

Sustainable and Social Local Energy Systems (LES)

12 jan 2023

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Agenda

1. Introduction project
2. Objectives
3. Current status
4. Q&A



1.

Introduction project



Towards More Sustainable and Social Local Energy Systems

Cooperation China-The Netherlands (NSFC)

Call for Proposals

Merian Fund

2020









Local Energy Systems

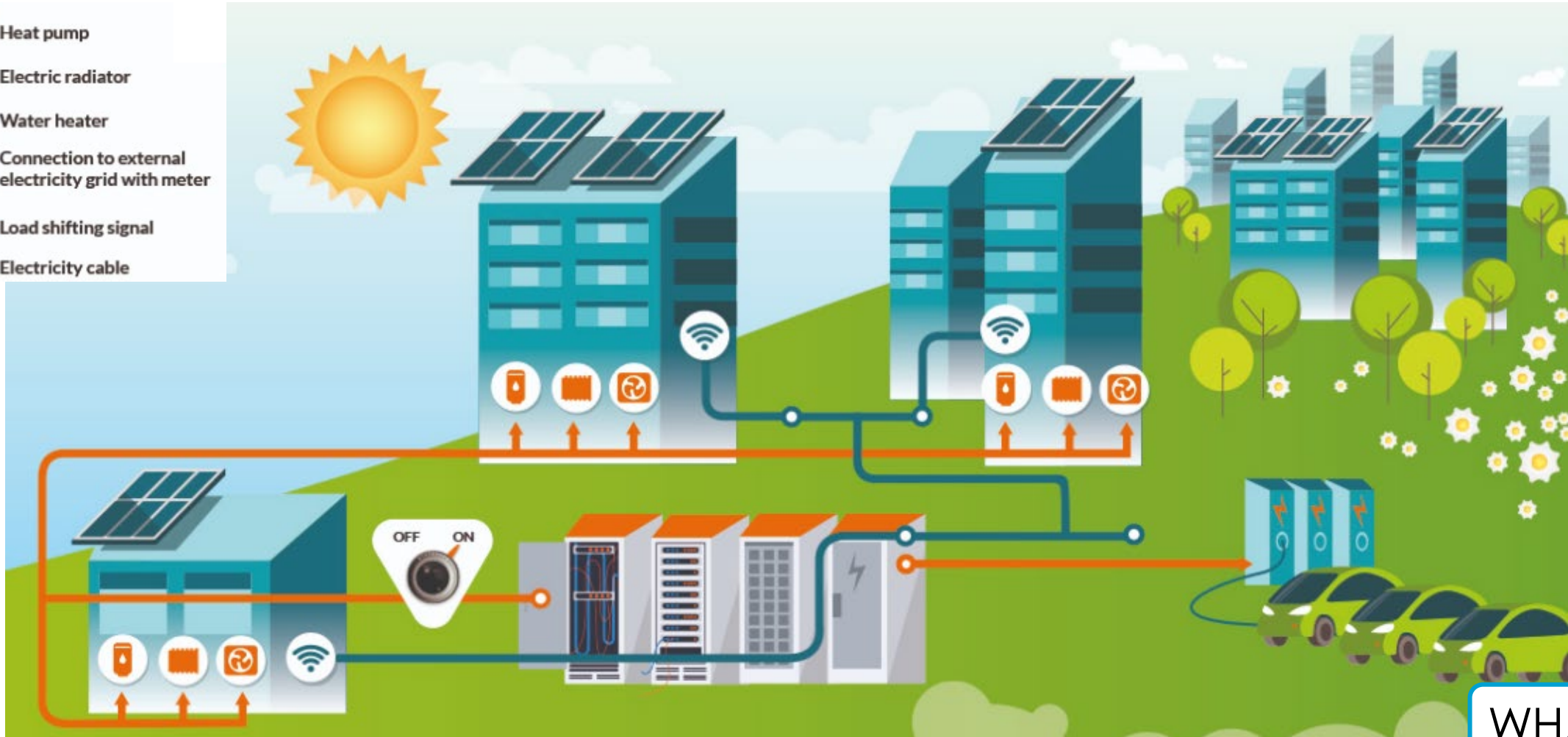
LES: A local energy system is a system for generating, distributing, and consuming energy within a defined geographical area, such as a city, town, or neighborhood. The goal of a local energy system is to create a more sustainable, resilient, and efficient energy system by reducing dependence on centralized power sources and enabling greater participation and control by local communities and individuals.



WHAT?

Local Energy System (LES)

-  Heat pump
-  Electric radiator
-  Water heater
-  Connection to external electricity grid with meter
-  Load shifting signal
-  Electricity cable



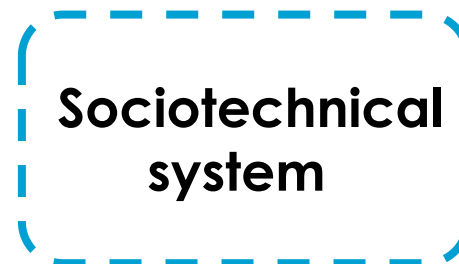
WHAT?

Title: Optimizing the design and operation of Local Energy Systems for neighbourhoods with high self-sufficiency and high actor engagement

This project aims to improve the **design** and **operation** of local energy systems (LES) with **high self-sufficiency** and **high stakeholder engagement**.

An integrative approach including both **technical** and **social** aspects.

Details of the whole project see [link](#).



Project participants Dutch side

Dutch side of consortium



Collaboration partners:



