

Energy use feedback: A behavioural OR approach toward better decisions and more efficient energy behaviours

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Inês Reis, Carlos Henggeler Antunes, Hermano Bernardo and Humberto Jorge

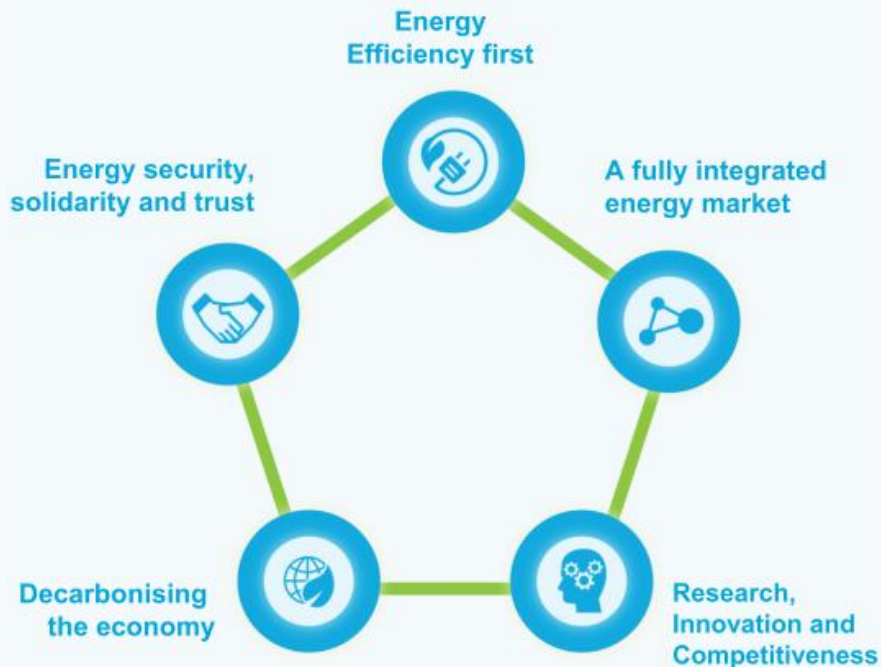
IFORS, July 18, 2017, Québec



Context: Energy Union and Climate Action



ENERGY UNION STRATEGY



1. Security, solidarity and trust
2. A fully integrated internal energy market
3. Energy efficiency
4. Decarbonising the economy
5. Research, innovation and competitiveness

Context: Energy Union and Climate Action



CLIMATE DELIVERABLES – PARIS AND BEYOND



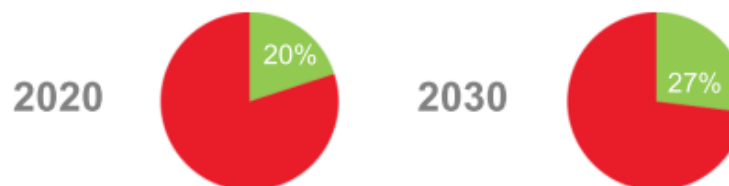
PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21-CMP11

CUT GREENHOUSE GAS EMISSIONS BY AT LEAST 40%



(Compared to 1990)

INCREASE THE SHARE OF RENEWABLES
IN THE ENERGY MIX TO AT LEAST 27%



IMPROVE ENERGY EFFICIENCY BY AT LEAST 27%

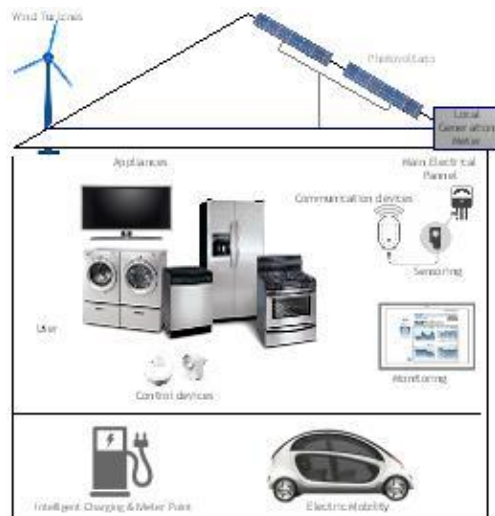


(Compared to the "Business-as-usual" scenario)

Context: People are key



Consumers and communities are active and central players on the energy market



Everyday tasks involve:

- Billing, switching suppliers and getting a new contract
- Producing electricity for own consumption, storing it, sharing it, consuming it or selling it back to the grid
- Access to information through digital technologies
- Controlling/managing energy use and responding to price signals



Increased complexity from the end-users' perspective

The problem: What support for end-users?



