



Microgrids, Smart Buildings, Energy communities

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CERTH SmartWins Summer School: **Day 4**

07 July 2023

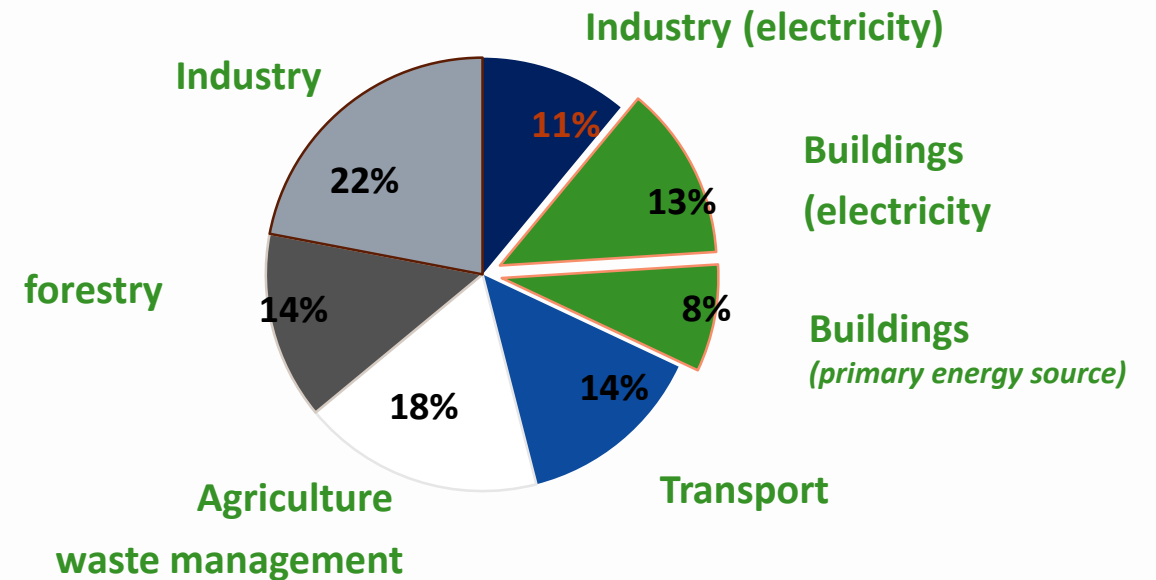
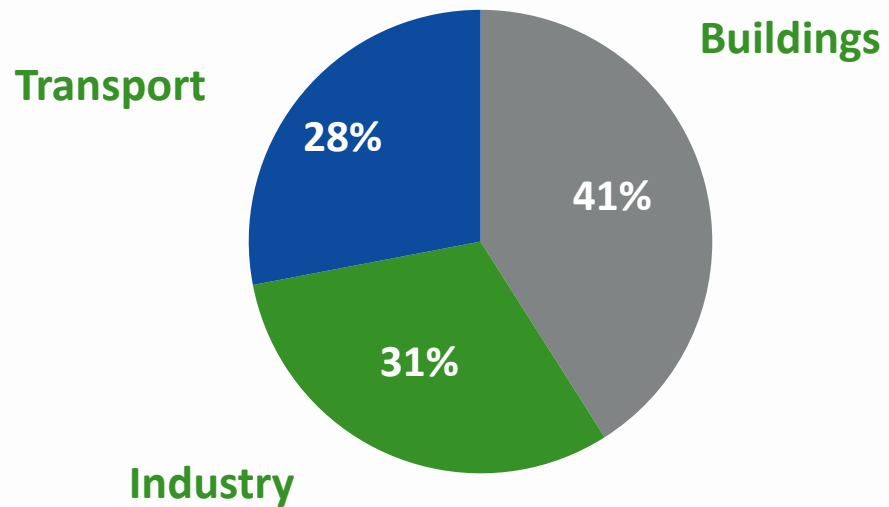
Thessaloniki

