

Agent-based Modeling of Consumer Participation in Demand Response Programs with the Consumat Framework

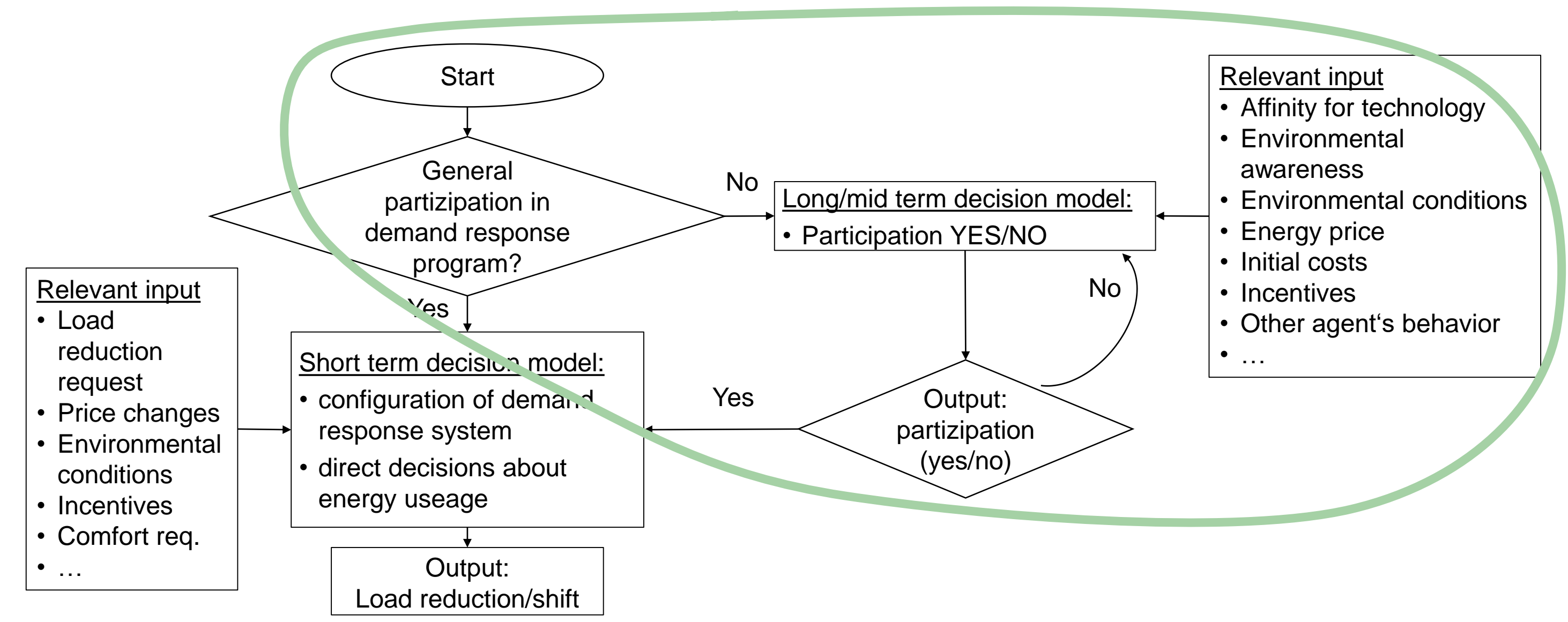
Judith Schwarzer and Dominik Engel
Center for Secure Energy Informatics