European Energy CONSUMERS' RIGHTS

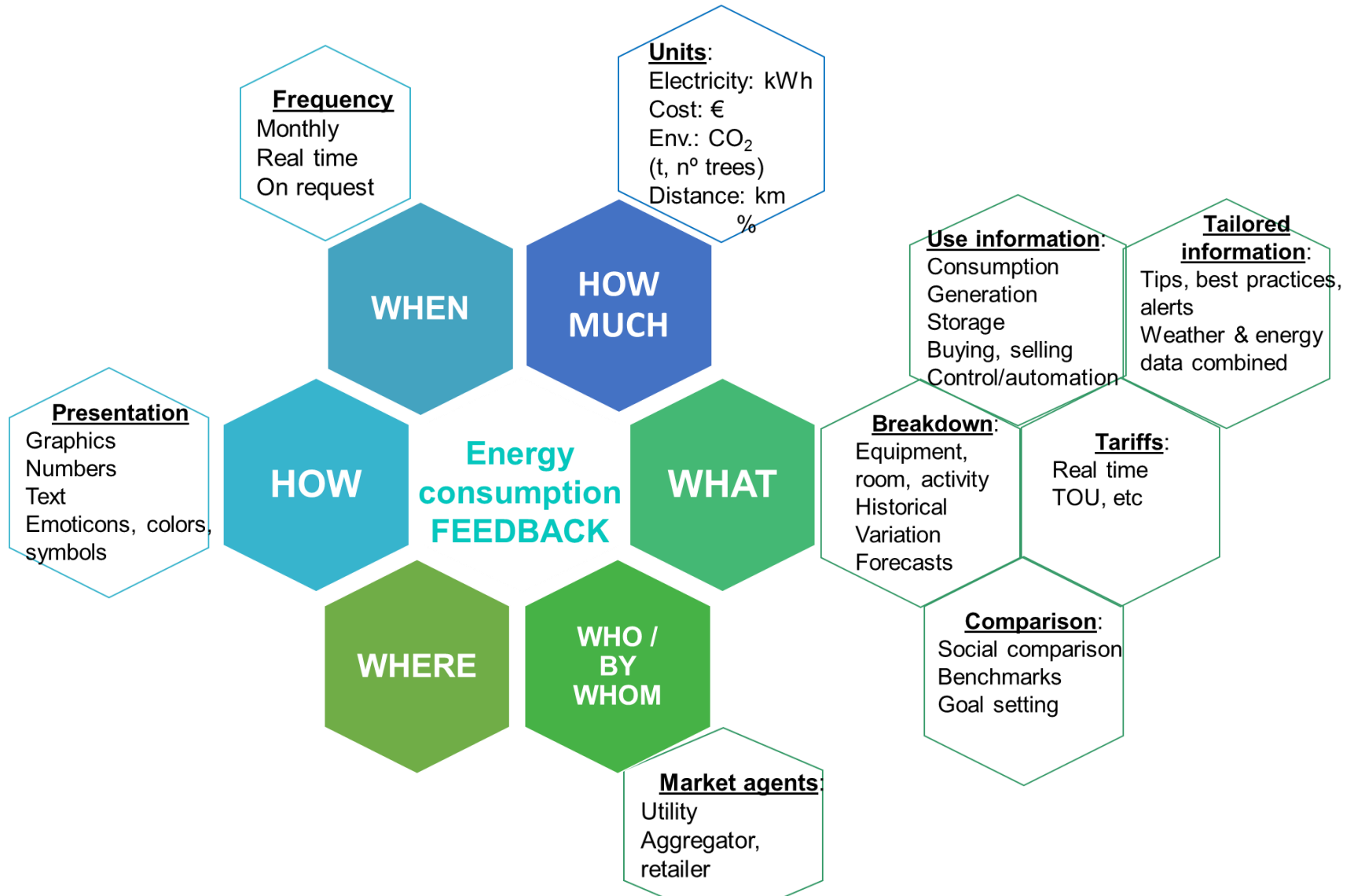
- Electricity connection
- Clear information on the energy contract
- Accurate information on the energy consumption
- Energy performance certificate for the home
- Information on energy efficiency and on the benefits of using energy from renewables
- Choice of energy supplier, easy and fast switch, easy resolution of complaints and disputes
- Protecting most vulnerable consumers
- A national contact point for energy information