T5.2 Smart Buildings #1

Building Energy footprint

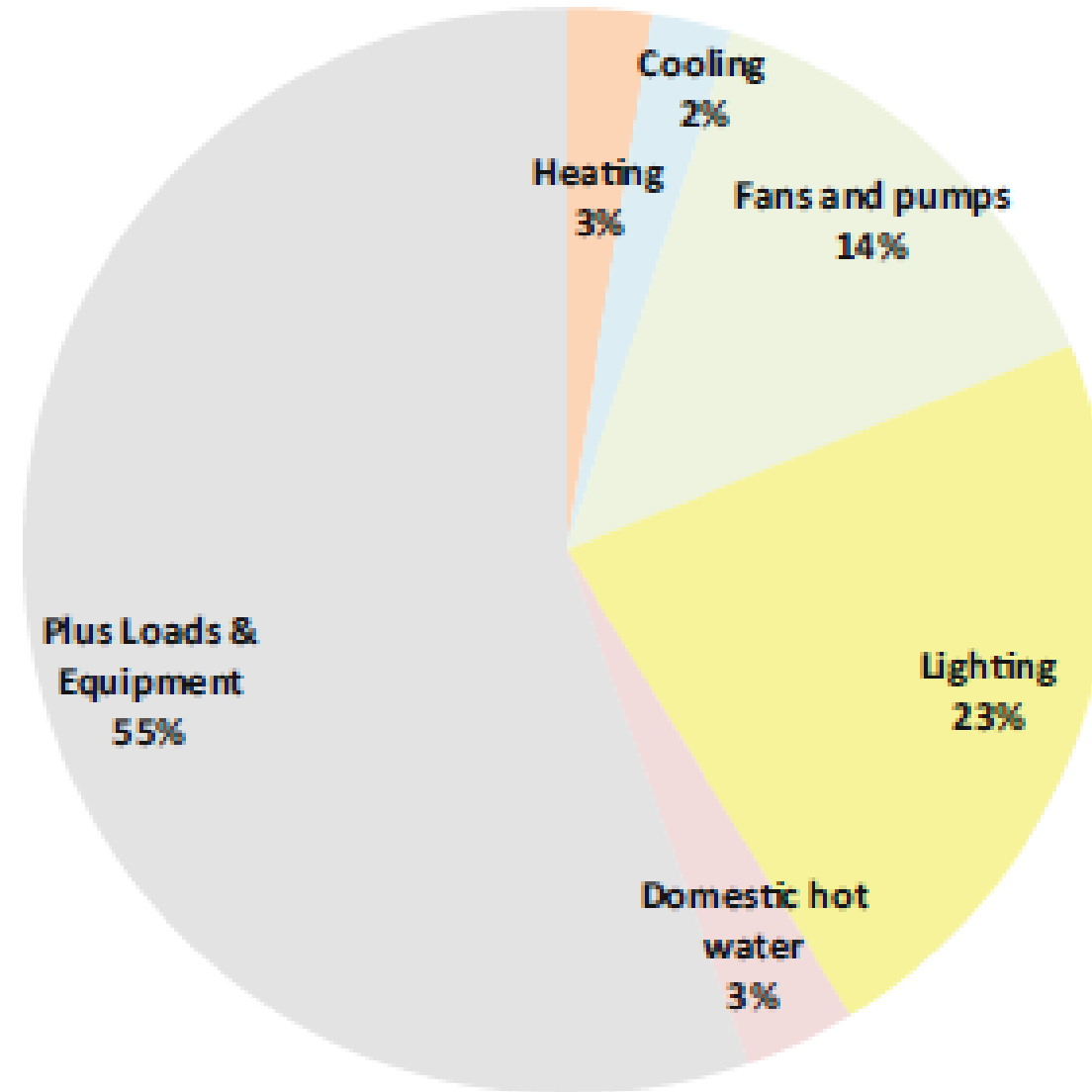
40% of consumption worldwide

21% of GHG emissions



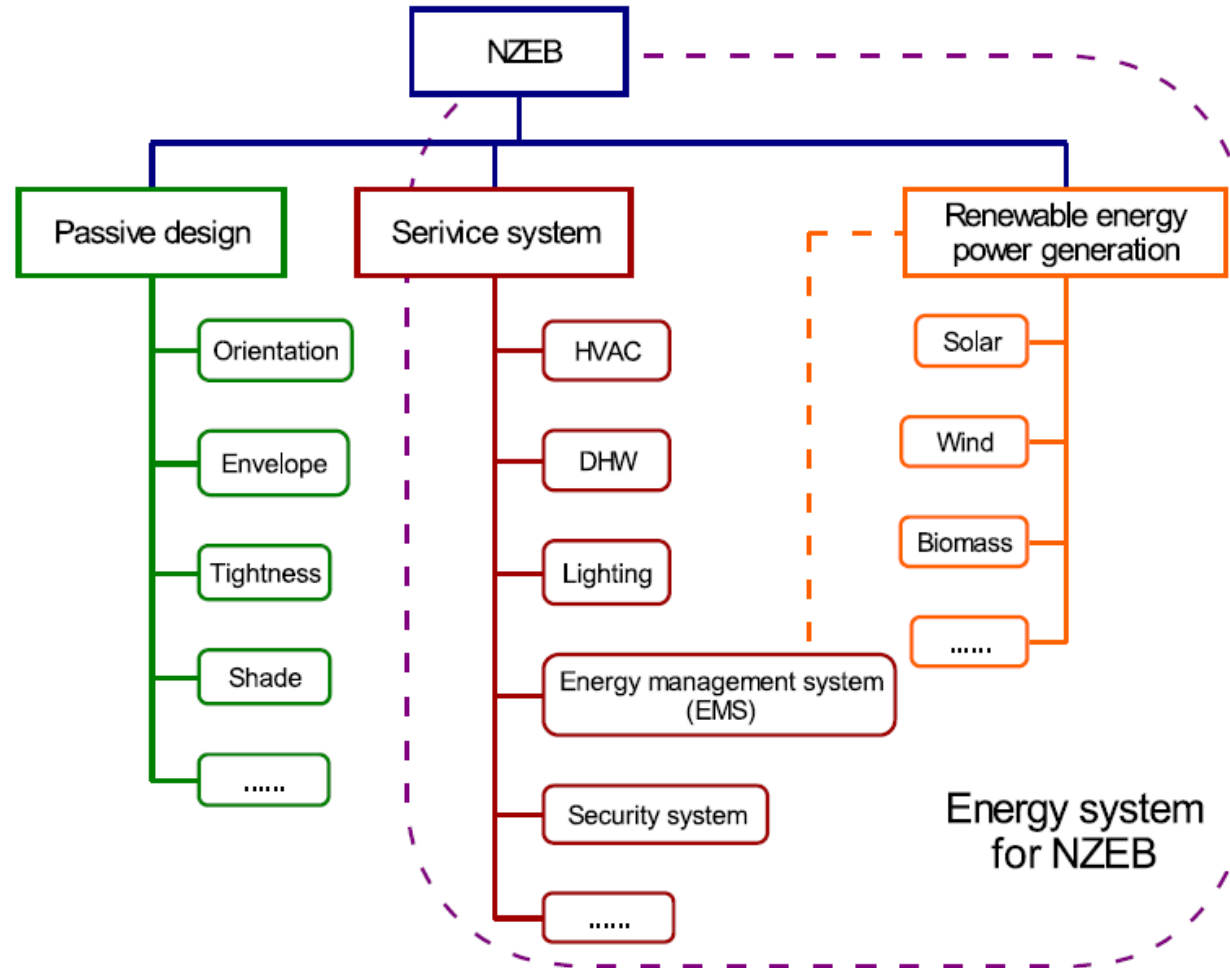
T5.2 Smart Buildings #2

Building Energy footprint



T5.2 Smart Buildings #3

Building Energy footprint – Green building – Near Zero Energy Building Concept

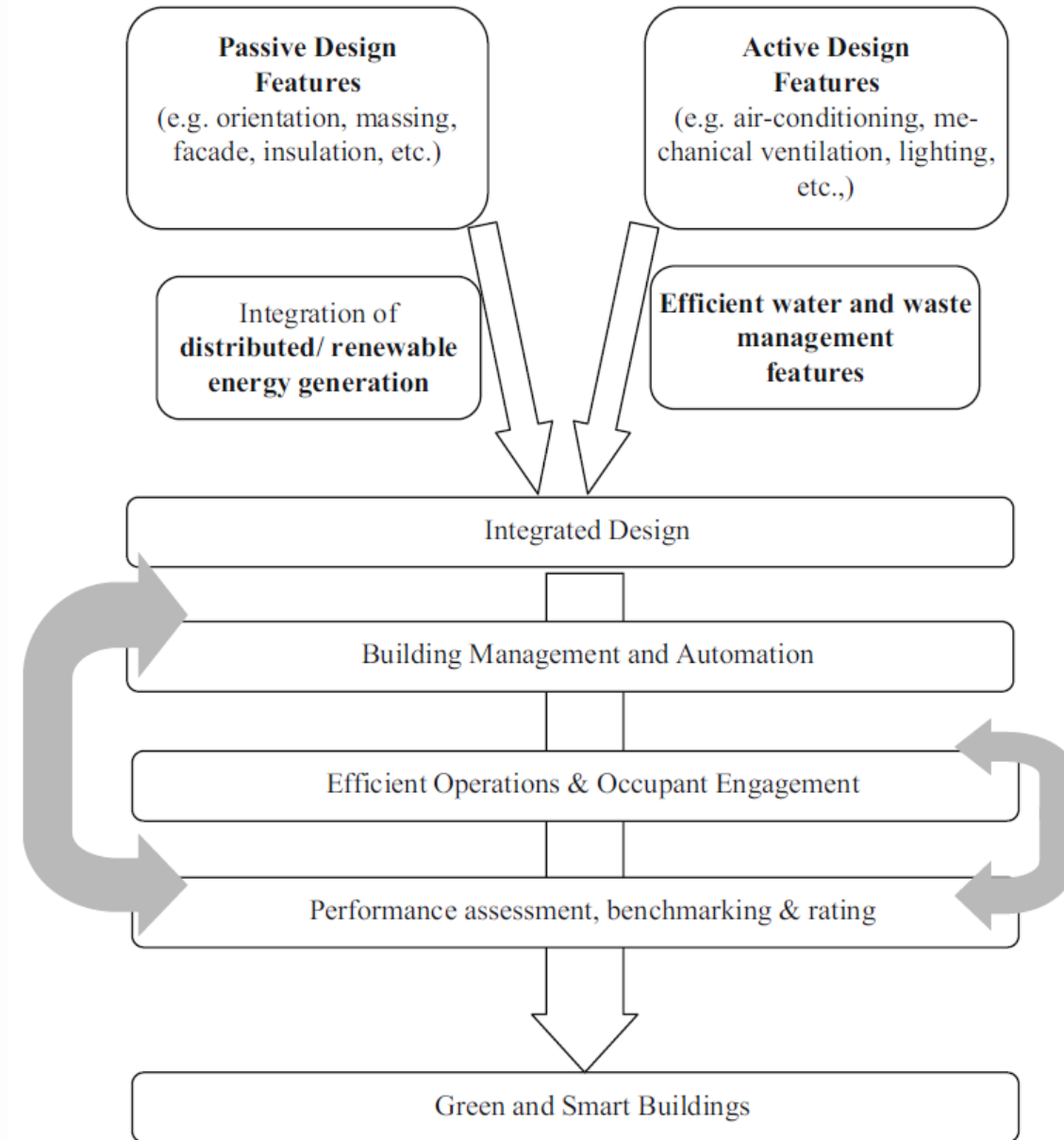


T5.2 Smart Buildings #4

Building Energy footprint

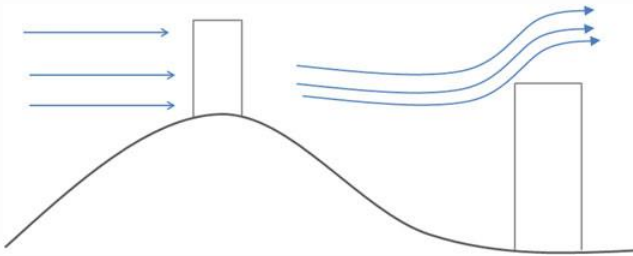
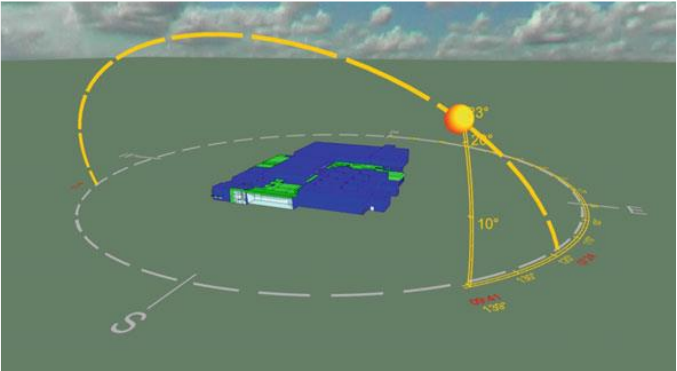
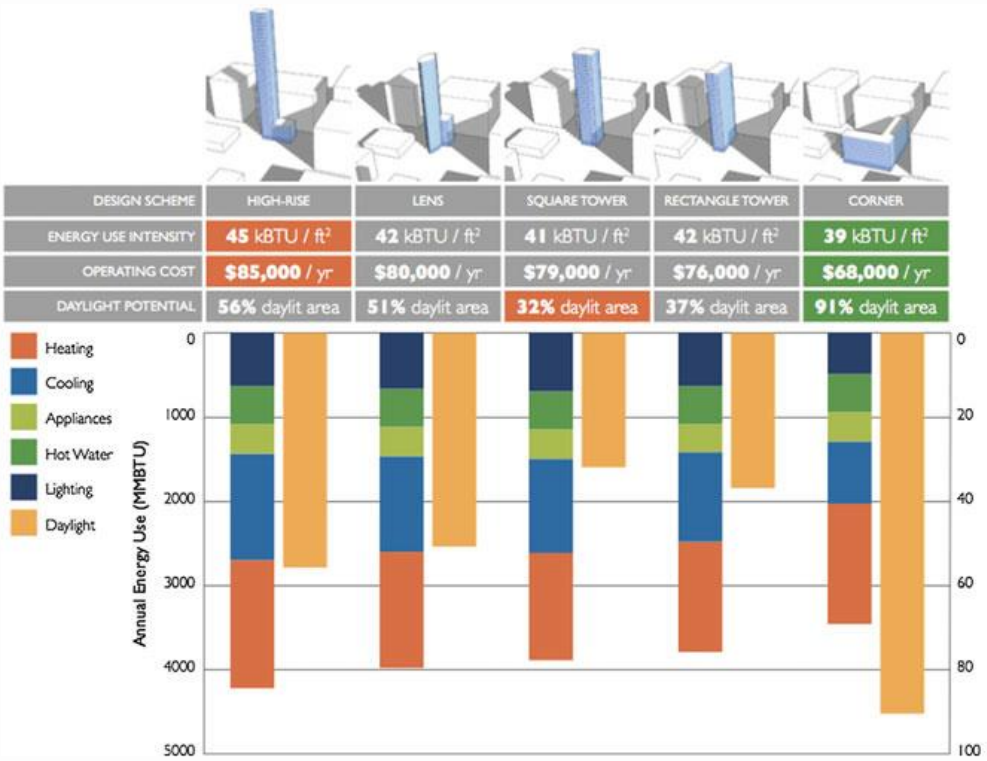
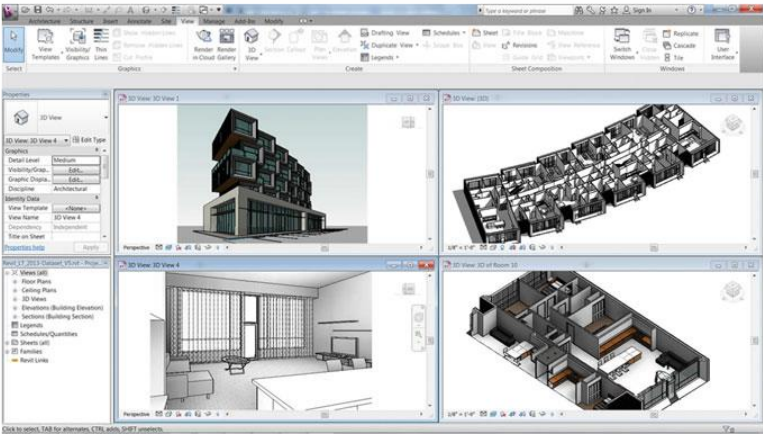
Green building

Near Zero Energy Building Concept



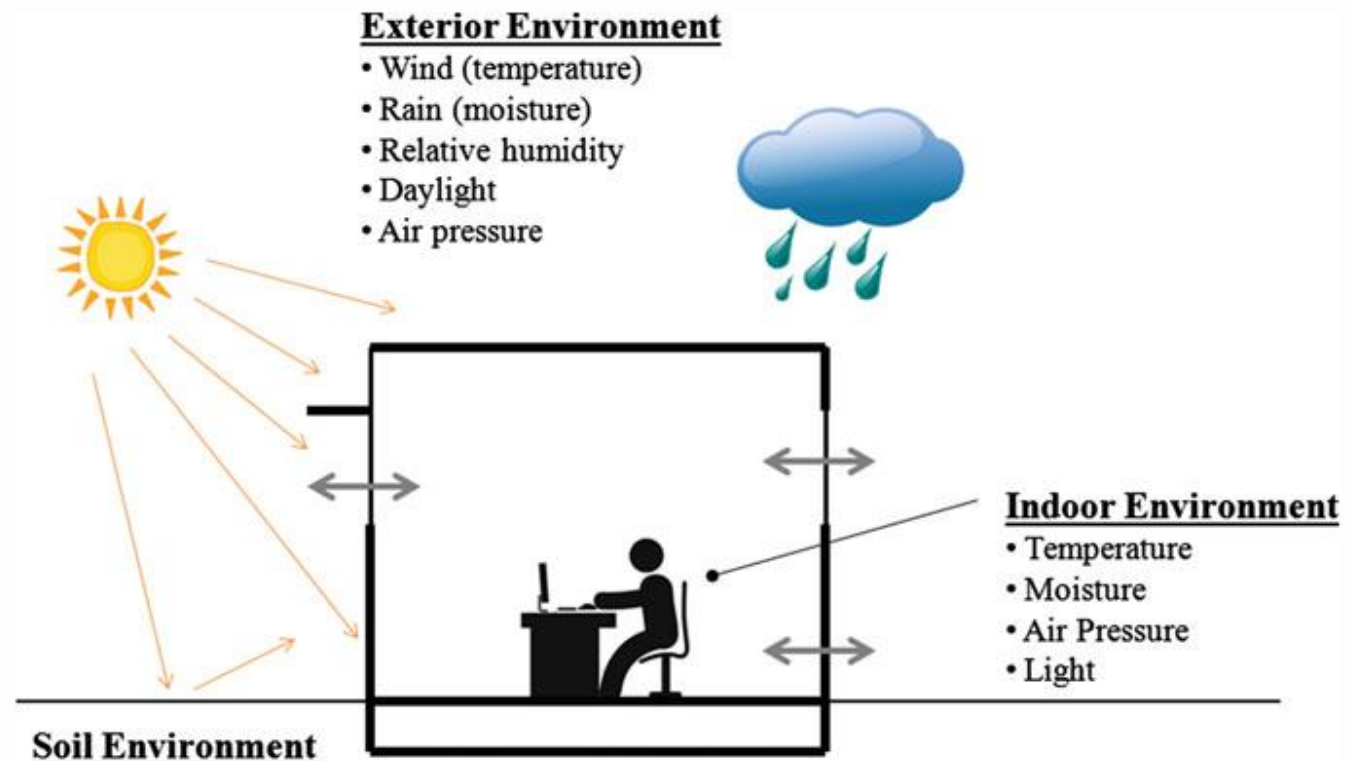
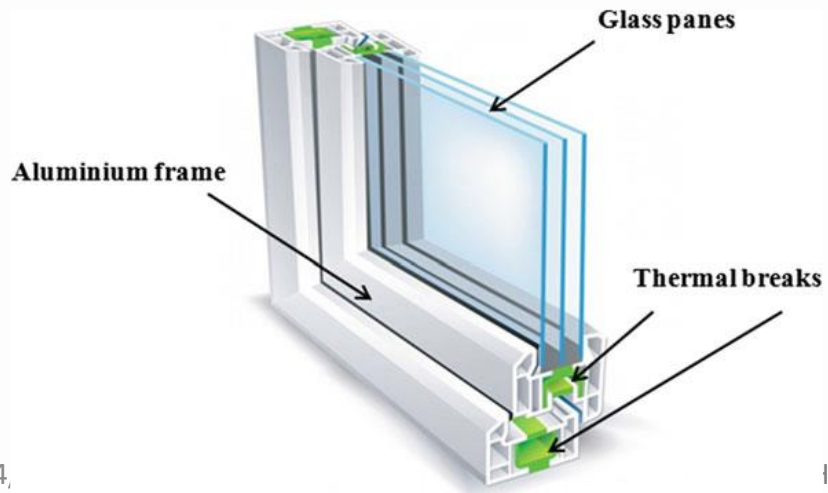
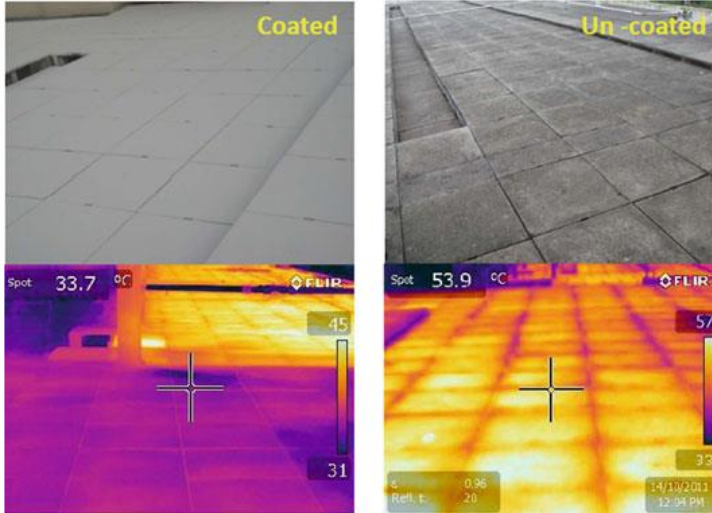
T5.2 Smart Buildings #5

