

# SMARTGYsum

## Research Outcomes of IRP-14

**S. M. Masum AHMED**

Early Stage Researcher-14 (ESR-14)

*Energy value chains and markets developed with the new paradigm of distributed EES*

Supervisor: **Edoardo CROCI**, Professor of Practices; Senior Research Fellow at GREEN (Centre for Geography, Resources, Environment, Energy and Networks); Bocconi University.

Co-Supervisor: **João MARTINS**, Professor, Department of Electrical and Computer Engineering; Senior Researcher, UNINOVA; Universidade NOVA de Lisboa.

Co-Supervisor: **Enrique ROMERO-CADAVAL**, Professor, Department of Electrical and Computer Engineering; University of Extremadura.

## ESR-14



**S.M. Masum AHMED**  
ESR-14, SmartGYSUM  
Bocconi University  
Ph.D. Student (3<sup>rd</sup> Year)  
University of Extremadura

## Supervisory Team



**Edoardo CROCI**  
Professor of Practice  
Bocconi University  
Supervisor of IRP-14



**João MARTINS**  
Professor  
Universidade NOVA de Lisboa  
Co-Supervisor of IRP-14



**Enrique ROMERO CADAVAL**  
Professor  
University of Extremadura  
Co-Supervisor of IRP-14

# Background of ESR-14



Università  
Bocconi  
MILANO

