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INTEGRATION OF ROOFTOP PHOTOVOLTAICS AND COGENERATION FOR DECARBONISING THE MARGARINE PRODUCTION PROCESS

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INTRODUCTION

- The paradigm of industrial decarbonization in the food industry - the electrification of the process, which necessitates the delivery of greater quantities of renewable electricity (RES).
- One of the primary ways to use RES locally in industry is to produce electricity from solar energy using PV (photovoltaic) panels. PV panels are typically installed on the available roof surfaces of production halls.
- It is practically impossible in a food industry company to get all the electricity from PV panels due to the considerable energy requirements for food production and processing.
- The emission factor of the electrical grid, to which the company is connected, has a big impact on the overall emissions.
- Cogeneration (CHP) as the most effective technique for simultaneous generation of electricity and heat is recommended too.
- The goal is to define a method for selecting the best technological approach for the combined use of rooftop PV and CHP.

MATERIAL AND METHOD

- Energy Flow Analysis - ISO 50002:2014 (energy audits) – results: energy vs. production volume dependencies, monthly electricity and heat profiles, current CO_2 footprint
- PV potential (PV-GIS) + constraints (approved power, electricity consumption profile, available roof area, prosumer status)
- CHP potential (available fuel + heat/electricity consumption profile, base load)
- Optimization (linear programing) - objective function: minimization of CO_2 emissions
- Sensitivity analysis includes the variation of production volume

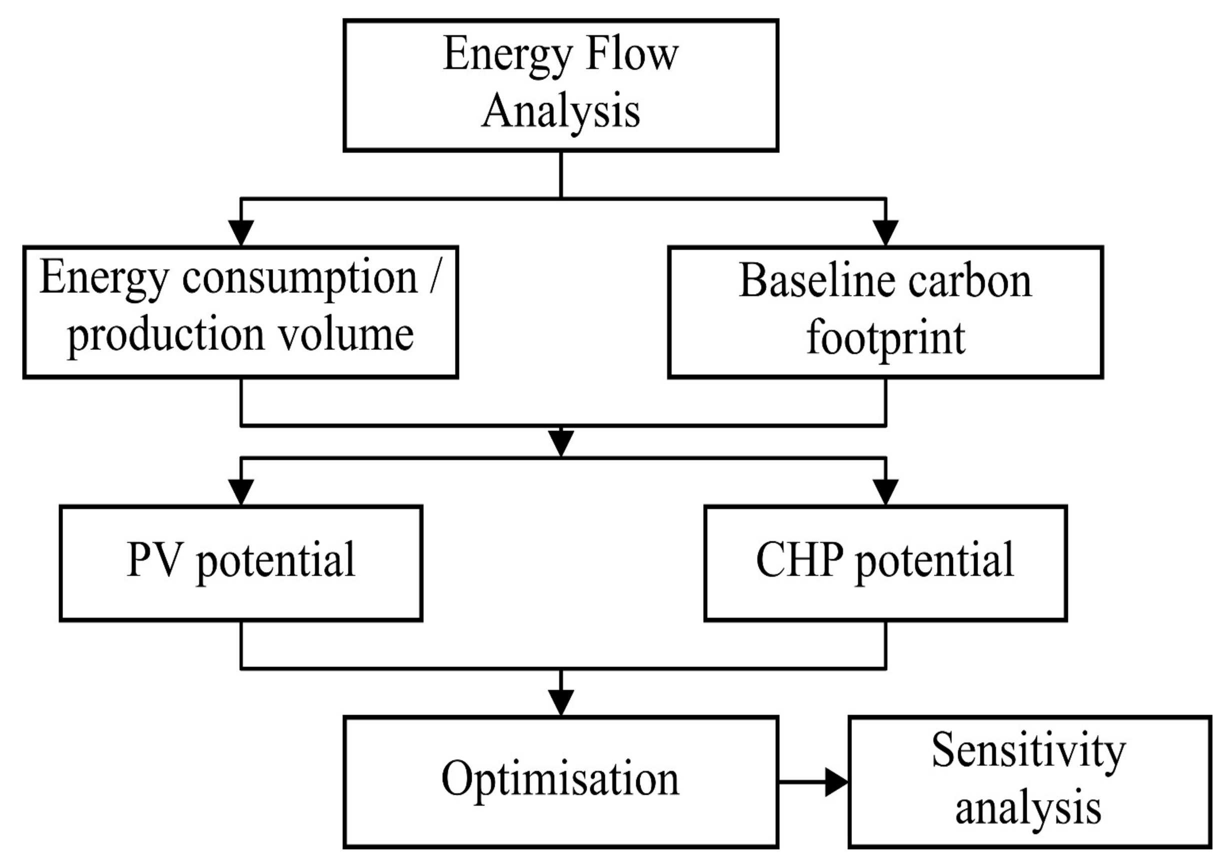

Fig. 1. Methodology for determining the optimal solution for the integrated application of rooftop PV panels and cogeneration