Green Building concept – passive design



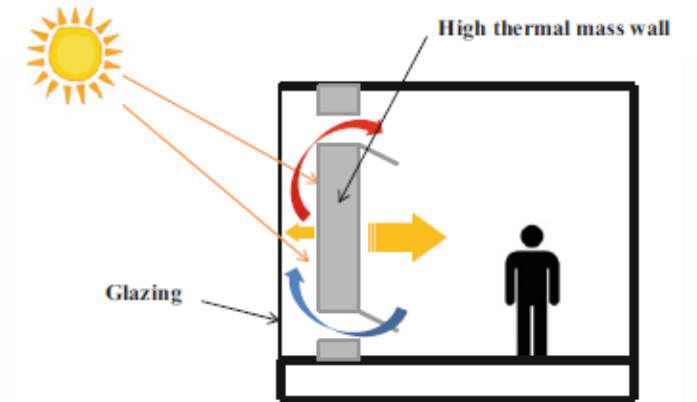
T5.2 Smart Buildings #6

Green Building concept – passive design



Soil Environment

- Temperature
- Relative humidity



T5.2 Smart Buildings #7

Green Building concept – passive design

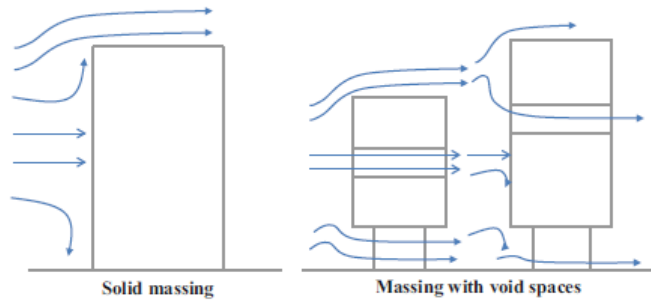


Fig. 4.15 Enhancing airflow through better massing and provision of void areas

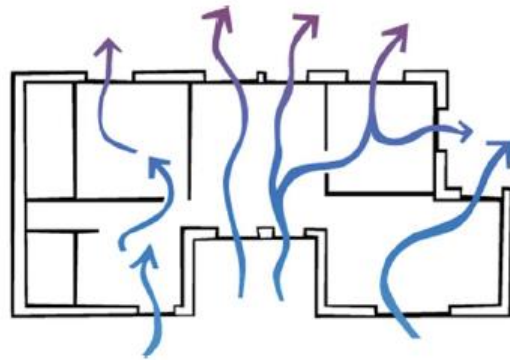


Fig. 4.16 Openings for cross ventilation can enhance natural air circulation

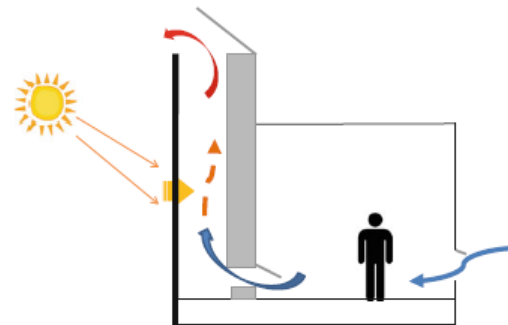


Fig. 4.17 Illustration of the Solar Chimney with stack ventilation effect

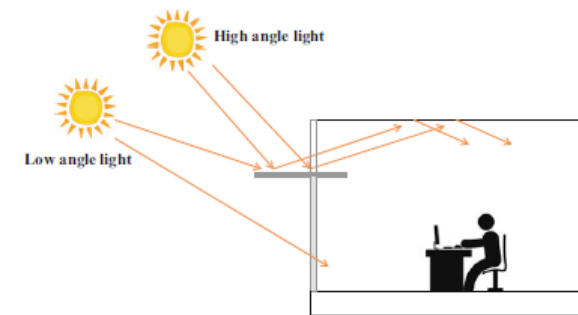


Fig. 4.23 Illustration of the light shelf concept

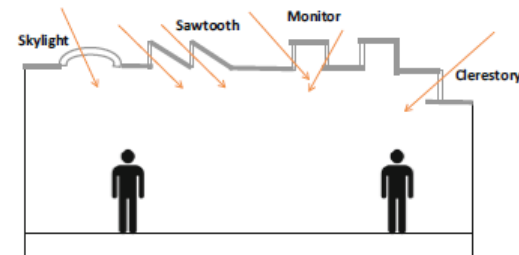


Fig. 4.22 Different types of top (roof-based) lighting techniques

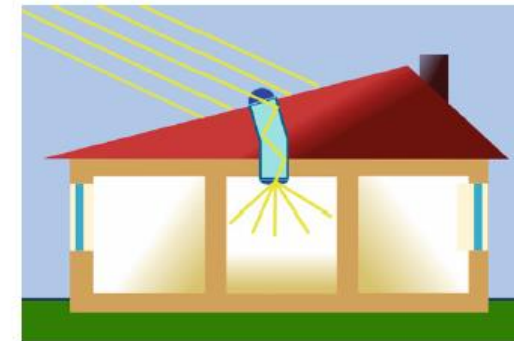
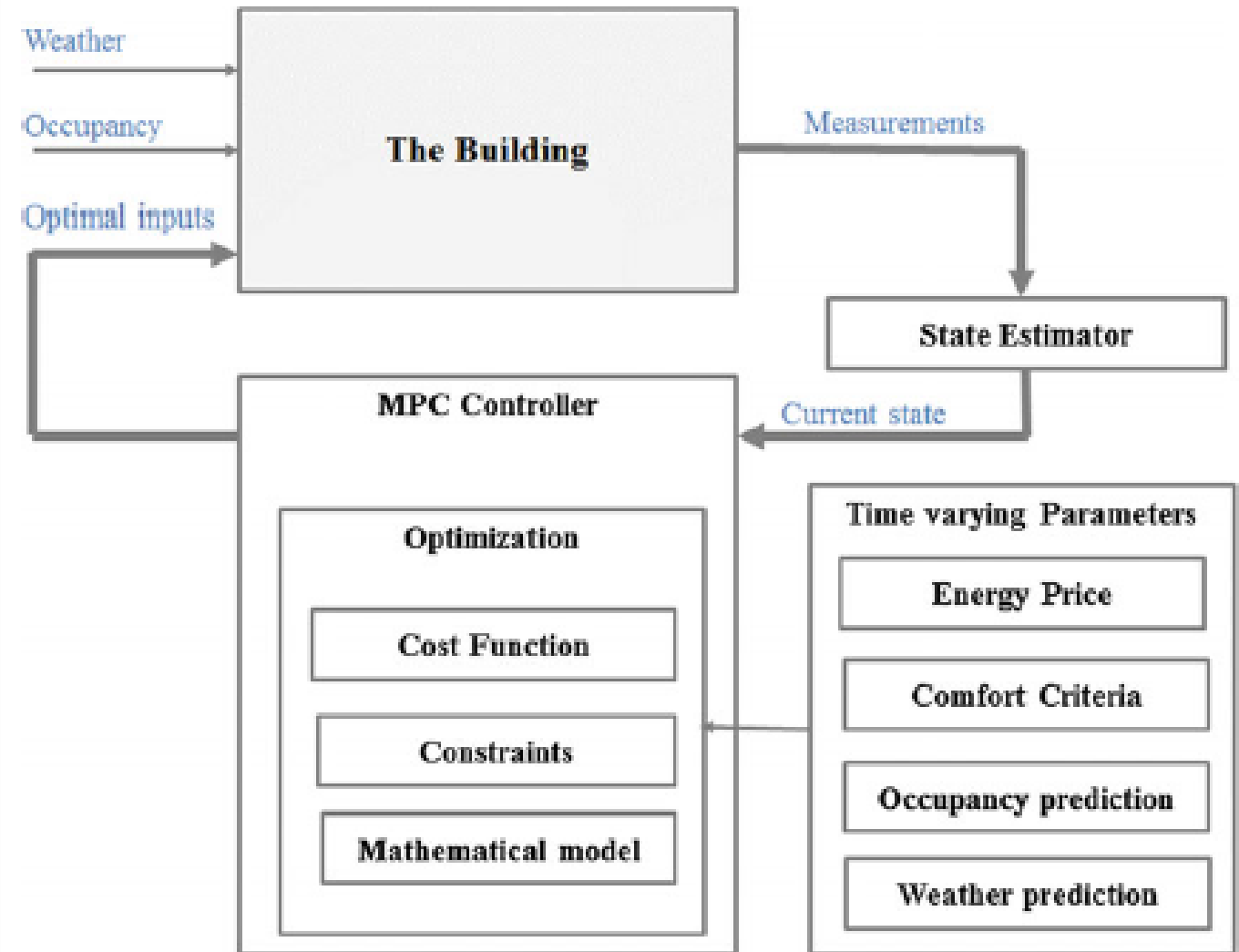


Fig. 4.24 Light pipes for indoor lighting using daylight (Kuhn 2007)

T5.2 Smart Buildings #8

Green Building concept – active design



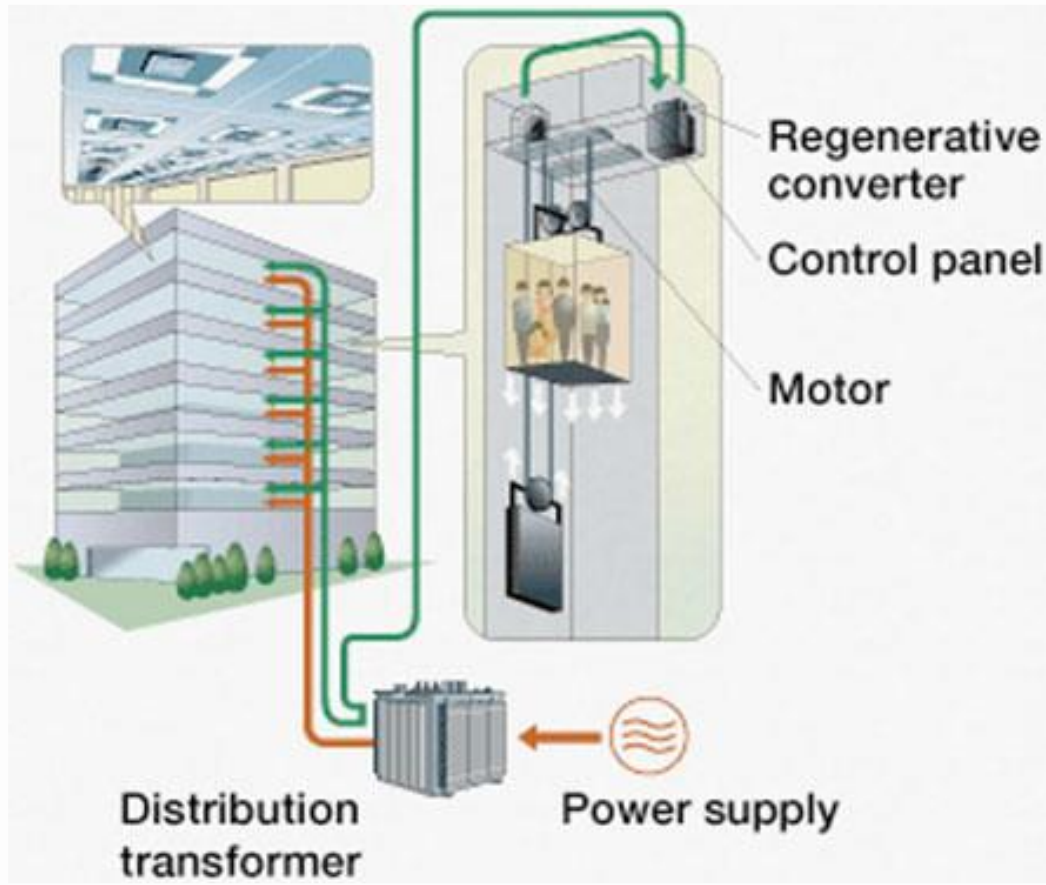
T5.2 Smart Buildings #9

Green Building concept – active design



T5.2 Smart Buildings #10

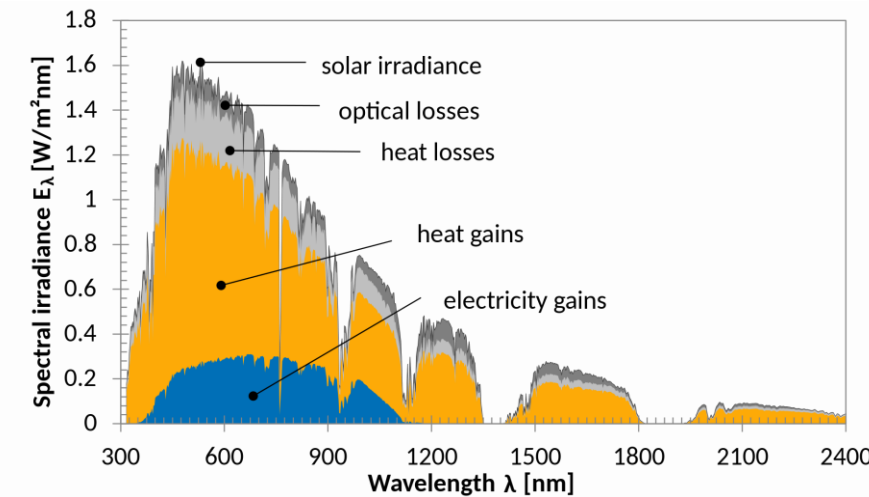
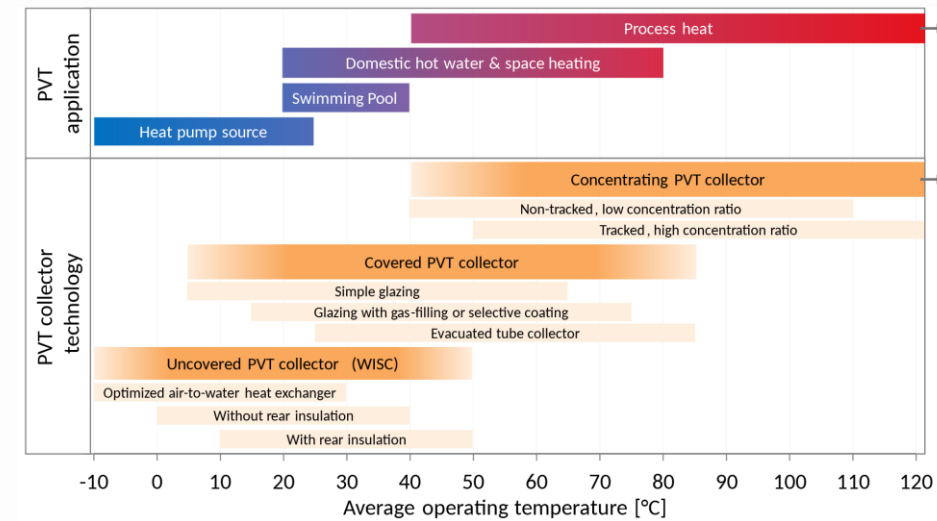
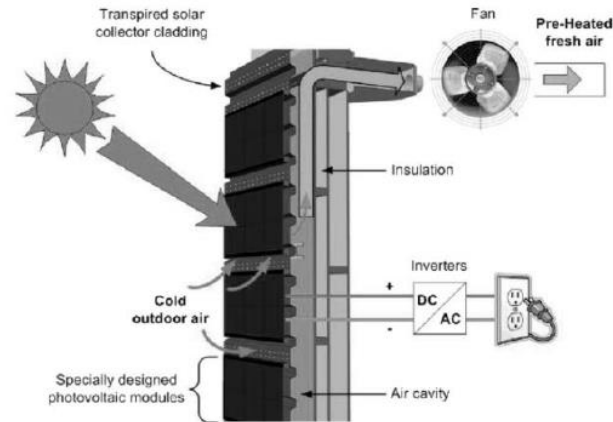
Green Building concept – active design



SmartWins

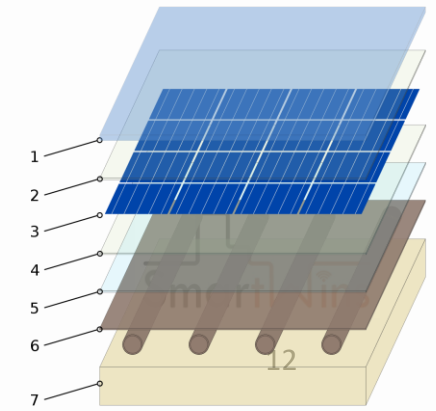
T5.2 Smart Buildings #11

Green Building concept – active design



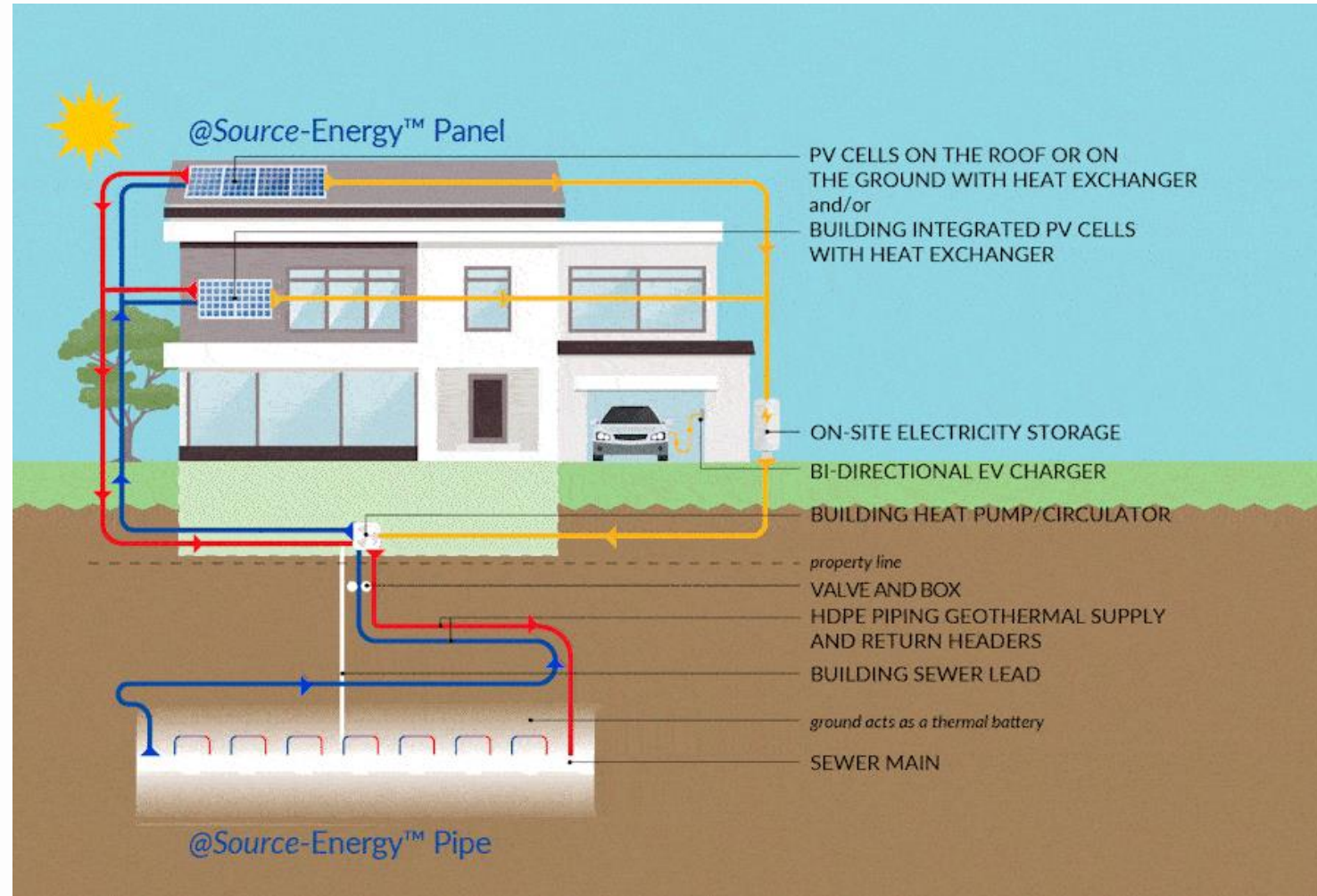
Black, monolithic TFGS can be a stylish and powerful addition to building surfaces.

