



## Microgrids, Smart Buildings, Energy communities

Dr. Paschalis Gkaidatzis , CERTH

CERTH SmartWins Summer School: **Day 4**

07 July 2023

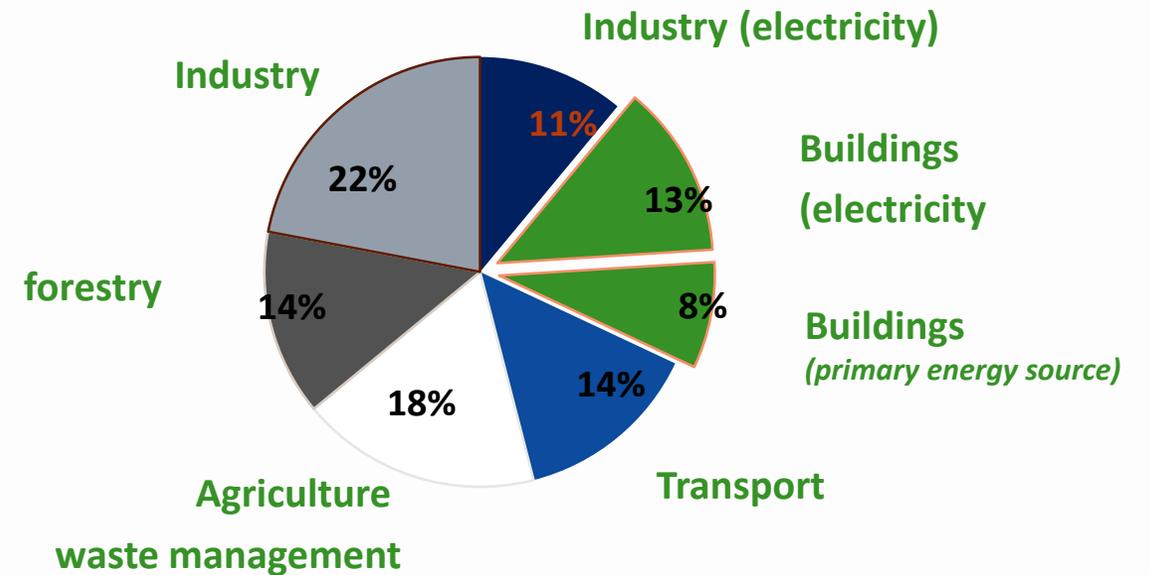
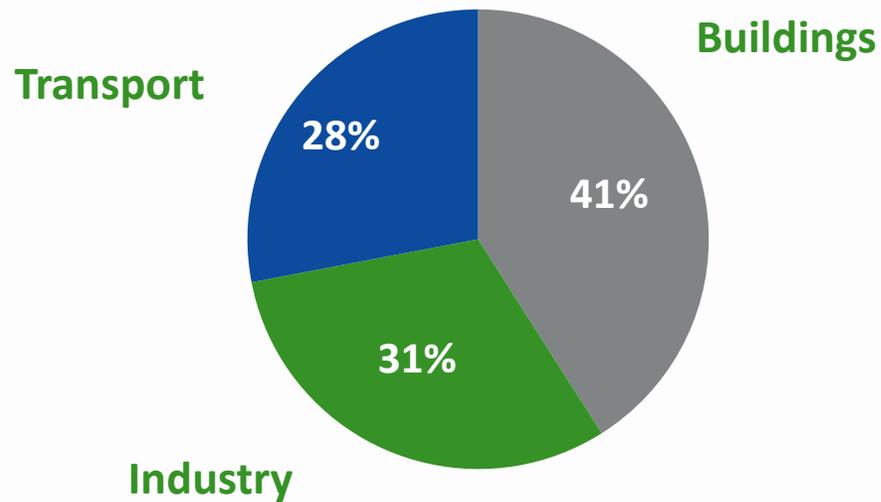
Thessaloniki