**NOVA**

UNIVERSIDADE NOVA  
DE LISBOA

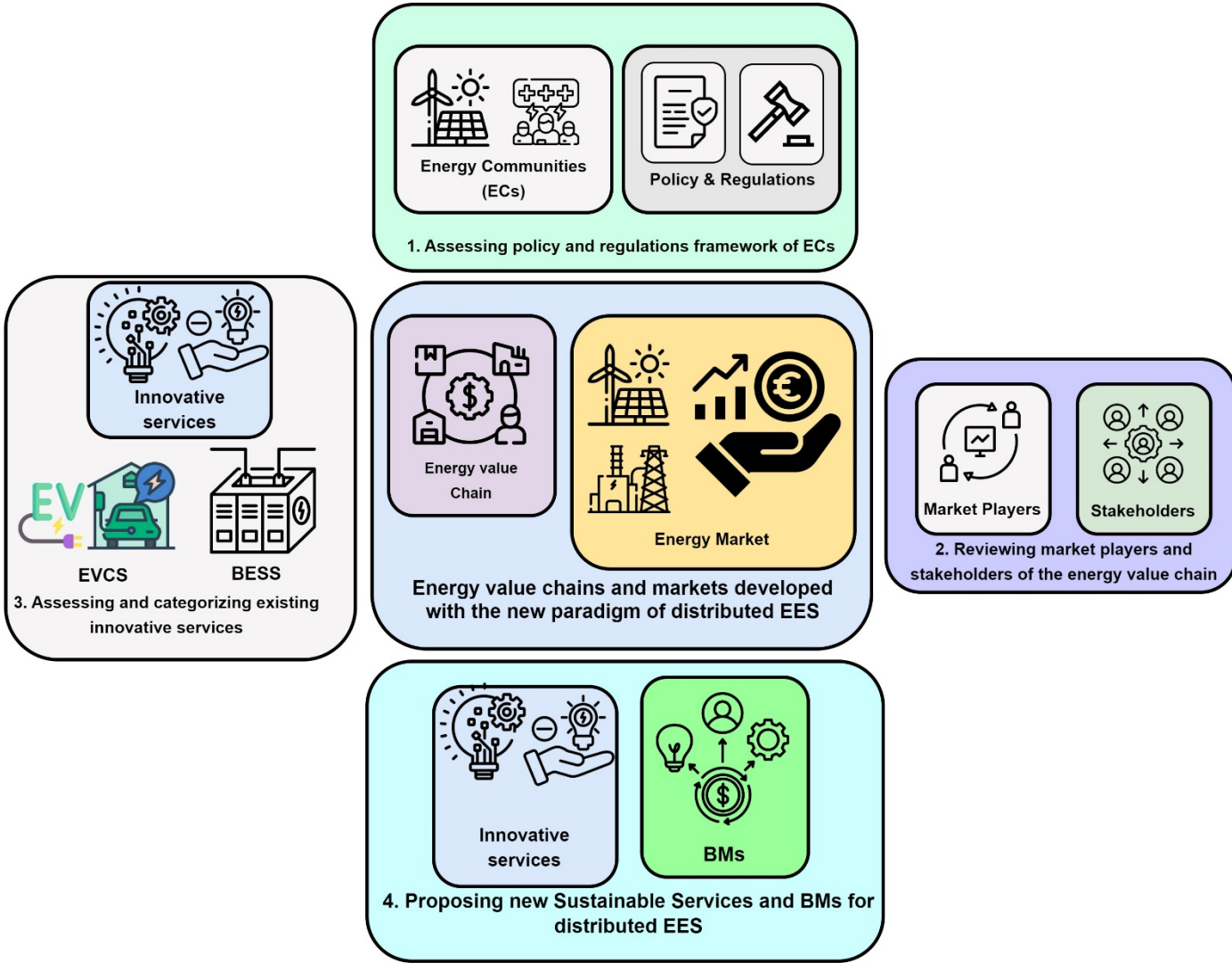
UNIVERSIDAD  DE EXTREMADURA

## **S.M. MASUM AHMED, [Khulna, Bangladesh]**

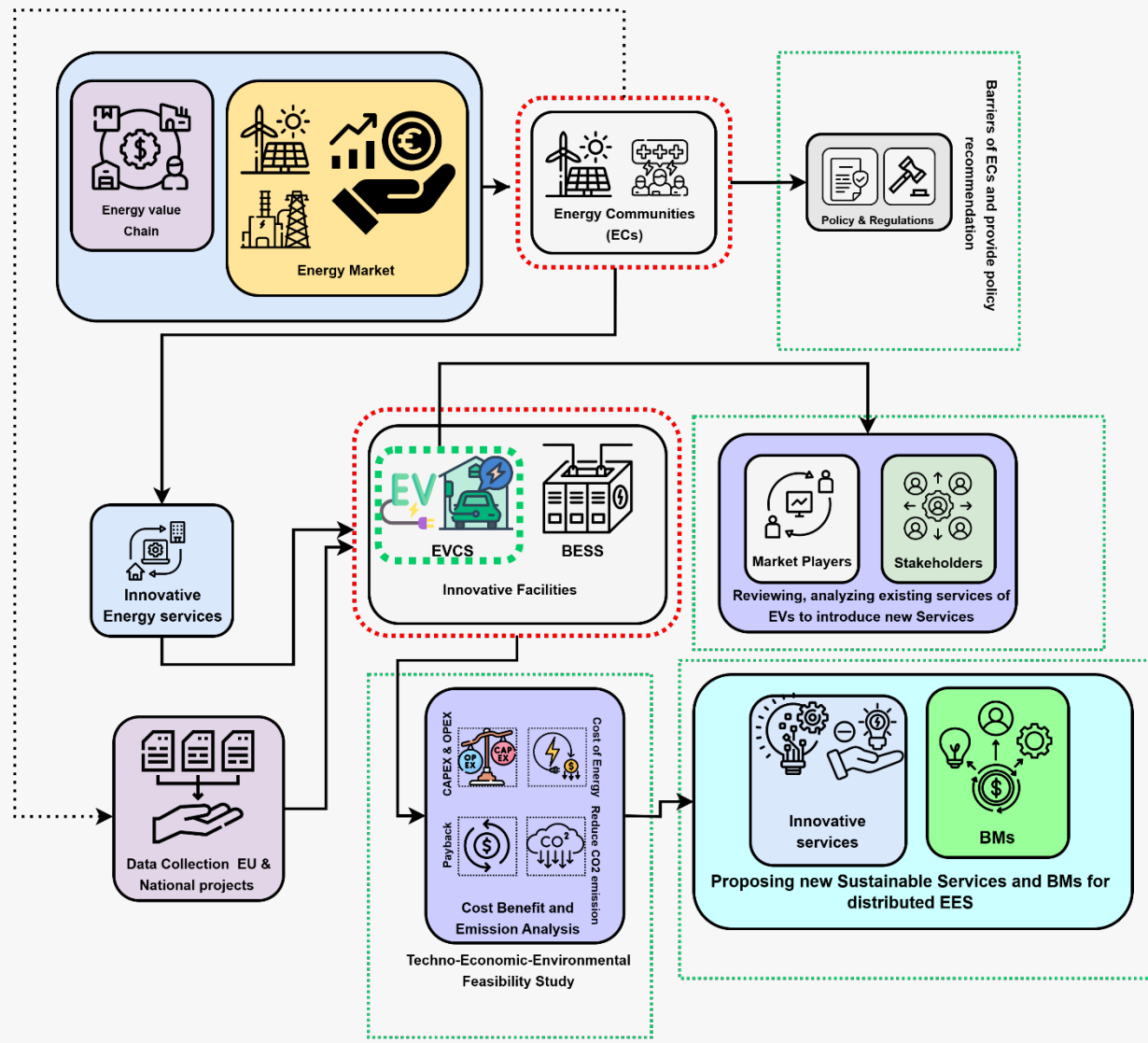
- **ESR – 14 [September 01, 2022-August 31, 2025]**  
*Università Commerciale Luigi Bocconi, Milan, Italy.*
- **First Secondment [June 01, 2023-July 31, 2023]**  
*Universidade NOVA de Lisboa, Lisbon, Portugal.*
- **Second Secondment [November 01, 2024 - 28 February, 2025]**  
*University of Extremadura, Badajoz, Spain.*
- **ERASMUS+ [2019-2021]** (3 Articles, 3 Book Chapters)  
**EMJMD in Smart Cities and Communities (SMACCs)**  
*Heriot-Watt University, Edinburgh, Scotland, United Kingdom.*
- **MSc in Mechanical Engineering [2019-2021]** (With 3<sup>rd</sup> highest distinction)  
*University of Mons, Mons, Belgium.*
- **BSc in Electrical and Electronic Engineering [2015-2018]**  
(Magna Cum Laude/2<sup>nd</sup> highest distinction, 5 Dean Awards, Best Thesis/Project award 5<sup>th</sup> among 175 groups, Vice-Chancellor Award Nomination, 2 Articles)  
*American International University-Bangladesh (AIUB), Dhaka, Bangladesh.*
