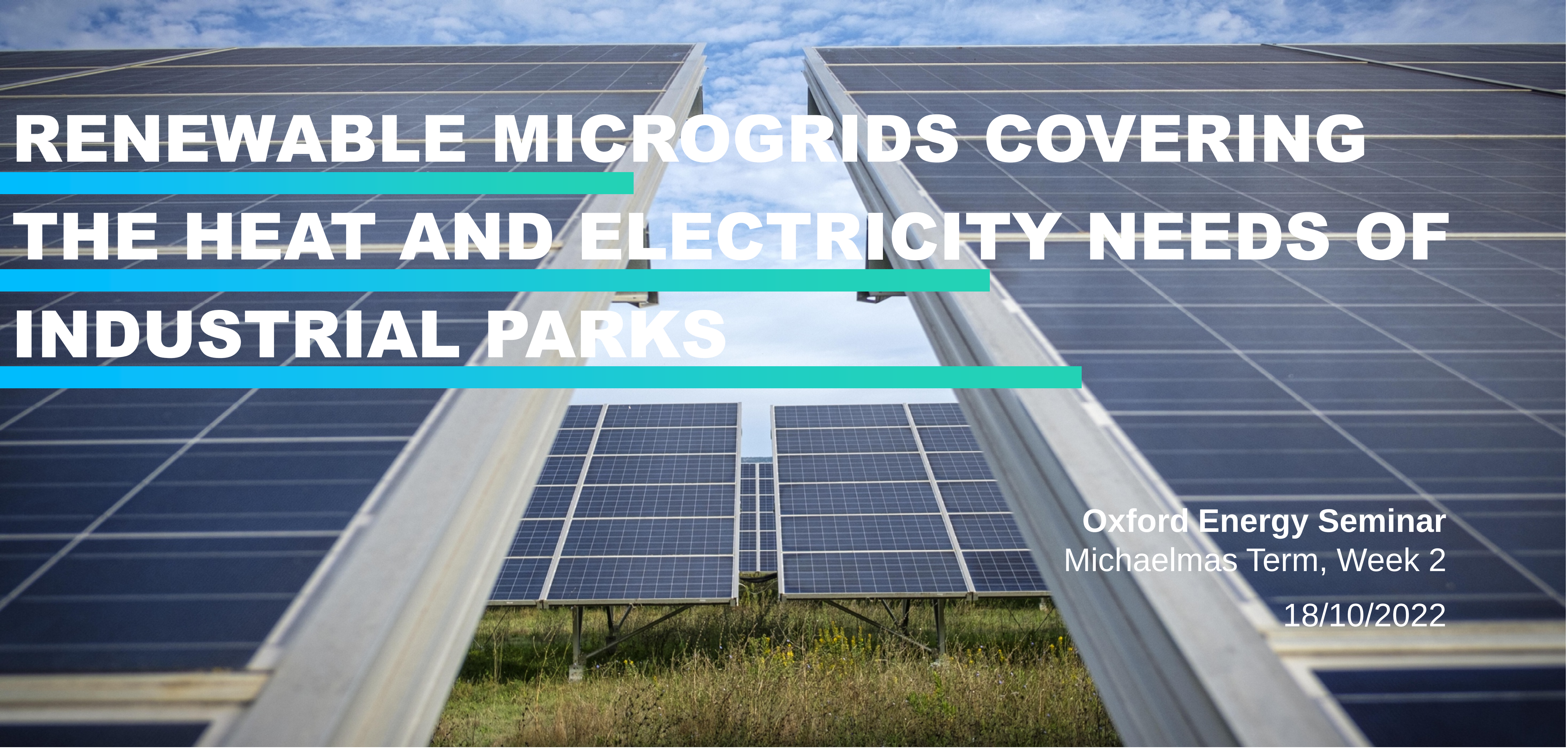


RENEWABLE MICROGRIDS COVERING THE HEAT AND ELECTRICITY NEEDS OF INDUSTRIAL PARKS

Oxford Energy Seminar
Michaelmas Term, Week 2

18/10/2022

Eflamm GUEGUEN
MSc Energy System Graduate, University of Oxford
Consultant in Strategy at ENGIE

Presentation

Education

Oxford University – Oxford, United Kingdom **October 2020 – June 2021**
MSc in Energy Systems
Study the energy system on a technical, political, economic point of view to make it more sustainable in the future.