# T5.2 Smart Buildings #1

## Building Energy footprint

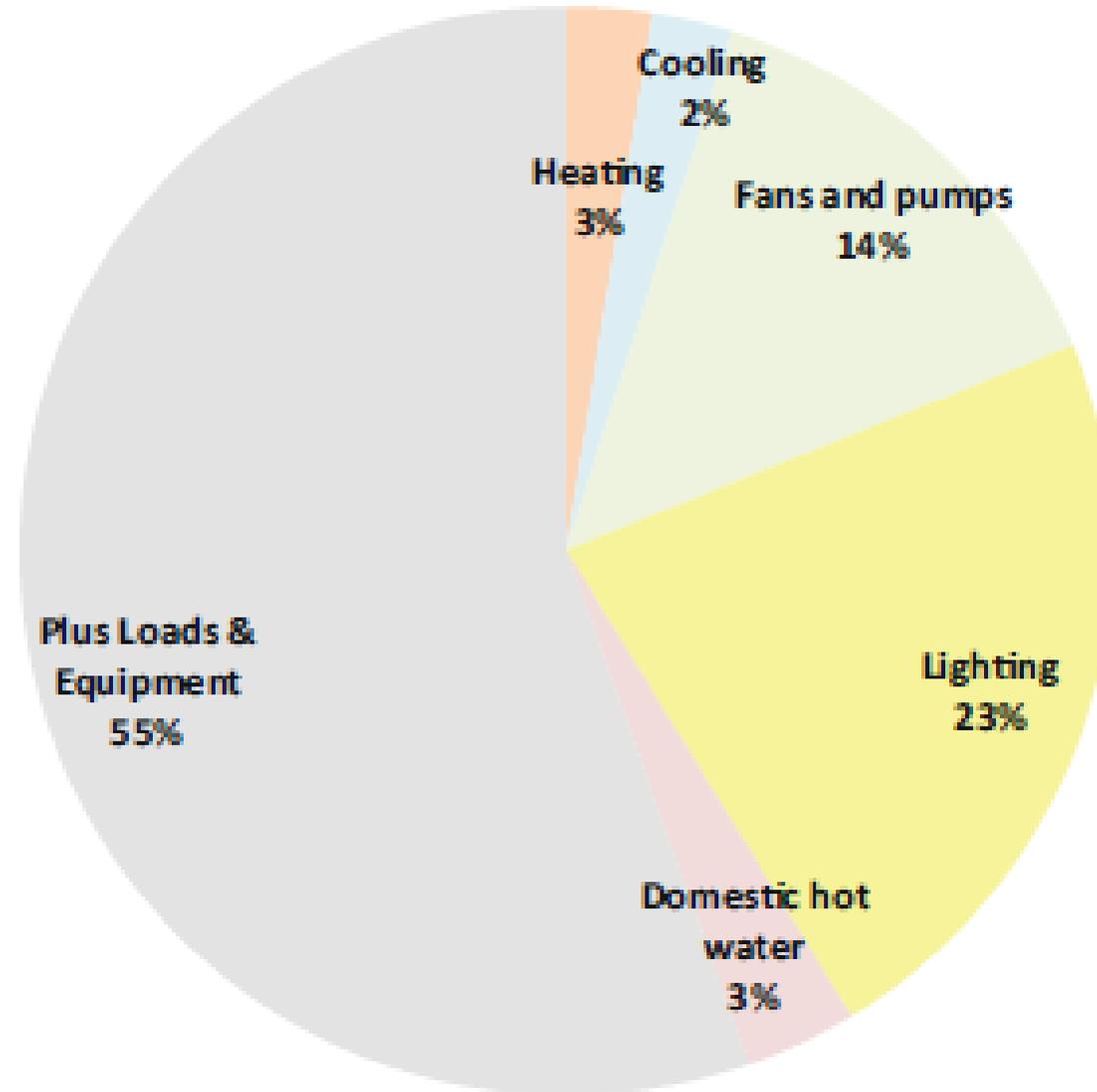
40% of consumption worldwide

21% of GHG emissions