- **Hobbies:** Travelling and Football.



# Project Objectives (ESR-14)



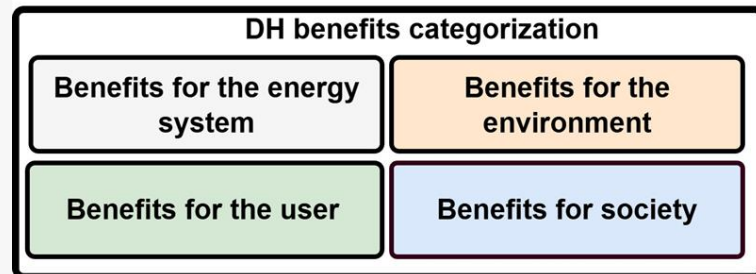
# Solution – Novelty of Research and Technological Innovation



### District Heating benefits

Evidence from a Systematic Literature Review

- Systematic literature review of **123 studies**.
- **Identification and synthesis of DH (and Cooling) benefits**, addressing a previously fragmented and heterogeneous literature.
- DH benefits are **consistently classified into four categories**.
- It aims to consolidate dispersed evidence into a **shared reference base**, enabling comparability and cumulative research.



### Economic assessment methods and the role of emerging technologies

- Across 123 studies, **26 DH benefits are monetised**, but **only 10 studies clearly document the methods used** (*avoided cost, net present value, net present cost, levelised cost of heat, hedonic pricing, willingness to pay*), highlighting a major comparability gap.
- Results show that **emerging technologies** (AI, digital twins, IoT, cyber-physical systems) **enhance DH performance and benefits** across **design, operation, and management** phases.

