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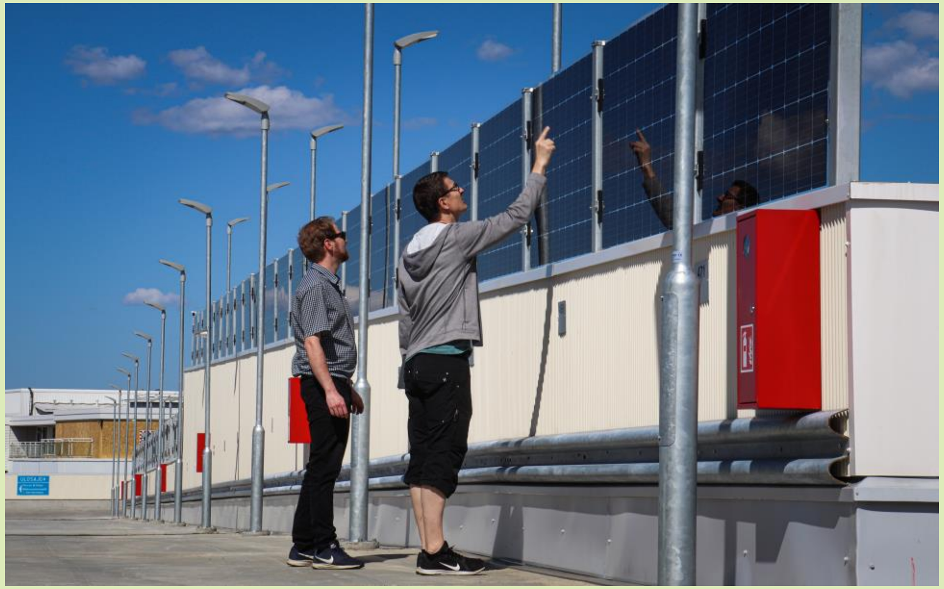
ammattikorkeakoulu

Kommunikoiva Energia – communicative energy

https://kommunikoivaenergia.karelia.fi/

Karelia · tovarri · hurry. · BUSINESS JOENSUU | JOE (WITH JOE) · PKS Sähkönsiirto Oy · PKS Sähkökauppa · SOLARWORKS · Vipuvoimaa EU:lta 2014–2020 · Euroopan unioni Euroopan aluekehitysrahasto



Communicative Energy

The project develops:

- Low-carbon energy communities and digital service solutions for energy communities
- Sustainability and carbon neutrality of digital services
- Carbon neutrality as a strategic choice for companies

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Background and need for the project

- The ongoing energy transition, technology and digital transition in energy (IOT to EOT)
- The electrification of society's functions and the growth of electricity dependence, weather-dependent energy production, demand and response needs
- Carbon footprint of digital services (LCA)
- The European Union's Renewable Energy Directive (2018/2001/EU) strengthens citizens' opportunities to produce renewable energy, and according to the directive, member states must ensure a framework that promotes and facilitates the development of energy communities.

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Project goals (workpackage 1)

- The project engouraces the establishing of new energy communities regionally and especially increases awareness of different energy communities and their operating models through communication, events, business and project cooperation, pilots and publications.
- The project study the impact of energy communities in the progress of the regional energy transition and create the conditions for a digital green transition
- Direct consultation and concrete support for the establishment of energy communities (e.g. advice, dimensioning, economical calculations, simulations)
- The project plans and implements pilots related to various energy communities
- Through energy communities, more and more citizens have the opportunity to influence energy issues and manage their own energy resources

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Project goals

What we are developing and researching?

- Local own electricity and (heat) production as a community
- Decision-making and influence in energy communities
- Energy citizenship, energy democracy, identifying energy vulnerability and poverty
- What kind of policy actions and means of control as well as public sector support are aimed at energy communities
- Different energy resources and their utilization in energy communities (storages, demand response as a service, sector integration)
- Development of business and service models and ecosystems in energy communities
- Digitalization services/platforms for energy communities (different credit calculation models in energy communities, peer-to-peer networks, other new services around energy communities)