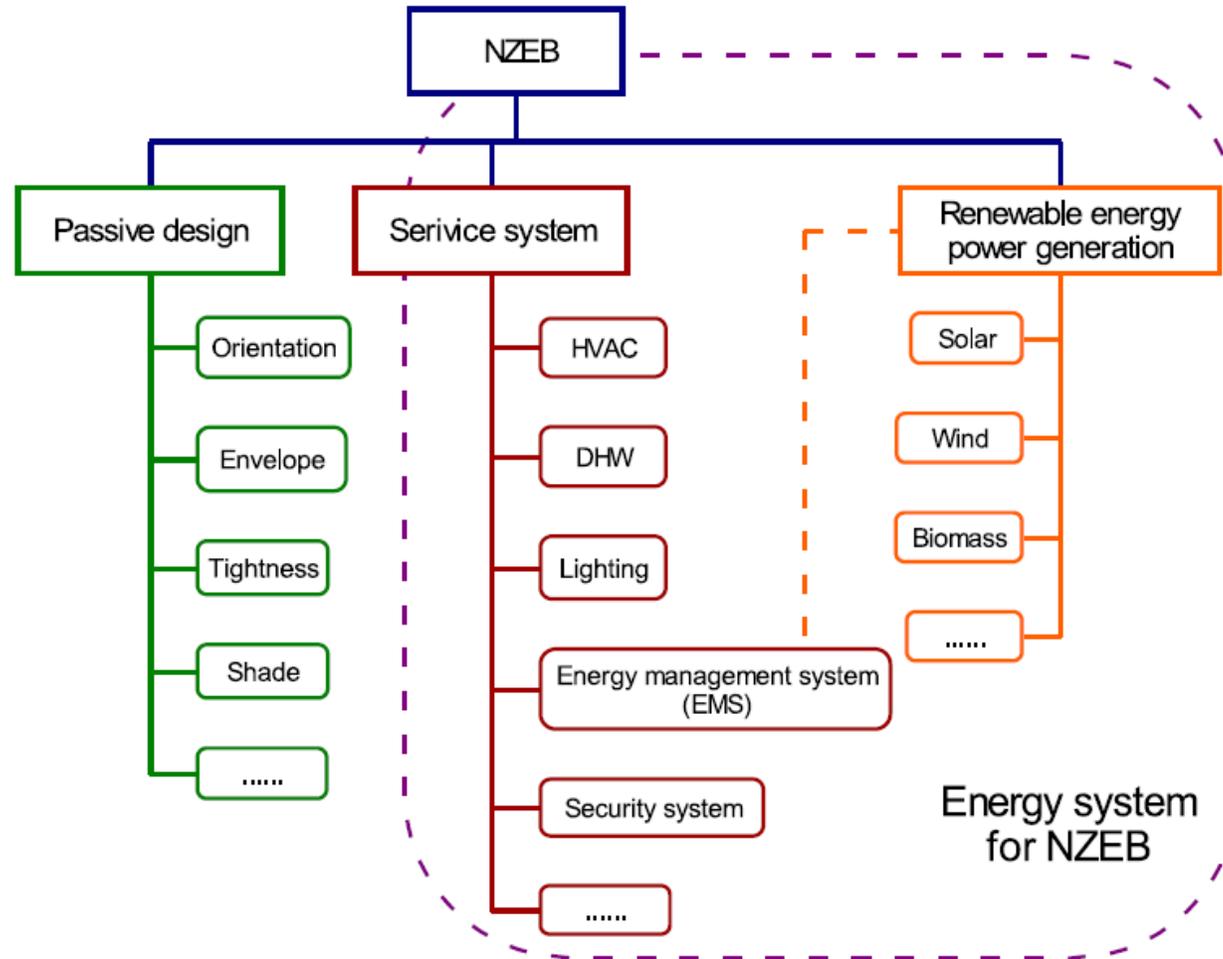
# T5.2 Smart Buildings #2

## Building Energy footprint



# T5.2 Smart Buildings #3

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