Increased transparency, better information and regulations

The problem:

End-users are exposed to a complex puzzle of information which affects their decisions

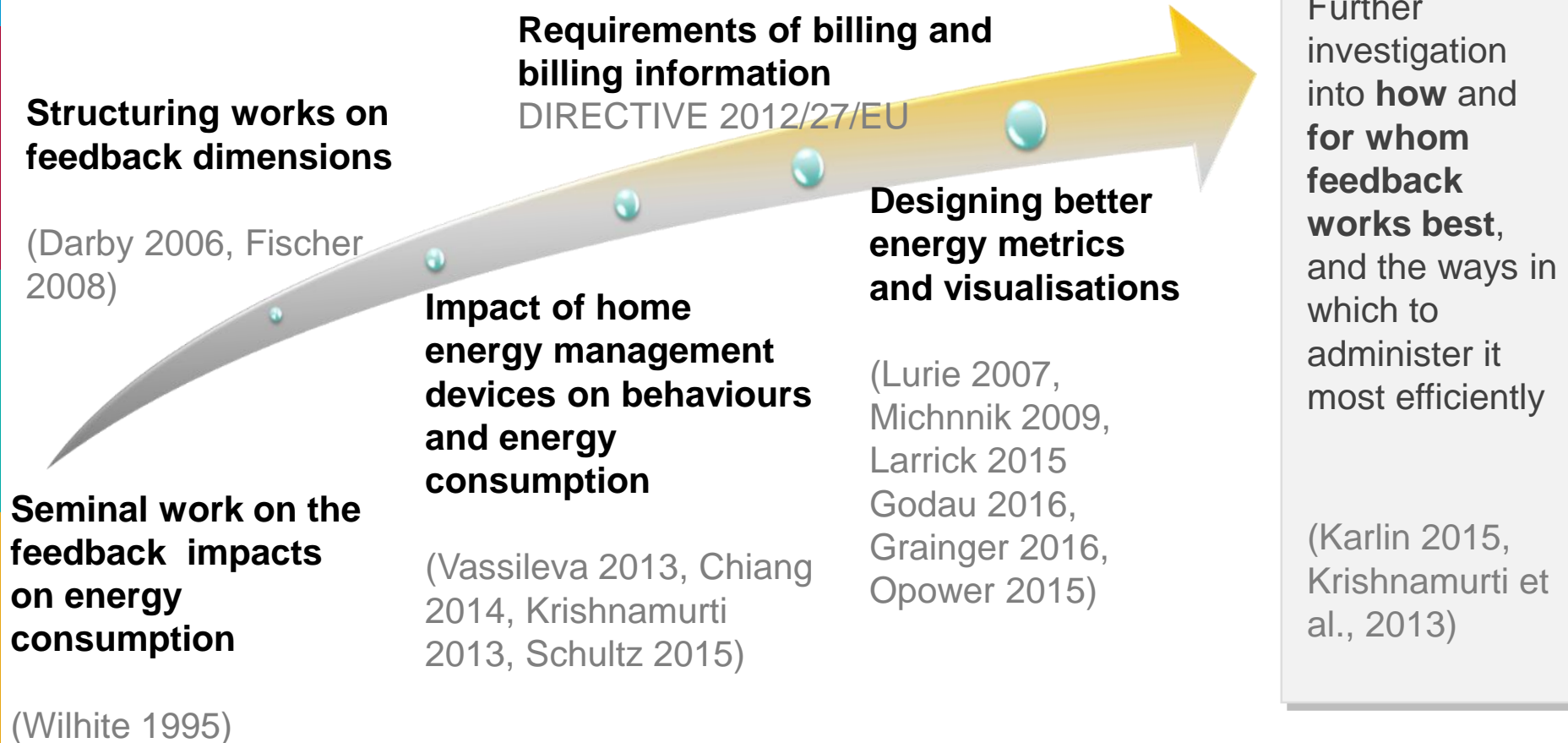


Literature overview:

Energy feedback research

Feedback: Information on energy consumption

There is a plethora of works in this topic



BOR overview:

Biases and heuristics in a energy context

Biases related with information

- Information overload
- Information relevance
- Anchoring effect
- Pattern recognition
- Ambiguity

(White 2016)

