

# Deliverable 2.3 – Analysis of the influence of individual consumer characteristics and governance approaches on their engagement in collective flexibility concepts



**University of Antwerp**  
| **ENVECON** | Environmental Economics  
Research Group Engineering Management

**Background**

# Context and Motivation

## Energy Communities

### **Energy (Sharing) Communities (ECs):**

- **Renewable Energy Communities (RECs):**
  - Local focus on renewable energy production and consumption.
- **Citizen Energy Communities (CECs):**
  - Broader participation, potentially involving more diverse energy activities.

### **Contributions of ESCs to Grid Flexibility:**

- **Passive Contribution:**
  - Integration of Distributed Energy Resources (DERs):
    - Local generation and storage, reducing load on the grid.
- **Active Contribution:**
  - Engagement in Flexibility Measures:
    - Demand side management and load shifting.
    - Supporting grid stability through frequency regulation.

# Context and Motivation

## Research Gap

### The Problem:

- Current research focuses on **technology, financial incentives, and community benefits** of ECs.

### The Gaps and Objectives:

- **Governance:**
  - **Gap:** How can governance structures be designed to encourage member participation?
  - **Objective:** Explore governance models that enhance social inclusivity.
- **Grid Integration:**
  - **Gap:** How can ECs actively contribute to grid stability and flexibility?
  - **Objective:** Investigate EC operationalization for grid engagement.

# Theoretical Framework

# Energy Communities as Common Pool Resources

## Energy Communities as Common Pool Resources:

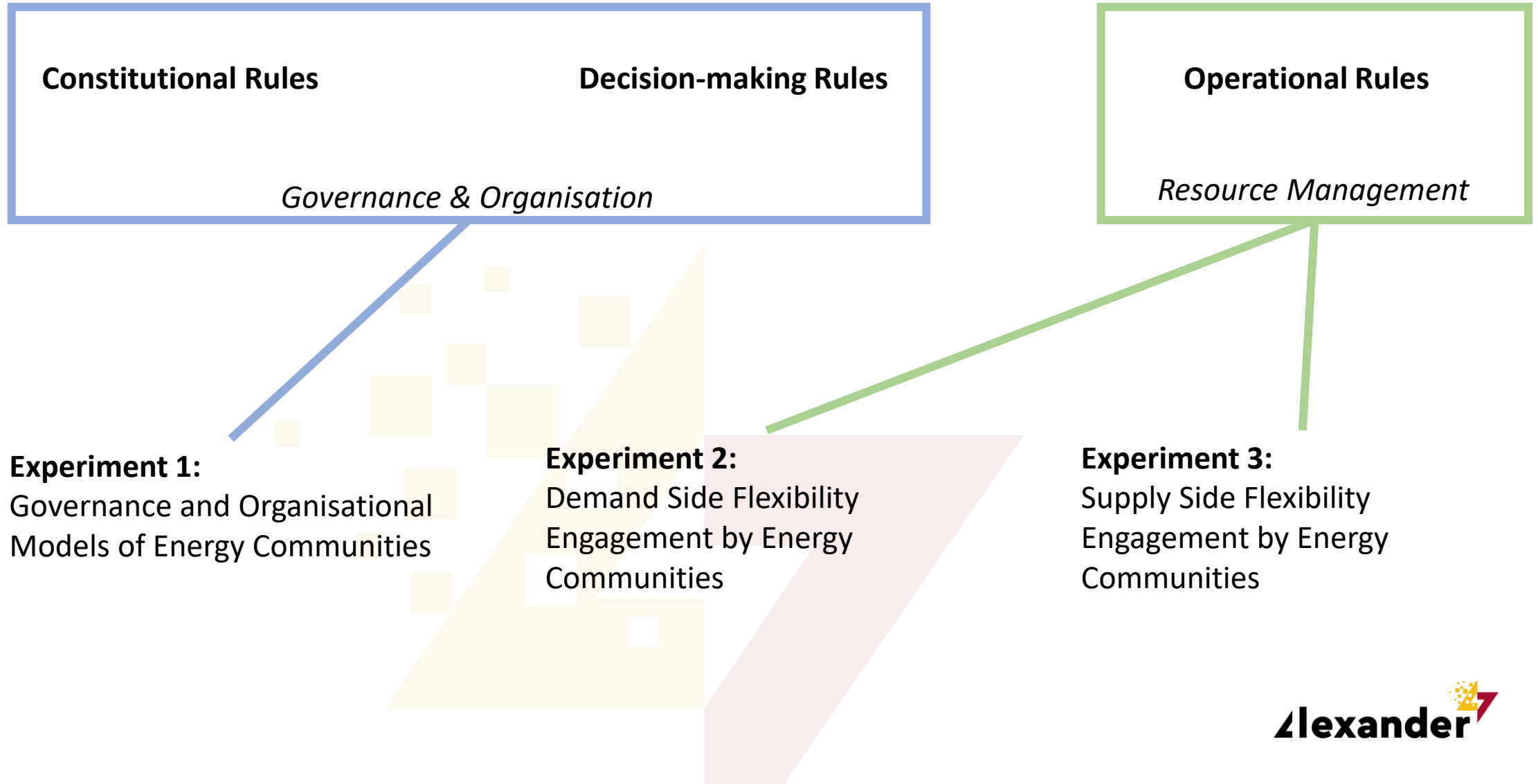
- **Characteristics**

- Rivalrous – Limited availability and Usage Impact
- Non-Excludable – Shared Access and Collective Use