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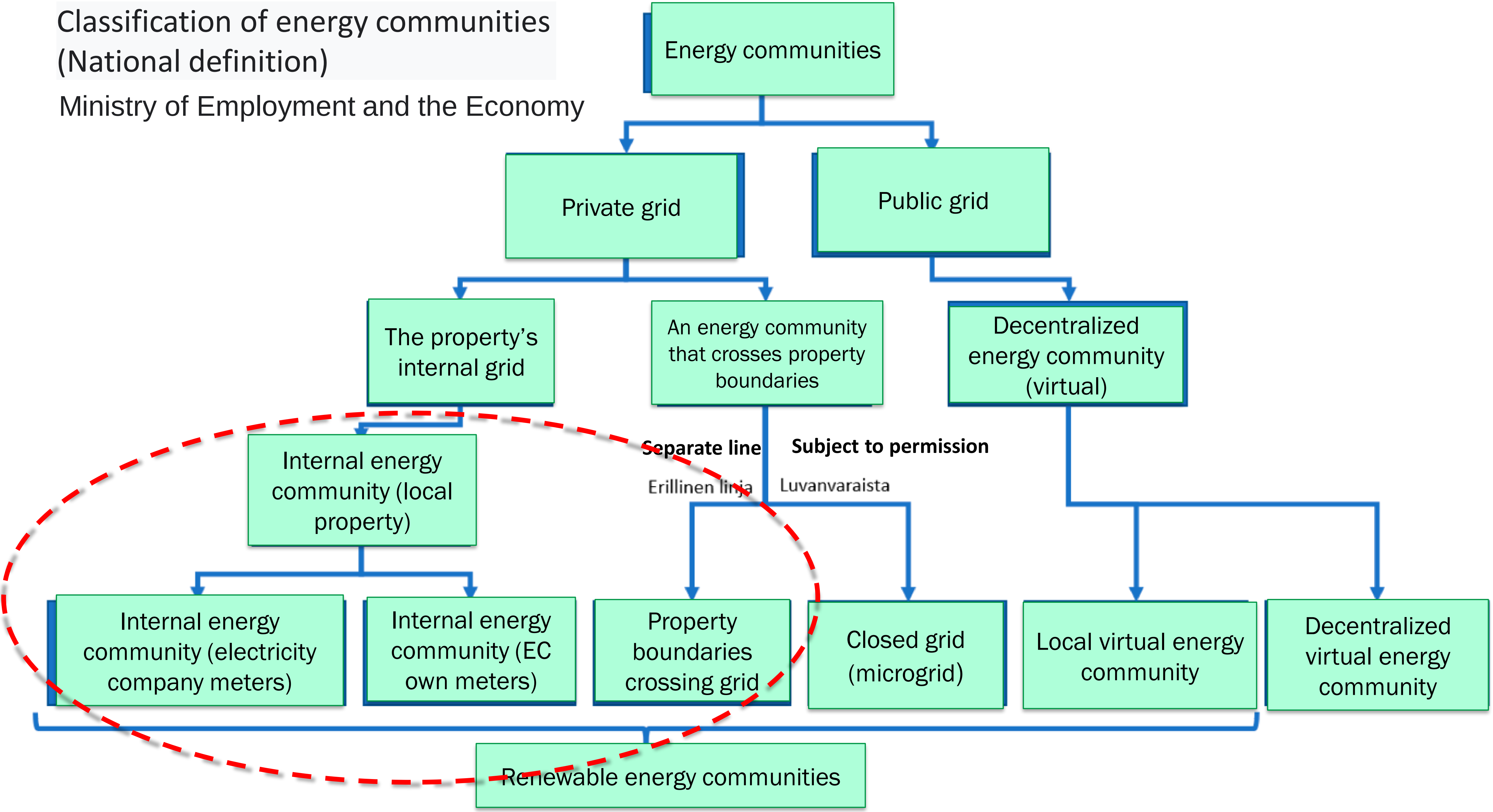
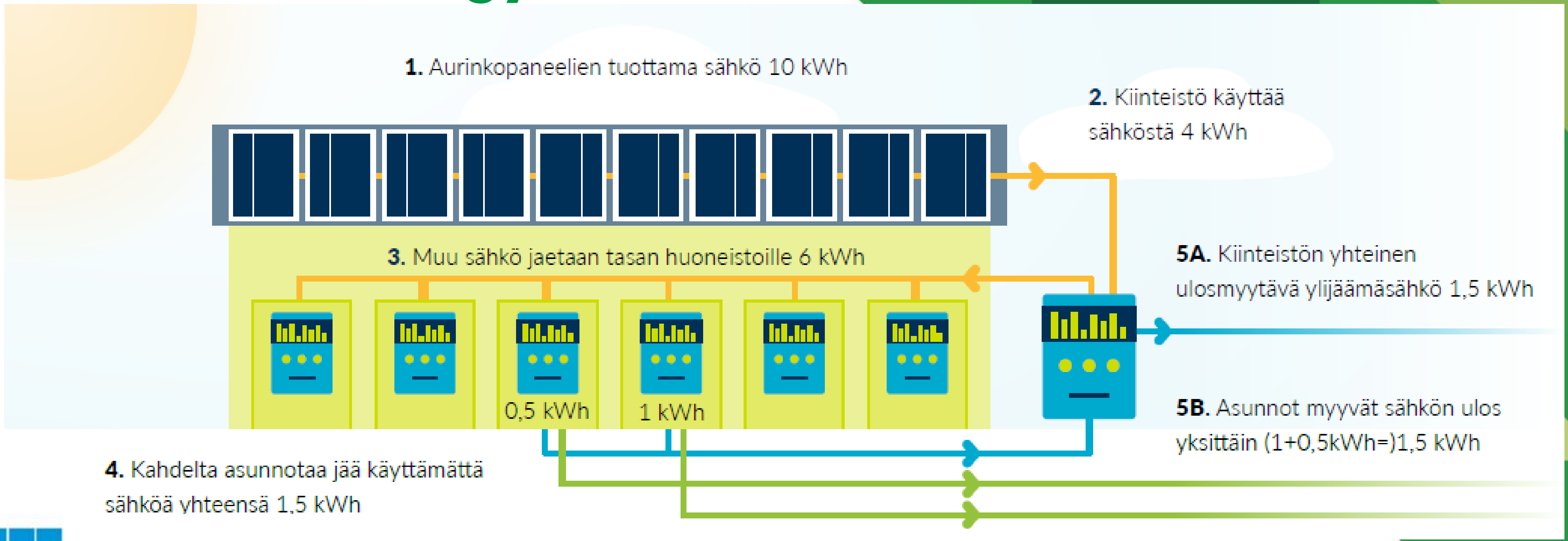
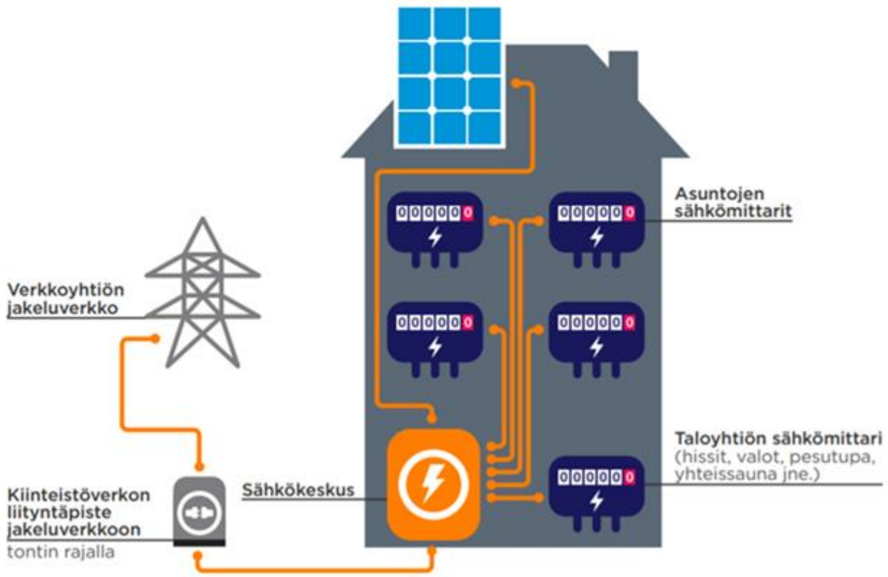
Classification of energy communities (National definition)