Image: ZSW



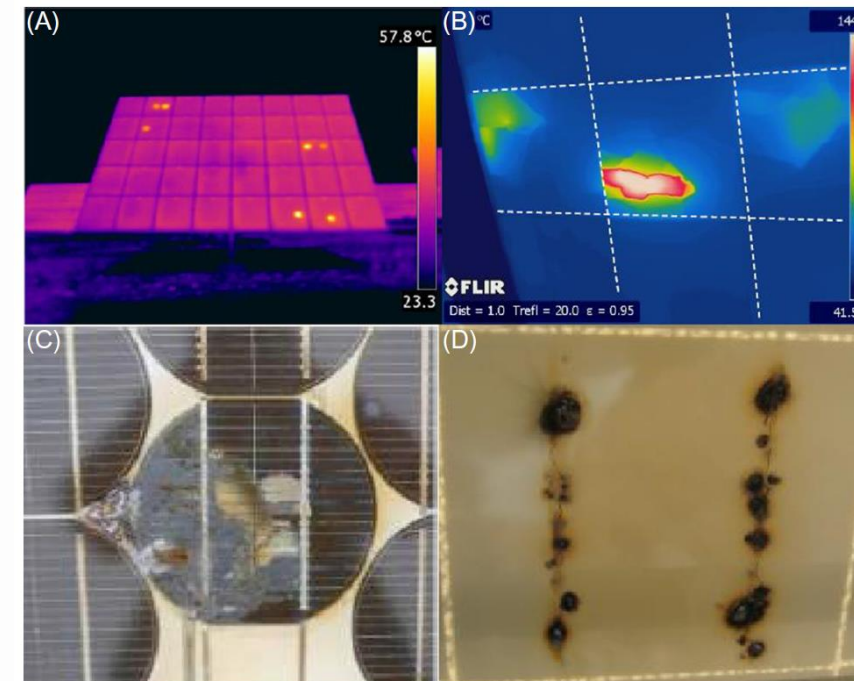
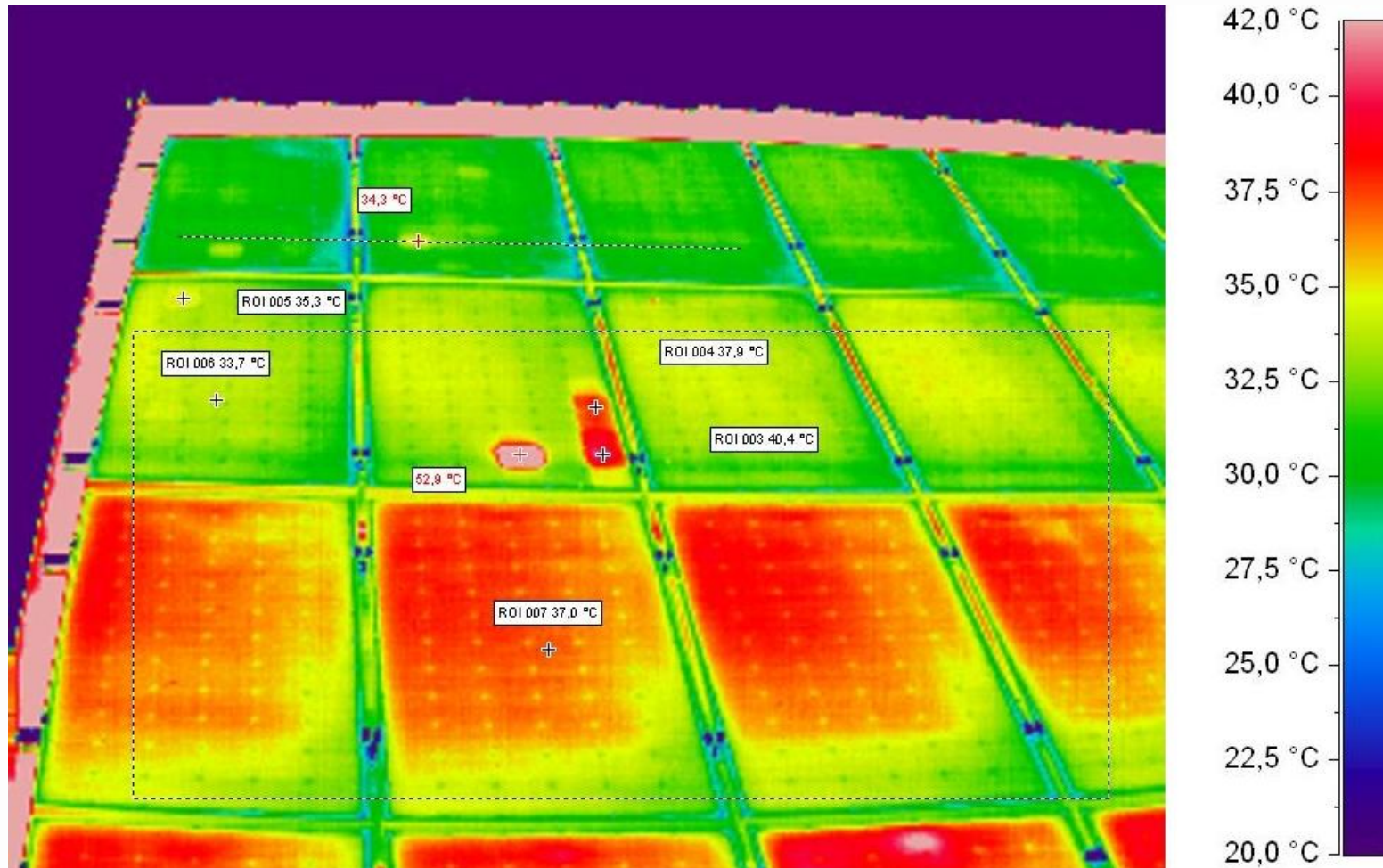
T5.2 Smart Buildings #12

Green Building concept – active design



T5.2 Smart Buildings #13

Green Building concept – active design



T5.2 Smart Buildings #14

Green Building concept – active design

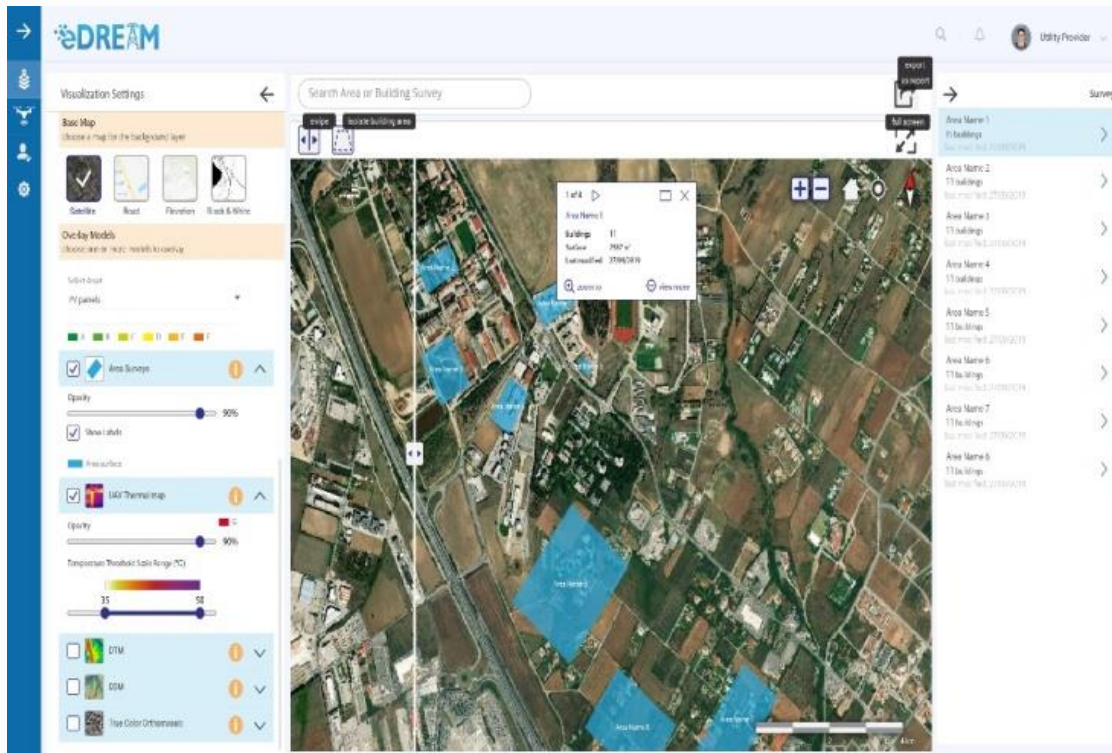
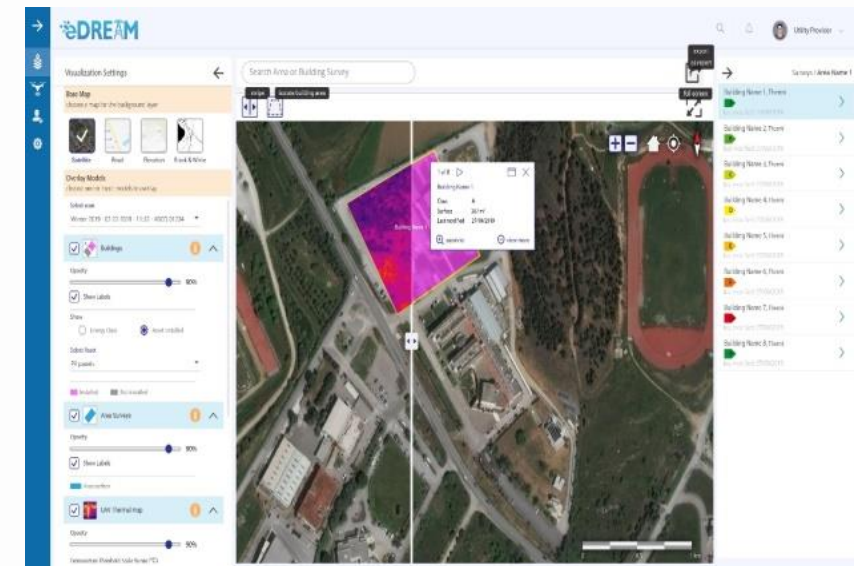
I searched a lot of literature to find all the factors leading to partial shading in photovoltaics. Still missed one. 😊



T5.2 Smart Buildings #15

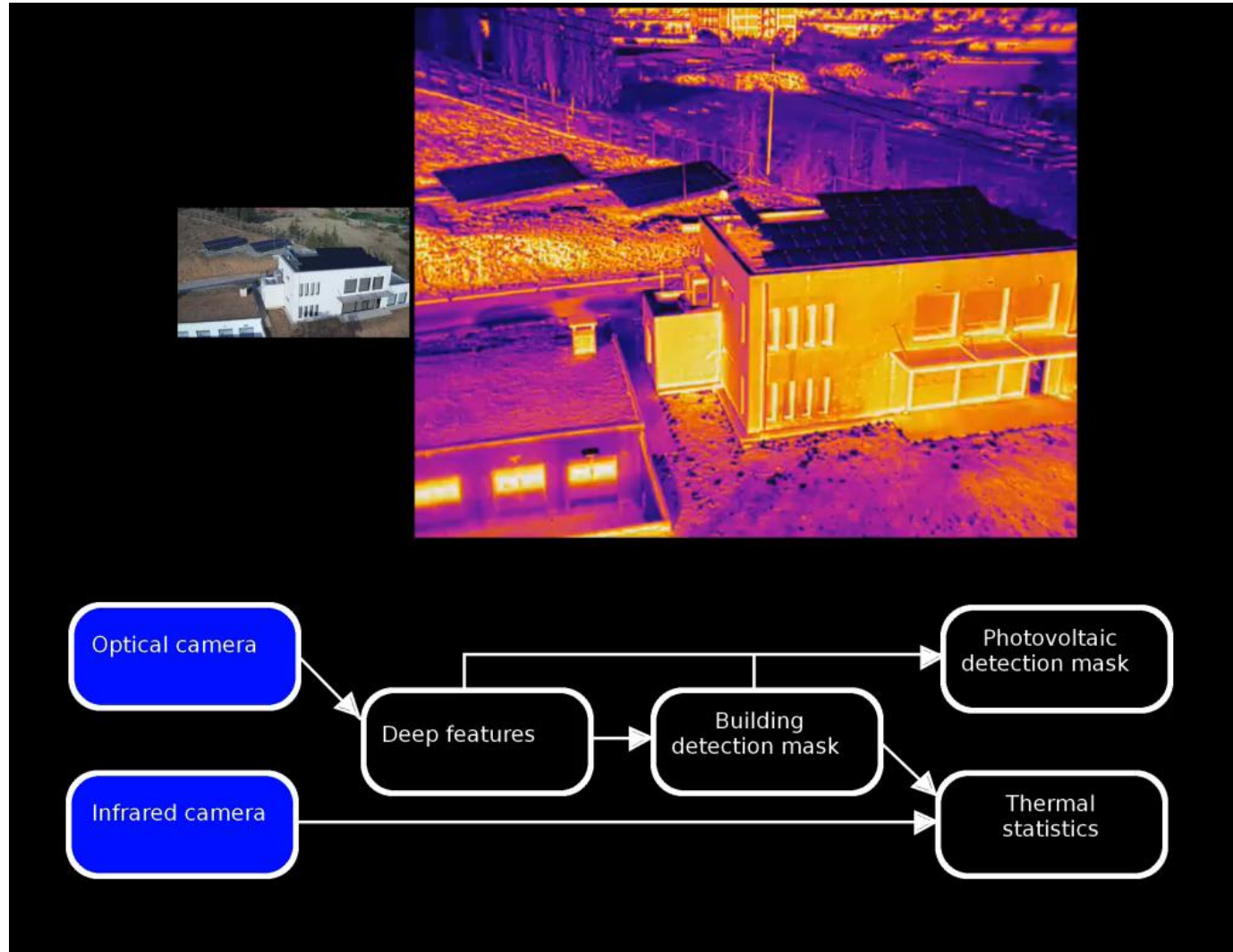
Green Building concept – active design

- Utilization of remote scanning and extracting building energy characteristics, e.g. assets, e.g. PVs, using drones via optical and thermal cameras.
- Use of advanced techniques (e.g. Deep feature extraction via supervised learning),