EDHEC Business School – Nice, France **September 2017 – September 2020**
Finance Economics degree – Double Degree with Ecole Centrale de Lille – Grande Ecole
MSc in Corporate Finance and Banking.

École Centrale - Lille, France **September 2015 – September 2020**
Engineering degree – Grande Ecole

Experiences in Energy Decentralization

University of Oxford & Veolia – *Academic Master Thesis*

- **“Renewable microgrids covering heat and electricity needs of industrial parks.”**
- Creation of a sizing and identification methodology of renewable microgrids for industrial parks.
- Publication and participation to ECEEE Summer Study 2022.

EDHEC Business School – *Academic Master Thesis*

- **“Mini grids optimal portfolio strategy: aggregating diverse mini grid technologies.”**
- Study of the impact of power generation diversification (biomass, solar PV and hydro) on the risk return profile of a portfolio of mini grids.
- Publication in *The Handbook of Energy Policy* (2022), F.Taghizadeh-Hesary & D.Zhang. Award winner of the Veolia 2020 Performance Trophy and GARP Research Fellowship.

EDF R&D Singapore Lab – *Research Intern*

- Creation of strategy and tools enabling the development of microgrid projects in Southeast Asia.
- Launch of pilot projects in Myanmar and Indonesia.

Motivation

Sustainability

Affordability

Security of supply

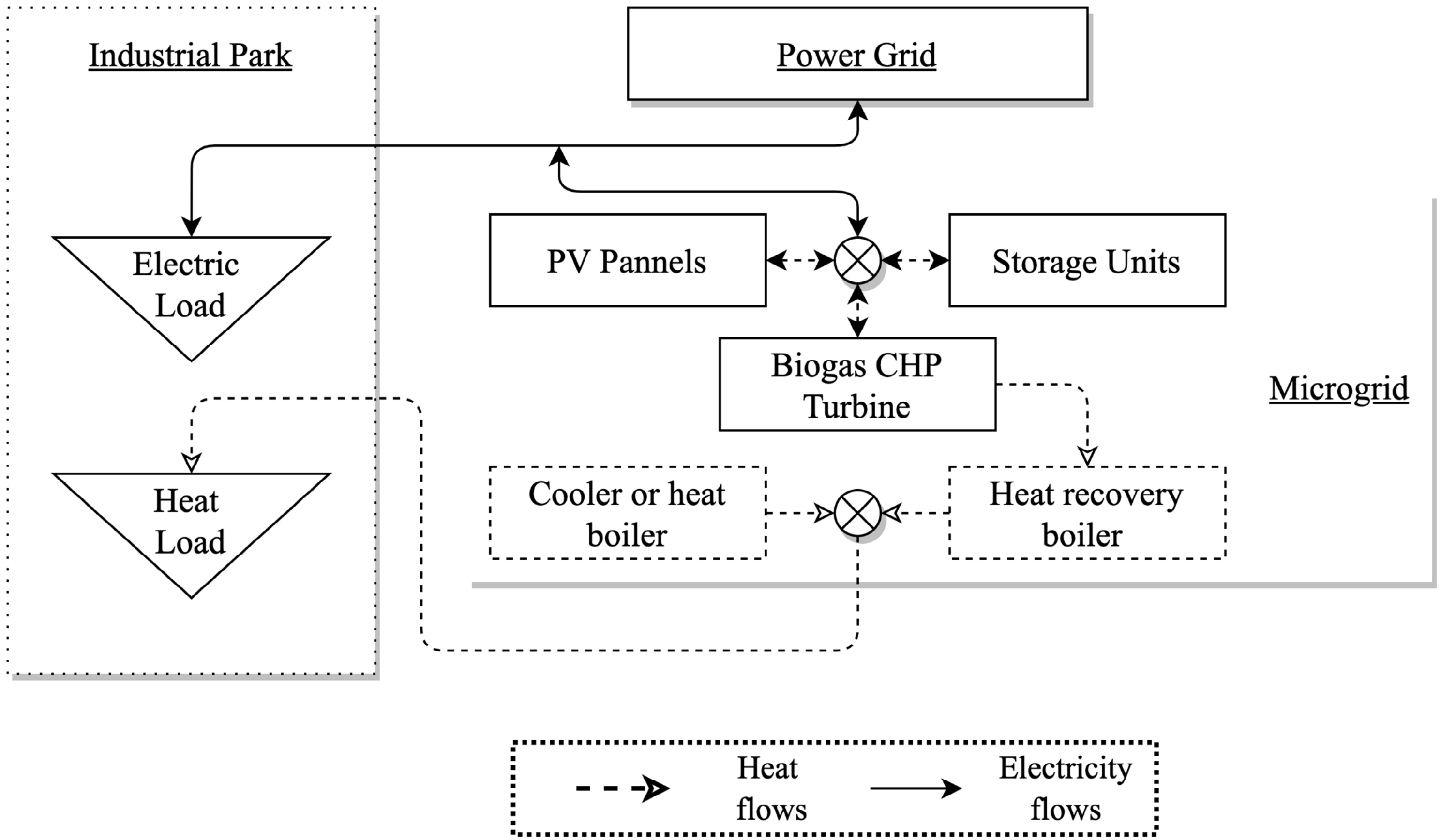
Renewable microgrids, an answer to the industrial energy trilemma?