Funded for 4 years
We have started project LES from August 2022

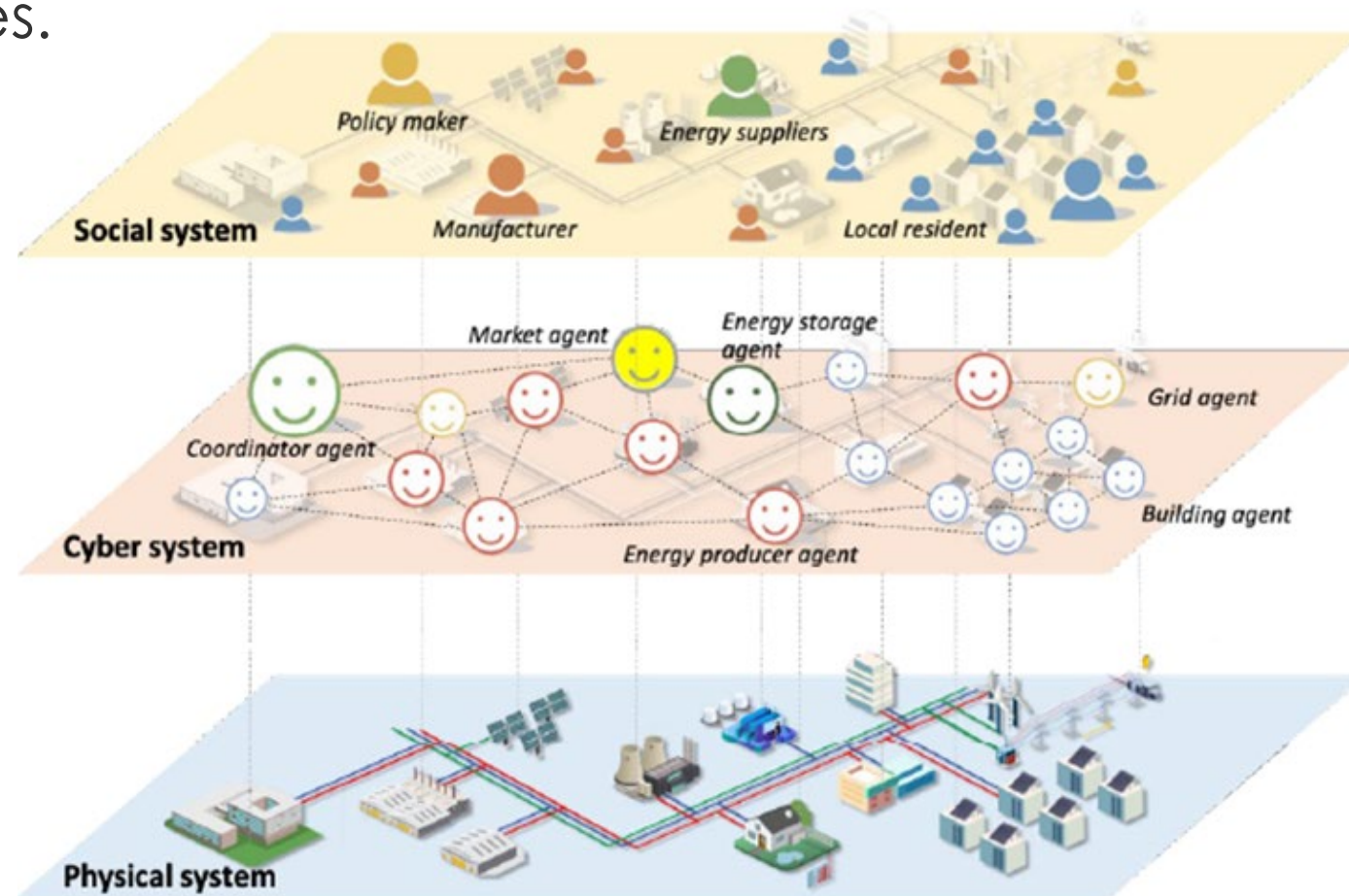
WHEN?

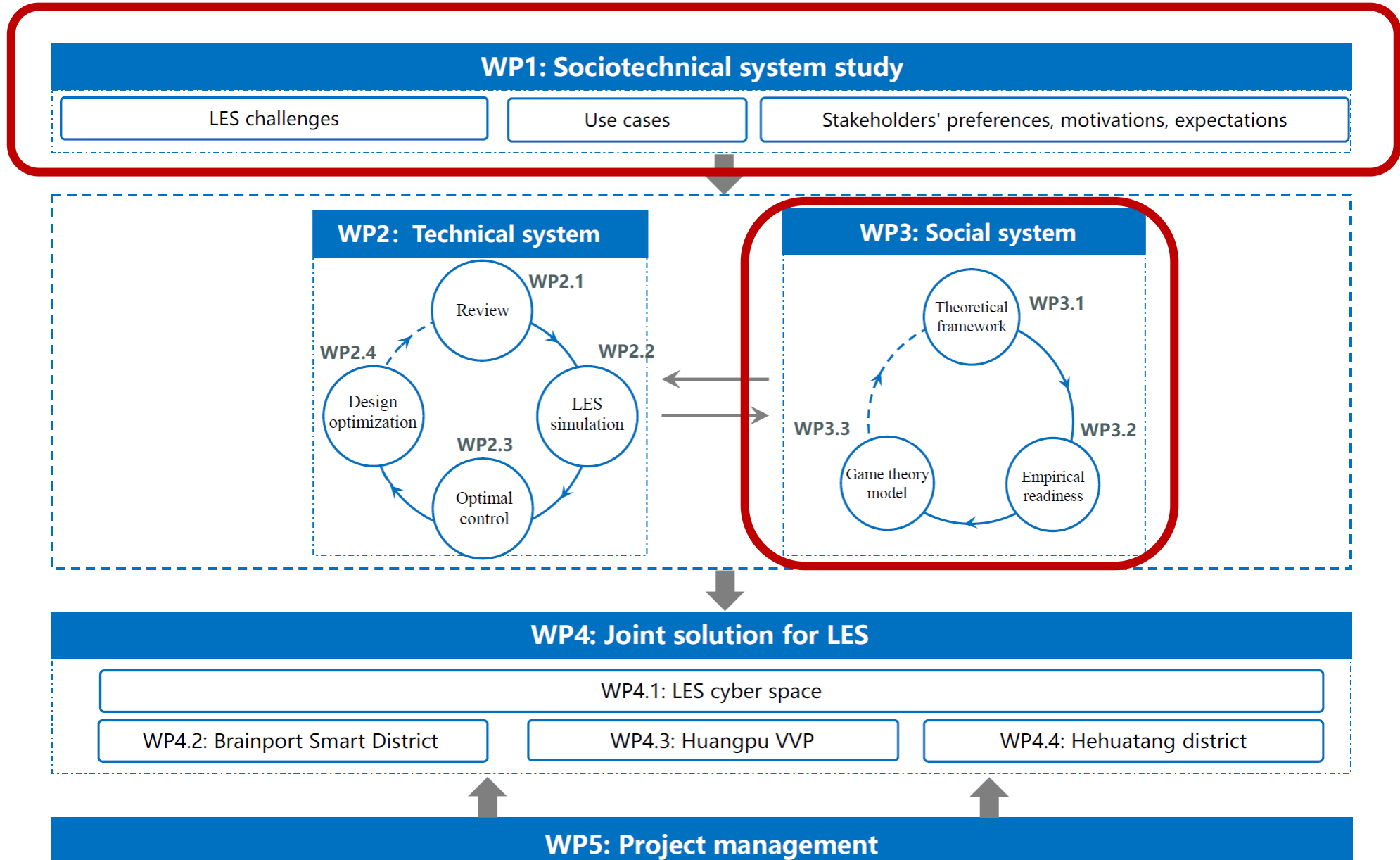
2.

Objectives

Research objective

Create an integrated cyberspace (a digital twin) which links the stages of design, retrofitting, policy making and operation from technical and social perspectives.