Other Biases

- Loss aversion
- Status quo
- Social comparison
- Trust
- Satisficing
- Confirmation
- Time saving
- Risk aversion
- Sunk cost effects
- Temporary discount
- Motivation (rewards and incentives)
- Endowment effect

Heuristics

- Availability
- Affect
- Substitution
- Anchoring and adjustment
- Representativeness

(Camara et al 2017,
Frederiks et al 2015)

The objectives and the approach

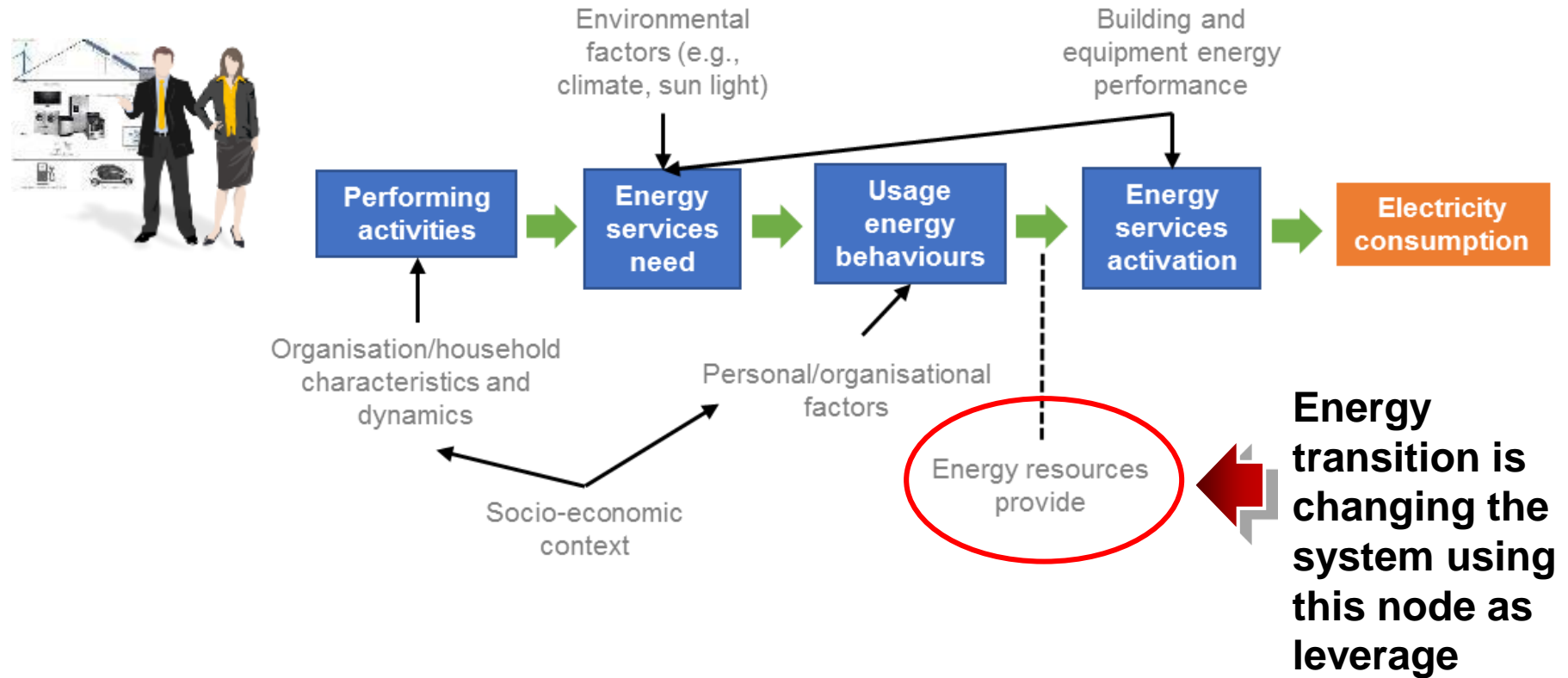
Using BOR to **explore behavioural issues in energy decision making** to facilitate end-users' decisions