Objective of the study: *Create a methodology to assess the techno-economic and financial feasibility of renewable heat and power microgrids for industrial parks.*

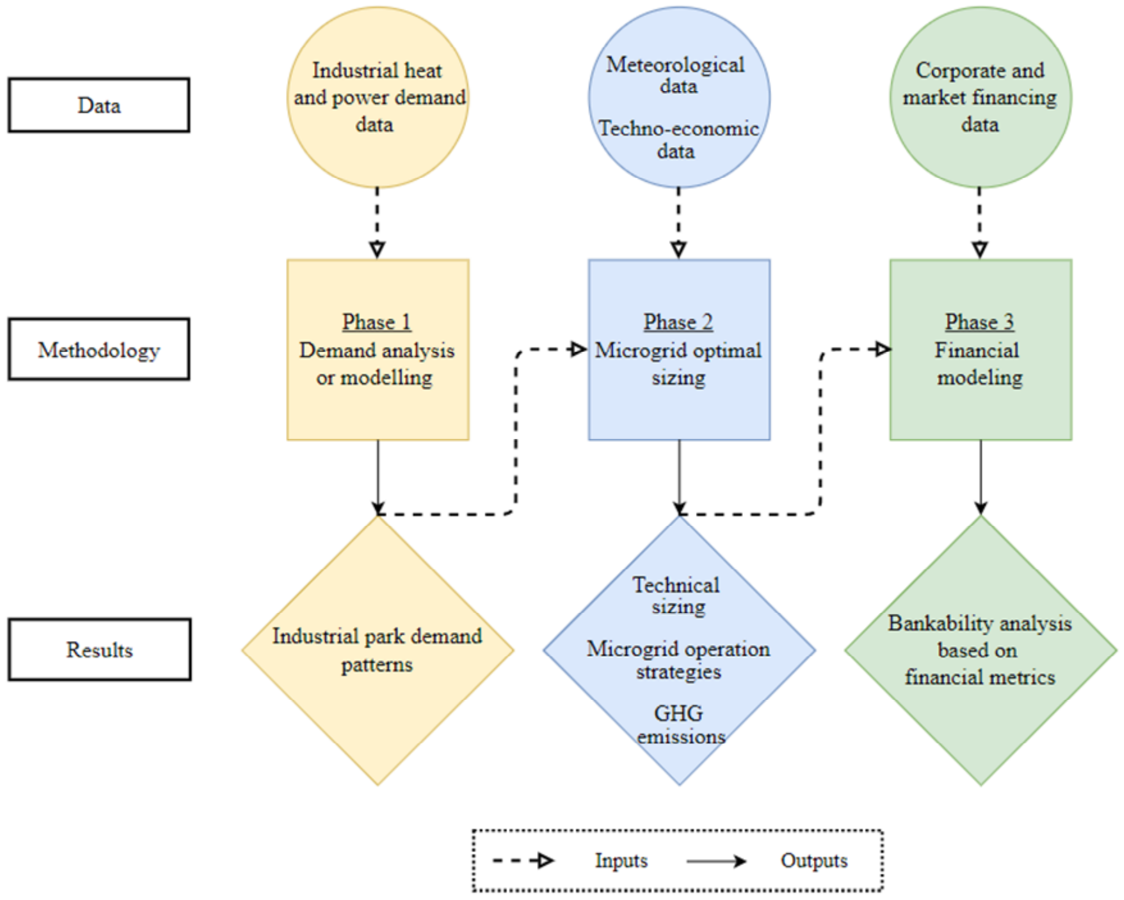