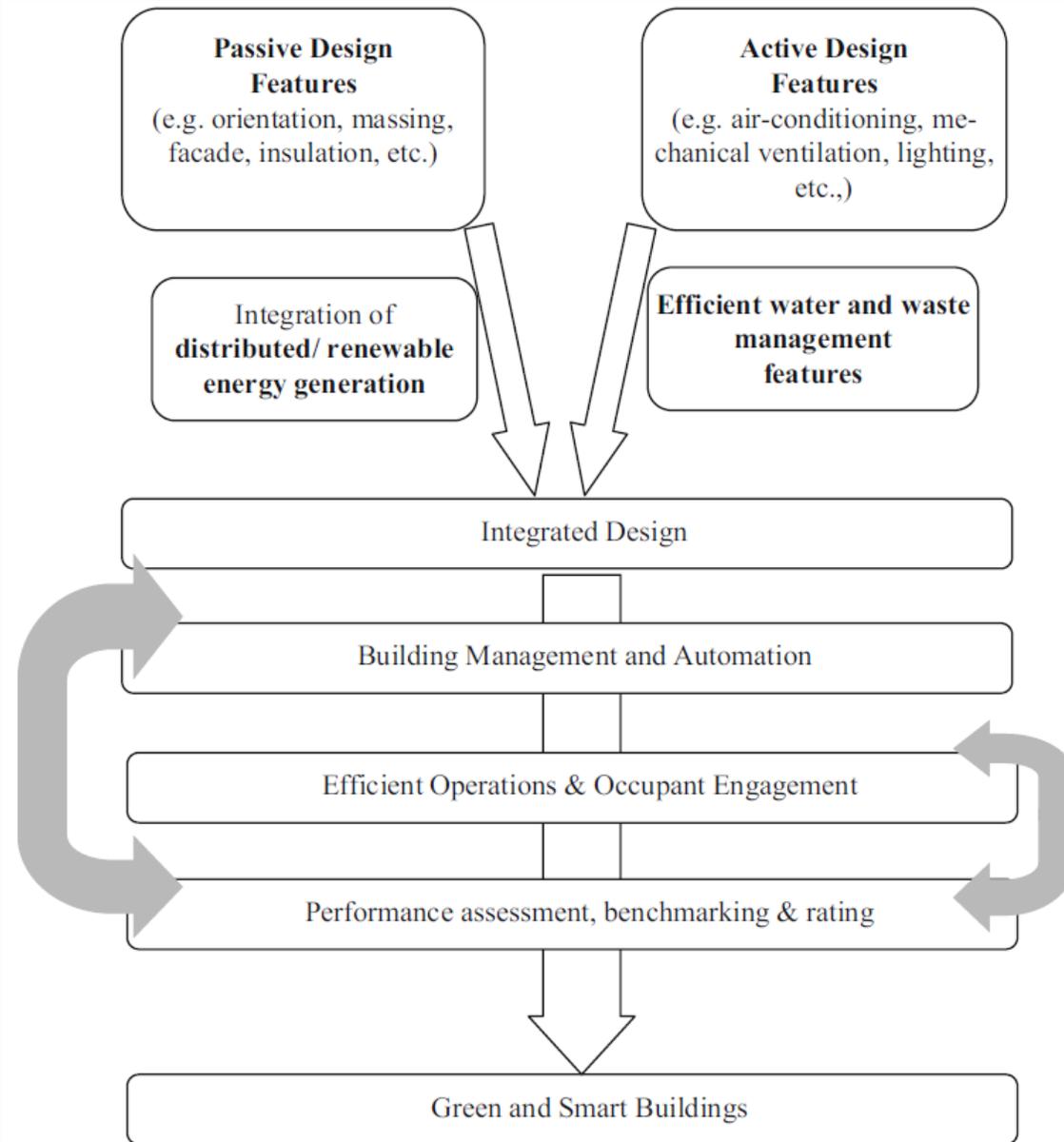


# T5.2 Smart Buildings #4

Building Energy footprint

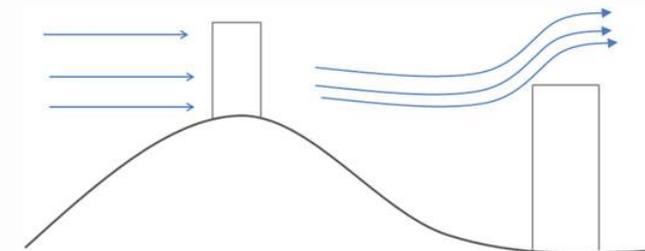