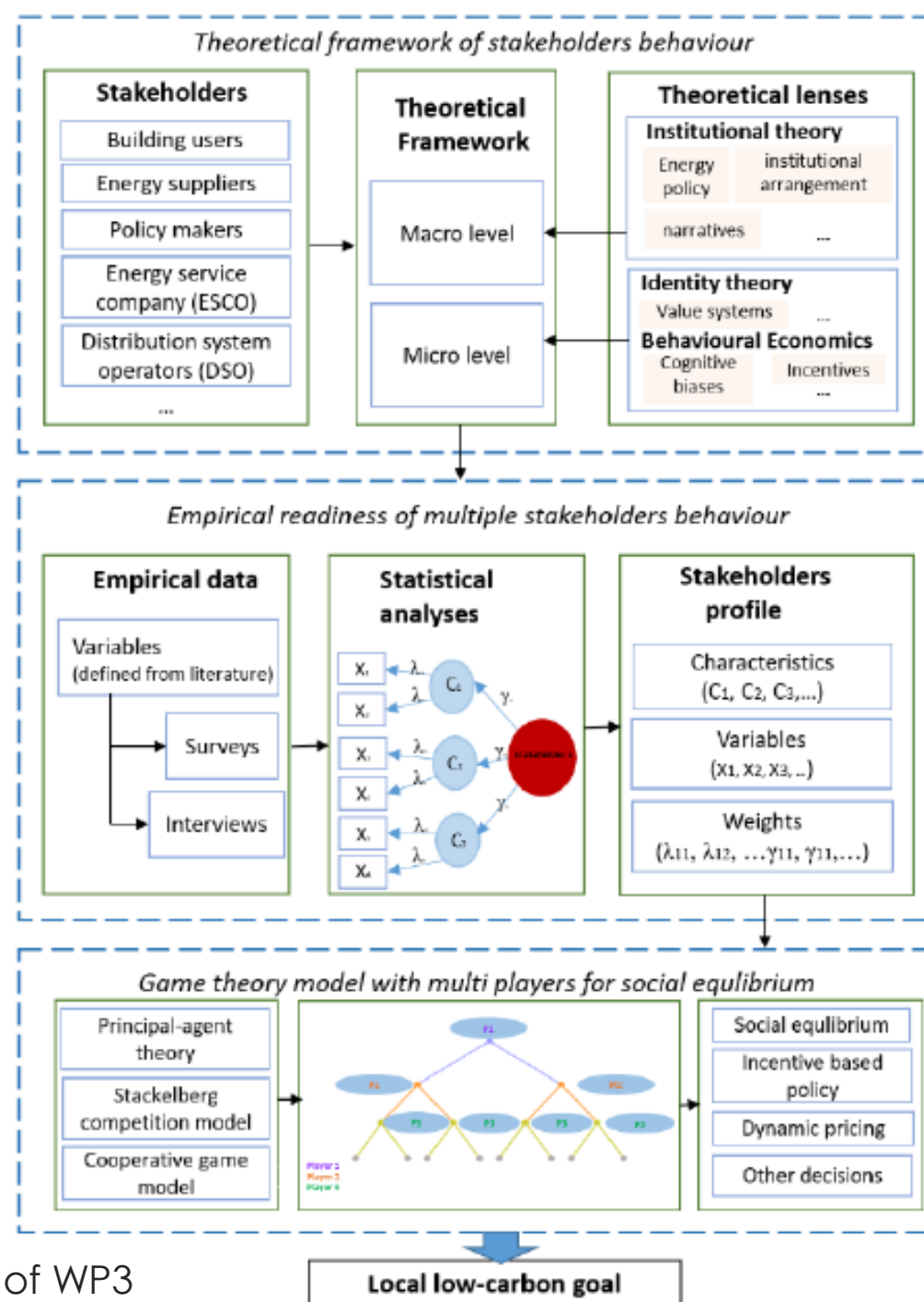
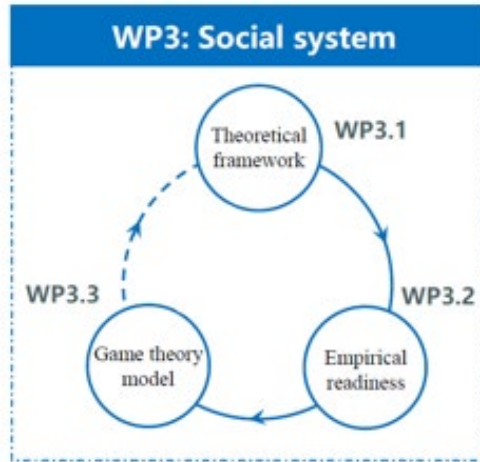


WP1: Sociotechnical system study

LES challenges	Use cases	Stakeholders' preferences, motivations, expectations
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Stakeholders in LES



Research framework and workflow of WP3

3.

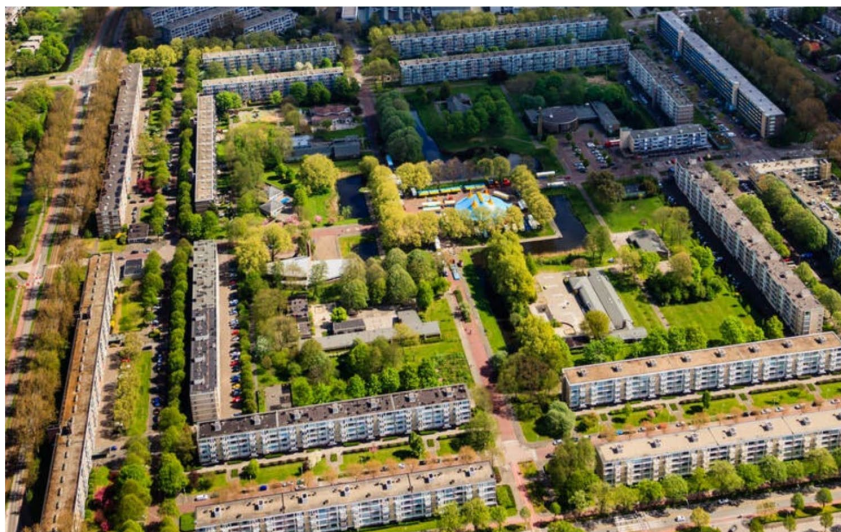
Current status

Status Aug-Dec 2022

For WP1

- Interview Heuvel/Amstelwijk
- Qualitative analysis

De Heuvel/Amstelwijk



Wat gaat er wanneer gebeuren?



2022-2024: wijkuitvoeringsplan opstellen samen met de wijk
2024-2032: uitvoeren plan: overgang naar duurzame energie

<https://leidschendam-voorborg.incijfers.nl/>

De Heuvel/Amstelwijk

Matrix

Logische
transitiewijken

	Goed geïsoleerde woningen	Gasvangingsopgave	Veel dynamiek (nieuwbouw)	Renovatieplan woningcorporatie	Ligging binnen Dunea-zone	Eenvormigheid woningen	Moelijk te isoleren woningen	Reeds rioolwerkzaamheden	Verwachte stadsdynamiek uitgevoerd	Korte termijn gasdynamiek op termijn	Veel kleine VvE's
De Heuvel & Amstelwijk	Green	Grey	Grey	Green	Green	Green	Grey	Grey	Grey	Orange	Grey
Leidschendam-Zuid	Grey	Green	Grey	Green	Green	Grey	Grey	Grey	Grey	Grey	Grey
Essesteijn	Grey	Grey	Grey	Green	Grey	Green	Grey	Grey	Grey	Grey	Grey
Klein Plaspoelpolder	Grey	Grey	Green	Grey	Green	Green	Grey	Grey	Grey	Grey	Grey
	Criteria geschikte transitiewijk						Criteria ongeschikte transitiewijk				