Ministry of Employment and the Economy



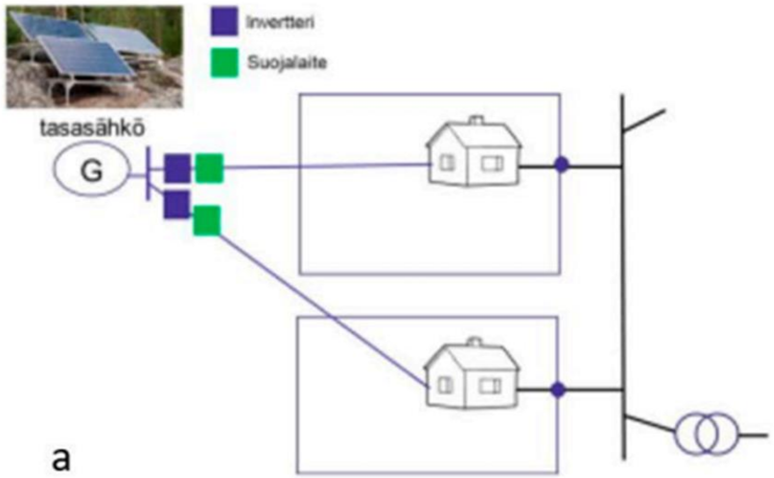
The property's internal energy community