Agenda and outline

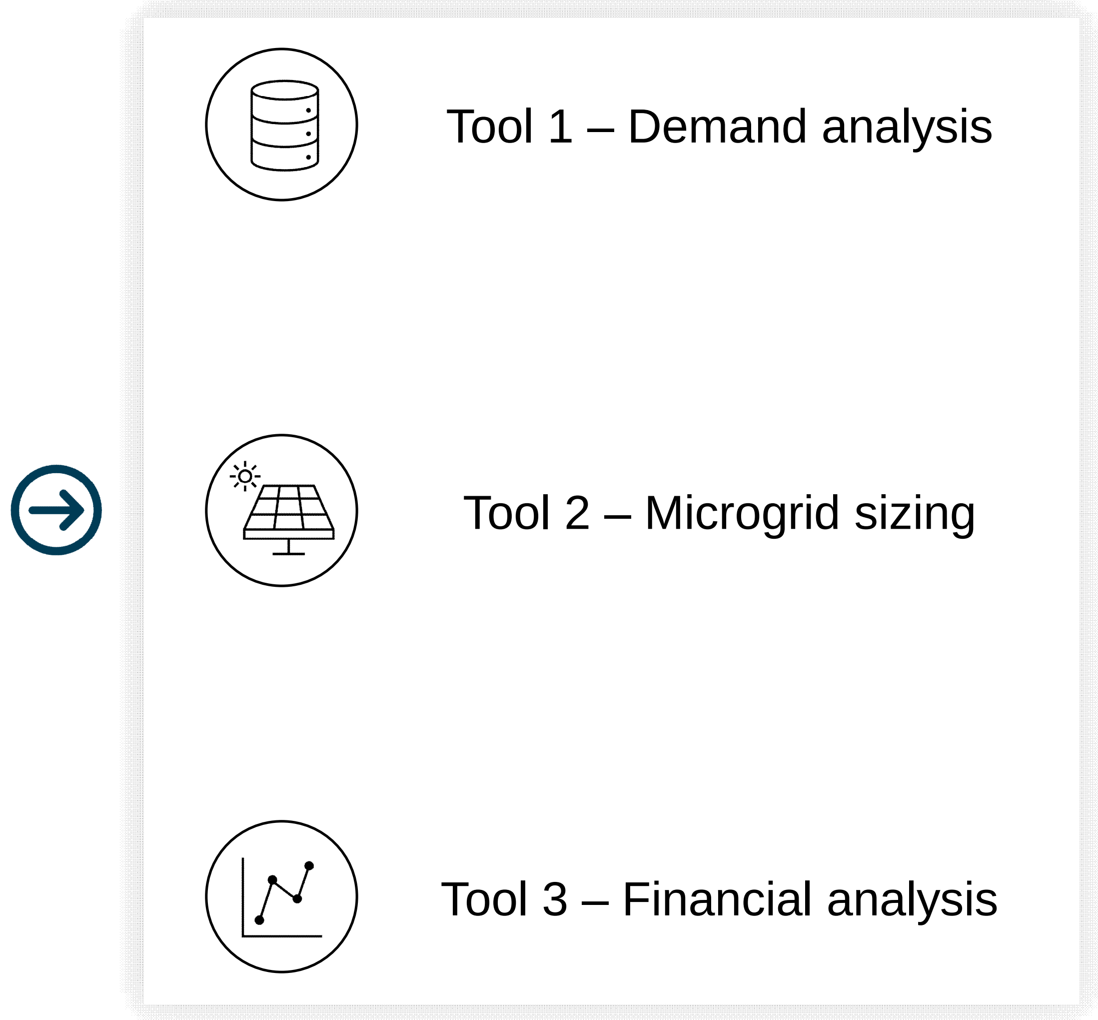
- Introduction
- Methodology
- Case study – UK industrial park
- Results presentation and improvements
- Conclusion and discussion

