

Real-time Control and Fair Sharing of Renewable Energy Resources in Energy Communities

Context:

- Strong drive towards: more decentralized, less carbon intensive, and fairer energy systems
- Rise of prosumers: energy asset ownership (microgeneration, batteries, EVs), Demand Response (DR) participation, energy sharing or trading

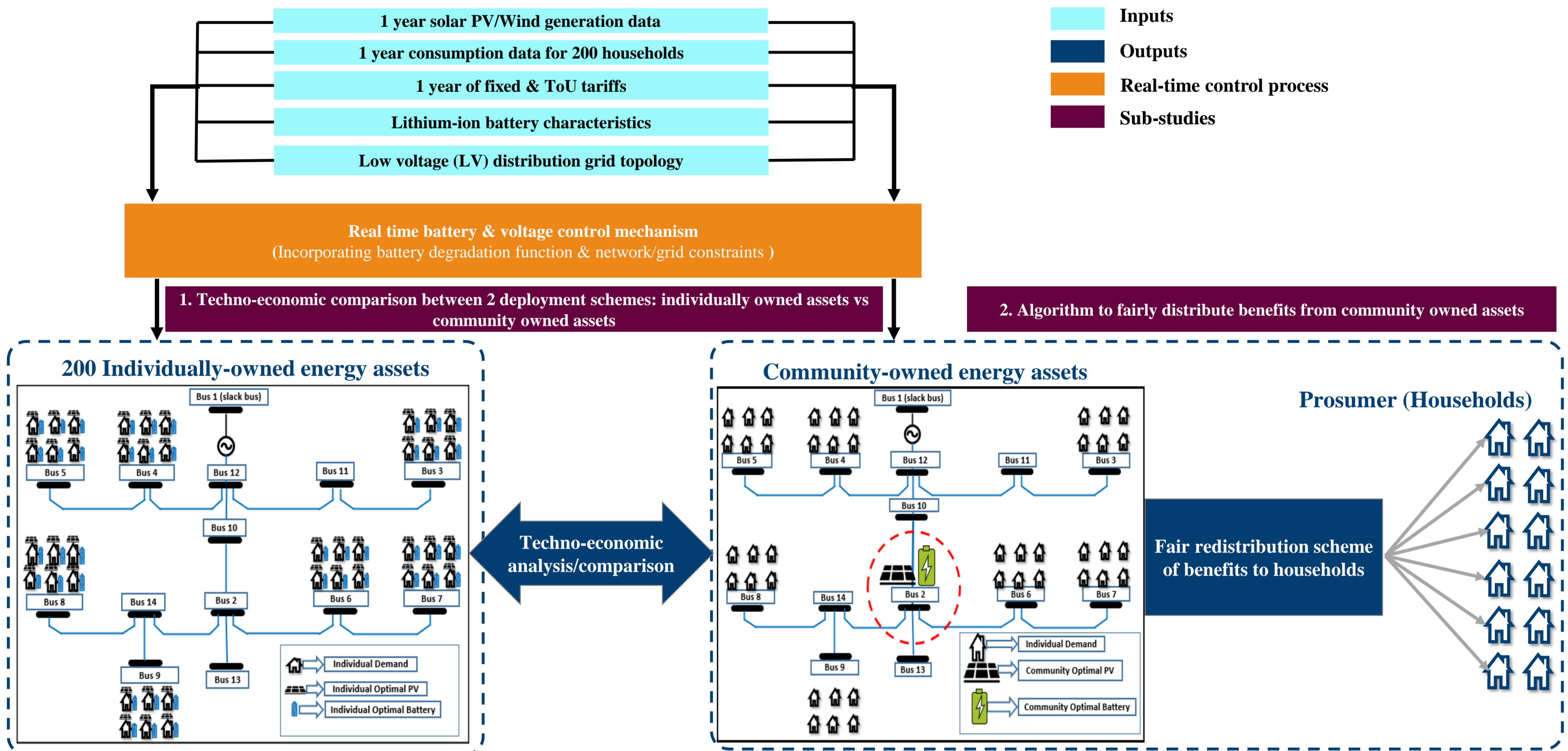
Motivation-Solutions for Smart Local Energy Systems:

- Increase profitability of distributed energy sources within a community
- **Energy Communities:** community of prosumers that operates in collaborative manner optimizing the usage of renewable resources

