GENTE Energy Community Toolkit

MOTIVATION
Why should I participate in or setup an energy community?

Purpose

QUESTIONS YOU MIGHT BE ASKING

- What is an energy community?
- How are energy communities described in the pertinent literature?
- What are the main characteristics of energy communities?
- What are the four archetypes of energy communities defined for the GENTE project?

Goals & Motivations

- What are your most important needs as an energy stakeholder either as consumer, prosumer, technology provider or asset owner?
- What are your motivations for participating in local energy community projects?

Why

- Why are energy communities an important concept?
- Why choose to join or create an energy community?

People

- Who are the relevant stakeholders and what is their role?
- How can end users and other stakeholders be involved in the establishment and design of an energy community?
- What are the benefits of installing an energy management system from the end-users, society and aggregator perspective?

Use cases

- What use cases exist for the creation and operation of energy communities?
- What business model is best suited to you?
- How can energy communities help DSOs with grid services?
- What are the motivations for energy communities participating in grid services?
- What frameworks are required for energy communities participating in grid services?
- What are the benefits of installing an energy management system from the end-users, society and aggregator perspective?

Future of Energy Communities

- How many energy communities are there in Europe?
- How have energy communities developed over time?
- What factors influence the development of energy communities?
- What are the key factors that create an enabling environment for energy communities?
- What concepts will be important to energy community development in the future?
- How are energy communities predicted to develop in the future?
- What technologies or solutions can reshape the energy market in the future?

CREATION
How do I setup and/or participate in an energy community?

Process

- How do we make decisions?
- How do I find other people to get involved?
- What regulations apply?
- How can end users and other stakeholders be involved in the establishment and design of an energy community?
- What are the possibilities and limits of a co-design approach for creating a potential energy community?
- What are the key learnings derived from the initial phase of the co-design process?
- What is the business logic that relates to smart contracting in an energy community?

Options

- What types of energy community business model are there and how are they defined?
- What are the guidelines and requirements for implementing a distributed, interoperable, and private energy community?
- How can an energy community handle personal information in a private, secure, trustworthy way?
- What types of technologies are used to develop secure, private, distributed energy management systems?
- What open source tools and services exist to help manage community and personal data in a private, secure, trustworthy way?
- What needs to be considered when designing a data management plan for an energy community?
- How do applications of blockchain technology adhere to GDPR requirements?
- How does the EU Digital Wallet apply to energy communities?
- What is Zero Knowledge Proof and how does it apply to digital wallets?
- What does a system architecture look like for an energy community?
- What grid services can energy communities provide and what does a grid services workflow look like / contain?

OPERATION
What technology and tools are available to operate an energy community?

Simulate

- How do the different aspects of a building (materials, type of controllers, outdoor conditions, occupancy) affect building energy performance and indoor conditions?
- What are the benefits of simulating building and energy systems during the design process?
- What value could adding a heat pump system in a building bring?

Forecast

- Can short term solar power (1 day) be forecast (on the edge) reliably?
- How can renewable energy generation (e.g. PV output) be accurately predicted to optimize its integration into the grid?
- What is the most reliable way to forecast electricity demand and supply for efficient energy balancing?
- How can heat load forecasting support efficient operation of district heating systems or heat pumps?

Manage

- What can be done to improve the energy production from the PV plants/modules?
- What is the under-performance level of the PV modules/ plants and why are they under-performing?
- How to schedule devices within a building to minimize cost and peak load?
- How to handle uncertainties related to PV and load forecasts?
- How much flexibility can be provided by buildings?
- What open source tools and services exist to help manage community and personal data in a private, secure, trustworthy way?
- What is an example of how smart contract technologies can be implemented at energy communities to manage energy consumption, production, and remuneration?
- How can energy communities help DSOs with grid services?
- What are the benefits of installing an energy management system from the end-users, society and aggregator perspective?

Optimize

- How can the energy production and consumption of an energy community be optimized?
- What tools exist to optimize energy production?
- What tools exist to optimize energy consumption?
- What goals and/or services can energy communities be optimised to fulfil?

INSPIRATION
What energy communities exist already and how do they operate?

GENTE demo sites

- What are some examples of conceptual data models for energy communities?
- What are some examples of logical data models for energy communities?
- What are some examples of a data management system applied to real-world energy communities (physical data models)?
- What is the potential for energy communities in reducing CO2 emissions?
- Could an energy community help me increase autarky and self consumption of my PV installation?
- Can energy communities help to reduce power peaks from the grid?
- How can energy communities measure and validate their solutions?
- What lessons have been learnt through the GENTE project?
- How can the lessons learnt and technologies created be replicated outside the GENTE project?

Other toolkits

- Where can I find information and guidance about other energy community topics?
- What other toolkits and guidance exist to help me create, join, and operate an energy community?