### Policy & wider Impacts

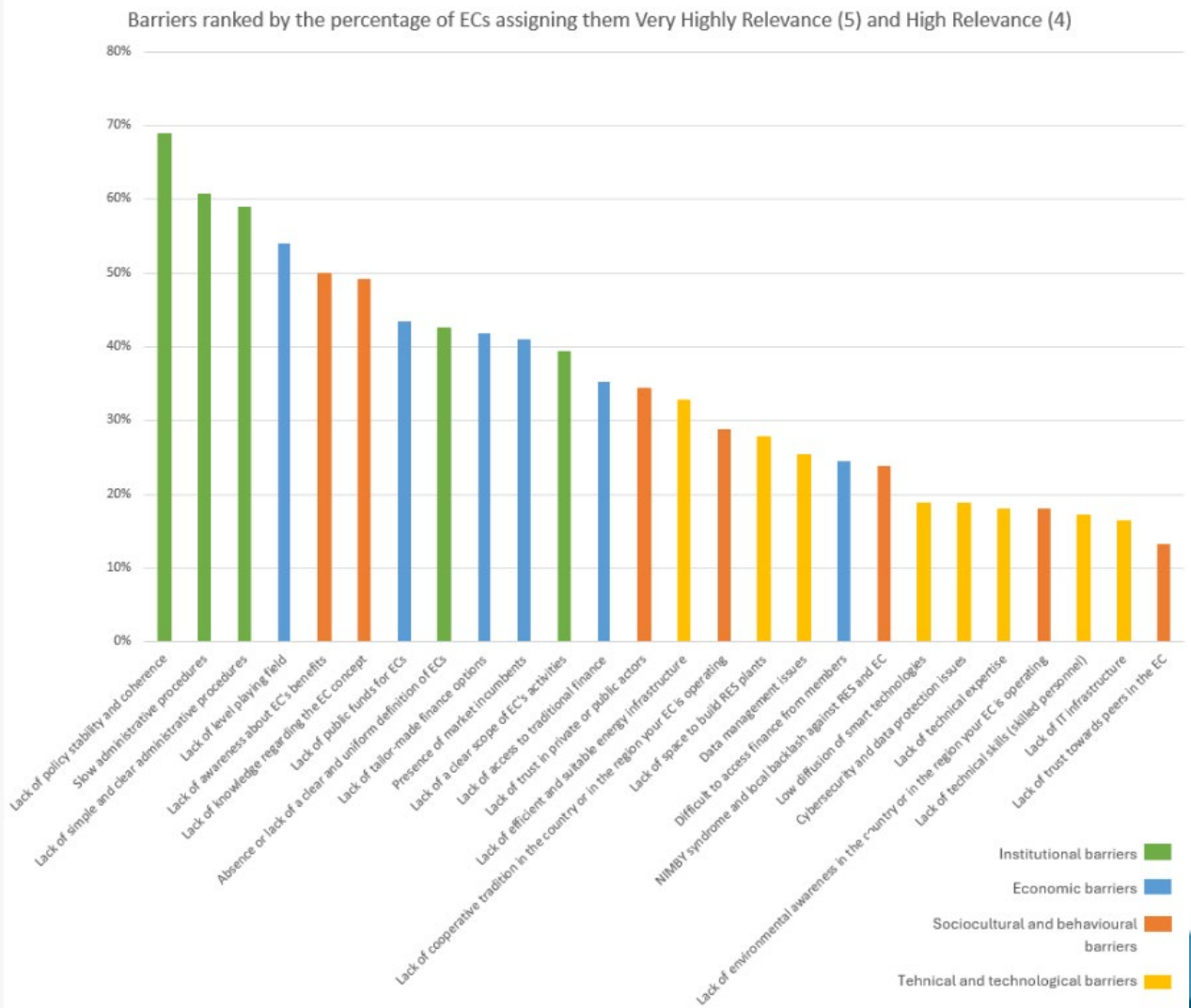
- Provides a **structured and evidence-based understanding of DH benefits**, supporting policy design aligned with EU climate and energy goals.
- Highlights the need for **transparent and standardised evaluation frameworks**, essential for sustainable finance and EU Taxonomy alignment.
- Strengthens the case for DH as a **key enabler of decarbonisation, energy efficiency, and social benefits**, including reduced emissions, improved comfort, and local economic impacts.