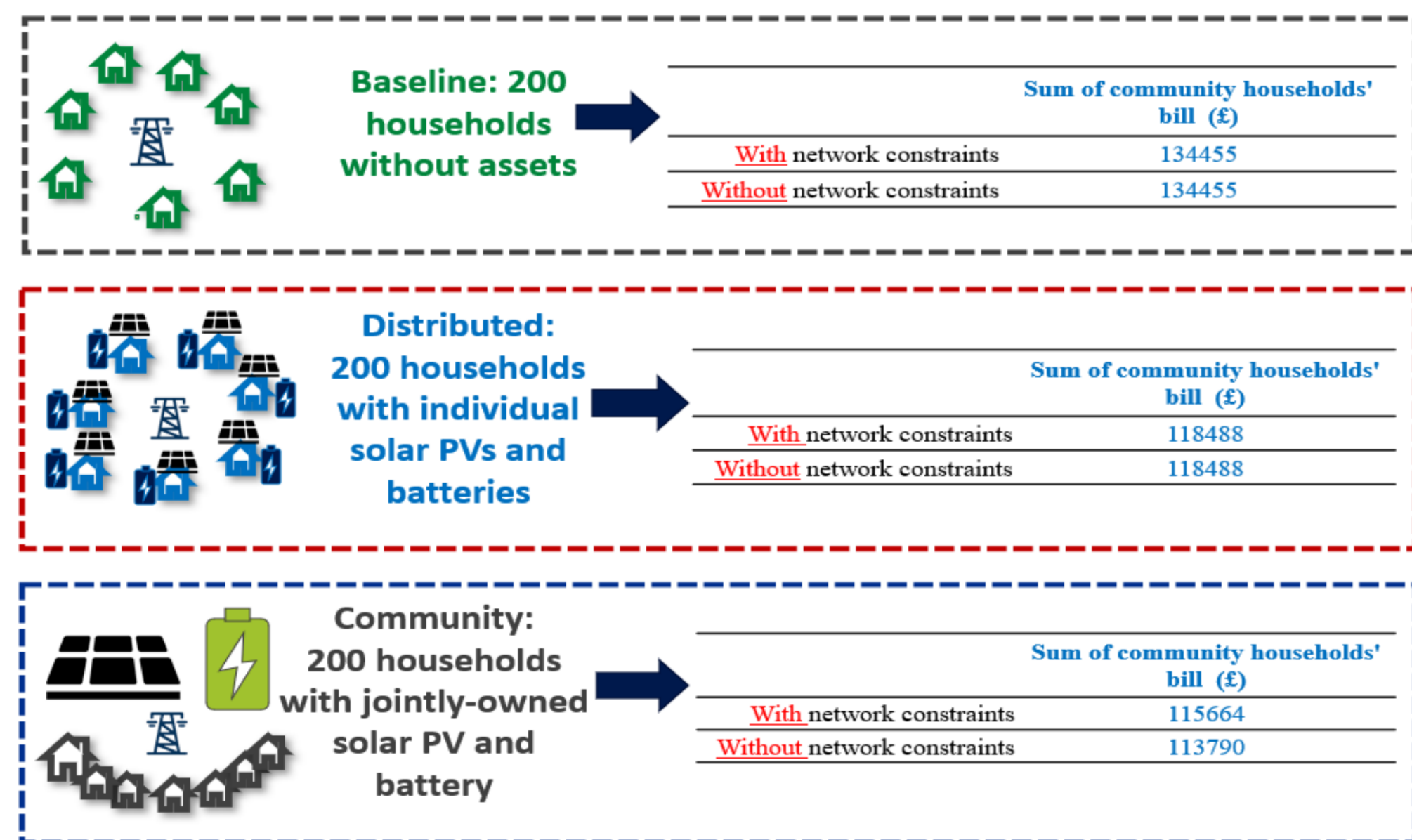
Key Challenges Addressed:

- Real-time smart control of energy assets (residential and community batteries)
- Understand what are the best schemes for renewable generation investment within a community (individual assets, or community owned assets)
- **Fair redistribution** of benefits obtained from jointly-owned community energy assets incorporating **battery degradation** and **network constraints**

Overview of the Energy Community Modelling and Real-time Analysis:



Results:



Comparison of individual Vs community assets for reduction of annual bill, where network constraints reduce the benefits from assets

$$\Gamma_i(T) = \frac{\Pi_C(T) \Theta_i(T)}{\sum_{i \in \mathcal{C}} \Theta_i(T)} \quad \forall i \in \mathcal{C}$$

$\Gamma_i(T)$ Money redistributed to household i
 $\Pi_C(T)$ Community savings at time T
 $\Theta_i(T)$ Marginal contribution of household i