Stakeholder analysis

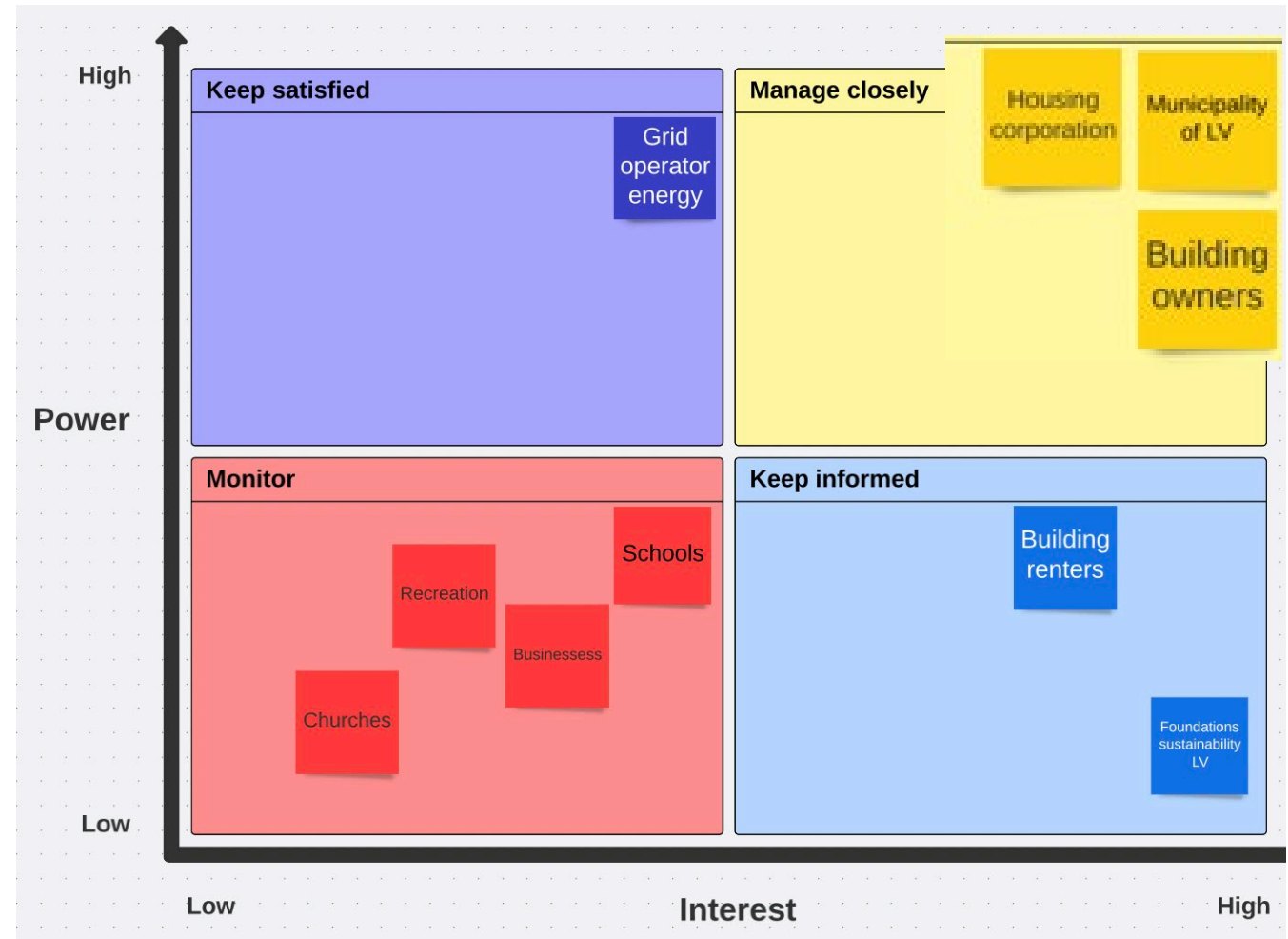
Which stakeholders to begin with?

Stakeholdersmatrix

67 Stakeholders

10 categories

Power and interest



Analyseproces

Amberscript
Atlas Ti

Key codes –
LES project

Knowledge

Attitude

Behavior

Challenges

Scope of action/agency

Communication

Relationship with other stakeholders

Initial analyse

communication

big challenge with the VvEs

financial costs

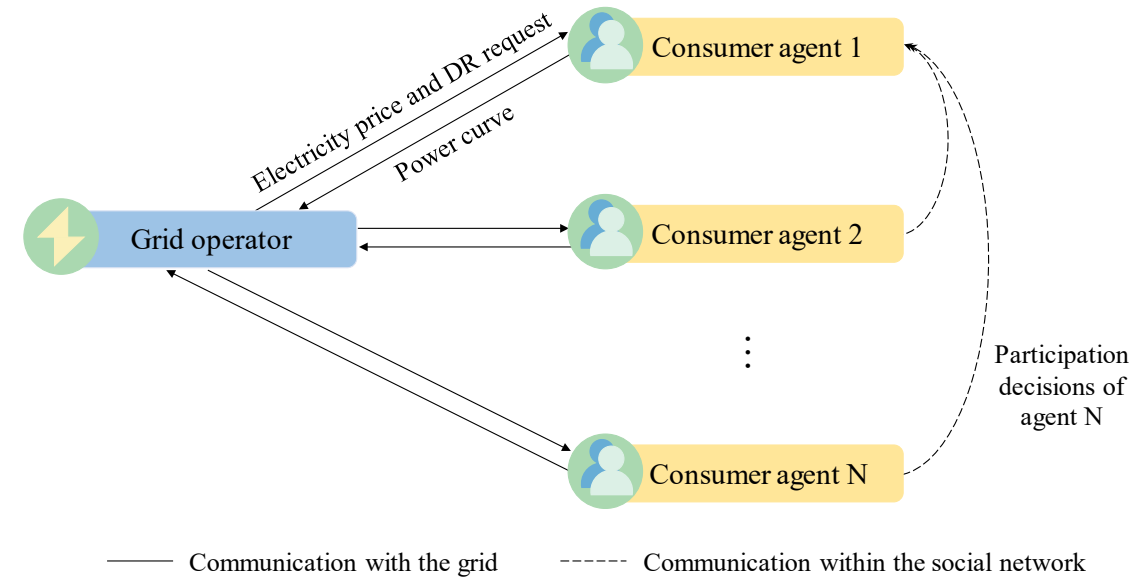
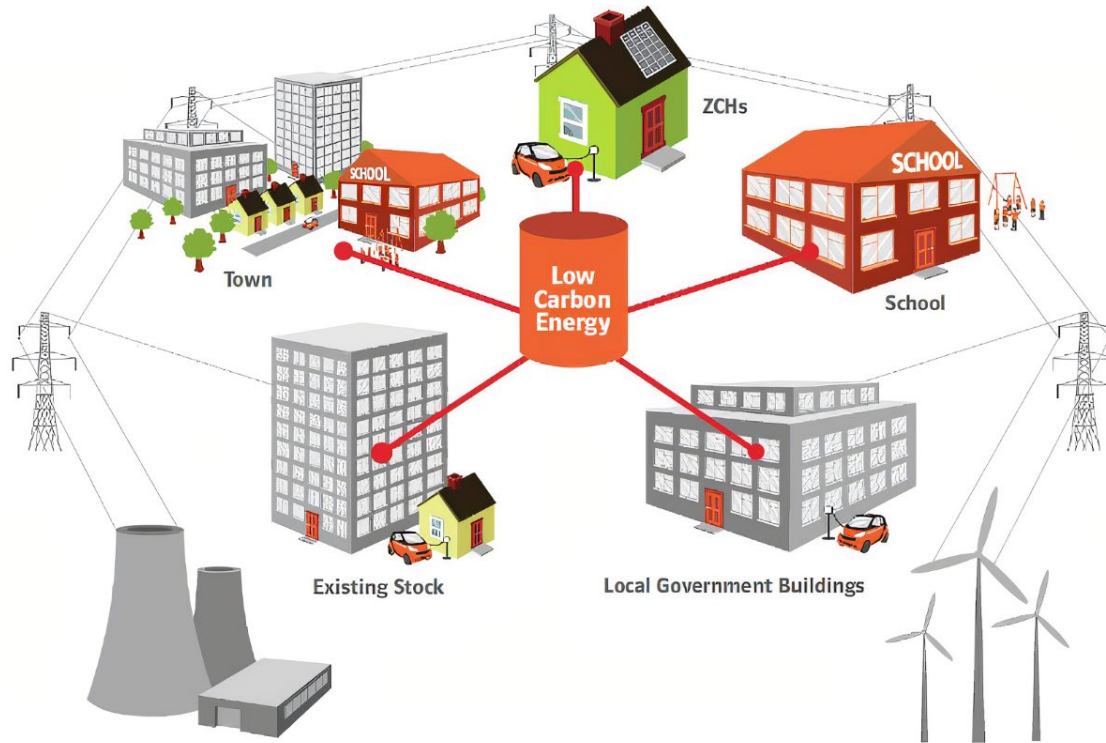
Uncertainty development
energy systems