### Main barriers:

- Policy instability, unclear regulations, and slow administrative procedures.
- Limited funding, lack of tailored financing, and lack of level playing field.
- Low knowledge and awareness regarding EC concept and benefits.

### Policy recommendations:

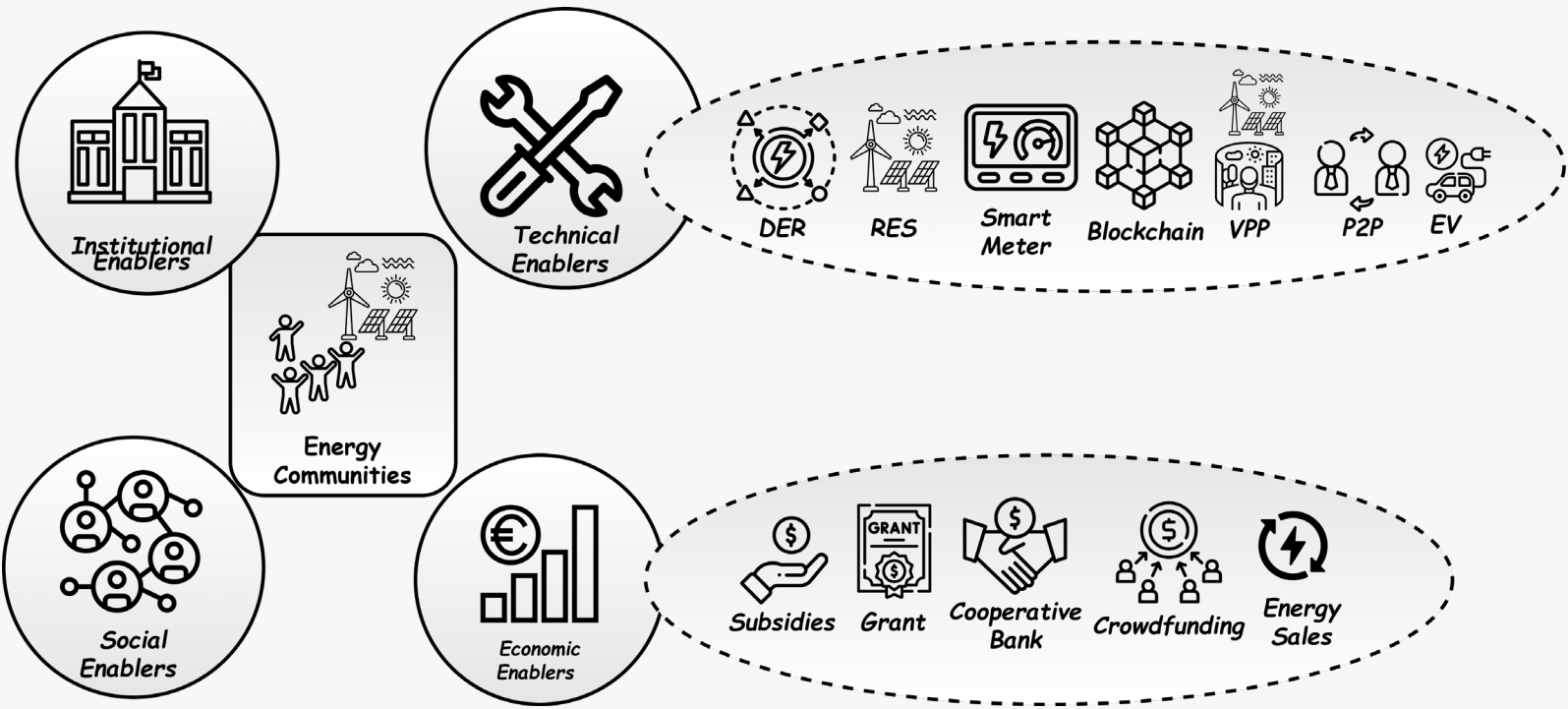
- Ensure regulatory stability and clarity
- Simplify and accelerate administrative procedures
- Develop tailored financial instruments (grants, guarantees, low-interest loans)
- Ensure a level playing field by adapting market rules
- Increase awareness and capacity-building through information campaigns