- **Governance**

- Collective Input and Decision-Making
- Policing and Enforcement
  - *Self-Policing*: The EC monitors member usage through smart metering
  - *Enforcement*: Rules are enforced through mutual agreements, sanctions, or penalties

# ECs as CPRs – How do we Understand These Rules?



# **Experiment 1: Governance and Organisation of Energy Communities**



## RQ and Hypothesis (?)

### Research Questions:

*How do **governance structures** within community energy and energy-sharing models **influence** Belgian residents' **willingness to participate** in Energy Sharing Communities?*

*How do the **time requirements** of establishing an EC affect members' **willingness to volunteer** and actively engage in Energy Sharing Communities?*

*What are the **preferences** regarding the **membership** scope of Energy Communities, including the types of members (e.g., households, businesses) and geographic limitations?*

### Hypotheses:

- Members of Energy Sharing Communities are more likely to actively participate when governance structures emphasize participatory decision-making and offer inclusive leadership roles.
- The willingness to volunteer is higher when members perceive greater value from the community, which is influenced by how well the governance structures meet their expectations.
- Members will prefer Energy Communities that have a geographically limited scope and focus primarily on households, rather than those with broader geographic reach or significant business involvement

# Survey Design

- **Discrete Choice Experiment (DCE) Approach:**

- Focuses on constitutional rules (who participates) and decision rules (how decisions are made).
- Captures preferences for governance structures within Energy Sharing Communities.
- Examines key attributes like decision-making processes, leadership roles, and membership scope.

- **Willingness to Volunteer (WTV):**

- Used instead of traditional economic metrics like Willingness to Pay (WTP) or Willingness to Accept (WTA).
- Reflects non-monetary commitment, measuring the extent to which individuals are willing to contribute time and effort.
- Captures the value members place on governance attributes that align with their ideals and the perceived benefits they receive from the community.

# Survey Design

## Context

- When installing solar panels, you're introduced to Energy Communities (ECs).
- ECs can take various forms, requiring your input on how they operate and who can join.
- Participation involves a time commitment—hours per week over several months.
- Your decisions will shape the community's governance and membership.
- This experiment seeks to understand your preferences regarding the governance and organization of Energy Communities.

# Survey Design

## Attribute Table

Attribute	Attribute Levels				
<b>Solar Panel Ownership</b>	Individual	Community			
<b>Member Types</b>	Only Households	Micro and Small Enterprises	Medium Enterprises	Local Government and Community Services	Open to All
<b>Geographic Limits</b>	Immediate Neighbours	Local Energy Network	Municipality	Country	
<b>Decision-making Responsibility</b>	Members Majority Voting	Board of Directors and Member Forums	Board of Directors		
<b>Primary Benefit</b>	Energy Pricing	Energy Pricing and Community Investment	Energy Pricing and Individual Payouts		
<b>Minimum Membership Length</b>	No Minimum	Yes, decided within community			
<b>Time Investment</b>	<i>Month Investment</i> <ul style="list-style-type: none"> <li>6 to 12 Months</li> <li>12 to 18 Months</li> </ul>	<i>Time Investment</i> <ul style="list-style-type: none"> <li>2 to 3 Hours per Month</li> <li>5 to 7 Hours per Month</li> <li>9 to 12 Hours per Month</li> </ul>			

# Survey Design

## Choice Card

	Community 1	Community 2	Individual Consumption
<b>Solar Panel Ownership</b> ?	Individuals	Individuals	You do not share your energy with others, and you only consume what you produce and from the grid
<b>Member Types</b> ?	Local Government and Community Services	Medium Enterprise	
<b>Geographic Limit</b> ?	Country	Country	
<b>Decision Making and Responsibility</b> ?	Members Majority Voting	Board of Directors with Member Forums	
<b>Primary Benefits</b> ?	Electricity Pricing	Electricity Pricing and Individual Payouts	
<b>Minimum Membership Length</b> ?	No Minimum Membership Length	No Minimum Membership Length	
<b>Time Investment</b> ?	6 to 12 Months 2 to 3 Hours per Month	12 to 18 Months 5 to 7 Hours per Month	
	<input type="radio"/>	<input type="radio"/>	

# Survey Design

## Choice Card

	Community 1	Community 2	Individual Consumption
<b>Solar Panel Ownership</b> ?	Individuals	Individuals	You do not share your energy with others, and you only consume what you produce from the grid
<b>Member Types</b> ?	Local Government and Community Services	Medium Enterprise	
<b>Geographic Limit</b> ?	Country	Country	
<b>Decision Making and Responsibility</b> ?	Members Majority Voting	Board of Directors with Member Forums	
<b>Primary</b>	- Members Majority voting - All decisions about the functioning of the community are made by majority vote of the members		
<b>Minimum</b>	- Board of Directors and Member Forums - An elected board of directors makes all decisions, after required input of members through a forum		
<b>Time</b>	- Board of Directors - The elected board of directors makes all decisions about the community independently		
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

? This focuses on how decisions are made within the community.