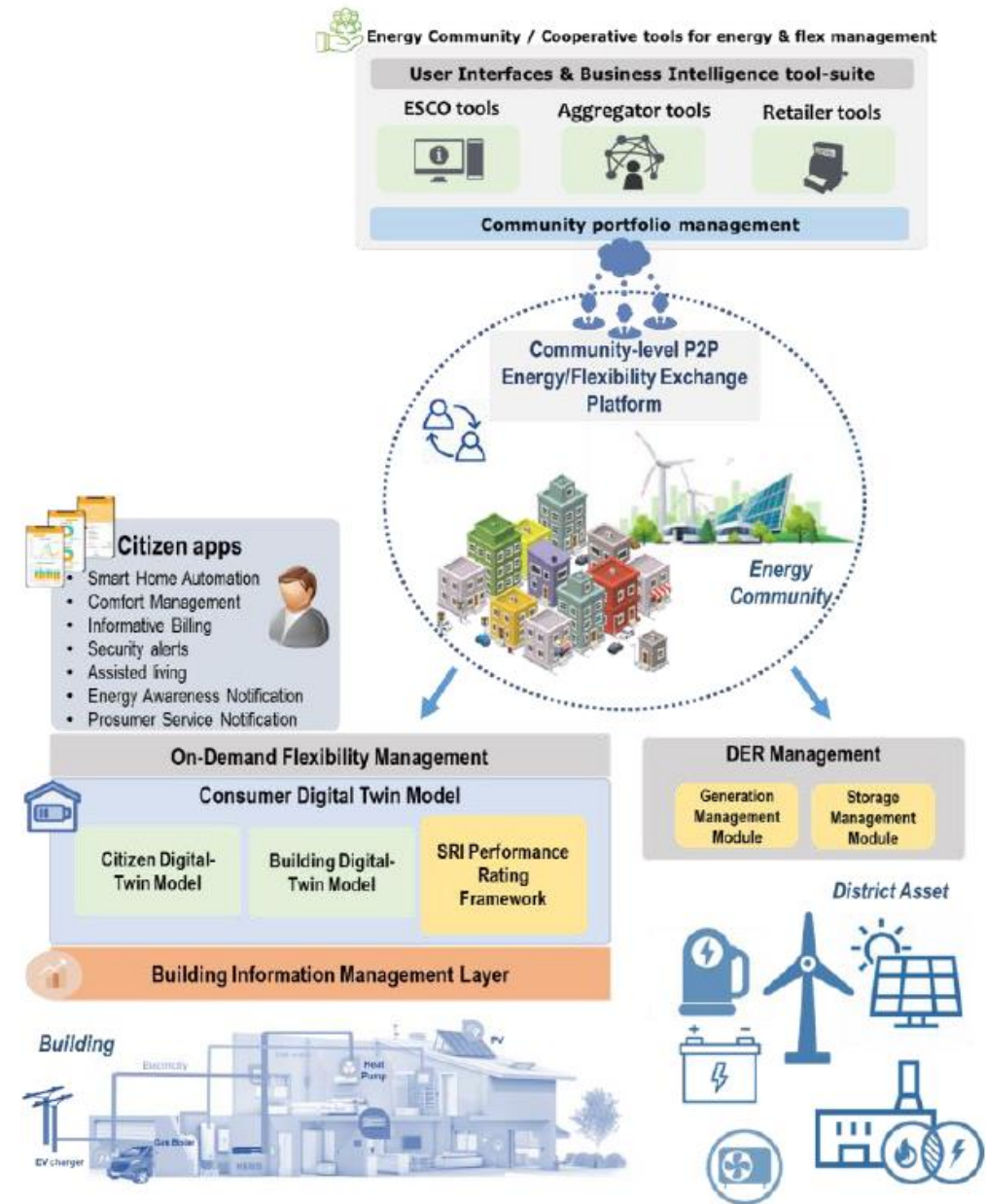
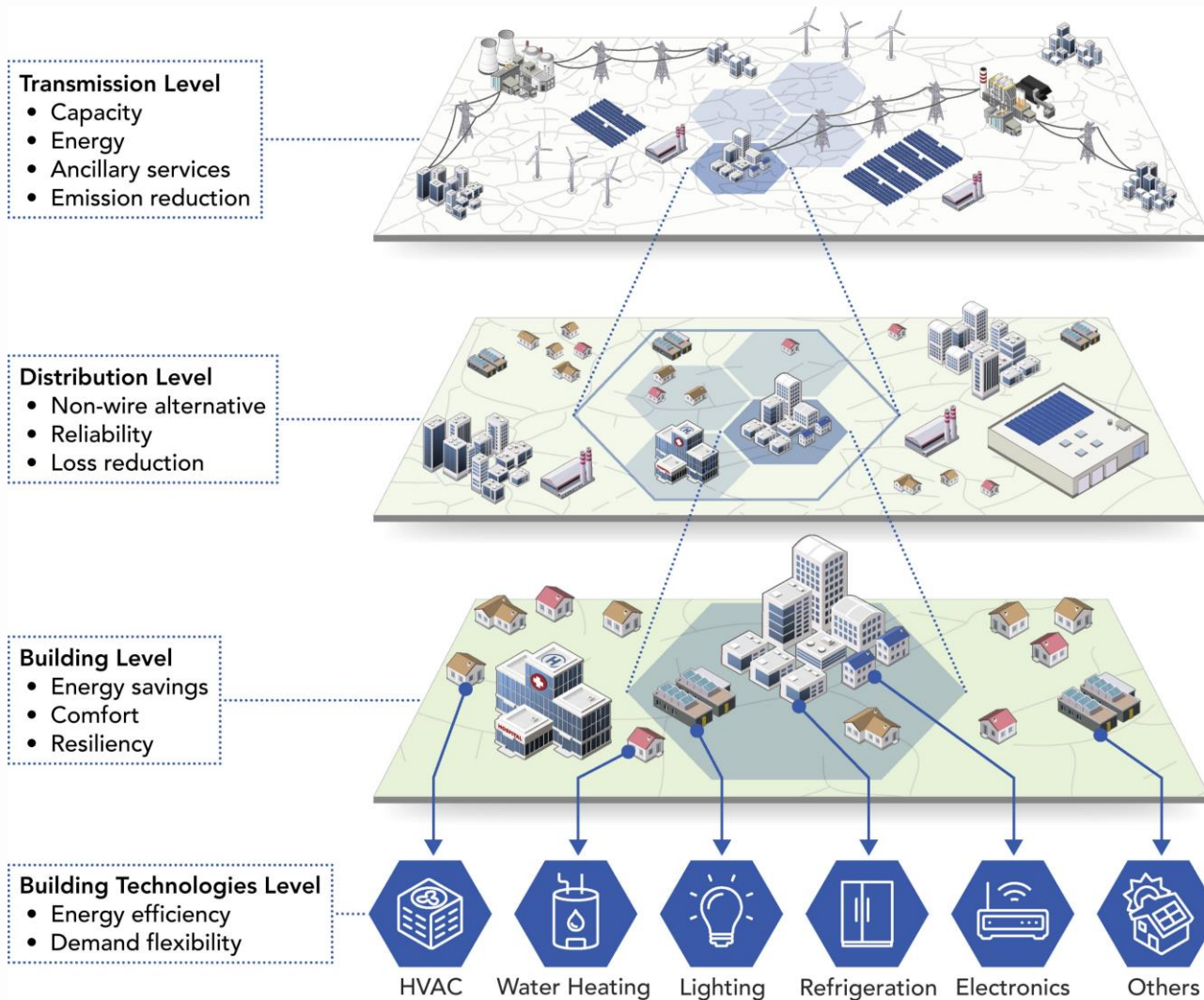


T5.2 Smart Buildings #16

Green Building concept – active design



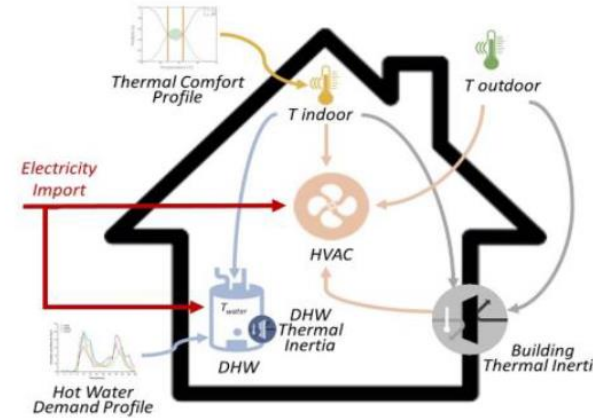
T5.2 Energy communities #1



T5.2 Energy communities #2

- In 2018 EU acknowledged the right of local communities and citizens to play an active role in the energy sector by defining “energy communities”.
- An Energy Community is a cooperative aiming to promote the social and solidarity economy and innovation in the energy sector, to address energy poverty and to promote sustainable energy production, storage, energy management, self-consumption, distribution and energy supply, as well as to enhance energy self-sufficiency and security.
 - Governance: Participation is open and voluntary
 - Ownership and Control: Participation and effective control by citizens, local authorities etc.
 - Purpose: the primary purpose is to generate social and environmental benefits rather than financial
 - Geographical scope: proximity between renewable energy projects and the Energy Community
 - Activities: can cover a broad range of activities referring to all forms of RES and heating sector.
 - Participants: Natural persons, local authorities and micro, small and medium-sized enterprises
 - Autonomy

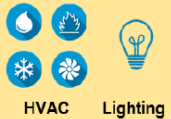
T5.2 Energy communities #3



Consumer Digital Twin Model

Citizen Digital-Twin Model

Thermal & Visual Comfort



Lifestyle



Mobility Habits

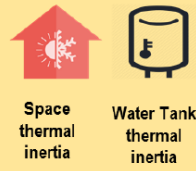


Demand elasticity estimation



Building Digital-Twin Model

Virtual Energy Storage models



DER models (load, generation, storage)



SRI Performance Rating

- Dynamic Self-calibration
- On the fly characterization - certification
- System inspection
- Fault detection & analysis



Citizen apps

- Smart Home Automation
- Comfort Management
- Informative Billing
- Security alerts
- Assisted living
- Energy Awareness Notification
- Prosumer Service Notification



On-Demand Flexibility Management

Consumer Digital Twin Model

Citizen Digital-Twin Model

Building Digital-Twin Model

SRI Performance Rating Framework

Building Information Management Layer



DER Management

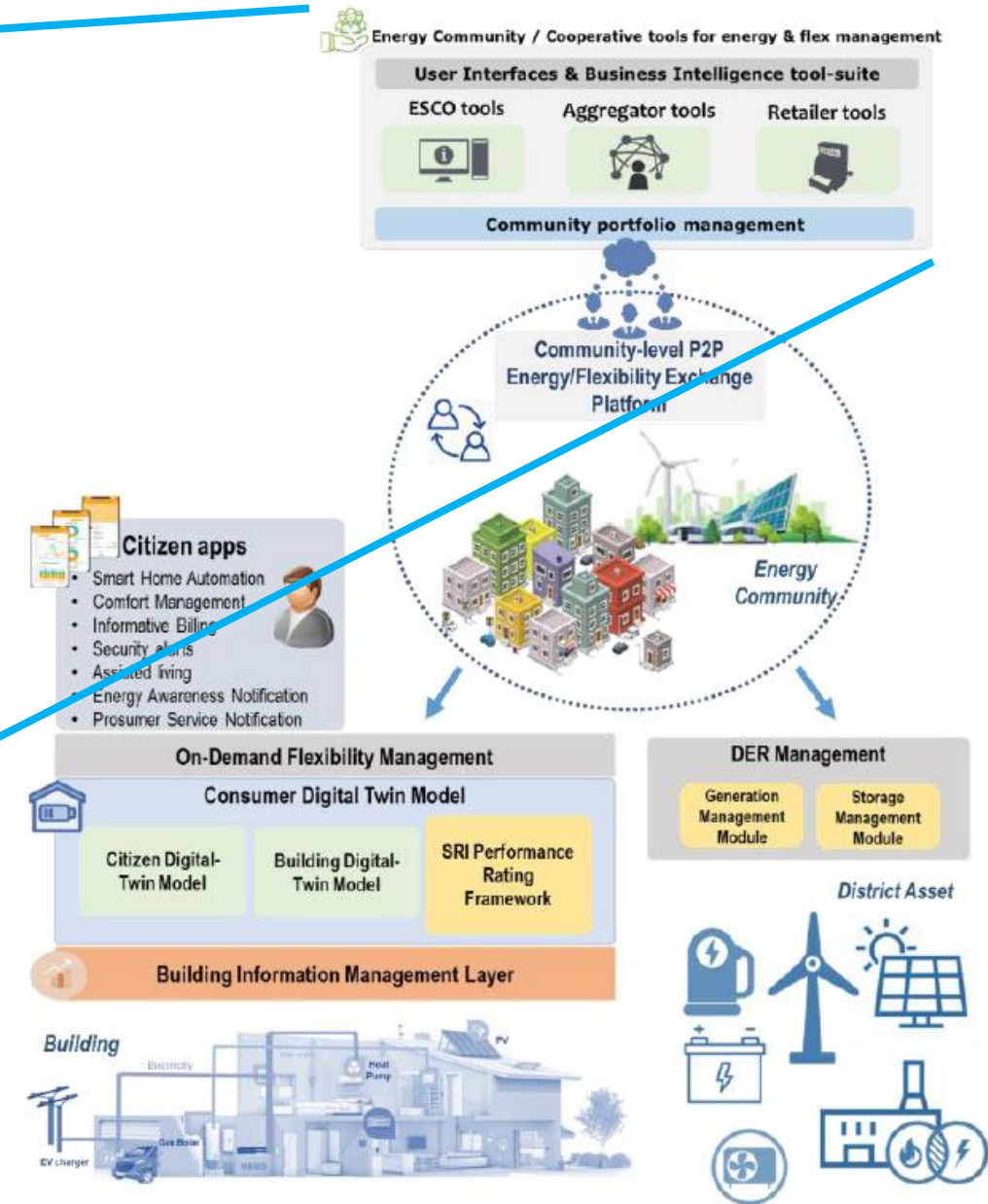
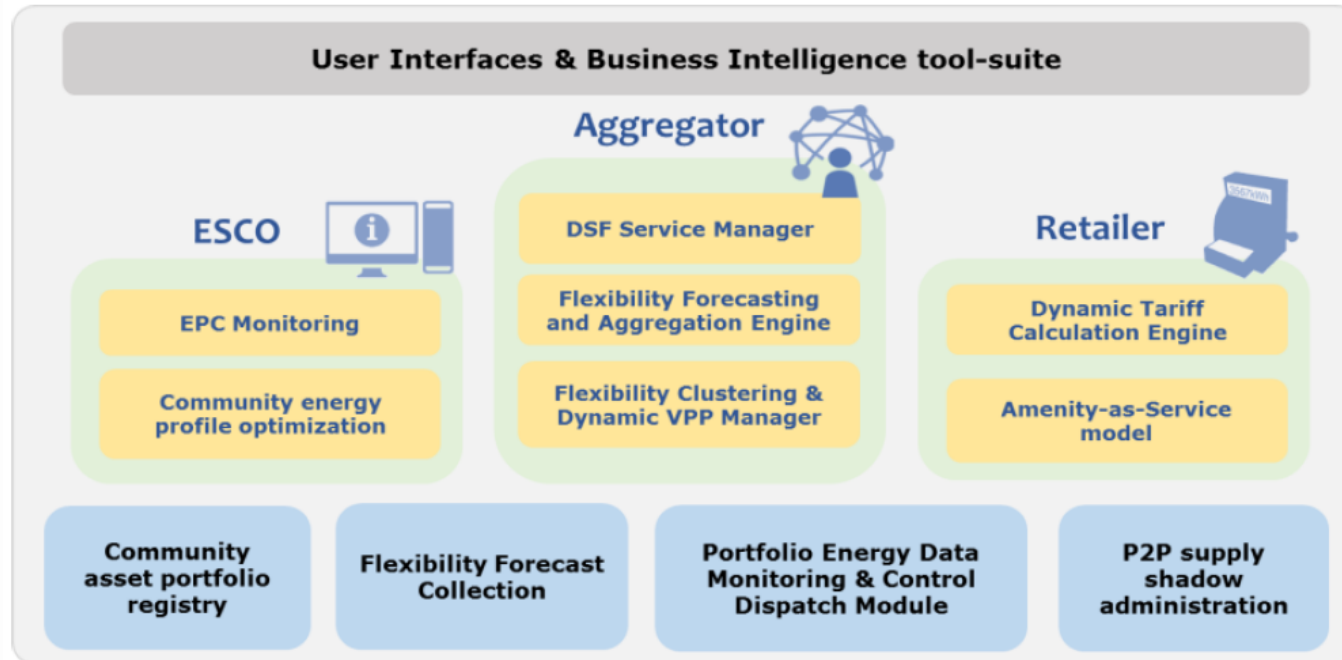
Generation Management Module