### ECs Enablers

**Methodology:** Semi-systematic literature review.

**Results:** Key **Technical** and **Economic Enablers** of ECs.



### Virtual Power Plant (VPP)–powered EV Charging Stations

- Two-stage **techno-economic optimisation** applied to EV charging stations to assess operational and economic viability.
- Development of a **RES-powered energy system** serving **89 households and 42 EVs** within a VPP configuration.

Results show an **energy bill reduction of 16.15%** in the optimised scenario compared to the baseline.

### Optimization of EVCS for a University campus (NOVA, Lisbon)

- Development of a **data-driven algorithm** to estimate realistic EV charging load profiles based on parking behaviour.
- Integrated energy–economic–environmental (**3E**) **optimisation** of a grid-connected EVCS with PV and wind integration.

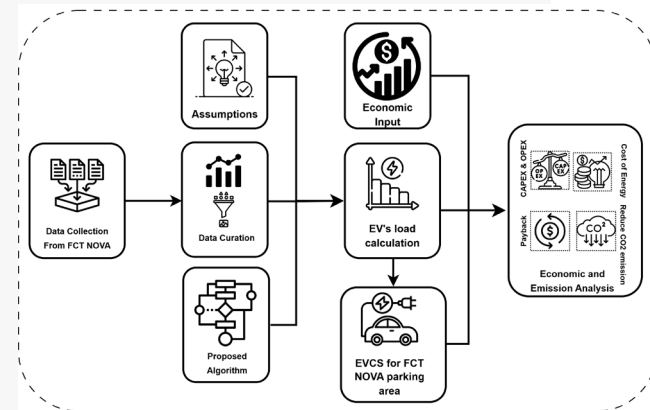
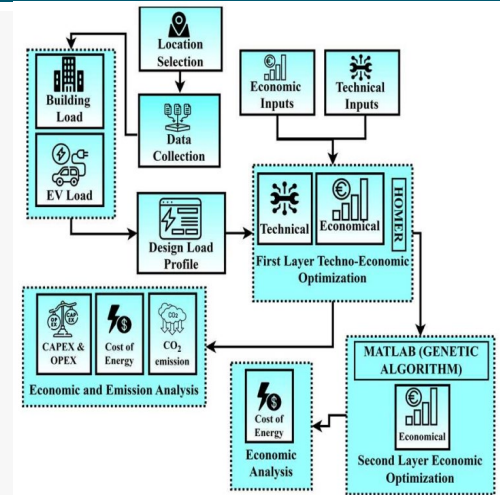
### Key results (PV–Wind–Grid vs grid-only):

- Cost of Energy reduced **substantially lowering charging costs** for users
- CO<sub>2</sub> emissions reduced by **5 times than base case**

Results show the **feasibility of RES-powered EVCSs** in a real university campus context.