RESULTS AND DISCUSION

- Case study - margarine production facility in Serbia

Table 1. Baseline carbon footprint

	MWh	t/MWh	tCO_2
Natural gas	712.83	0.2	142.57
Electricity	655	0.763	499.77
Σ			642.33

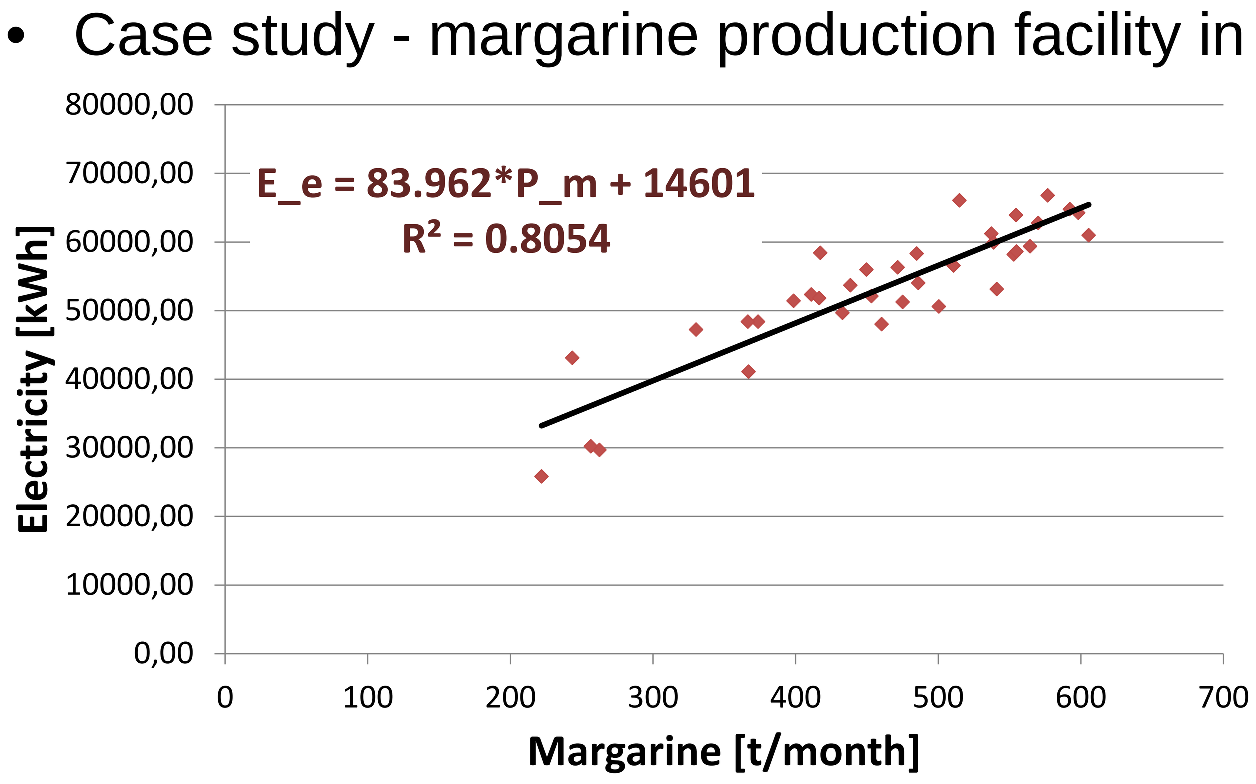