Design a renewable microgrid to meet the heat and electricity demand of an industrial park



Techno-economic methodology organized in three steps





Agenda and outline

- Introduction
- Methodology
- **Case study – UK industrial park**
- Results presentation and improvements
- Conclusion and discussion

Industrial park in the UK with high electricity and heat demand

1- Context

- Located in the UK
- Industrial park specialized in Food & Beverage
- 175 000 m², on which 89% is production area

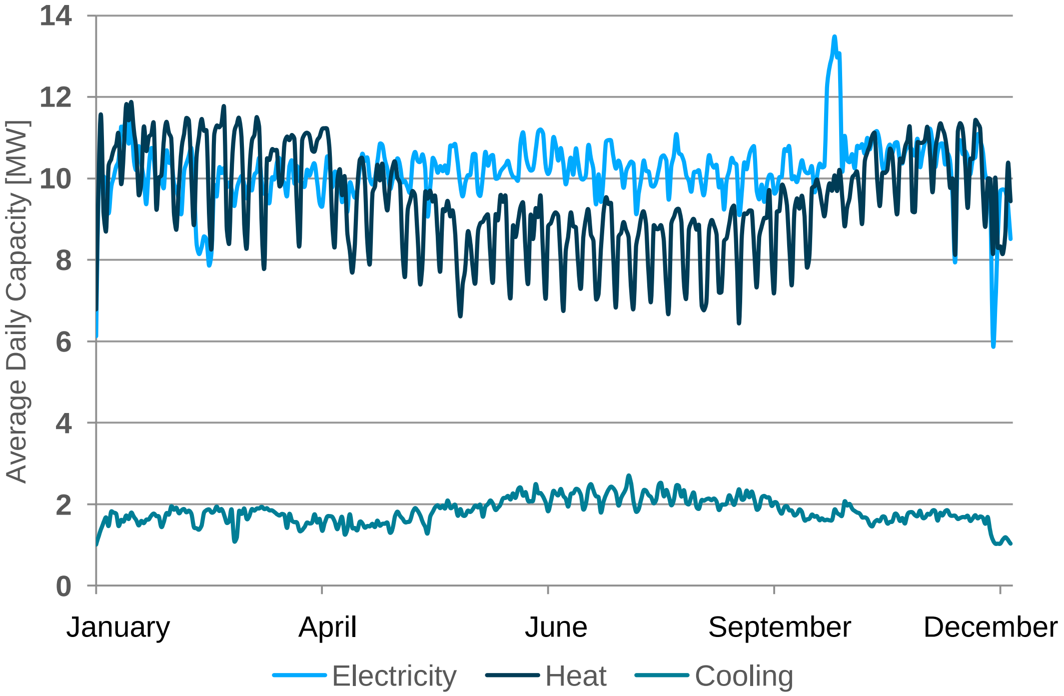
2- Energy Consumption

- Average Hourly Capacity: 21.4 MW
- Average Daily Consumption: 515 MWh
- Total Yearly Consumption: 188 GWh