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Other toolkits

KEY TERMS

Definition · Characteristics · History

Professionalisation · Commercialisation · Key Exploitable Results

Motivations · Surveys

Participation · Activation · End users · Stakeholder needs

Applications · Grid flexibility · Energy efficiency · Self-consumption optimization · Peak load management · CO2 emissions reduction · Community autarky · Community federation · Community energy costs · Co-design process

Enabling environment · Predictions · Legislation · Impact · Policies · Scenarios · Future perspectives

Decision making · Collaboration · Stakeholder engagement · Co-design · End user engagement · Replicability · Scalability

Archetypes · Organizational models · Business models · Market · System architecture · Compliance · Conceptual data models · Logical data models · Physical data models · Regulatory Frameworks · EUDI · Business Logic · Digital wallet

Digital twin · Building simulation

Forecast algorithms · PV forecasting · Load forecasting · Heat demand forecasting · Day-Ahead Forecast · Irradiance Prediction · Weather Forecasting

Edge devices · Submetering Devices · PV fault detection · Current-Voltage characteristics · Microcontroller · Heat pumps · Grid services · PV module degradation · Building energy management · Energy management system · Interoperability · Modularity · Flexibility · Autarky · GDPR compliance · Zero Knowledge Proof · Self-consumption · Decentralisation · Privacy by Design · IoT platform · Smart Contracts · Open Source · Data management · Distributed Computing · Digital Wallet · Ontology · Decentralized Identifiers · Distributed Ledger Technology · Blockchain Technology · Multi-Party Computation · Self-Sovereign Identity

Production estimates · Heat pump optimization · Artificial intelligence (AI) · Privacy-Preserving Learning · Edge intelligence · Optimization · Uncertainty handling · Flexibility · Self-consumption · Autarky

Test cases · Validation · Lessons learned · Replicability · Scalability · Guidelines · KPIs · Potential of Energy Communities · Potential for CO2 reduction · Increase in community autarky · Peak load reduction

Toolkits · Guidance · Best Practices

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RESOURCES

Energy community definition

- Video - GENTE Project intro
- D4.1 report abstract - "Characteristics of energy communities and motivations, engagement, and socio-economic profiles of end users"
- D4.1 report - "Characteristics of energy communities and motivations, engagement, and socio-economic profiles of end users"
- Am Aawasser Community website
- HSB Living Lab Community website
- Article - "Trouver le juste milieu" ("Finding the middle ground") in bulletin.ch

Stakeholders - needs

- D3.2 report - "Specification of relevant need owners"
- Blog post - survey - "Are you part of an Energy Community? Contribute to GENTE by filling out our survey about your needs."

Energy community definition

- D4.1 report abstract - "Characteristics of energy communities and motivations, engagement, and socio-economic profiles of end users"
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Future energy community scenarios

- D3.1 report abstract - "Future energy community scenarios"
- D3.1 report - "Future energy community scenarios"
- Research paper - based on D3.1 - "The Development of Energy Communities in Europe: History, Success Factors, Future Perspectives"

Why energy communities are important

- Video - GENTE Project intro
- Article - "Trouver le juste milieu" ("Finding the middle ground") in bulletin.ch

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Co-design process

- D4.2 - summary of findings - "User engagement in co-design process"

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Use case definition - need owners

- D3.3 report - "Definition of highly applicable use cases"
- D6.3 report - "Optimal LEC operation based on smart BEMS"

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Use case definition

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Grid support services

- D6.4 report - "Grid support services from LEC to system operators"

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Business models

- D4.5 report - "Business models for GENTE solutions with replicability and scalability evaluation"

System architecture & Data models

- D8.1 report - "GENTE System Architecture: Conceptional, logical and physical data models for LEC"

Business models

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Organisational perspective

- D4.1 report abstract - "Characteristics of energy communities and motivations, engagement, and socio-economic profiles of end users"
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- D3.1 report abstract - "Future energy community scenarios"
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Technical & privacy perspective

- D7.1 report - "Guidelines and requirements, initial set of smart rules and related ontology"
- D7.2 report - "Validation of DLT and GDPR compliance legal rules"
- D7.3 report - "Data privacy and Smart Language ABC"

System architecture & Data models

- D8.1 report - "GENTE System Architecture: Conceptional, logical and physical data models for LEC"

Digital twin

- D5.3 report abstract - "Community digital twin"
- D5.3 report - "Community digital twin"
- Research paper - based on D5.3

Generation forecasting

- D5.2 report - "Edge-based DER forecasting and diagnostic algorithm, including privacy-preserving learning"
- GitHub repo - Forecaster algorithm - forecast PV generation and electricity usage
- GitHub repo - Jupyter notebook of forecasting results
- D6.1 report - "Advanced Load and Generation Forecast"
- Research paper - "Scalable and Lightweight Machine Learning Based Load Forecast: Netload versus Disaggregated Forecast"

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Electric load forecasting

- D6.1 report - "Advanced Load and Generation Forecast"
- Research paper - "Scalable and Lightweight Machine Learning Based Load Forecast: Netload versus Disaggregated Forecast"