- Members Majority voting - All decisions about the functioning of the community are made by majority vote of the members
- Board of Directors and Member Forums - An elected board of directors makes all decisions, after required input of members through a forum
- Board of Directors - The elected board of directors makes all decisions about the community independently

## **Experiment 2: Understanding of Member Preferences for Demand-side Flexibility**

## Research Question

*Are Low-voltage electricity consumers more likely to **engage in Load-Shifting** flexibility when part of an **Energy Community**?*

*What **factors influence the willingness** of energy community members to **participate** in providing Load Shifting services to the grid?*

**Hypothesis:** Community members are more likely than individuals to participate in Demand Side Flexibility when they receive clear benefits, both as a member and for the community.



# Survey Design

## **Focus of the Experiment:**

- Decision to engage in Load Shifting Demand Side Management (DSM).

## **Split Sample Design:**

- Two different contexts: Individual engagement vs. Community engagement.
- Same choice scenarios and attributes across both contexts.

## **Impact of Choice Context:**

- Testing how the context (individual vs. community) influences the choice outcome.
- Assessing the effects of collective thinking and benefits on the decision to provide Load Shifting services.

## **Implications for Grid Engagement:**

- Understanding how communities might engage with the grid as aggregated flexibility providers.
- Determining if there is a significant difference between individual and community choices.

# Survey Design

## Survey Context

### *Individual*

**Scenario:** Shift personal energy use to balance the grid.

**Incentives:** Receive individual remuneration based on flexibility.

**Focus:** Decide when/how to shift energy and opt-out conditions.

### *Community*

**Scenario:** Community-wide energy shifts for grid stability.

**Incentives:** Collective remuneration shared among members.

**Choice Focus:** Decide on community participation frequency and opt-out conditions.

# Survey Design

## Attribute Table

Attribute	Levels	Source
<b>Remuneration per Year</b>	<ul style="list-style-type: none"><li>• 0€, 20€, 50€, 90€, 140€, 200€</li></ul>	Ruokamo et al., 2019 Broberg et al., 2016 Kim et al., 2023
<b>Time of Engagement</b>	<ul style="list-style-type: none"><li>• 7 a.m.–10 a.m.</li><li>• 10 a.m.–1 p.m.</li><li>• 1 p.m.– 4 p.m.</li><li>• 5 p.m.– 8 p.m.</li></ul>	Kim et al., 2023
<b>Frequency of Participation</b>	<ul style="list-style-type: none"><li>• Rarely (Once a month)</li><li>• Occasionally (Once a week)</li><li>• Frequently (Several times a week)</li></ul>	
<b>Load Reduction Level</b>	<ul style="list-style-type: none"><li>• 5%</li><li>• 10%</li><li>• 15%</li><li>• 20%</li></ul>	
<b>Grid Emission Reduction</b>	<ul style="list-style-type: none"><li>• 0%</li><li>• 10%</li><li>• 30%</li></ul>	Ruokamo et al., 2019
<b>Participation Opt-out</b>	<ul style="list-style-type: none"><li>• No Opt-out Option</li><li>• Daily window of 1 hour</li><li>• Daily window of 2 hours</li></ul> <p><i>Or (both?)</i></p> <ul style="list-style-type: none"><li>• 1 Call per Month</li><li>• 3 Calls per Month</li></ul>	Bender et al., 2014

# Survey Design

## Choice Card

Attribute	Option 1	Option 2	Status Quo
Time of Engagement	5 p.m.– 8 p.m.	10 a.m.–1 p.m.	No engagement in Load Shifting Contracts
Frequency	Occasionally (Once a week)	Frequently (Several times a week)	
Load Reduction	15%	20%	
Grid Emission Reduction	10%	10%	
Participation Opt-out	Daily window of 1 hours	Daily window of 2 hours	
Remuneration per Year	150€	40€	
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

# Expected Outcomes

## Understanding Participation:

- **Governance Models:** Identify the attributes that drive participation in energy communities.
- **Engagement in Load Shifting:** Determine the factors influencing willingness to participate.

## Contextual Insights:

- **Individual vs. Community:** Compare the impacts of decision-making contexts on engagement.
- **Aggregated Flexibility:** Understand how the community context affects the mobilization of flexibility.

## Practical Applications:

- **Grid Operator Insights:** Clarify how Energy Communities prefer to engage in load shifting.
- **Enhanced Modeling:** Provide data to improve models, including household preferences.
- **Energy Community Optimization:** Gain insights into improving ECs as common pool resources.

## Policy and Program Design:

- **Policy Recommendations:** Guide the design of effective demand-side management programs.



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