Storage Management Module

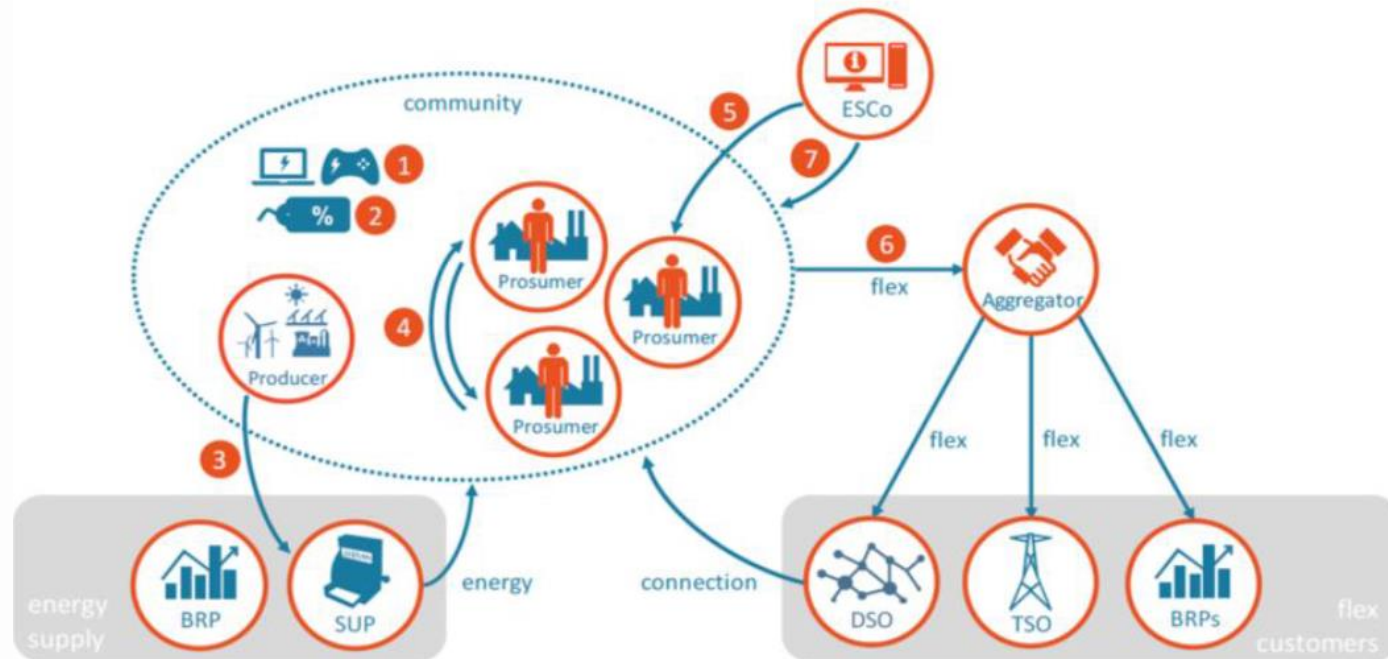
District Asset



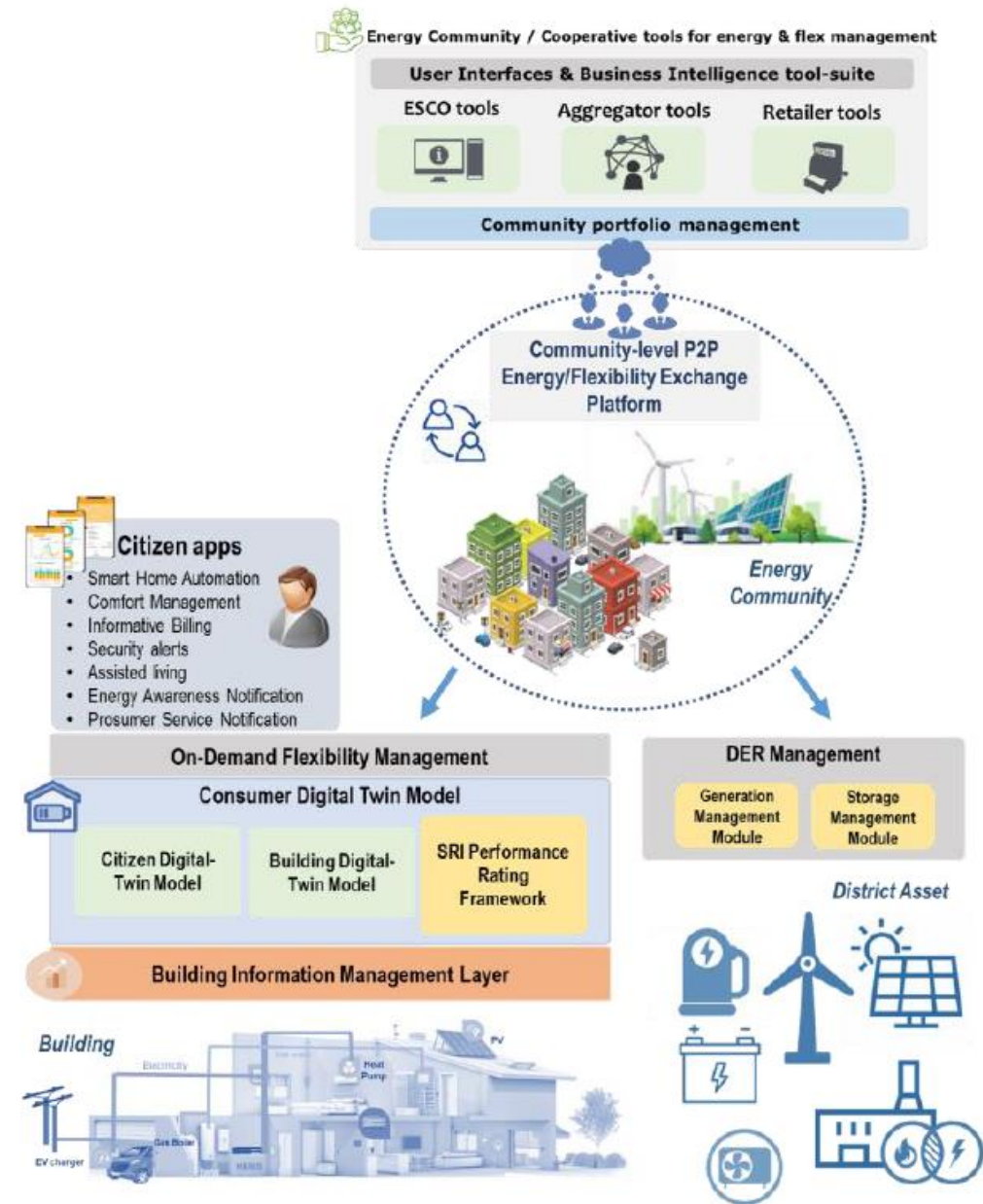
T5.2 Energy communities #4



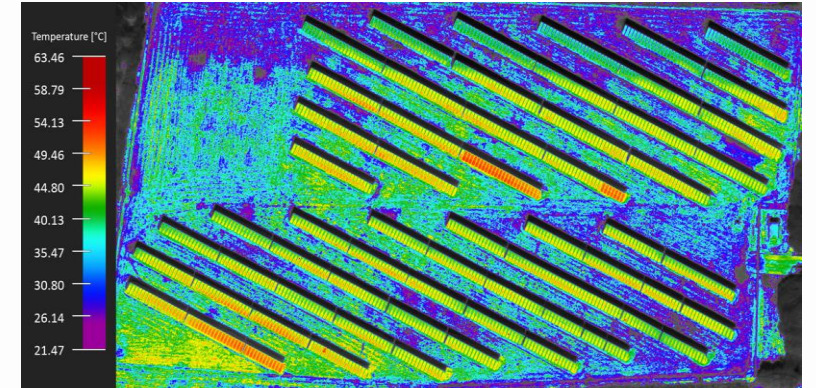
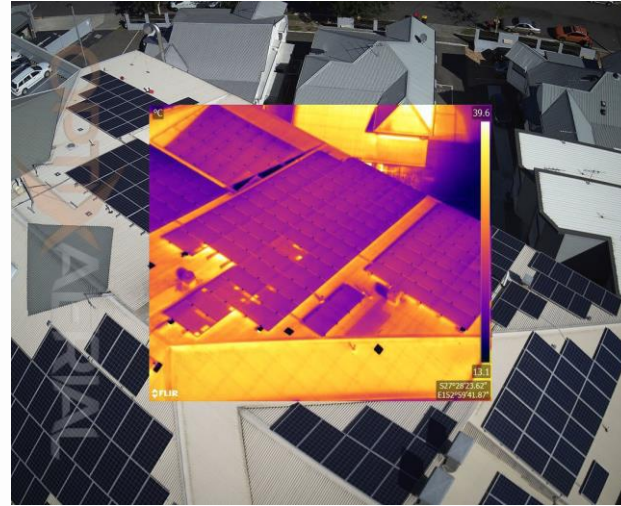
T5.2 Energy communities #5



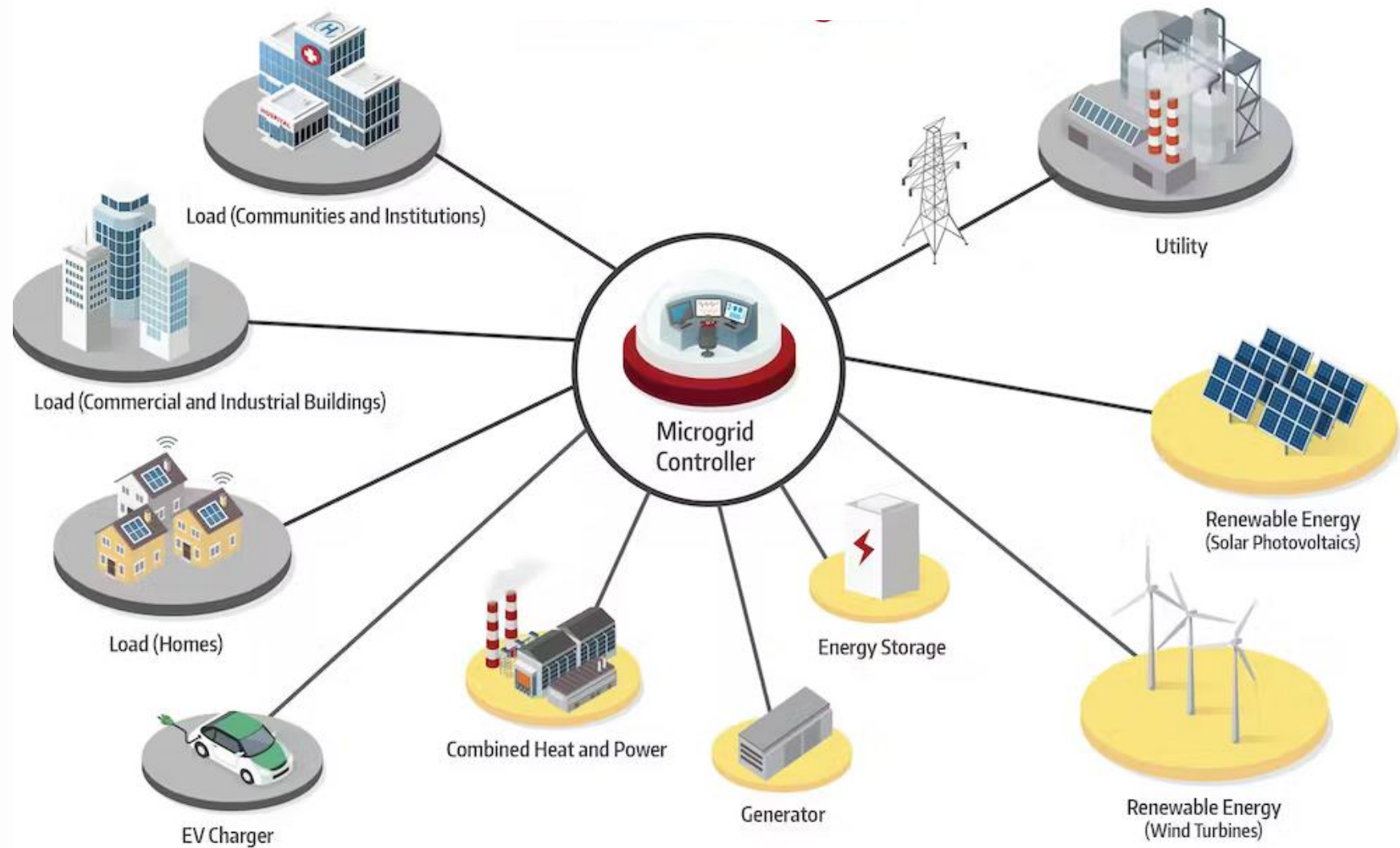
Energy and flexibility services offered within a Citizen Energy Community context. ① Services for energy awareness, ② Services related to the shared assets, ③ Supply of community-produced energy, ④ Peer-to-Peer supply, ⑤ Implicit demand-side flexibility services, ⑥ Explicit demand-side flexibility services, ⑦ Aggregated community load profile optimisation. Source: USEF