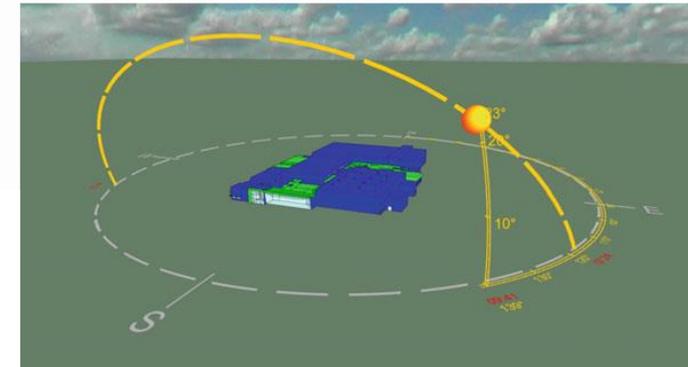
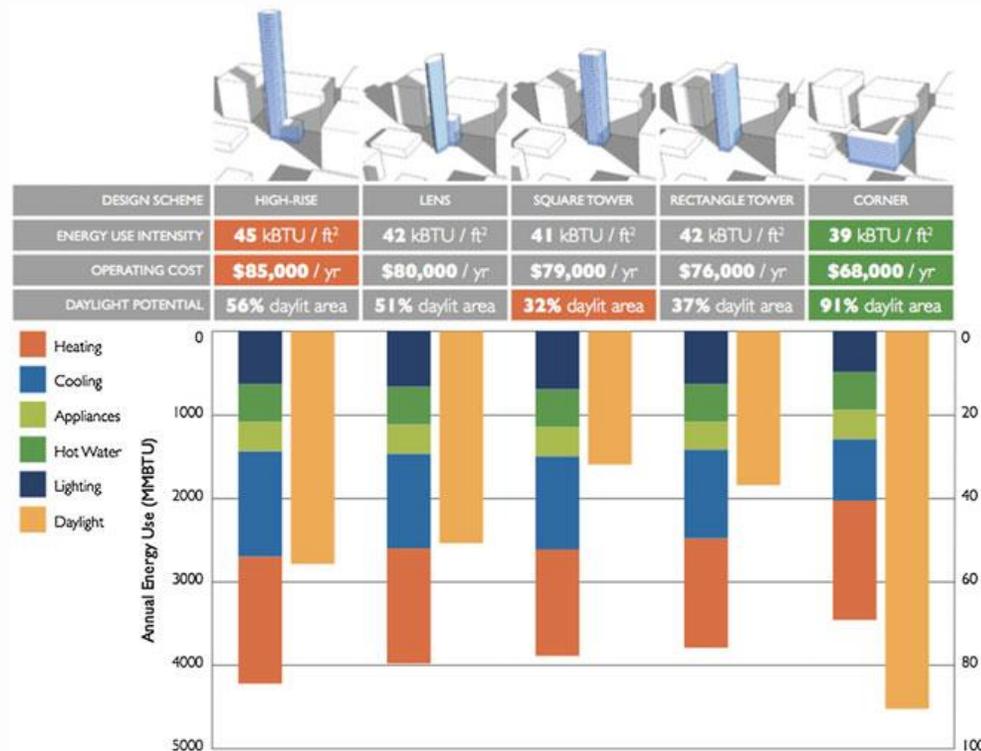
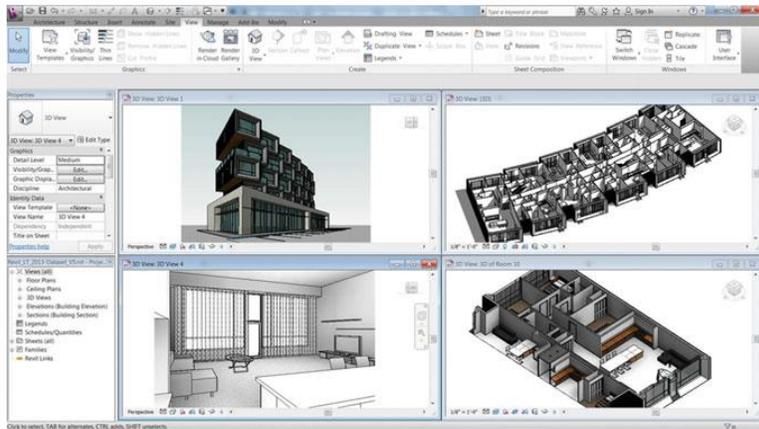
Green building