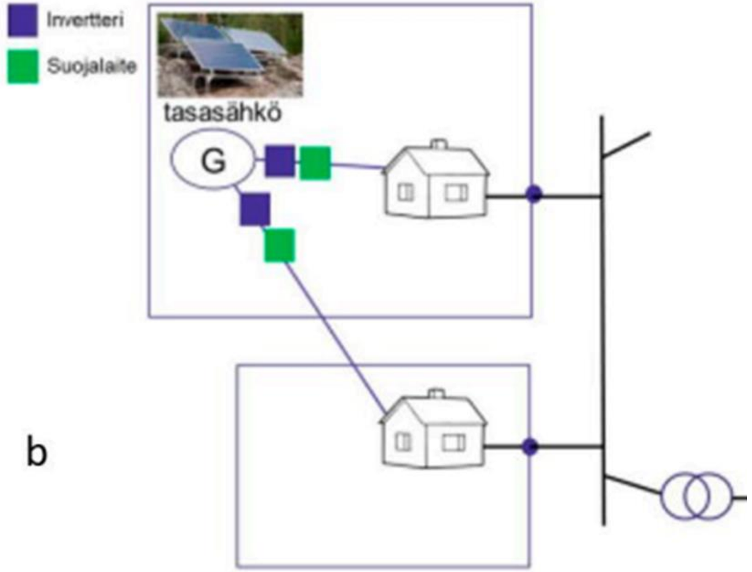


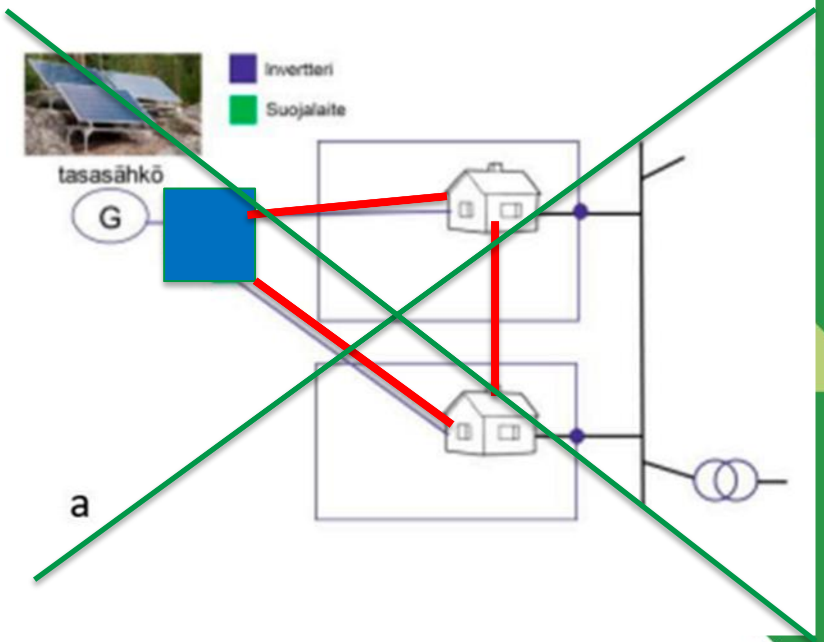


Lähde: Elenia energiayhteisöopas

An energy community that crosses property boundaries







An energy community that crosses property boundaries means
energy community, where energy production and consumption are located within different properties or groups of properties, but in close proximity to each other.

Property boundaries crossing energy community is connected to the electricity grid through one connection point.

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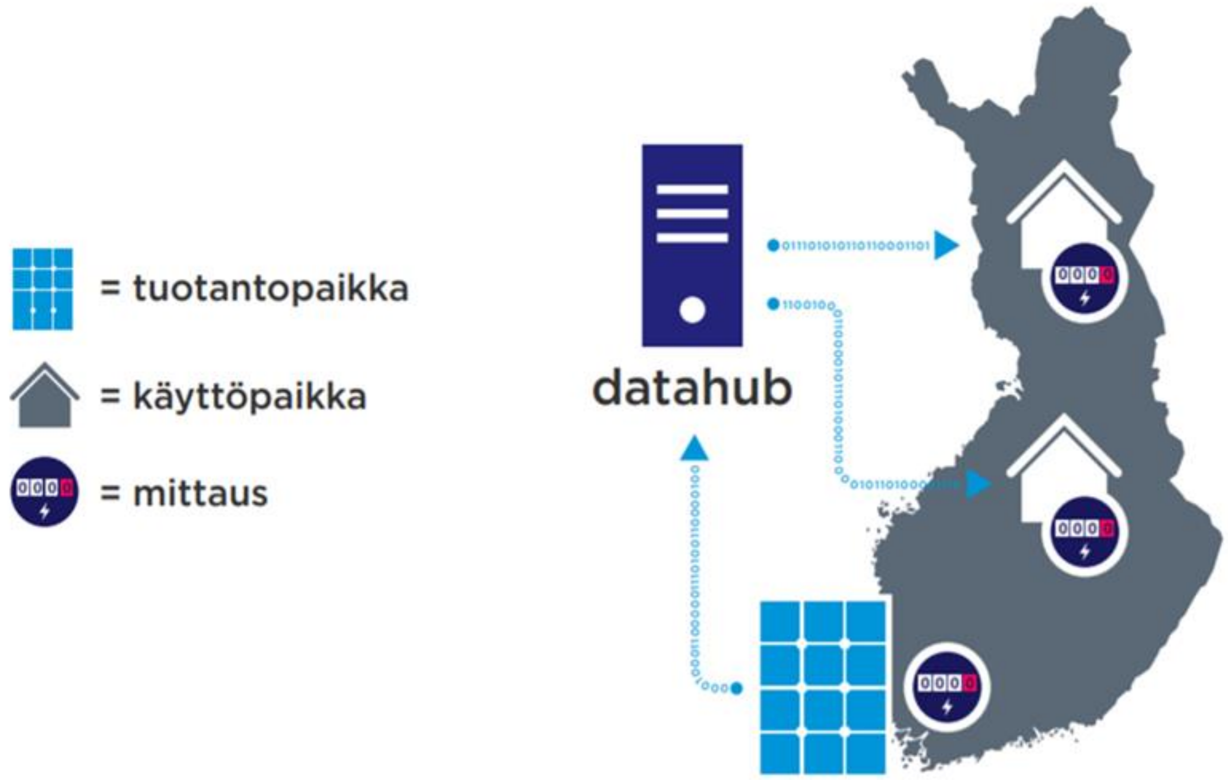
Kuva: Työ- ja elinkeinoministeriö. 2018.

Decentralized virtual energy community



Kuva: *Työ- ja elinkeinoministeriö. 2018.*

Decentralized energy community means an energy community that is geographically distributed and whose members can be located anywhere in Finland.
Electricity production and storage resources can then be located in the most convenient places, and those can be acquired as joint procurement in different places among resident members.