T5.2 Energy communities #6



T5.2 Microgrids #1

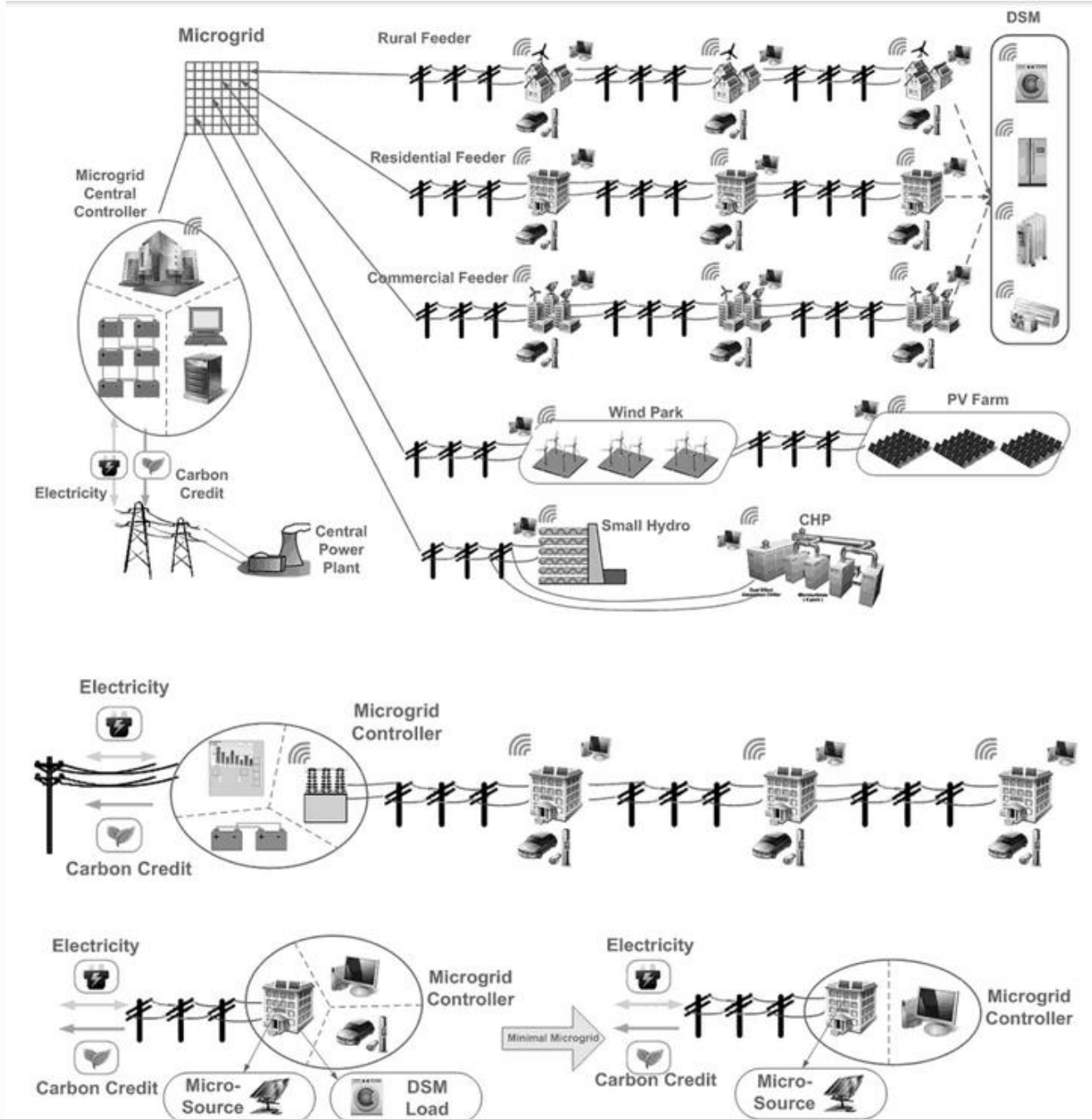


T5.2 Microgrids #2

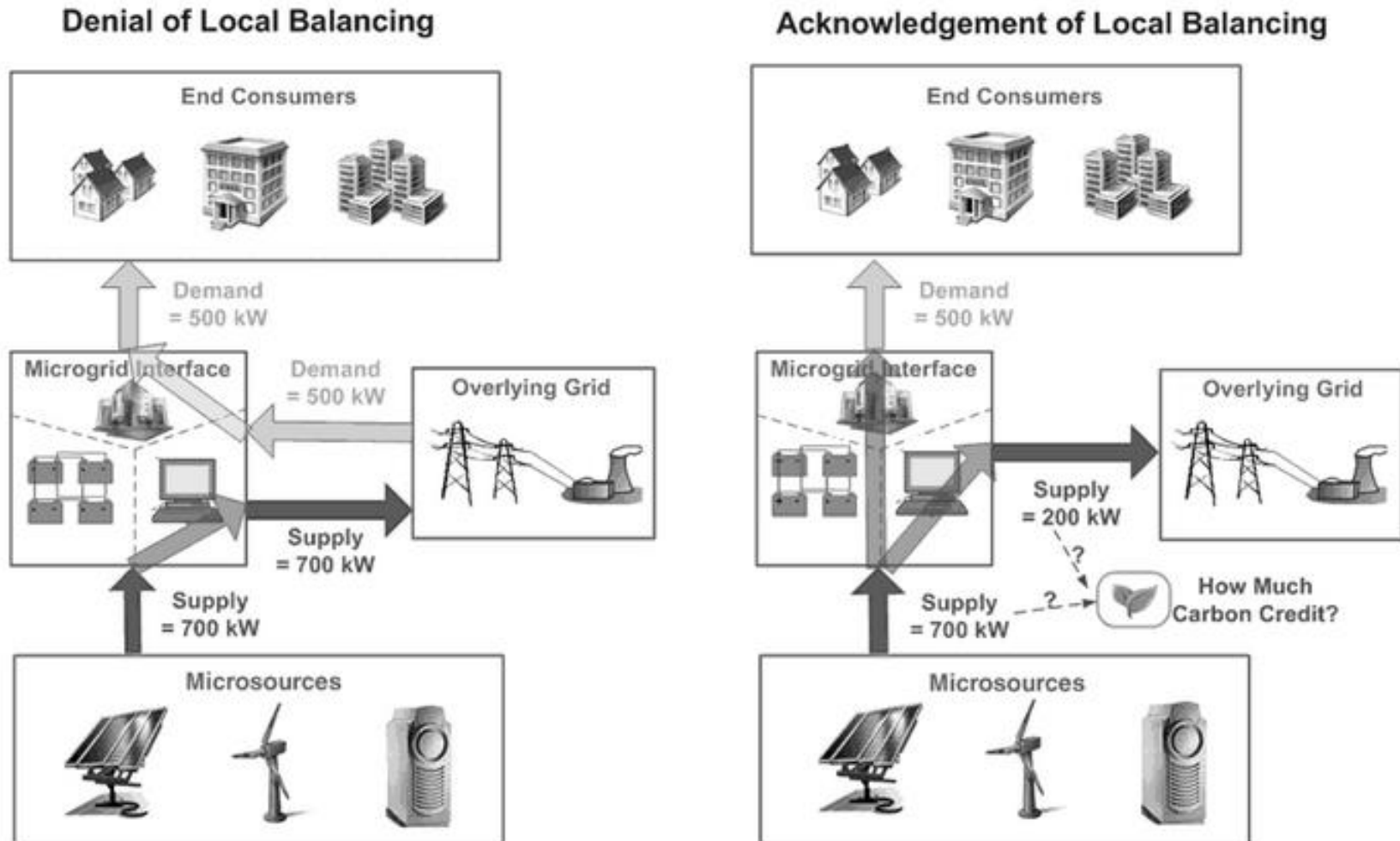
Definition: A Microgrid is a self-sufficient energy system that serves a discrete geographic footprint, such as a college campus, hospital complex business center or neighborhood.

- Local
- Independent
- Intelligent
- Benefits
 - Improves electric reliability
 - Enhances resilience/recovery
 - Can lower energy costs for consumers or businesses
 - Improves the environment/promotes clean energy
 - Strengthens the main grid
 - Bolsters cybersecurity
 - Brings economic value to society
 - Improves community well-being
- Categories per operation: Stand-Alone (islanded/isolated), grid-connected.

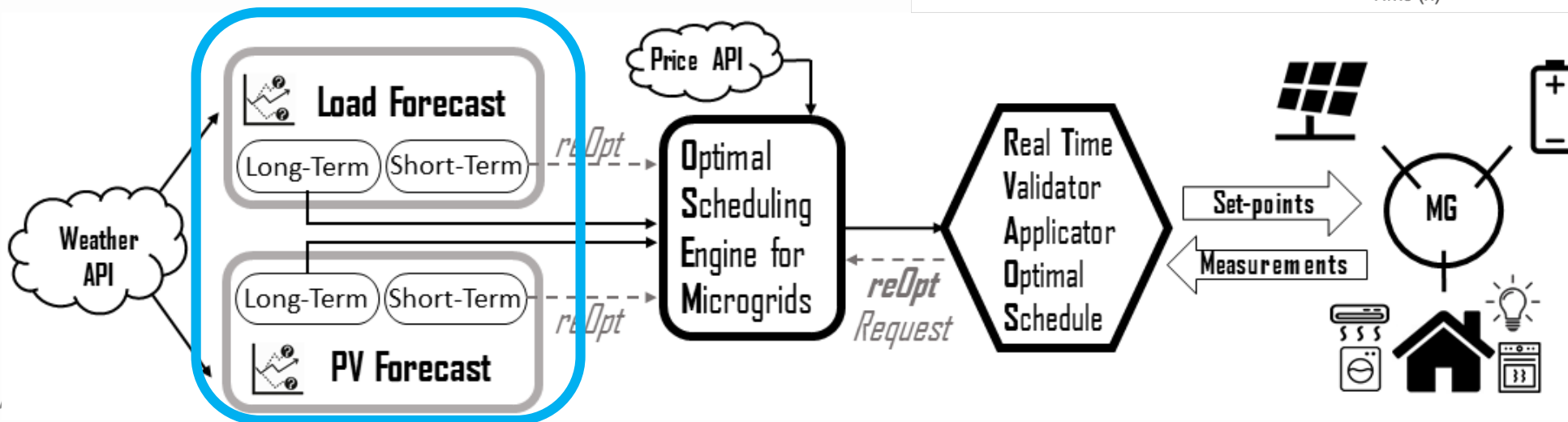
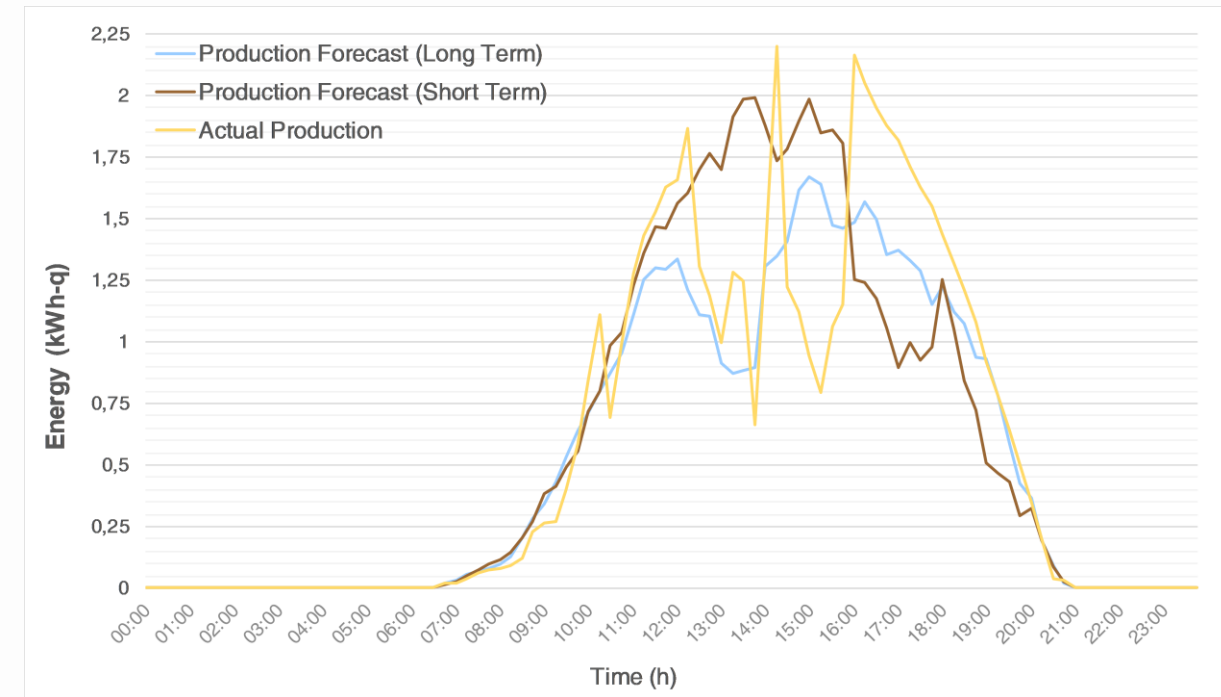
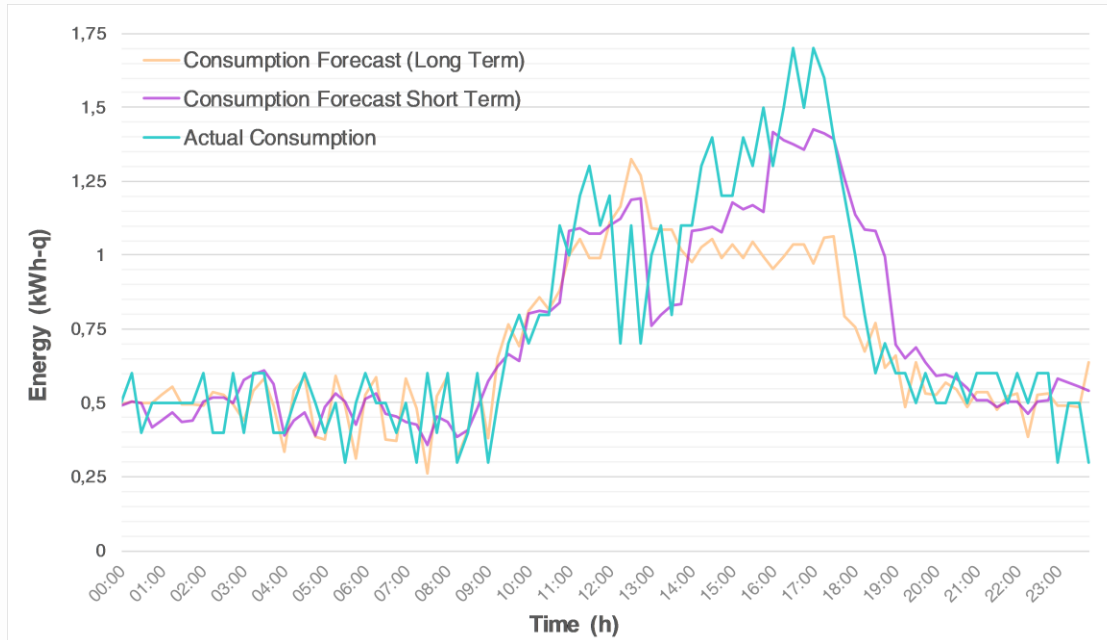
T5.2 Microgrids #3