Near Zero Energy Building Concept



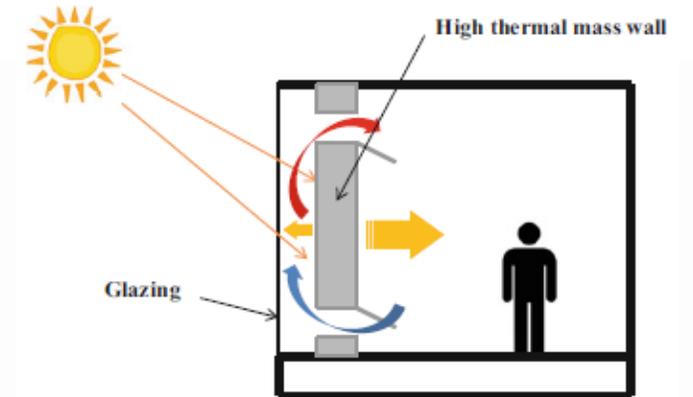
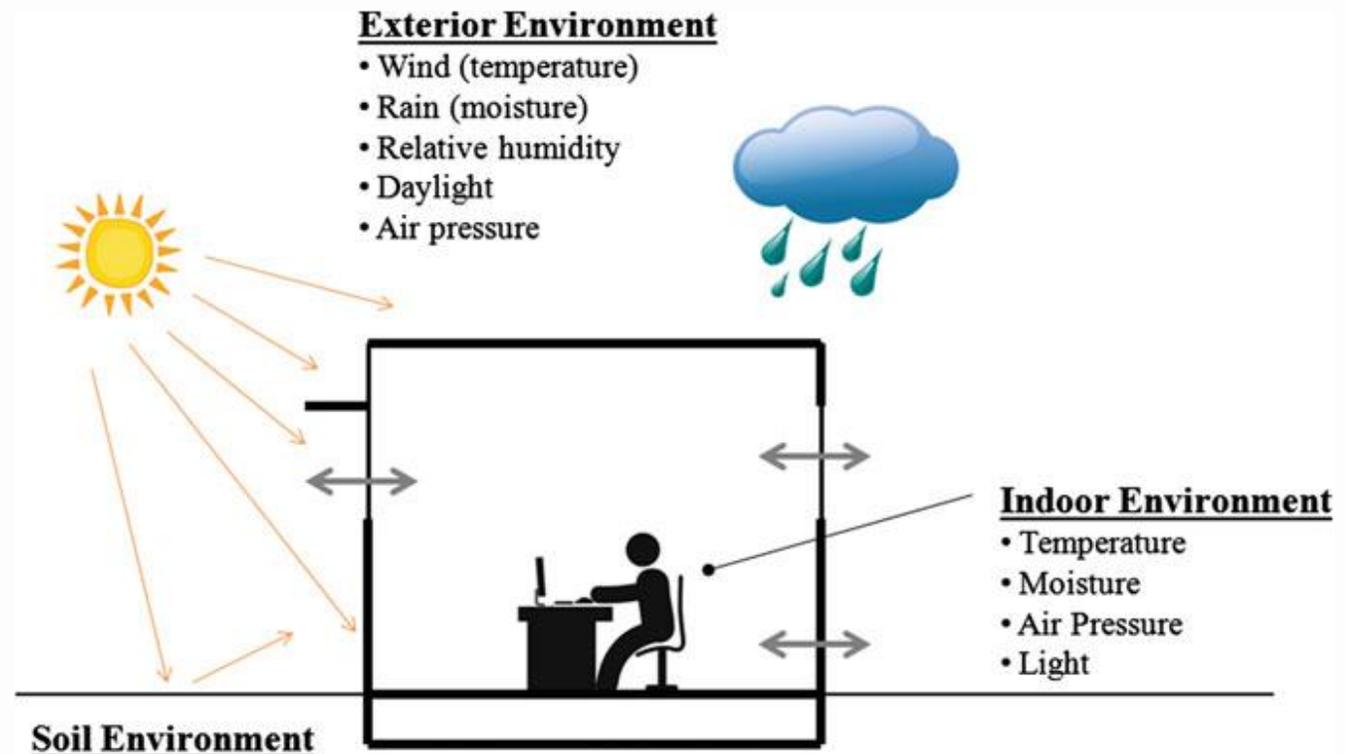