APPROACH

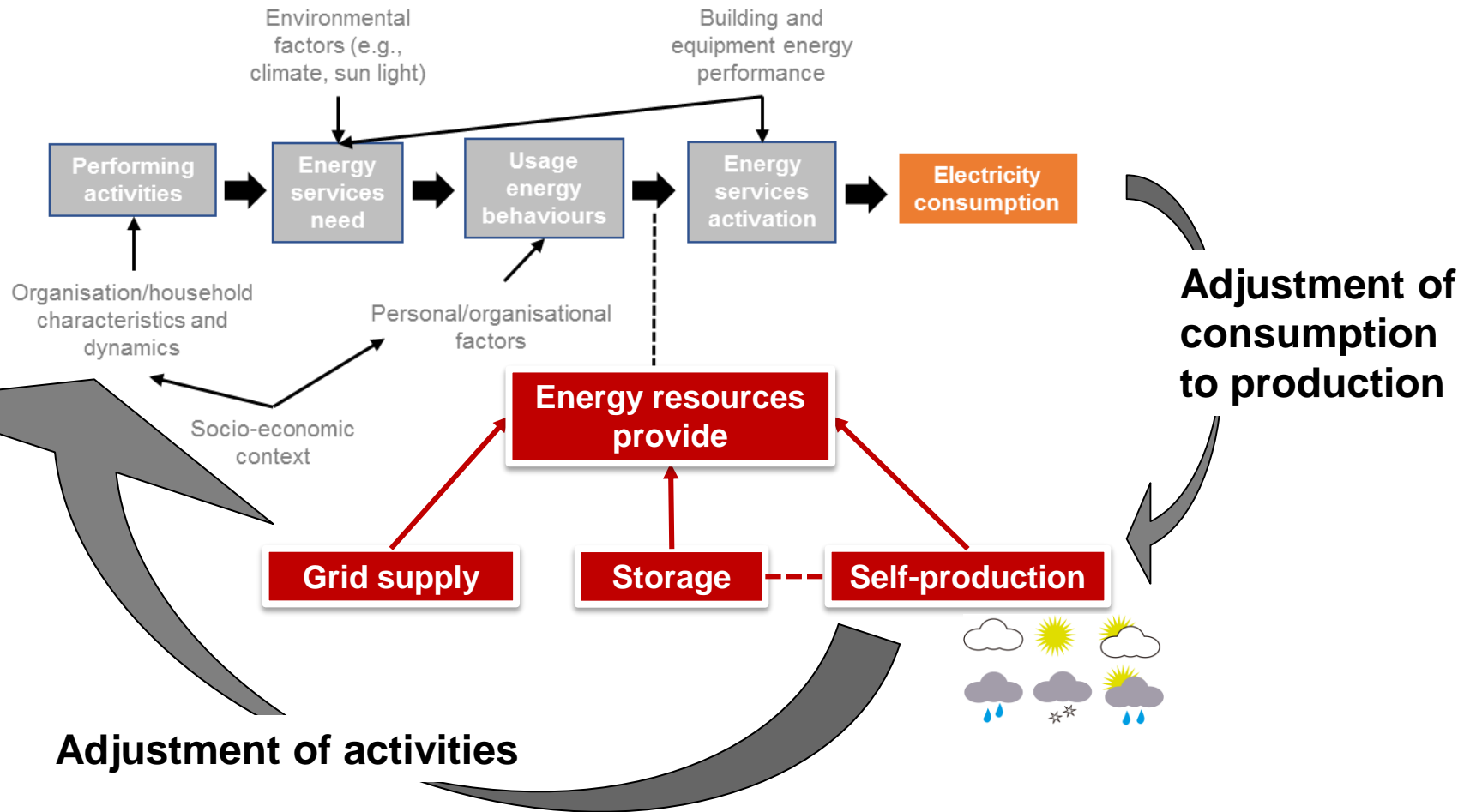
1. Systemic analysis
2. Addressing end-users' decision process through a multidisciplinary approach
3. Using BOR and test biases/heuristics through controlled experiments