Abstract

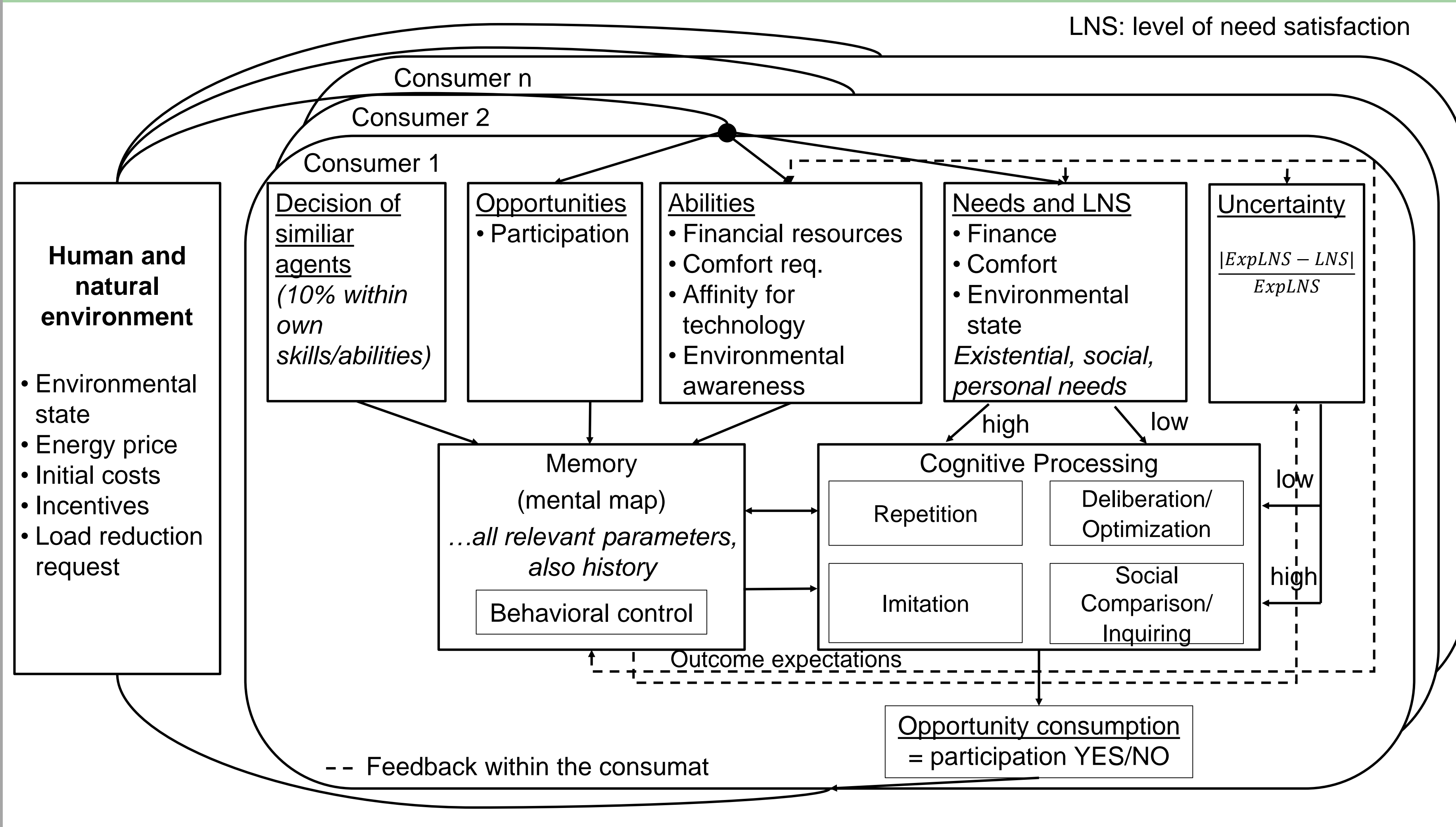
- ▶ Success of demand response (DR) programs essentially depends on the end consumers' decisions and interactions
- ▶ Technical demand response models require presumptions concerning general user participation
- ▶ In this work an agent-based model of consumer participation in demand response programs based on the Consumat framework is developed
- ▶ The approach constitutes the basis for an overall model to simulate consumer decisions in the context of demand response

Consumer Decisions in the DR Context

- ▶ Short and mid/long term decision
- ▶ Focus of this work: general participation (long term)