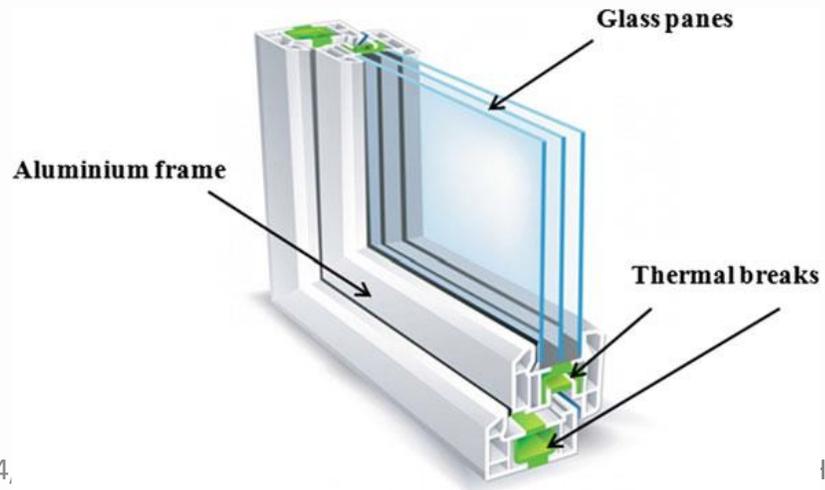
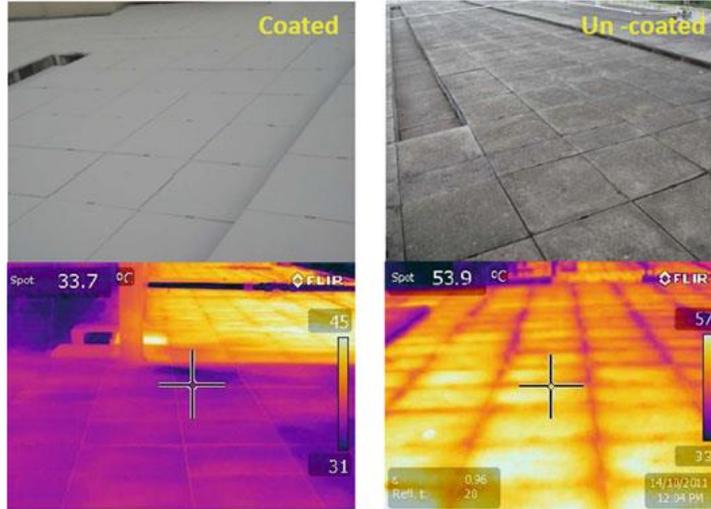
# T5.2 Smart Buildings #5