Fig. 2. Monthly electricity consumption vs. production volume

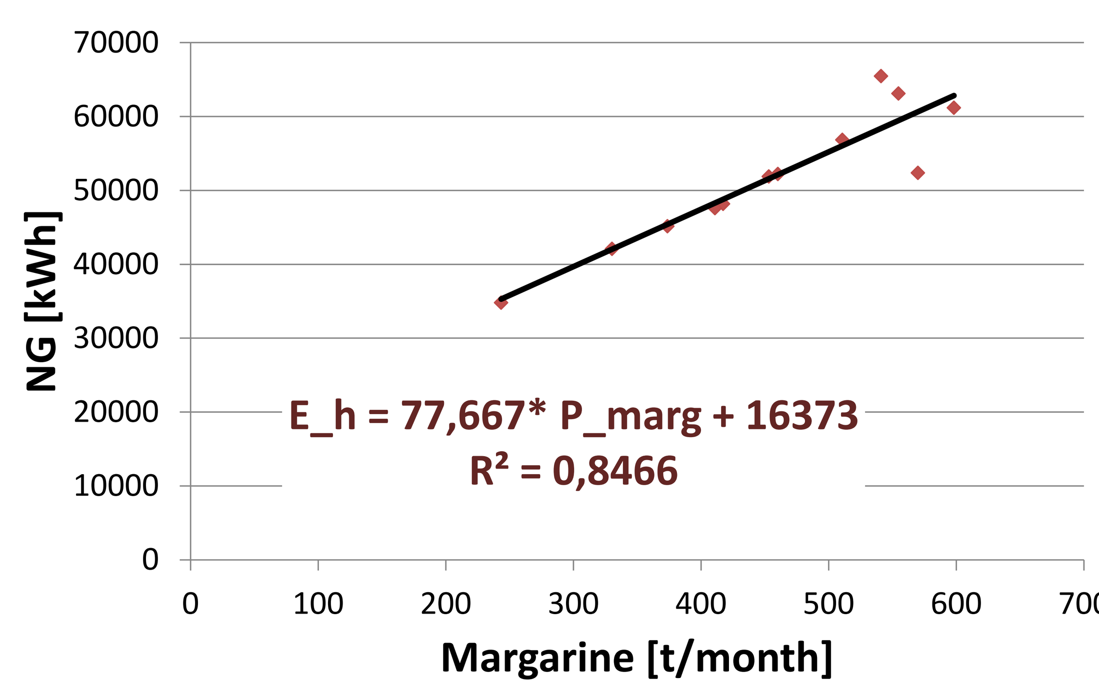

Fig. 3. Monthly natural gas consumption vs. production volume

- Two scenarios for PV: the whole available roof area: 311 kW PV and bylaw limited version 150 kW PV + gas motor CHP (40 kW_e/65 kW_t)