Case studies

- According to the case studies (6 housing associations), the energy community enables the housing association to have a **3-4 times larger system size**.
- As an energy community (internal), the potential of small-scale PV production would be **1.5 to 2 times greater regionally** compared to previous studies
- With the electricity storage, the size of the energy communities solar-PV system can be 2-3 times bigger
- The benefit of the electricity storage primarily comes from increasing the energy self-suffiency
- The economic use of energy storages must be versatile and 24/7 and year-round.
- Electricity storage should be able to be used for demand response, automated to store cheaper energy when prices are low, cutting the energy community's own power peaks or equalizing the charging peaks of electric cars

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Case studies

- If the solar electric system is expanded for electric cars, the profitability will improve, because the unit cost will decrease in a larger system while the rate of PV self-use will increase.
- However, the size of the optimal system does not increase significantly if the charging rhythm of the cars is tied to the working time
- With smart charging control using the car's battery, savings can be achieved, especially if the electricity billing principles use a power charge.
- Heating, ventilation and cooling offer the best demand-response or grid frequency balancing capacity
- In practice, every controllable electrical load must be remotely controllable and automated, so that adjustment procedures are optimized and economical

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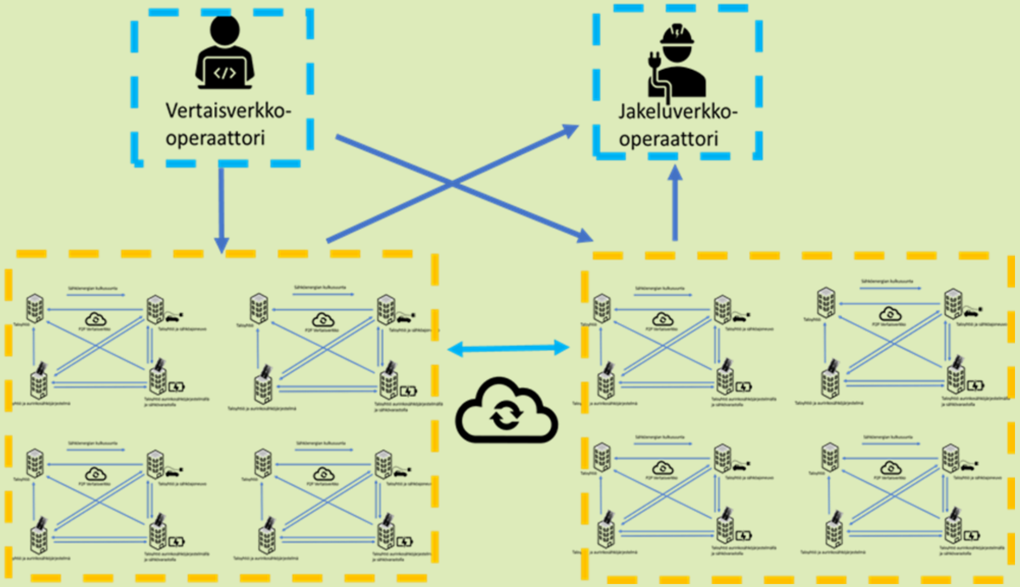
Energy communities business models



- Optimization of electricity procurement
- Selling jointly owned production to the market
- Virtual power plants
- Price arbitrage
- Optimization of self-production consumption
- Demand – response services
- Improving operational reliability
- Peer-to-peer networks as an electricity marketplace

Piloting digital service platform for energy communities

- Intelligent energy resource management digital application is being developed for energy communities in the project.
- The developed application is tested and its functionality is verified in a real operating environment
- The piloting target is a terraced house company where new generation electricity meters were previously installed as part of the piloting case (PKS and Kamstrup).
- Geothermal and solar PV system is installed in the pilot property.
- The goal of the pilot is a community-based, intelligent and versatile energy management service and informative visualization for members in energy communities.
- ICT Students from Karelia are involved in the application development

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Energia*

- New generation electricity meters can produce even one second real time information
- At the moment whe have 1 hour period based metering in Finland, soon it will be 15 minutes metering
- The application is implemented on the Microsoft Azure cloud service platform
- Open based and rather low cost platform
- A member of the energy community can see his own consumption, the community's shared electricity consumption, and the distribution of production among the community
- In addition, the community member can see the energy weather forecast and the price for the energy
- With the help of the information, the community member can direct or change his own consumption
- information is characterized by openness and transparency, and historical information is verifiable

Virtual energy community pilot in Joensuu

- The pilot uses the Energia* digital energy community application developed in the project
- In the pilot, an operating model for the virtual energy community is created, as well as the tools, methods and systems to implement the virtual energy community
- New ways to encourage the purchase and utilization of renewable energy sources
- More opportunities for electricity users to influence their own energy solutions
- Experiences from new types of virtual energy communities
- Develops energy communities and recognizes the potential of energy communities in the energy system (policy recommendations)
- Local distributed virtual energy community
- The pilot started on June 2023 and last to June 2025
- Pilot stakeholders are Caruna Oy, Joensuun Elli, PKS sähkönmyynti ja sähkönsiirto, Karelia university of applied sciencies