3- Carbon intensity

- ***258 gCO2eq/kWh****

Industrial Park Energy Consumption



* The carbon intensity of the industrial park was computed using the carbon intensity of the electrical national grid, and natural gas power for heating and cooling

Agenda and outline

- Introduction
- Methodology
- Case study – UK industrial park
- **Results presentation and improvements**
- Conclusion and discussion

Solution design, performance and financial assessments

Sizing	Solar PV (MW)	BESS (MWh)	CHP (MW)	Cooler (MW)
Microgrid	23.1	25.0	14.8	3.6

Resiliency

- 10.2% of electricity was imported from the grid
- 95% of the time industrial park is relying on the microgrid

Carbon

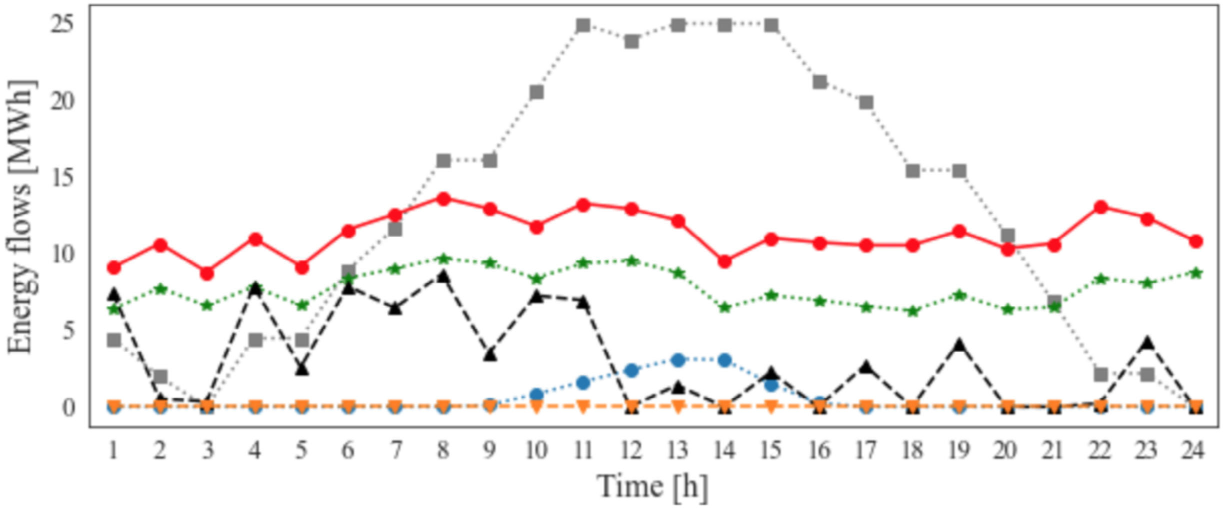
- The average yearly carbon intensity is 97.5 gCO2eq/kWh
- **Reduction of 62.2% of the GHG emissions** compared to the grid carbon intensity
- Reduction of 30% compared to the industrial partner solution