Status 2022 Aug-Dec

For WP3

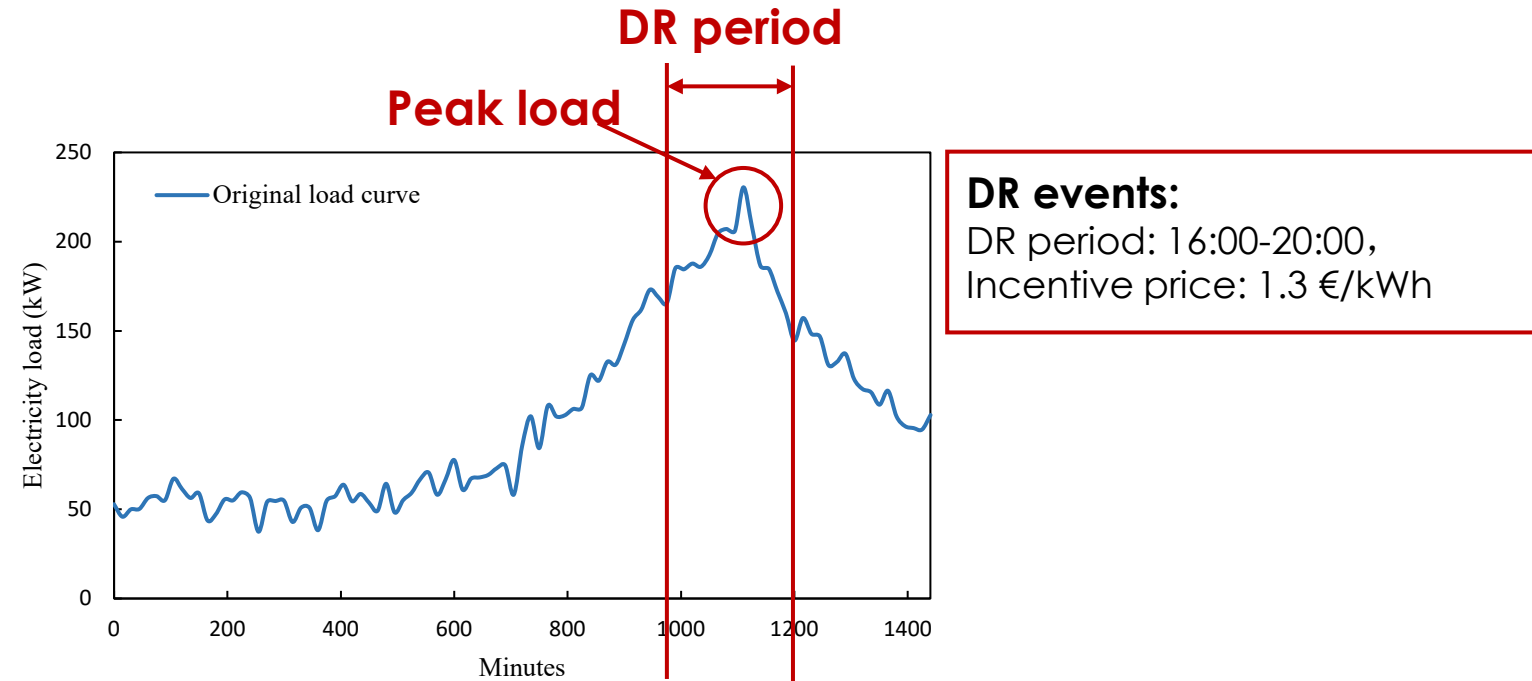
A belief-desire-intention (BDI) model for the simulation of end-user decision-making in demand response (DR) program

Background in LES Grid operator collects energy demand information of the whole community and gives an incentive at peak hours to reduce peak hour usage, users decide to participate this or not. - **Demand response (DR) program**



Research aim

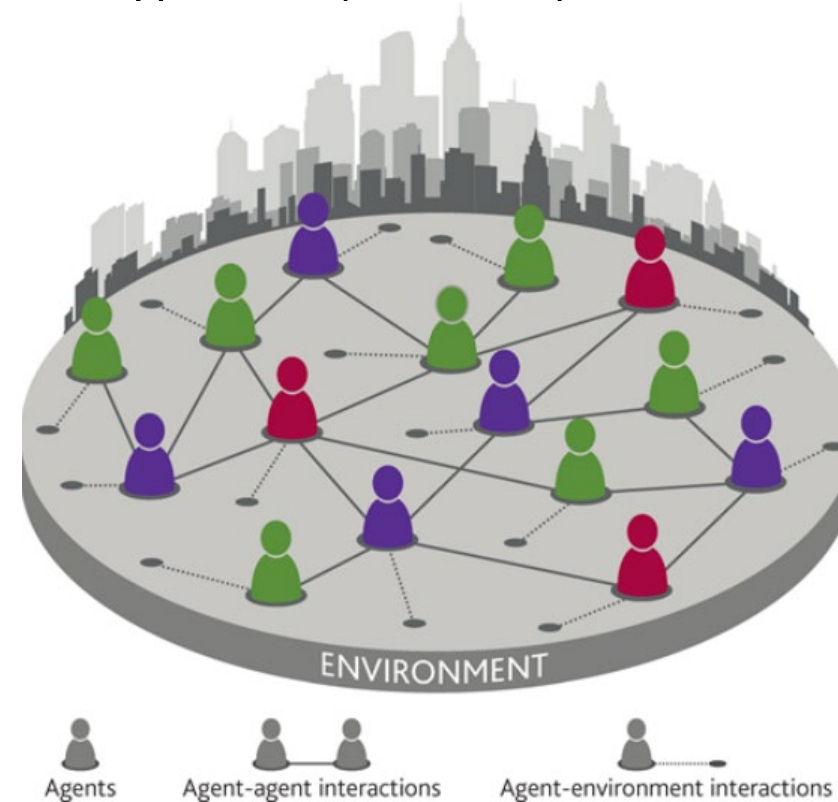
Reduce peak load **including end users behavior** in their decision making.