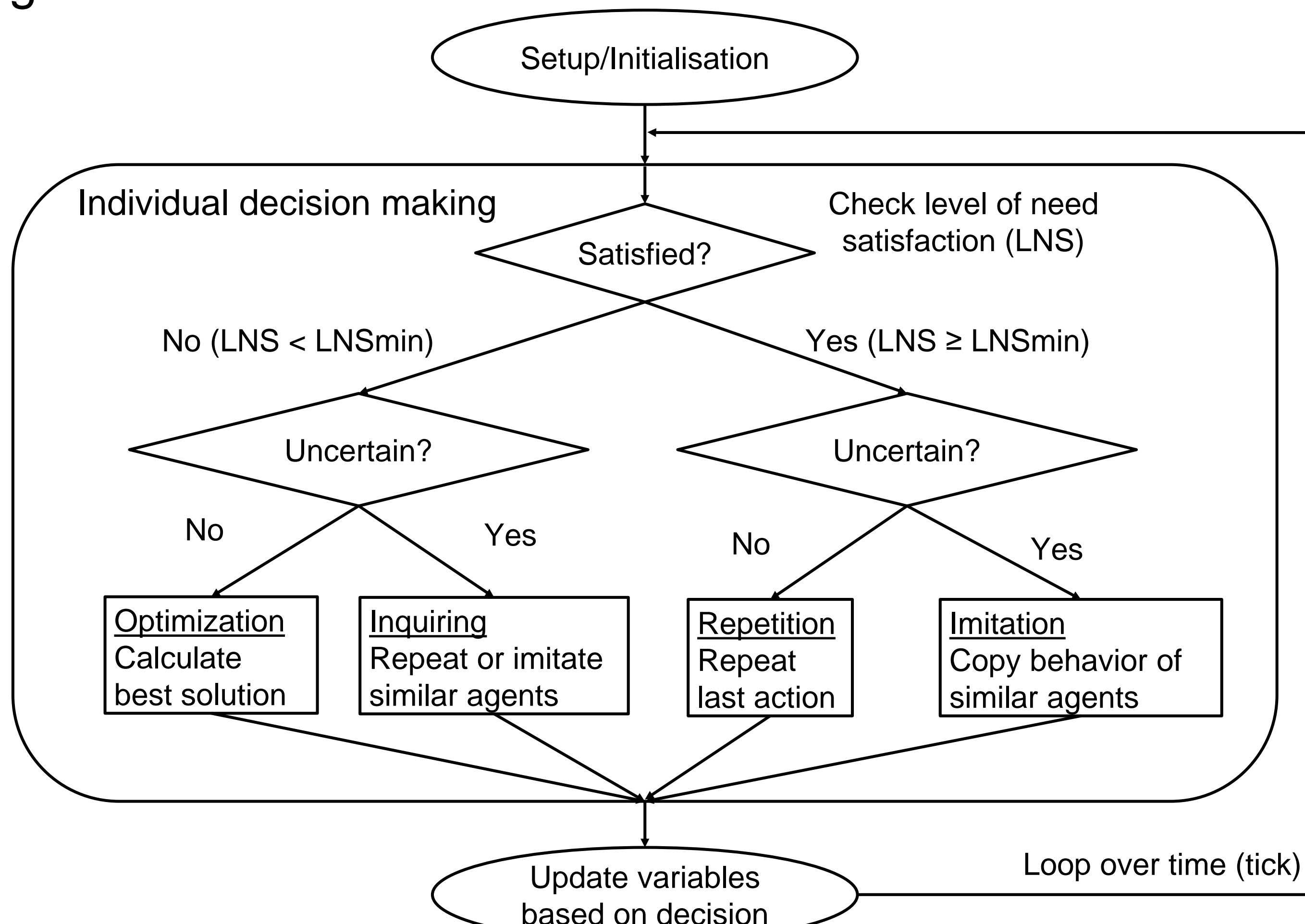
Demand Response Consumers as Consumats



- ▶ Consumers are modeled as agents based on the socio-psychological framework of Consumat [1]
- ▶ Agents have needs and they are equipped with abilities to satisfy these needs with a certain behavior (here: participation YES or No)
- ▶ Identified driving forces on the micro level are:
 - ▶ Needs: financial state, comfort, environmental state
 - ▶ Opportunity: participation in demand response program
 - ▶ Abilities: financial resources, general comfort requirements, affinity for technology, acceptance
 - ▶ Uncertainty

Individual Decision Making

- ▶ Based on its level of need satisfaction (LNS) and uncertainty an agent will select the underlying cognitive process
- ▶ Thresholds for LNS and Uncertainty may be individual or global



First Implementation, Conclusion and Outlook

- ▶ Based on first implementation in NetLogo (version 6.0.4) the model provides a basic framework for further research on:
 - ▶ Influence of varying input parameters on participation decision
 - ▶ variation of the agents' general behavior in time
- ▶ It may be used to find optimal policy options and measures to motivate consumers to participate in DR programs
- ▶ Future work will focus on refinement of the approach and its integration in an overall model of consumer decisions in the demand response context

References

- [1] W. Jager, M. A. Janssen, H. J. M. De Vries, J. De Greef, and C. A. J. Vlek, "Behaviour in commons dilemmas: Homo economicus and Homo psychologicus in an ecological-economic model," *Ecol. Econ.*, vol. 35, no. 3, pp. 357–379, 2000.
- [2] J. Schwarzer, D. Engel, and S. Lehnhoff, "Conceptual Design of an Agent-Based Socio-Technical Demand Response Consumer Model," in *Proceedings - IEEE 16th International Conference on Industrial Informatics, INDIN 2018*, 2018.