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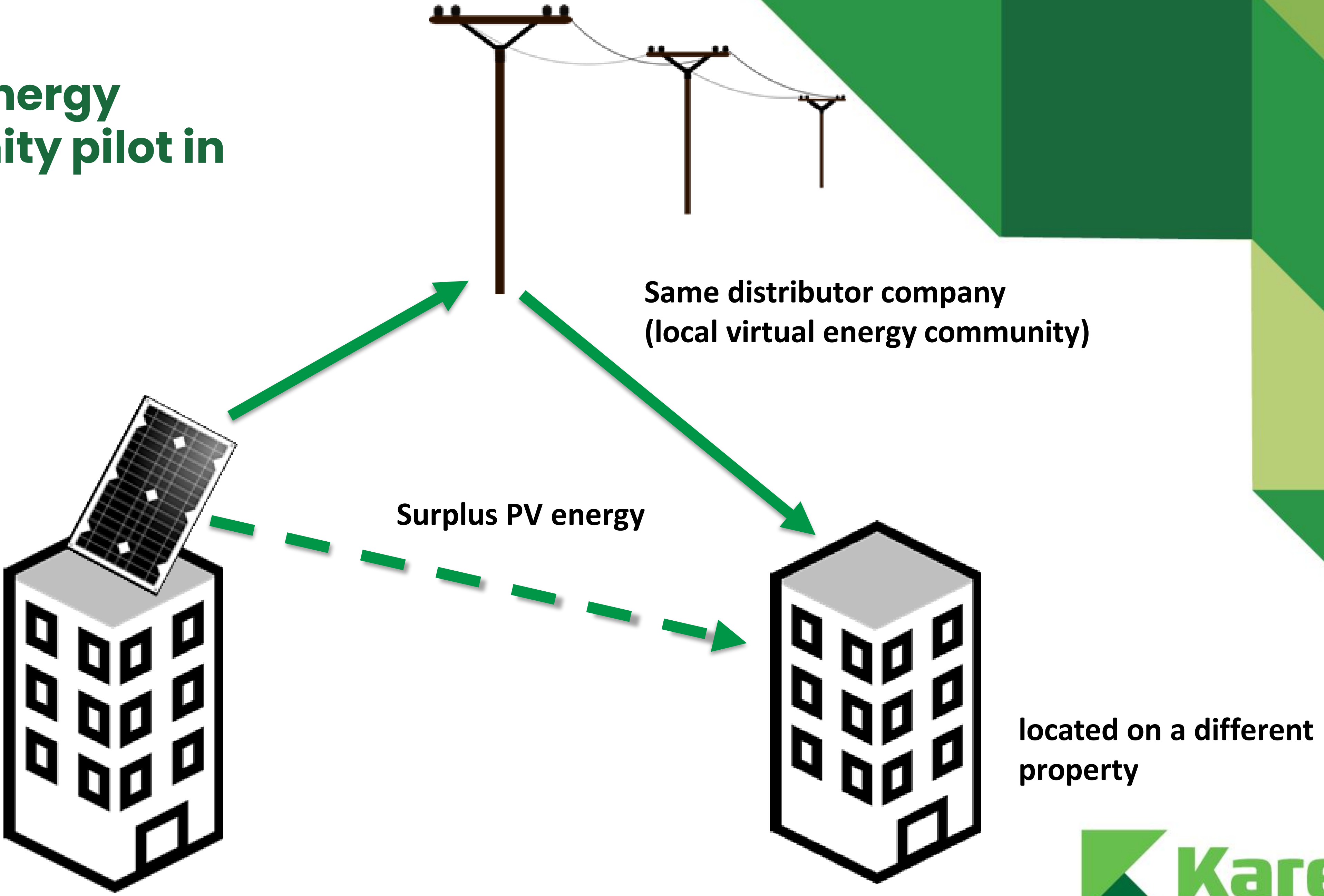
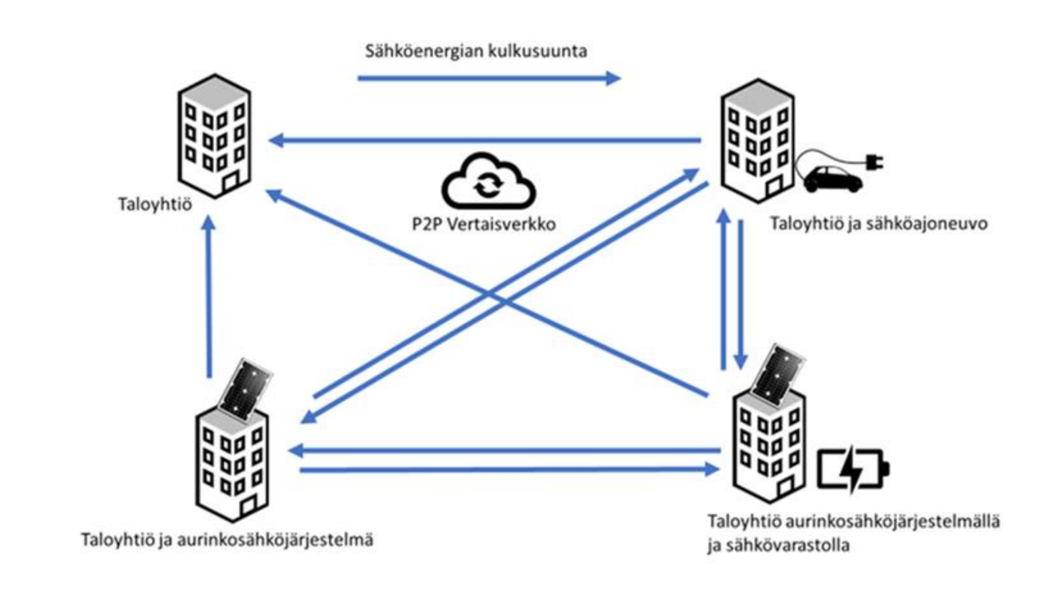
Virtual energy community pilot in Joensuu