Financial

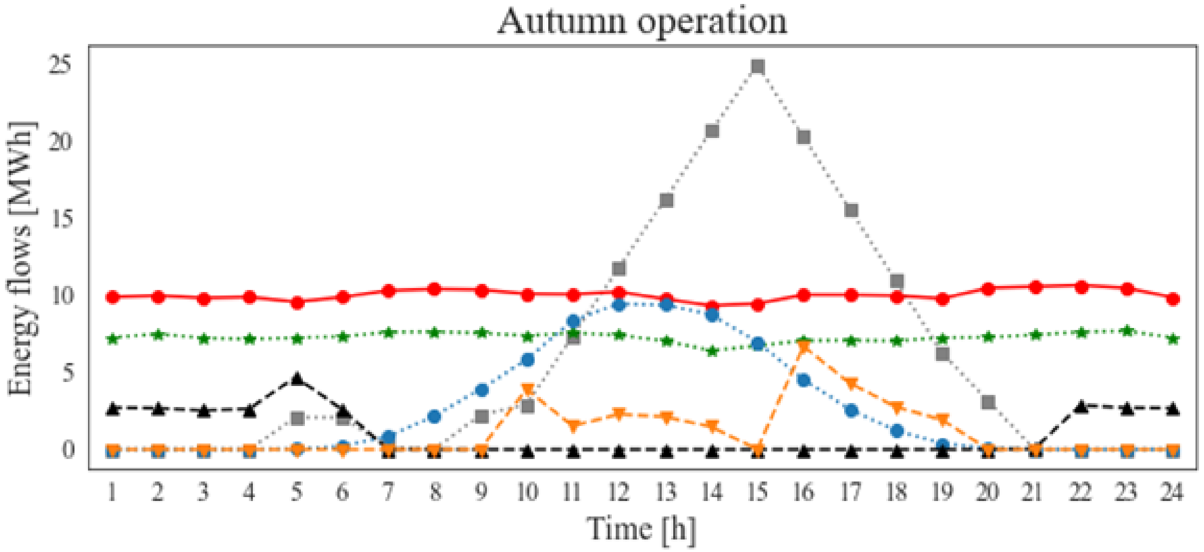
- **CAPEX: $65,000,000**
- **OPEX: $6,000,000**

The resiliency of the solution was tested on a critical day and during various seasons

Critical Day Operation Analysis



Seasonal Analysis



Potential improvements

1- Microgrid sizing

- The CHP and Cooling units sizings could be improved by introducing heat storage solutions
- Coding could also be improved to reduce the computation time

2- Storage systems

- Agile storage systems, improving the profitability and operation efficiency of the solution

3- Profitability and project development

- High profitability ratios for the solution and the industry.
  - Integration of more accurate project prices (technology, financing…)
- Biogas supply chain creation is more expensive that what was estimated in the project

Agenda and outline

- Introduction
- Methodology
- Case study – UK industrial park
- Results presentation and improvements
- **Conclusion and discussion**

Discussion: How can this solution be further investigated or implemented in a pilot project?

Metadata analysis estimation

- Combine industrial heat and power load curves to create fictive microgrids (using tool 1).
- Target the most promising industrial subsectors.
- Target the most promising size, combination of industrial parks

Real industrial park estimation

- Use the methodology and the set of tools to study the bankability of existing industrial microgrids portfolio or as future commercial targets

Pilot project launch

- Identify a first small pilot project
- Feedback and experience on the development of this type of projects
- Ramp-up and definition of strategic roadmap

Contact

Thank you !

Contact

Eflamm GUEGUEN

Consultant in Strategy at ENGIE

E-mail: eflamm.gueguen@gmail.com

Cell Phone: +33 6 64 65 11 12
Linkedin: https://www.linkedin.com/in/eflamm-gueguen-164911ba/

Papers in Energy Decentralization

University of Oxford & Veolia – *Academic Master Thesis*

- **“Renewable microgrids covering heat and electricity needs of industrial parks.” Eflamm Gueguen, David Wallom, Maomao Hu (2022)**

EDHEC Business School – *Academic Master Thesis*

- **“Mini grids optimal portfolio strategy: aggregating diverse mini grid technologies.” Gianfranco Gianfrate, Eflamm Gueguen** (2022) (To be published soon)