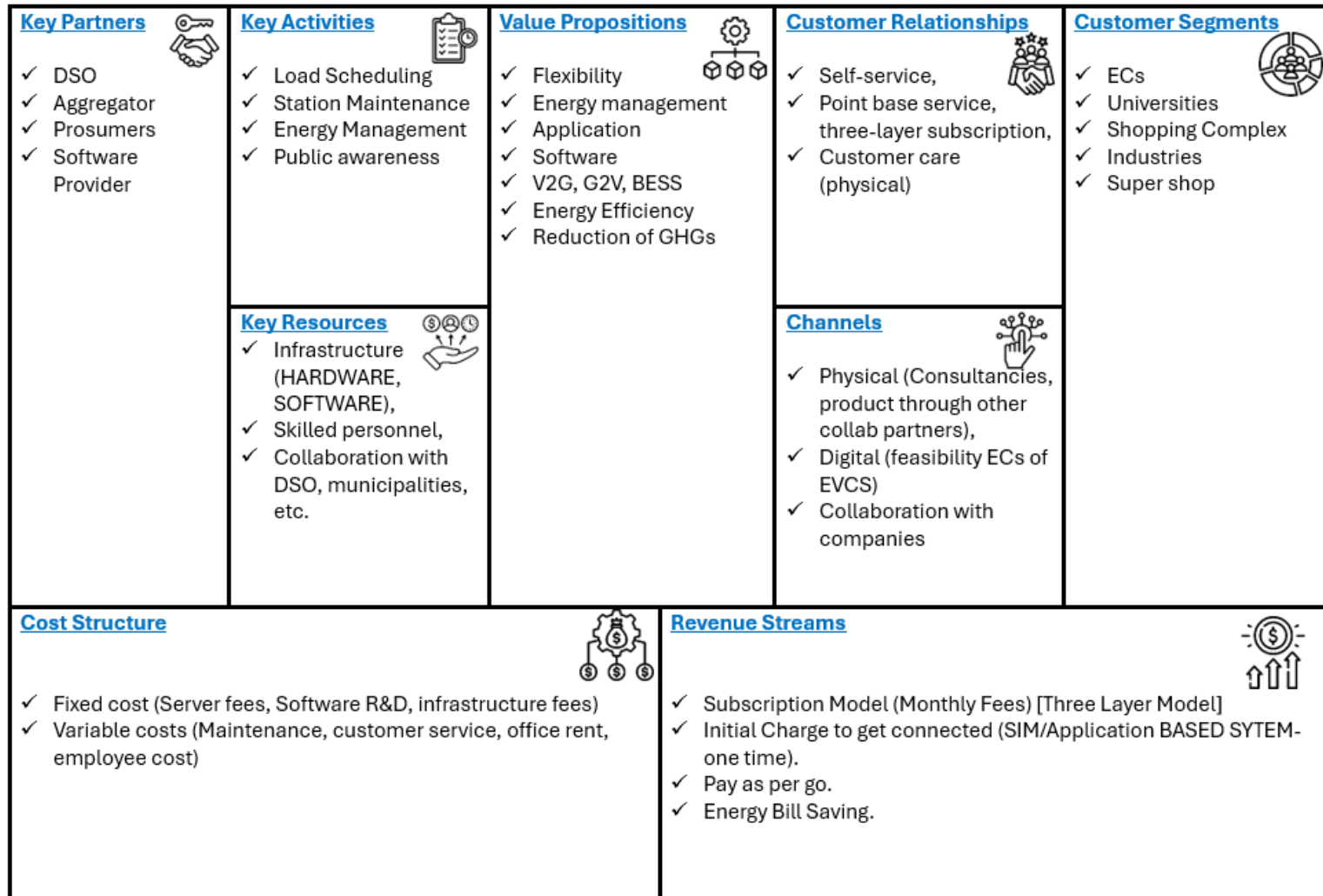
### Policy & wider Impacts

- Supports **cost-effective deployment of EV charging infrastructure** aligned with EU decarbonisation targets.
- Demonstrates how **RES-powered EVCSs strength the climate benefits of EV adoption.**
- Provides **evidence-based inputs** for **universities, municipalities, and Energy Communities** planning EV charging solutions.