The next development steps are to increase the Energia* application's usability, data security and improve the visual appearance.

Near future/next projects:

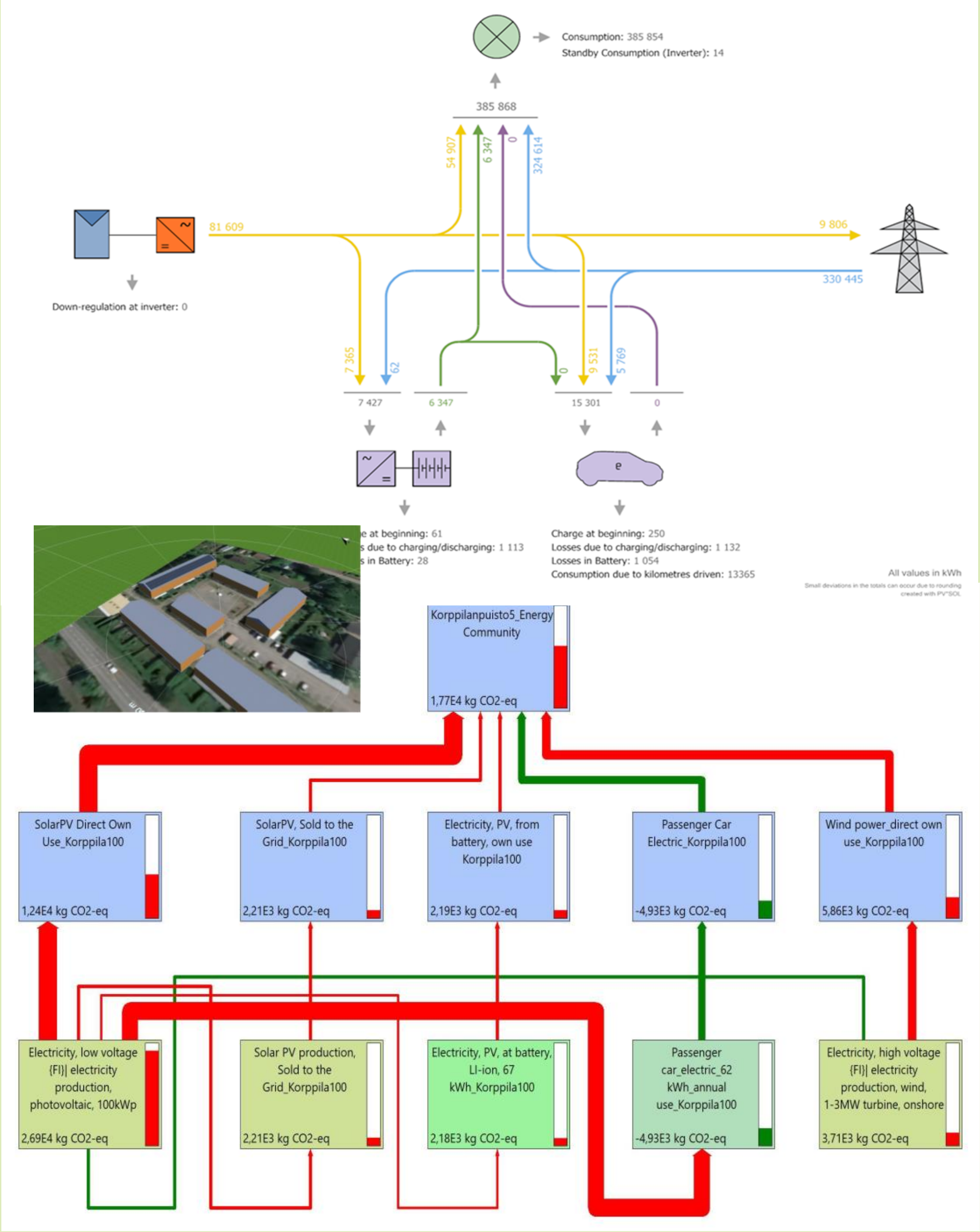
Digital twin for different kind of energy communities (block chain based p2p energy community)

Integrating artificial intelligence

Connecting energy stores, consumption control and consumption flexibility to the application

Adding elements of sector integration

Integrating the energy community/energy communities into a peer-to-peer network based on blockchain technology (e.g. intra-community two-to-one trade, inter-community trade, community participation in the electricity market)



raft of the life cycle assesment of the energy community, Lasse Okkonen

Energy communities life cycle assessment

- The study aims to understand the life cycle carbon footprint of local energy communities based on solar PV.
- We aim to understand how the local small scale communities contribute to carbon emission reductions in comparison to conventional solar PV systems and average grid electricity.
- Case studies included 3 different energy communities simulations
- The Life Cycle Assessments of the energy communities were established in SimaPro by utilizing energy flow data from PV*SOL simulations.