The load curve and peak load of a community

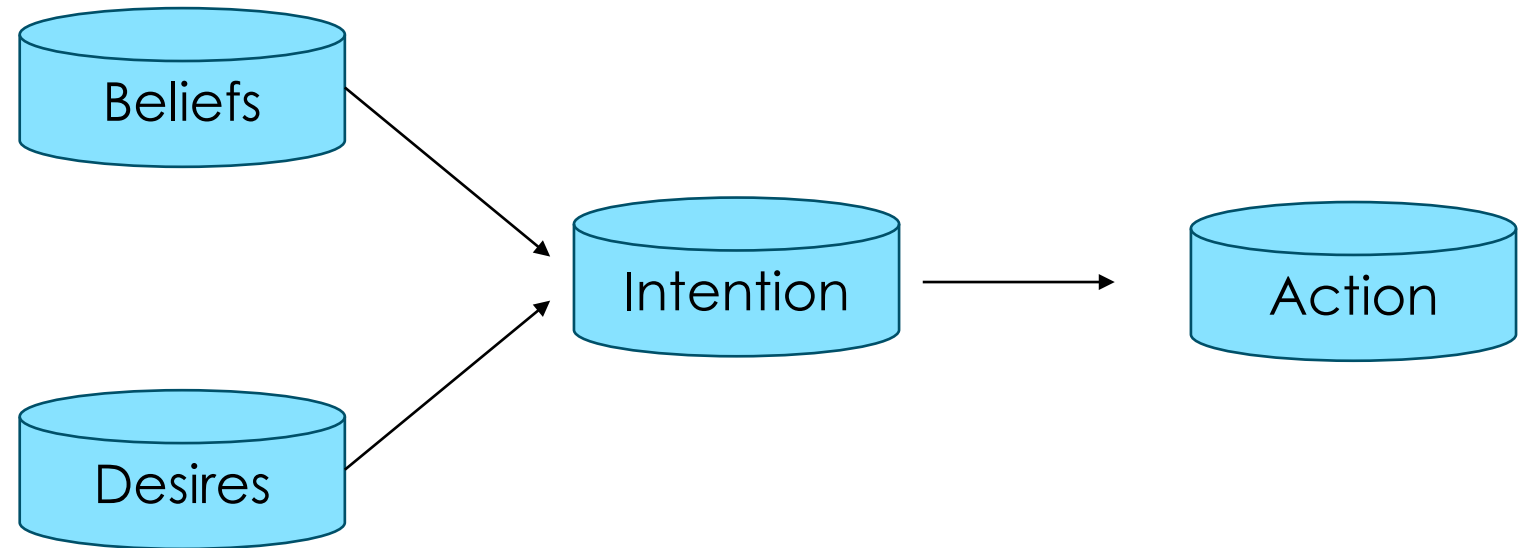
Methods

- **Agent-based modeling (ABM)** is a simulation methodology to understand complex phenomena by observing large number of agents repeatedly interacting with each other.



Methods

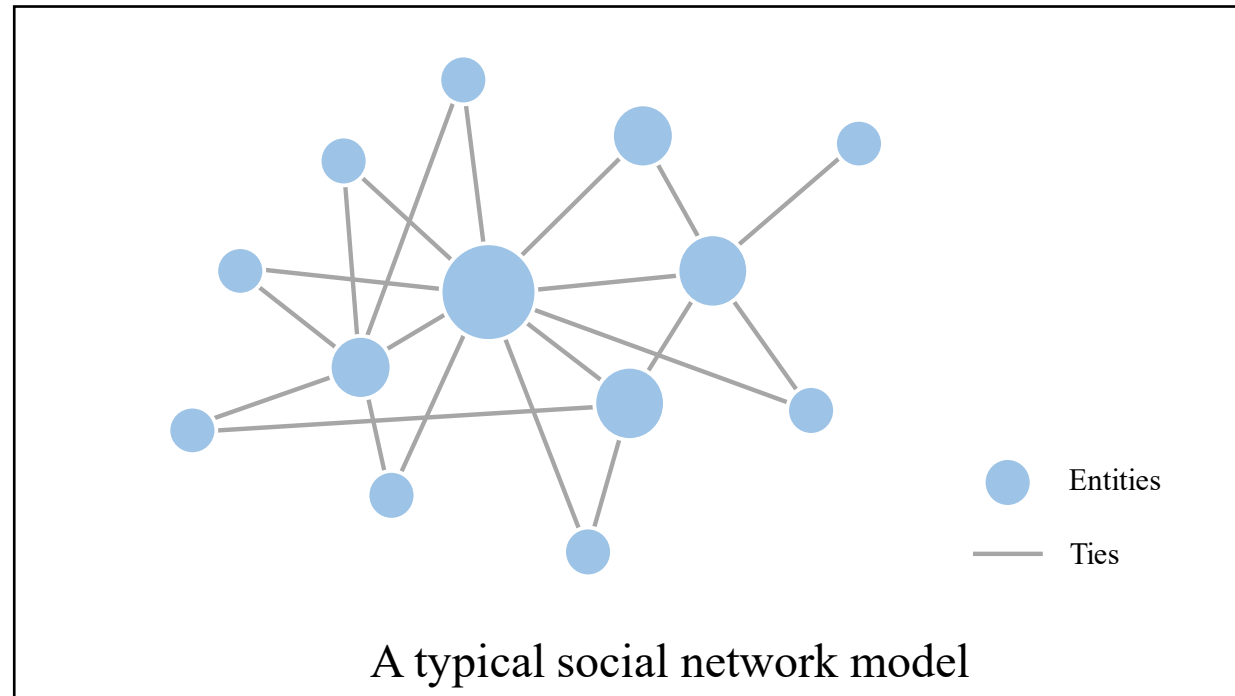
- **Belief-Desire-Intention (BDI)** paradigm^[1] is widely used to model the process of human decision making in the field of social science. Its mental state is characterized by three components: **beliefs, desires, and intentions**



[1] Patrick Taillandier, Olivier Therond, Benoit Gaudou. A new BDI agent architecture based on the belief theory. Application to the modelling of cropping plan decision-making. International Environmental Modelling and Software Society (iEMSs), 2012, Leipzig, France.

