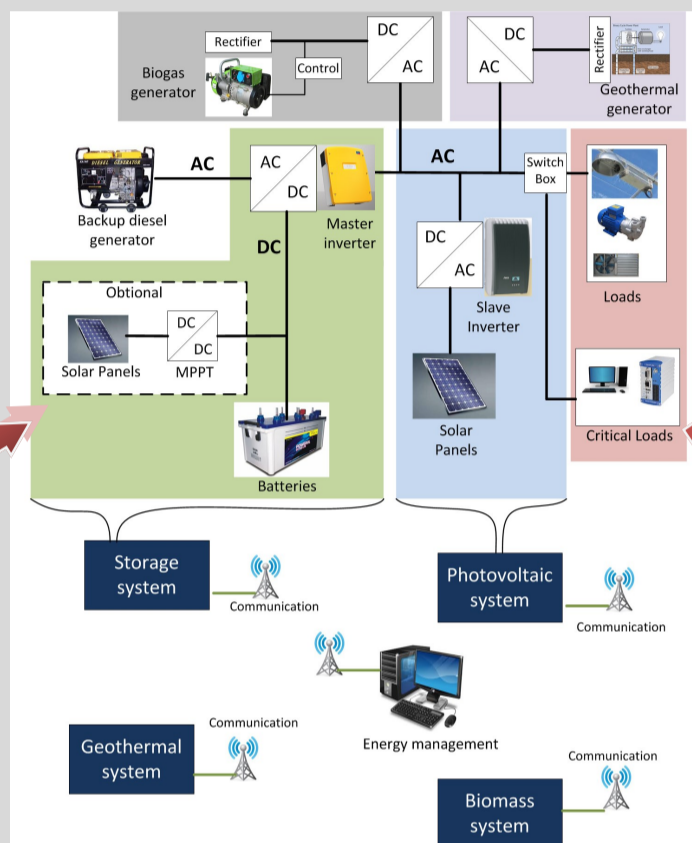
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Abstract: The paper presents the techno-economic analysis and optimization of a hybrid renewable energy system composed of solar panels, batteries a geothermal generator and a biomass generator in the region of Oradea, Romania that is intended to supply a vegetable greenhouse.

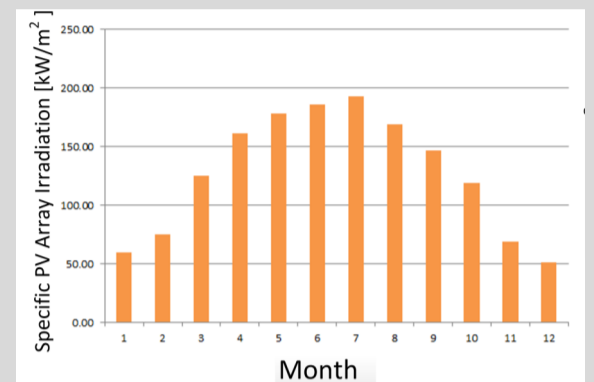
PROPOSED MICROGRID



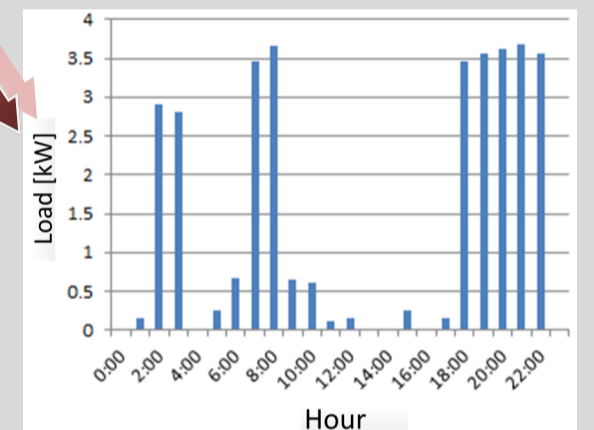
Greenhouse



Proposed Microgrid



Solar irradiation



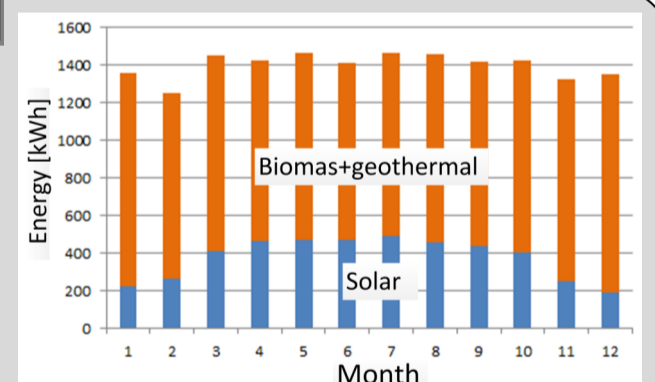
Load profile

OPTIMIZATION AND RESULTS

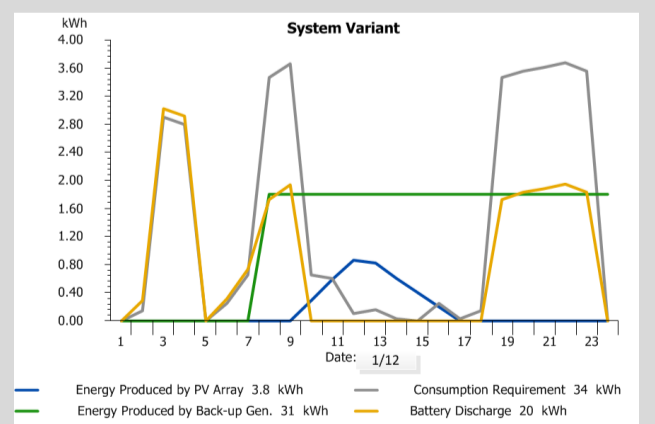
It was calculated that the hybrid renewable energy system needs 14 solar panels, eight 230Ah solar batteries, and a minimum of 2kW cumulated power of the geothermal and biomass generators. The system was simulated in PV*Sol and it can be concluded that the simulations agree strongly with the calculations.

BACK-UP GENERATOR			
Output Range [kW]	0.0 - 1.8	0.0 - 2.0	0.0 - 2.2
SIMULATION RESULTS			
Consumption Not Covered by System [kWh]	0.4	0	0
PV Array Surplus [kWh]	387	651.5	973.5
Energy Produced by Back-up Gen. [kWh]	11,959.80	12,267.20	12,518.60
Solar Fraction [%]	21.2	19.4	17.2
Performance Ratio [%]	49.6	45.4	40.3
System Efficiency [%]	7.5	6.8	6.1

BATTERY			
Number	12	8	4
Total Capacity [kWh]	33.1	22.1	11
SIMULATION RESULTS			
Direct Use of Back-up Gen. Energy [kWh]	4,155.90	4,253.50	5,590.30
Consumption Not Covered by System [kWh]	0	0	1,210.20
PV Array Surplus [kWh]	189.2	651.5	1,901.10
Solar Fraction [%]	22.5	19.4	11
Performance Ratio [%]	52.8	45.4	25.8
System Efficiency [%]	8	6.8	3.9



Energy produced



Operation scenario

ACKNOWLEDGEMENT

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