A conceptual model: From daily activities to energy demand



- **Energy consumption activation chain** is influenced by personal, contextual, technological and environmental variables
- This chain of relations is not static, it has a **dynamic dimension**

A conceptual model: From daily activities to demand flexibility

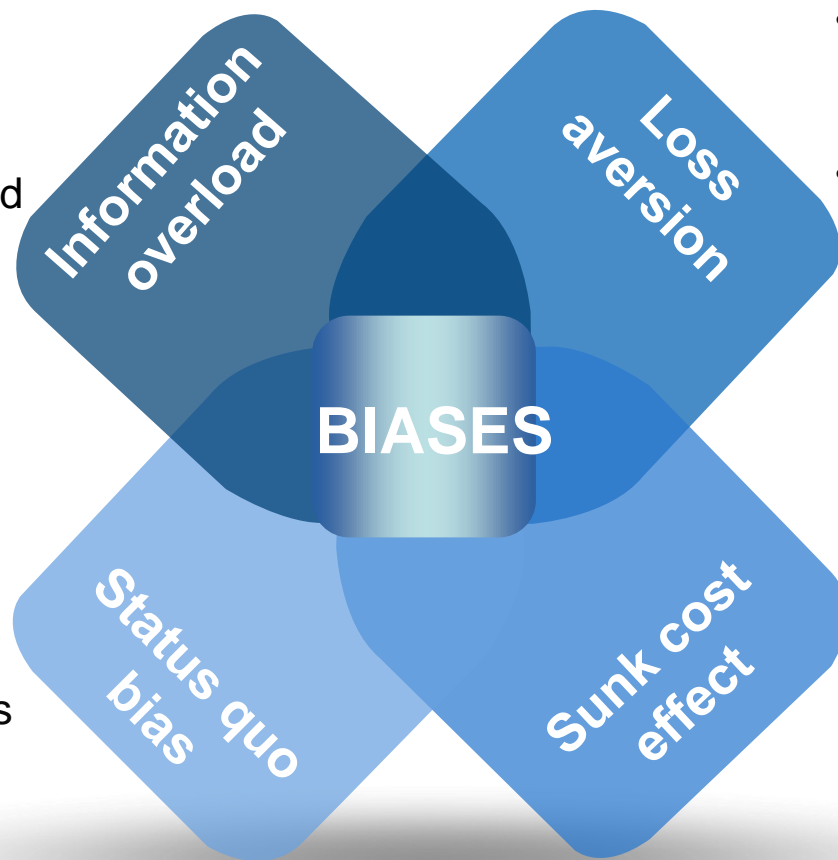


What are end-users' daily energy decisions?