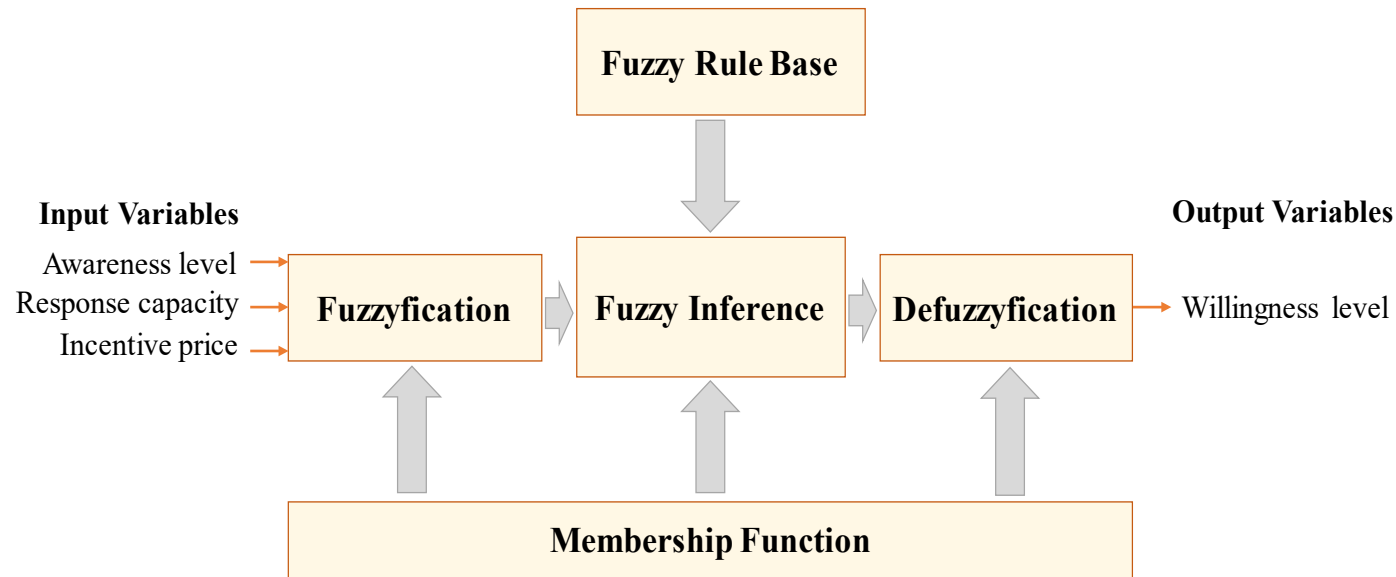
Methods

- **The awareness level** represents the degree of end-users' subjective identification to DR events. It can be influenced by the **social network**.



Methods

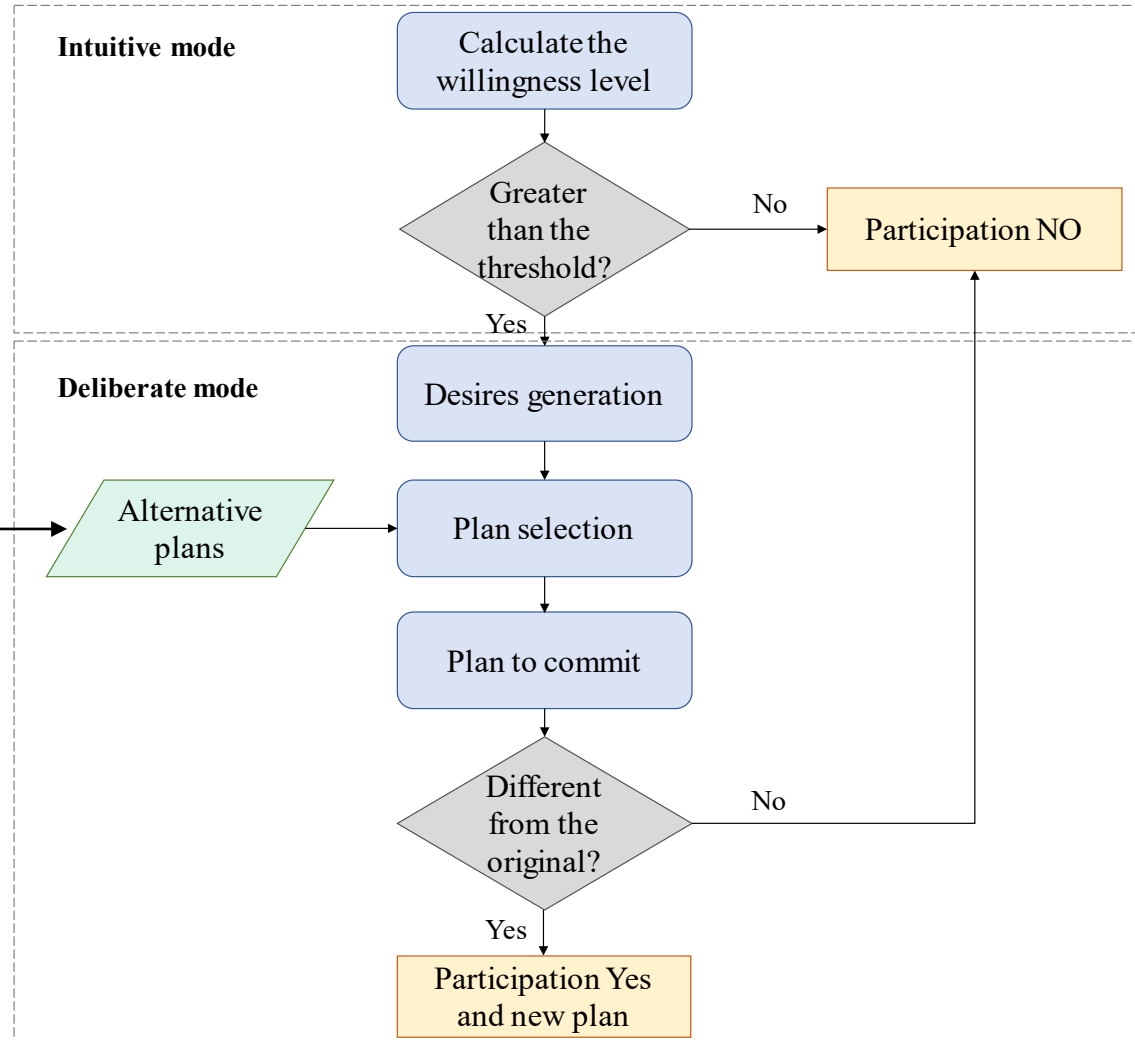
- **Fuzzy inference rules** ^[2] implement the reasoning process of the willingness level according to these influence factors.



