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Multi-actor modelling for MILP energy systems optimisation: Application to collective self-consumption

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ABSTRACT
We aim to propose a multi-actor modelling based on stakeholders’ objectives and constraints and to apply it on the optimisation model generation tool OMEGAlpes. Based on social science literature, this modelling aims to help stakeholders to formalise their constraints and objectives and to negotiate them in a multi-stakeholders problem setting process. This modelling has been applied to a simplified collective self-consumption project.

1 – Problematic: Reduce the Socio-technical Optimality Gap
- Social science literature highlights that energy project should be considered as sociotechnical as it depends on (Akrich, 1989):
  - Technical issues: material selection, available technology, etc.
  - Social dimensions: social practice, political and legal institutions, etc.
- Decision support tools only focus on technical optimima creating a socio-technical optimality gap defined by Hinker et al. (2017) as:
  A socio-technical optimality gap is said to be existing for an optimisation problem if the solution found is non-optimal because of an inprovable problem formulation, or if the optimum found is rejected due to non-feasibility in practice.

2 – From Social Science concepts to Object Oriented Actor Modelling with constraints and objectives
Social science literature tells us
- Stakeholders are one of the barriers of urban renewable energy development (Soshinskaya et al., 2014).
- Stakeholders are divided in two categories (North 1990; Moss 2009):
  - Regulators, who lay down rules and procedures
  - Operators, who operate energy units while respecting the regulators’ constraints
- Operators operate energy units in their area of responsibility, considered as a Socio-Energy Node (SEN) (Debiet et al., 2016)
- SEN Group of physical elements collecting, converting, and/or supplying energy, built or operated by the same decision-maker

3 – “Problem setting” step & stakeholder negotiations
Multi-stakeholder projects in pre-study phases require to help stakeholders to:
- Understand the impact of their requirements – constraints and objectives – on the solution (Fig 4)
- Discuss and coordinate on possible and satisfactory solutions mainly negotiating their constraints and objectives (Fig 3)

4 – Application to Collective self consumption
In France, the collective self-consumption act enables prosumers to share their electricity production between various consumers connected to the public network
Study cases available at: https://omegalpes-examples.readthedocs.io/en/latest/article_study_case.html

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