	Intermediate decisions	Who should make this decision?	What information is required to support it?
1	Energy need \leq Self-production?	Automation	Load diagram (power vs time)
2	Is storage sufficient?		Storage capacity
3	Utility storage < Utility sell to grid?	Automation + User preferences	Real time prices from the grid/retailer
4	Cost using storage > Cost buying grid?		+ User preferences (e.g., expectation of using storage, declining lifetime of batteries, loss of comfort, compatibility with activities)
5	Cost load management? > Cost buying grid?		+ Storage capacity
6	Cost using storage > Cost load management?		+ Automated load flexibility

What biases may influence the decision process?

- May impair best judgement: automation and enabling technologies are required
- Design and learning devices may facilitate end-users' decisions



- May impair a dynamic participation in the energy market
- Energy prices enhance the role of this bias

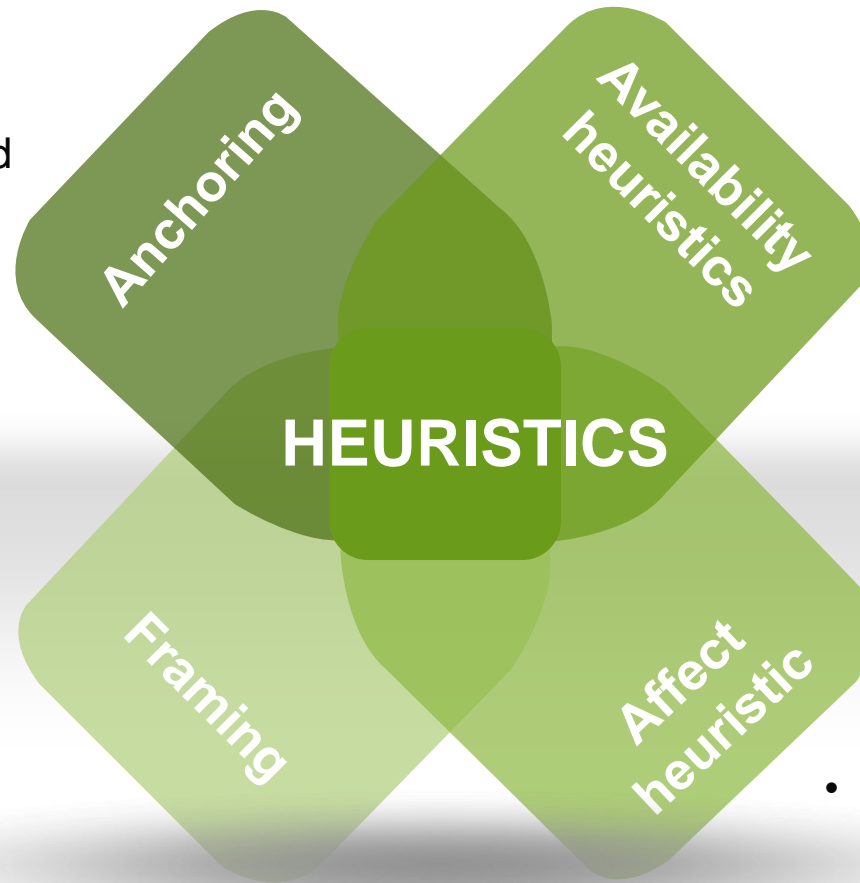
- May reinforce routines and impair changes

- Promotes a more dynamic participation in the energy market

Several biases may affect this decision process in different ways, working towards or against the efficiency of the energy system

What heuristics may influence the decision process?

- May reinforce routines and the status quo and impair changes



- May reinforce routines and impair changes
- Feedback and enabling technologies may reinforce this heuristic and promote best decisions

- More relevant in the adoption stage
- Or if combined with the loss aversion and loss/gains biases

- May strongly influence users' preferences towards selling/buying to/from the grid

Final considerations and next steps

- Although there is a vast research on energy feedback, **further investigation is required**
- **BOR approaches are interesting** to help designing feedback to facilitate and induce end-users' more efficient energy decisions
- Biases and heuristics may **either facilitate OR impair end-users' best (more efficient in the system perspective) decisions**
- Next steps will include **the design and implementation of experiments** to test in which conditions some of the biases and heuristics will be relevant

Thank you for your attention!
Suggestions are welcome 😊

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