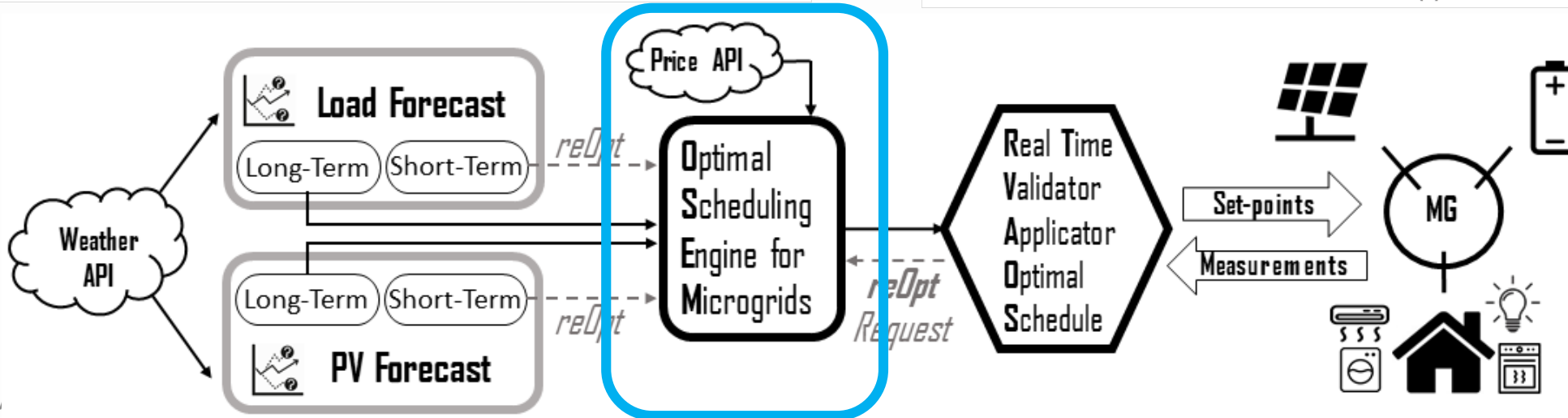
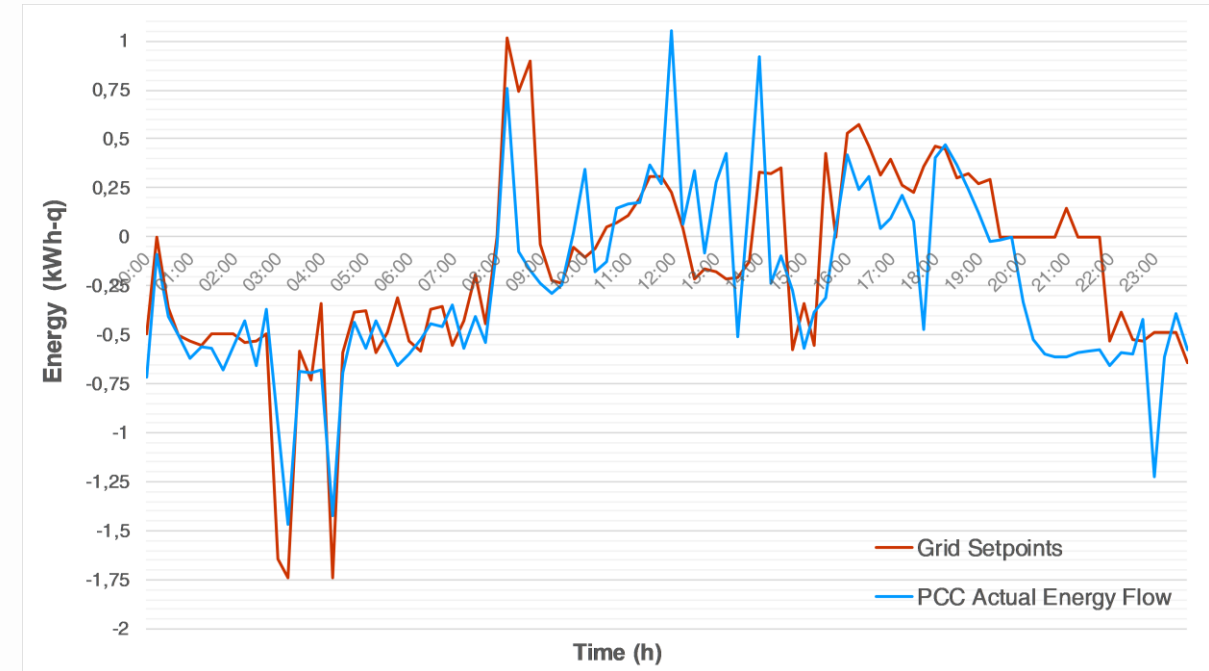
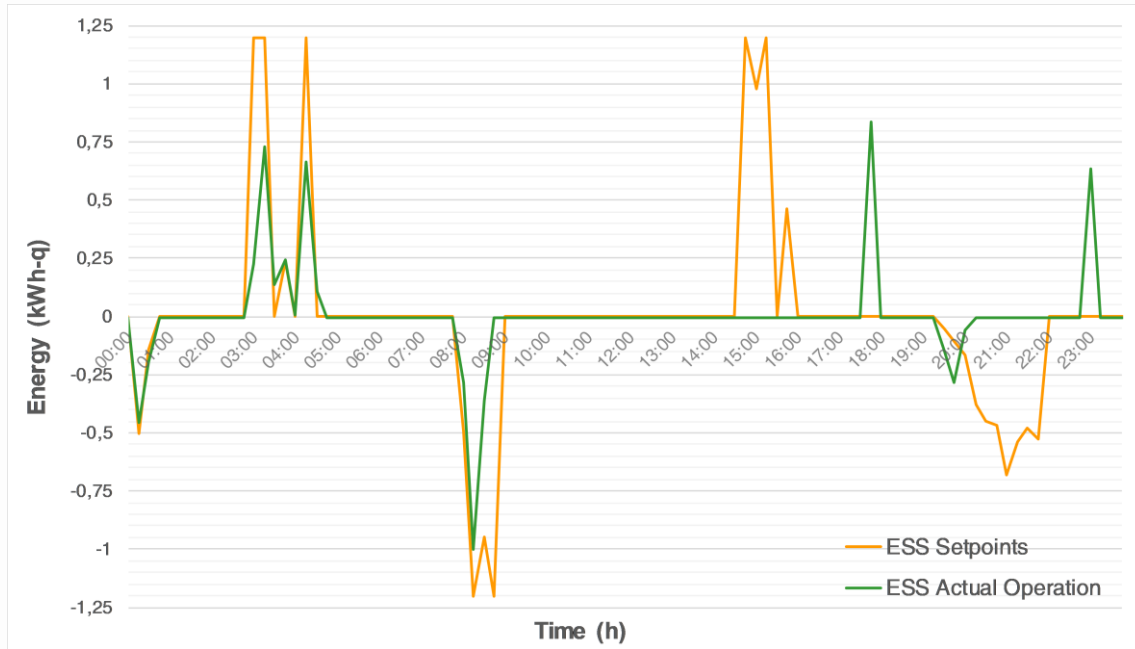
T5.2 Microgrids #4



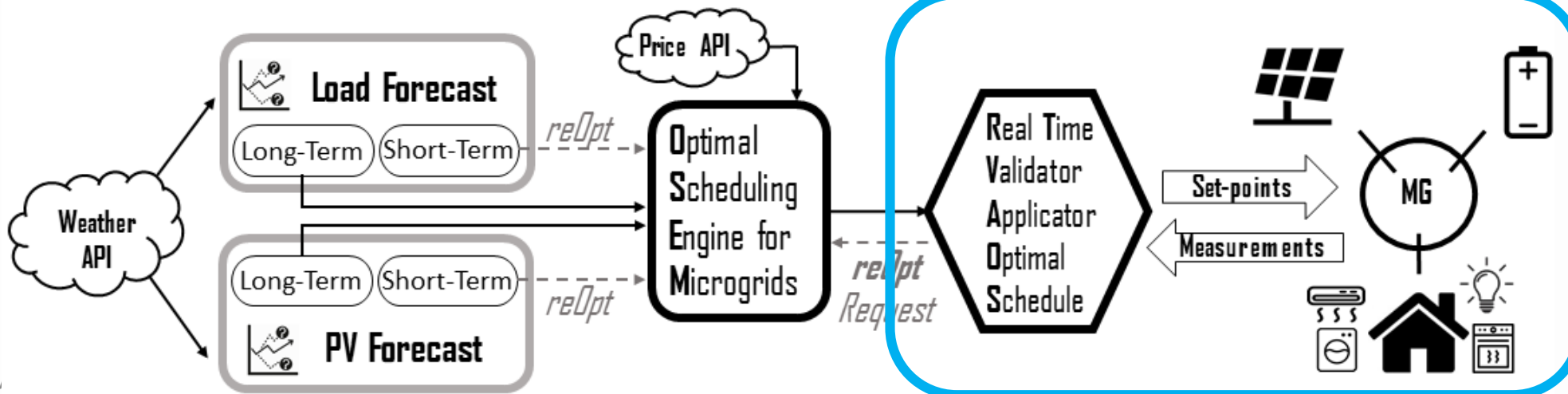
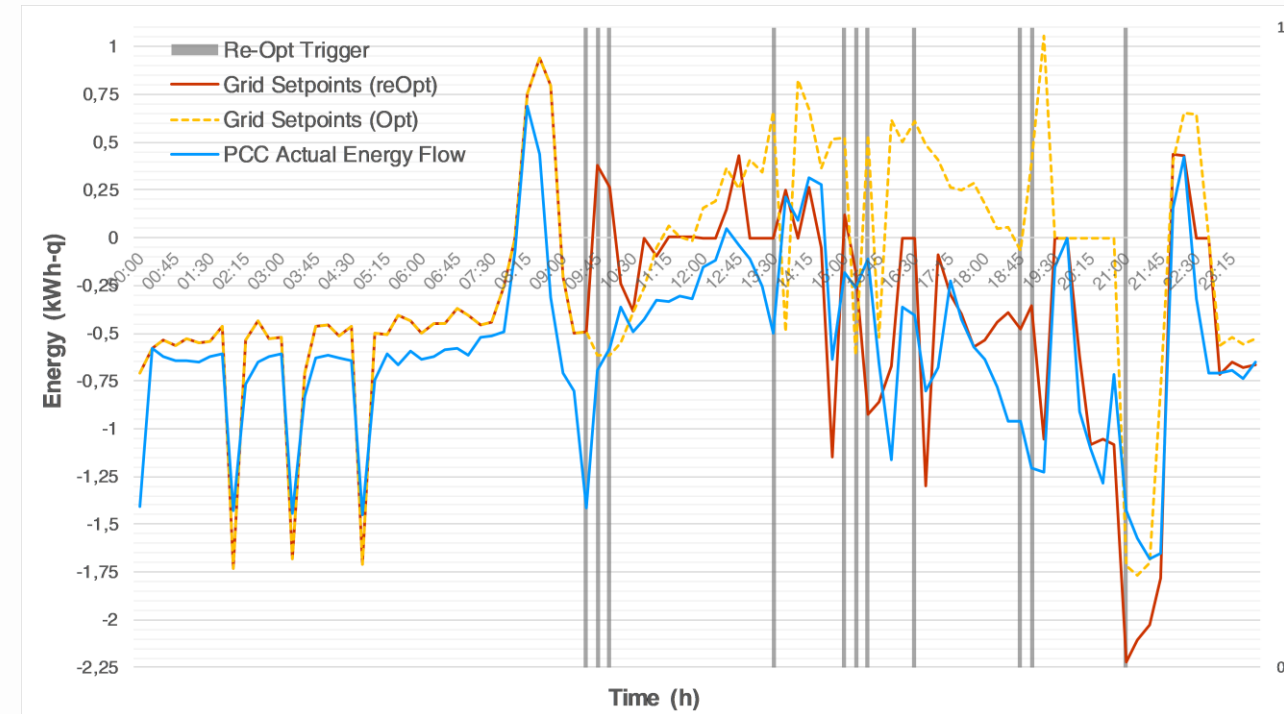
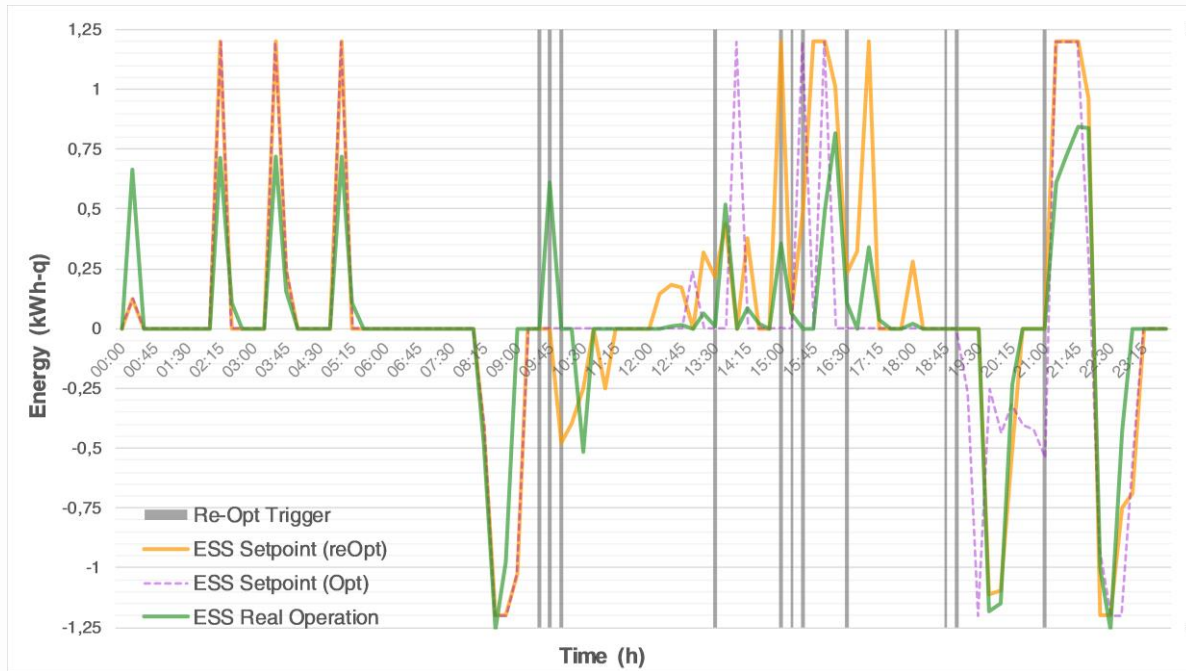
T5.2 Microgrids – Real-life Application #1



T5.2 Microgrids – Real-life Application #2



T5.2 Microgrids – Real-life Application #3



Thank you

Questions?

Project Partners



Funded by
the European Union

This project has received funding from the European Union's Horizon research and innovation programme under grant agreement No 101078997