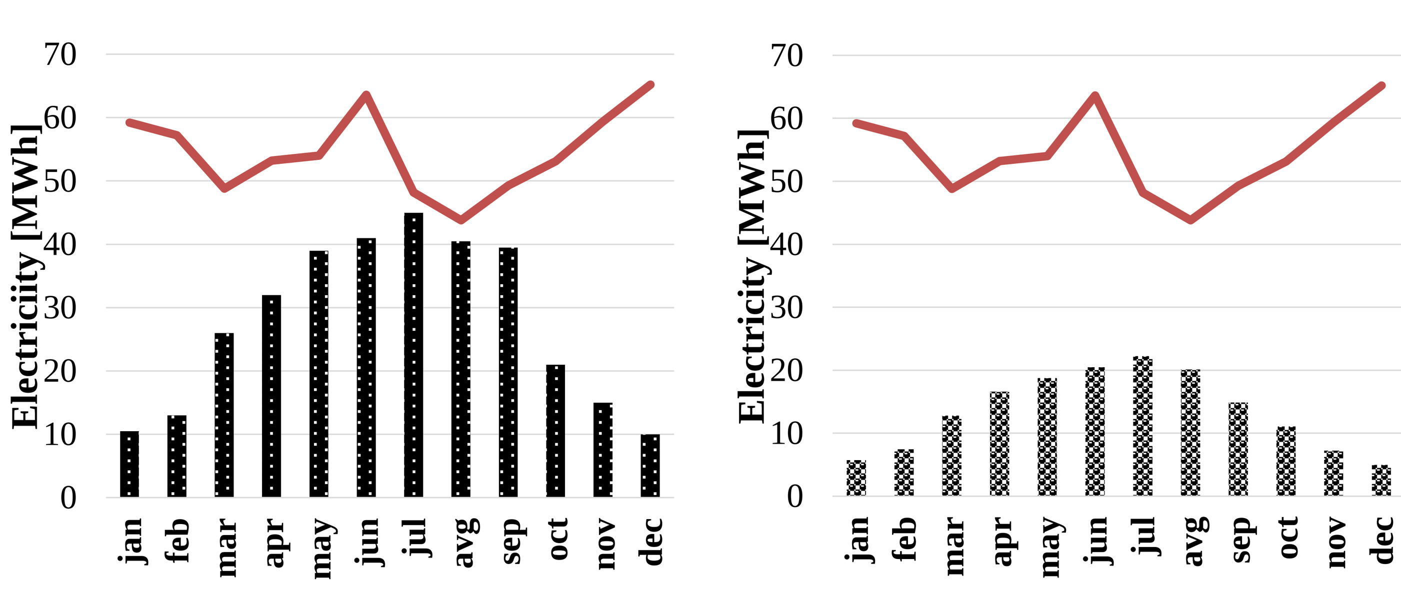

Fig. 4. Electricity production from PV 311 kW and 150 KW respectively

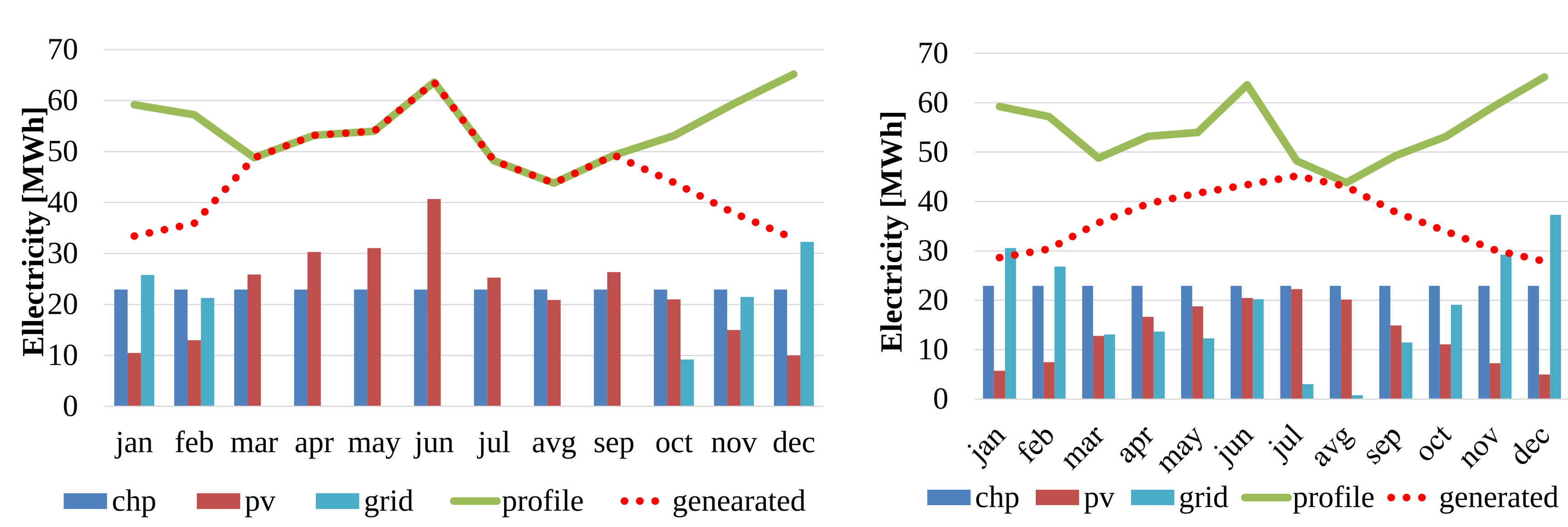

Fig. 5. Electricity production from PV (311 kW and 150 KW respectively) and electricity/heat from CHP

CONCLUSION

- Integral application of PV and CHP in a food industry company, significant reductions in CO_2 emissions can be achieved.
- In the specific company, the reduction of total CO_2 emissions is 44.5%, i.e. 56%, in case there is no change in the volume of production, the emission factor of the electric network and the amount of heat energy for heating buildings.

Key words: food industry, decarbonization, PV panels, cogeneration.