## Innovative Energy Service for ECs with EVCS and Energy Storage facilities

### Business Model Canvas



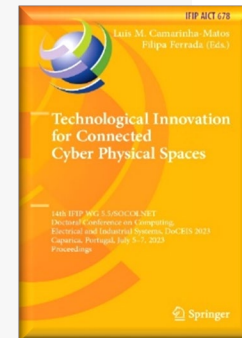
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Marie Skłodowska-Curie Actions (MSCA)  
Innovative Training Networks (ITN)  
H2020-MSCA-ITN-2020

Research and Training Network for  
Smart and Green Energy Systems and Business Models

- Design a **flexible and transferable evaluation framework** that can accommodate different technical, geographic, and economic contexts.
- Establish a **simple, transparent, and replicable assessment tool** to enable consistent comparison of benefits and support evidence-based policymaking.
- Apply advanced **optimization** and **probabilistic techniques**.
- Develop a **cloud-based energy management system** to support EC customers with **real-time, data-driven control** and **dynamic optimisation**.

***“A Critical Review of District Heating and District Cooling Socioeconomic and Environmental Benefits”, Published as a Book Chapter in 14<sup>th</sup> Advanced Doctoral Conference on Computing, Electrical And Industrial Systems (DoCEIS 2023) (Best Paper Award)***



***“Techno-economic Optimisation of Electric Vehicle Charging Stations with Virtual Power Plant – A University Campus Use Case”, Published as Conference Paper in IEEE EUROCON – 21<sup>st</sup> International Conference on Smart Technologies (Collaboration with ESR03 and ESR15)***



*Published as an Article “District Heating Benefits and Economic Assessment Methods: A Systematic Review and the Role of Emerging Technologies”*



*Published as an Article “Energy-Economic-Environmental (3E) Optimisation of Grid-connected Electric Vehicle Charging Station for a University Campus in Caparica, Portugal”*



*Published as a Book chapter “Energy Communities Enablers: Techno-Economic Optimisation Analysis of Renewable Energy System for Electric Vehicle charging Station”*

*Planned as an Article “**A Survey of Energy Community Barriers Assessment in Europe**”*

*(1<sup>st</sup> submission plan in July-August 2026) (Collaboration with ESR15)*



ELSEVIER

*Planned as an Article “**A Survey of Energy Community Impact Assessment in Europe**” (Collaboration with ESR15)*

*(1<sup>st</sup> submission plan in September 2026)*



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*Planned as an Article “**Systematic Literature Review On Energy Community Barriers**” (Collaboration with ESR15)*

*(1<sup>st</sup> submission plan in April 2026)*



ELSEVIER

Journal Article	Book Chapter	Conference Paper	Journal Articles in collaboration with ESR15
2	2	1	3



## A Critical Review of District Heating and District Cooling Socioeconomic and Environmental Benefits

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Review

## District Heating Benefits and Economic Assessment Methods: A Systematic Review and the Role of Emerging Technologies

S.M. Masum Ahmed<sup>1,2,\*</sup>, Annamaria Bagaini<sup>1</sup> and Edoardo Croci<sup>1,3</sup>

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- Department of Electrical, Electronic and Control Engineering, School of Industrial Engineering, University of Extremadura, Av. de Elvas, s/n, 06006 Badajoz, Spain
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Article

## Energy-Economic-Environmental (3E) Optimisation of Grid-Connected Electric Vehicle Charging Station for a University Campus in Caparica, Portugal

S. M. Masum Ahmed<sup>1,2,\*</sup>, Annamaria Bagaini<sup>1</sup>, João Martins<sup>3</sup>, Edoardo Croci<sup>1</sup> and Enrique Romero-Cadaval<sup>2,\*</sup>

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- Correspondence: sahmedn@alumnos.unex.es or masum.ahmed@unibocconi.it (S.M.M.A.); eromero@unex.es (E.R.-C.)

## Techno-Economic Optimization of Electric Vehicle Charging Station with Virtual Power Plant – a University Campus Use Case

S.M. Masum Ahmed<sup>a,b,\*</sup>, Anas Abdullah Alvi<sup>b</sup>, Konstantinos Pantazis<sup>a,b</sup>, Annamaria Bagaini<sup>a</sup>, Edoardo Croci<sup>a</sup>, Enrique Romero-Cadaval<sup>b</sup>, João Martins<sup>c</sup>

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Research and Training Network for  
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# THANKS

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