Fuzzy inference system (FIS) structure

Methods

- There are two modes in the decision-making process of the agent: **intuitive mode and deliberate mode.**



- **Intuitive mode:** fast, automatic and spontaneous
- **Deliberate mode:** slower, deliberate and conscious

Desires:

- Minimum electricity cost
- Minimum discomfort level

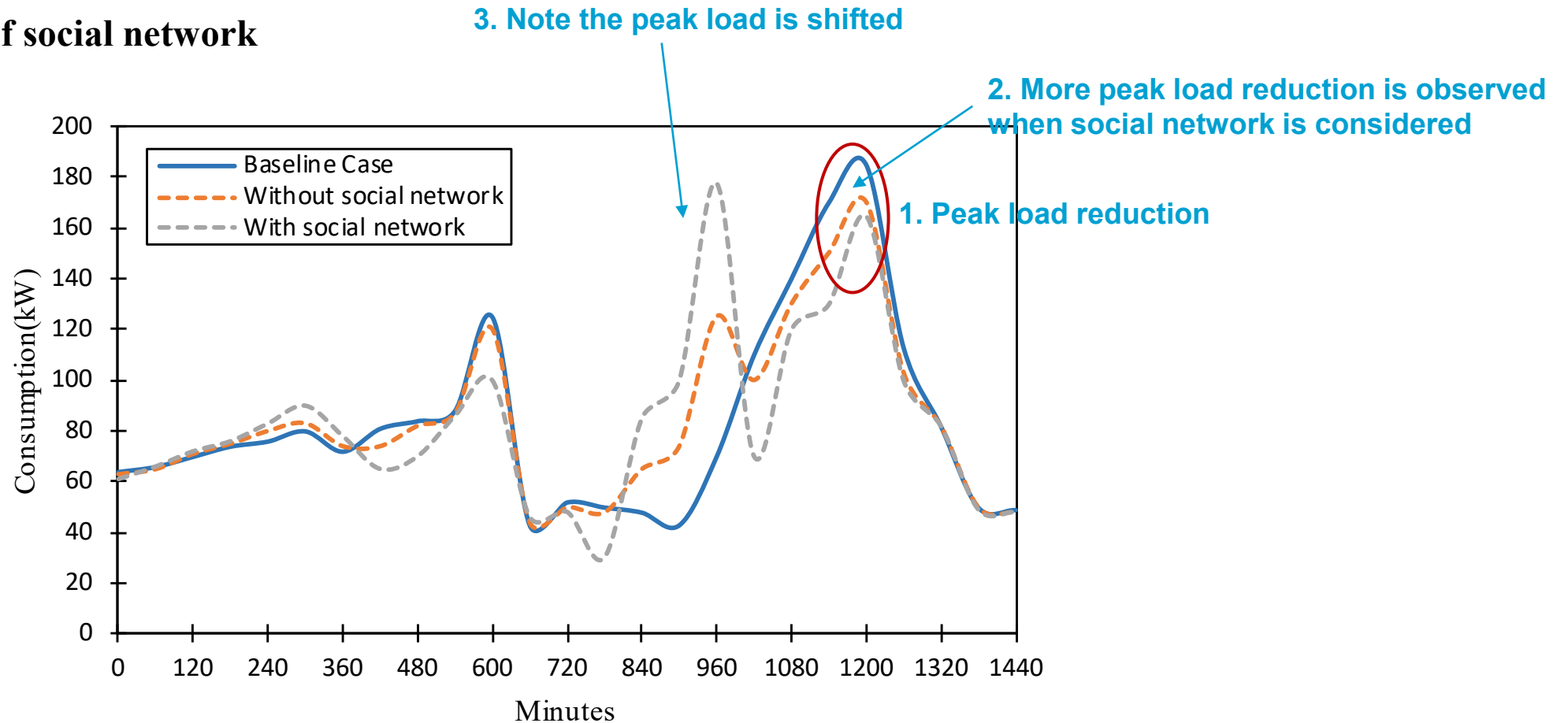
Plan selection:

- Maximum utility depends on cost and comfort

Two modes in the decision-making process of the agent

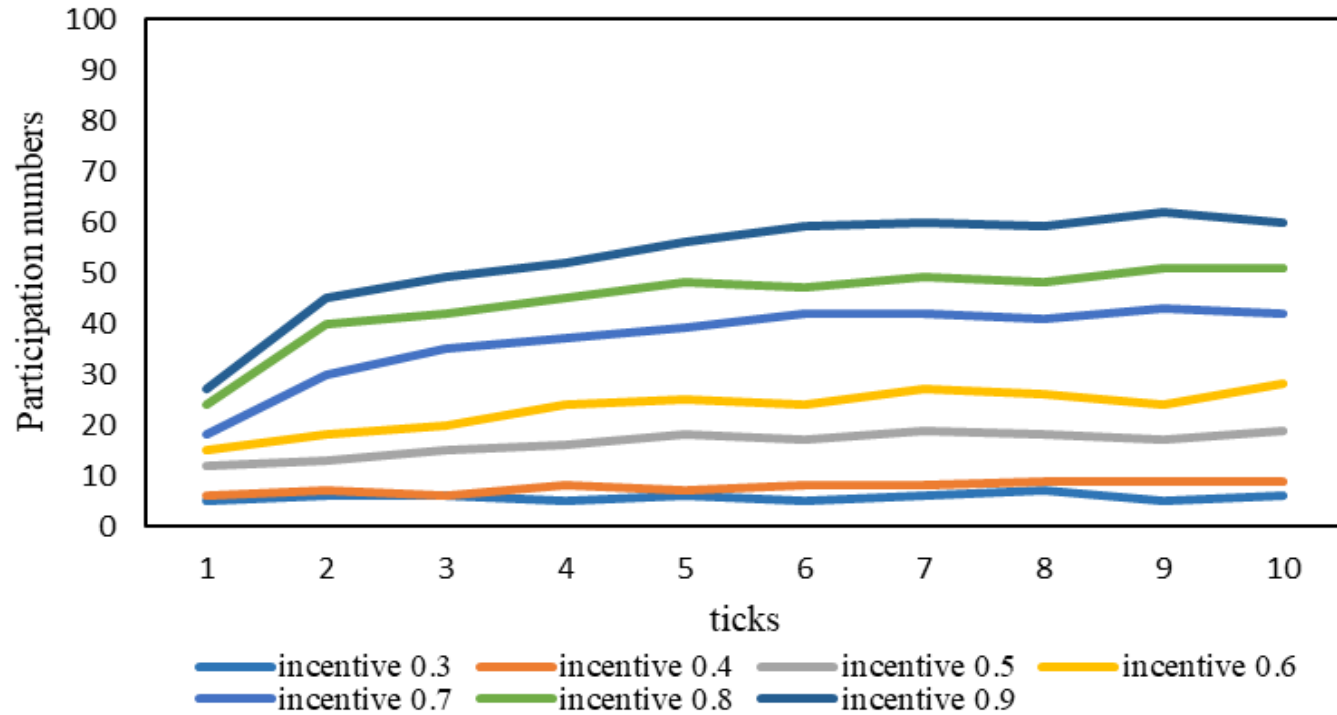
- Simulations based on a residential community consisting of 100 households.

Finding: Influence of social network



The electricity load curves under the baseline and with and without social network

Finding: Influence of incentive price



2. the participation is expected to reach a maximum no matter how higher the incentive price is set

1. no response when the incentive is small

Number of end-users participating in the DR program
in different incentives

Take aways

1. Belief-Desire-Intention (BDI) model can strongly influence the decision-making behavior and the overall performance of the whole community in a DR program.
2. The social network and incentive price together motivate end-users' participation in DR.

*DR program with incentive price intervention is the background of this study, future research should consider other framework with **non-monetary incentives**, this is relevant especially in association with psychological factors .*

4.

Thanks and questions