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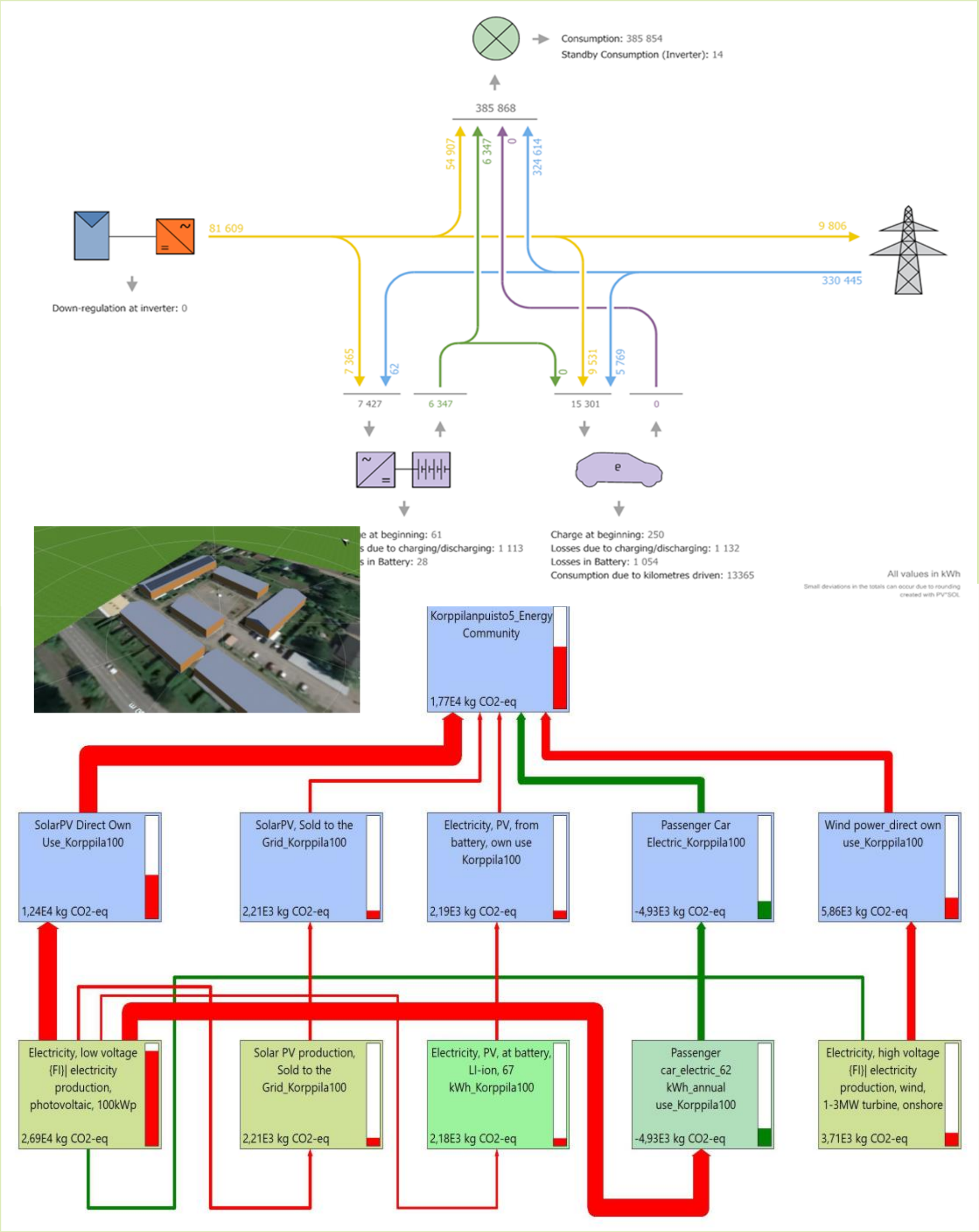

raft of the life cycle assesment of the energy community, Lasse Okkonen

Energy communities life cycle assessment

- The climate impact assessments indicated that housing corporations operating as energy communities may reach low carbon energy system.
- However, it remained essential that, as they were not self sufficient, the communities should be based on renewable grid electricity.
- In addition, potential emission reductions could be reached with (shared) electric cars if fossil transportation was replaced. This again requires renewable electricity for charging.
- The infrastructure processes of modern renewables (such as PV panels, batteries and control units, vehicle chargers) may create more impact for small scale RE when compared to mass production of RE with the economies of scale.
- However, these were very sensitive in this study, and scaling of the processes might overestimate the impact of infrastructure. There is increased need of LCI data on different size RE infrastructure processes, and their end of life processes.
- Finally this study did not yet include full analyses of heating energy, or the dynamics and the potential of energy community in adjusting production and consumption according to societal needs.
- This system flexibility requires dynamic simulations and integration of LCA tools directly into the energy community data systems.

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Thank you!

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