Thermal load forecasting

- D6.1 report - "Advanced Load and Generation Forecast"
- Research paper - "Scalable and Lightweight Machine Learning Based Load Forecast: Netload versus Disaggregated Forecast"

Building Energy Management System

- D6.2 report - "Advanced BEMS for "Building control as a service"
- Research paper - "A Novel Energy Management System for Optimal Energy and Flexibility Scheduling of Residential Buildings: A Case Study in HSB Living Lab"
- Research paper - "Flexibility provision from battery storage and PV inverters using IoT platform: Real-life demonstrations at Chalmers campus"
- D6.3 report - "Optimal LEC operation based on smart BEMS"
- Article - EcoCoach at Am Aawasser

Sub-metering device

- D5.1 - Presentation & Documentation - SmartHelio sub-metering devices
- SmartHelio website

Grid support services

- D6.4 report - "Grid support services from LEC to system operators"

Distributed Ledger Technology (DLT)

- D7.1 report - "Guidelines and requirements, initial set of smart rules and related ontology"
- D7.2 report - "Validation of DLT and GDPR compliance legal rules"
- D7.3 report - "Data privacy and Smart Language ABC"

Optimizer

- Video - "Introducing GENTE's Local Energy Community Optimization Algorithm"
- Blog post - "Introducing GENTE's Local Energy Community Optimization Algorithm"
- GitHub repo - Optimizer algorithm - control flexibilities

Generation forecasting

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- Article - EcoCoach at Am Aawasser

Grid support services

- D6.4 report - "Grid support services from LEC to system operators"

Am Aawasser - Switzerland

- Am Aawasser website
- Am Aawasser Factsheet
- Article - EcoCoach at Am Aawasser
- Video - "Introducing GENTE's Local Energy Community Optimization Algorithm"
- Blog post - "Introducing GENTE's Local Energy Community Optimization Algorithm"
- D5.1 - Presentation & Documentation - SmartHelio sub-metering devices
- D8.1 report - "GENTE System Architecture: Conceptional, logical and physical data models for LEC"
- D91 report - "Test cases, assessment framework and KPIs"
- Results - D9.2 report - "Summary of demo case requirements, scenarios, solutions and evaluation for each site"
- GitHub repo - Am Aawasser Test Case results
- Results - D9.3 report - "Assessment of demonstration, identification and lessons learned/best practices for replication"

HSB Living Lab - Sweden

- HSB Living Lab website
- HSB Living Lab Factsheet
- D6.2 report - "Advanced BEMS for "Building control as a service"
- Research paper - "A Novel Energy Management System for Optimal Energy and Flexibility Scheduling of Residential Buildings: A Case Study in HSB Living Lab"
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- D8.1 report - "GENTE System Architecture: Conceptional, logical and physical data models for LEC"
- D91 report - "Test cases, assessment framework and KPIs"
- D5.3 report abstract - "Community digital twin"
- D5.3 report - "Community digital twin"
- Research paper - based on D5.3
- Results - D9.2 report - "Summary of demo case requirements, scenarios, solutions and evaluation for each site"
- Results - D9.3 report - "Assessment of demonstration, identification and lessons learned/best practices for replication"

Toolkits from other projects

- Toolbox - REScoop.EU
- Energy Communities Repository - European Commission
- Global Observatory on People-Centred Clean Energy Transitions - IEA
- Community Energy Toolkit: Best practices for broadening the ownership of renewables - IRENA
- Energy Solidarity Toolkit - CEES
- Behavioural Insights Toolkit - UsersTCP
- Resources - Energy Community Platform
- Energy Community Card Game - Reschool Project
- COOLKIT: The knowledge repository to help you build your energy community - Compile Project
- Community Climate Action Toolkit - Schumacher Institute
- Energy Futures Toolkit - Carbon Coop

Energy community definition

- Research paper - "Terminologies and concepts of energy cooperations in Europe: A systematic review of characteristics, potentials, and challenges"

Co-design process

- QUBE Project: Accommodation-related energy cooperation in Wesemlin, Switzerland - HSLU project page
- QUBE Project: Accommodation-related energy cooperation in Wesemlin, Switzerland - Article
- QUBE Project: Accommodation-related energy cooperation in Wesemlin, Switzerland - Dialog Luzern

Icon key

LEC Local Energy Community
Link to a website
Link to a PDF document
Link to a code and data repository
Link to a video
Research paper - in progress
Research paper - published
Abstract of report
Report - in progress
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How to use this toolkit

Visit the how-to guide for a walkthrough and tips on how to use the toolkit.

If you have problems accessing any of the resources in the toolkit, have a look in the GENTE public deliverables folder - all resources are available there.

How-to guide · Public deliverables folder

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Contact us

Get in touch with the team on hello@genteproject.com or via the details on the HSLU GENTE Project page.

HSLU GENTE Project page · GENTE website · GENTE website - Toolkit page

Partners

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