

Privacy-preserving Transactive Energy Management (PriTEM)

Introduction:

What is the future of sustainable and resilient energy systems? How can we support the transition to new and robust ways of distributing energy to people and societies?

PriTEM¹ is a transdisciplinary project at University of Oslo funded by the UiO:Energy program in the period 2022 to 2026. The project addresses the issue of future energy systems and how human and social aspects can be understood as barriers for implementation.

PriTEM is a collaboration between the Department of Informatics, the Department of Technology Systems, and the Department of Psychology at the University of Oslo. There are six PhD students and twelve researchers associated from the respective project partners. In addition, there is a consortium of six external companies and organizations joining as stakeholders in the project².

The research group functions as an interdisciplinary team to examine and characterize the socio-psychological aspects that can act as potential barriers in the transition towards a transactive energy management (TEM) framework with P2P mechanism in place.

Background:

Transactive energy management (TEM) is a new concept that can bring in a large amount of flexibility into the distribution grid by adding renewable energy sources (e.g. solar cells, windmills, water energy) to the existing power grid. The local creation of additional energy by users can be either spent at own consumption or sourced into the distribution grid for financial compensation. Traditional consumers thus become 'prosumers' that can generate, buy or sell energy in their local energy grids.

The Peer-to-Peer (P2P) energy trade is a new paradigm that can play a crucial role in realizing increased renewable deployment in the grid- thus generating environmental benefits, while also empowering consumers and prosumers through economic incentives and added flexibility. While the potential for environmental benefits and economic incentives are clear, the psychological aspects related to the prosumers' needs, involvement, and adoption of the technology- are less explored.

The PriTEM research will develop an understanding of the role of trust, transparency and prosumer empowerment in this context, and develop computation efficient and scalable privacy preserving and secure data sharing solutions to build and enhance digital trust and to empower the prosumers.

Research questions:

The student position will primarily work with work package 1 in the project as this takes place in the first year of PriTEM. The research questions for this WP are:

¹ <https://www.mn.uio.no/ifi/english/research/projects/priitem/>

² Norwegian Water Resources and Energy Directorate, Nord Pool, Eye Networks AS, Smart Innovations Norway AS, Alpha Venturi AS, Prosa Security AS

RQ1: What are the barriers that prosumers have towards the acceptance and adoption of the P2P energy trade framework

RQ2: How to understand the role of trust, transparency and empowerment in the adoption of P2P energy trade frameworks?

RQ3: How do we build trust and actively support users in their effort to sort out their decisions of adoption related to trust?

Objectives and method:

Objective:

- (i) To understand and to gain deeper insight into the strategic needs and requirements of prosumers regarding privacy preservation and secure data sharing concerns and other socio-psychological barriers for adoption of the P2P energy trade framework.

Methods: Multiple methodological approaches

- (i) *Design methodologies* focus on input from end-user in terms of open and semi-structured verbal responses during workshops and one-on-one interviews. The verbal data will undergo both qualitative and quantitative analysis by use of verbal protocol analysis, content analysis, unitization of statements. This will produce insight and a systematic representation of the user perspective and behavioral intention for the P2P energy trade systems that can easily be translated into action to mitigate barriers in implementation.
- (ii) *Observation:* The project will also enrich subjective data from the design methodology based on the observation of users engaged with system prototypes and/or system simulations. This will produce objective data in terms of frequency counts of action, error rates, system usability traps, and behavioral sequences.
- (iii) *Survey:* the project will conduct survey studies of consumers in the traditional energy distribution grid in order to uncover attitudes, expectations, and other associated factors with transition to new energy systems. This will provide a wider foundation for theorizing and explicating practical mitigations to support technology uptake.
- (iv) *Literature studies:* The project will conduct literature studies to overview existing research and practices to inform the projects efforts in work package 1. This will enable the application of deliverables to other disciplines and practical applications.

Deliverables: Publications, Reports, dissemination

- (i) Report with research framework based on data collection and literature studies of relevant, existing material.
- (ii) Reports and publications based on collected data on prosumer definition and barriers for technology uptake.
- (iii) Report with outline of findings and conclusions to support other PriTEM research activities in remaining work packages.

Tools/Software:

- (i) SPSS IBM and/or R for statistical analysis of quantitative data
- (ii) NVIVO for analysis of qualitative data (e.g. verbal data)
- (iii) UIO Nettskjema for collecting survey data
- (iv) TSD/OneDrive for data storage

- (v) DS Wizard for creating a data management plan.
- (vi) MS Office suite for communication and manuscript production

Student assignments:

The student will take part in applying the methods outlined in order to produce one or more of the PriTEM project deliverables. Specifically, the student will get involved in contribution and co-authorship of a research publication in the PriTEM project. The student will work with the project group and the Department of Psychology PhD position (starting 01.02.2023) in particular.

About the research environment:

PriTEM is a between the Department of Informatics, the Department of Technology Systems, and the Department of Psychology at the University of Oslo.

Supervision:

Primary student supervisors will be project owner from Department of Psychology:

- Cato A. Bjørkli, associate professor in Work- and Organisational Psychology
- Knut Inge Fostervold, associate professor in Work- and Organisational Psychology
- Juliana Zhang, PhD student at Work- and Organisational Psychology

Secondary supervisors may be involved from the PriTEM research group as needed.

Ethical approvals and data:

Data collection will commence Q1/2023 by establishing the necessary ethical approvals from Norwegian Agency for Shared Services in Education and Research (SIKT, previously NSD). There will additional discussions and implementation of Open Science principles where possible.

Tentative article:

State of the art review of perspectives on prosumers in Peer-to-Peer (P2P) energy trade in Transactive energy management (TEM).

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