## Green Building concept – passive design



# T5.2 Smart Buildings #6

Green Building concept – passive design



# T5.2 Smart Buildings #7

## Green Building concept – passive design

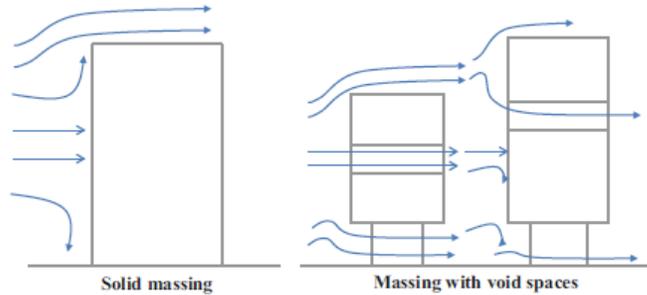


Fig. 4.15 Enhancing airflow through better massing and provision of void areas

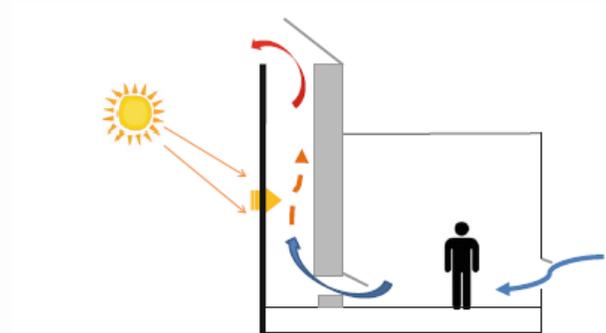


Fig. 4.17 Illustration of the Solar Chimney with stack ventilation effect

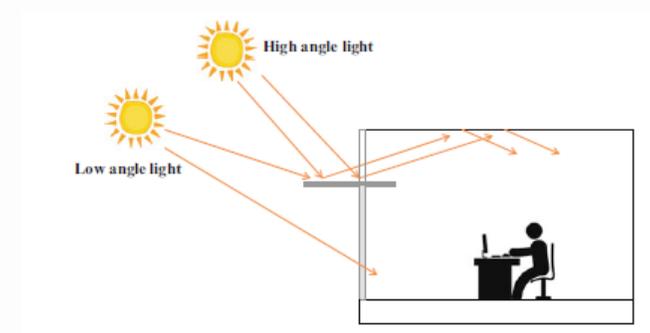


Fig. 4.23 Illustration of the light shelf concept

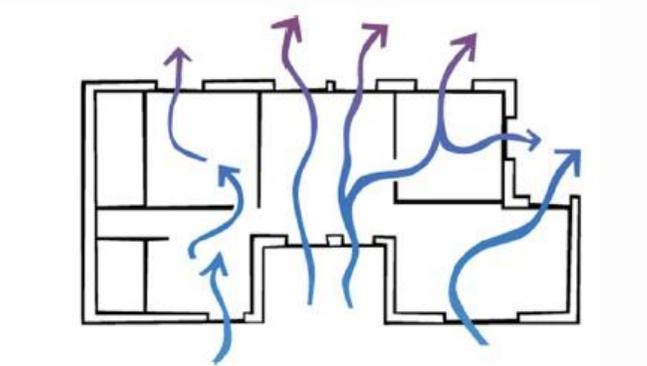


Fig. 4.16 Openings for cross ventilation can enhance natural air circulation

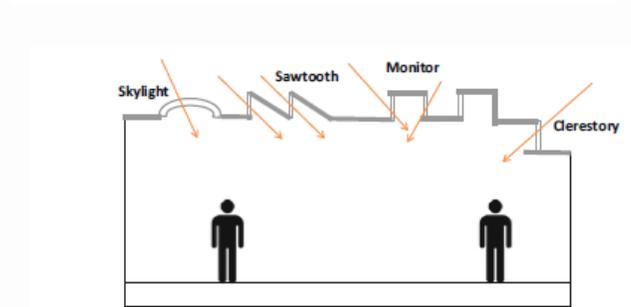


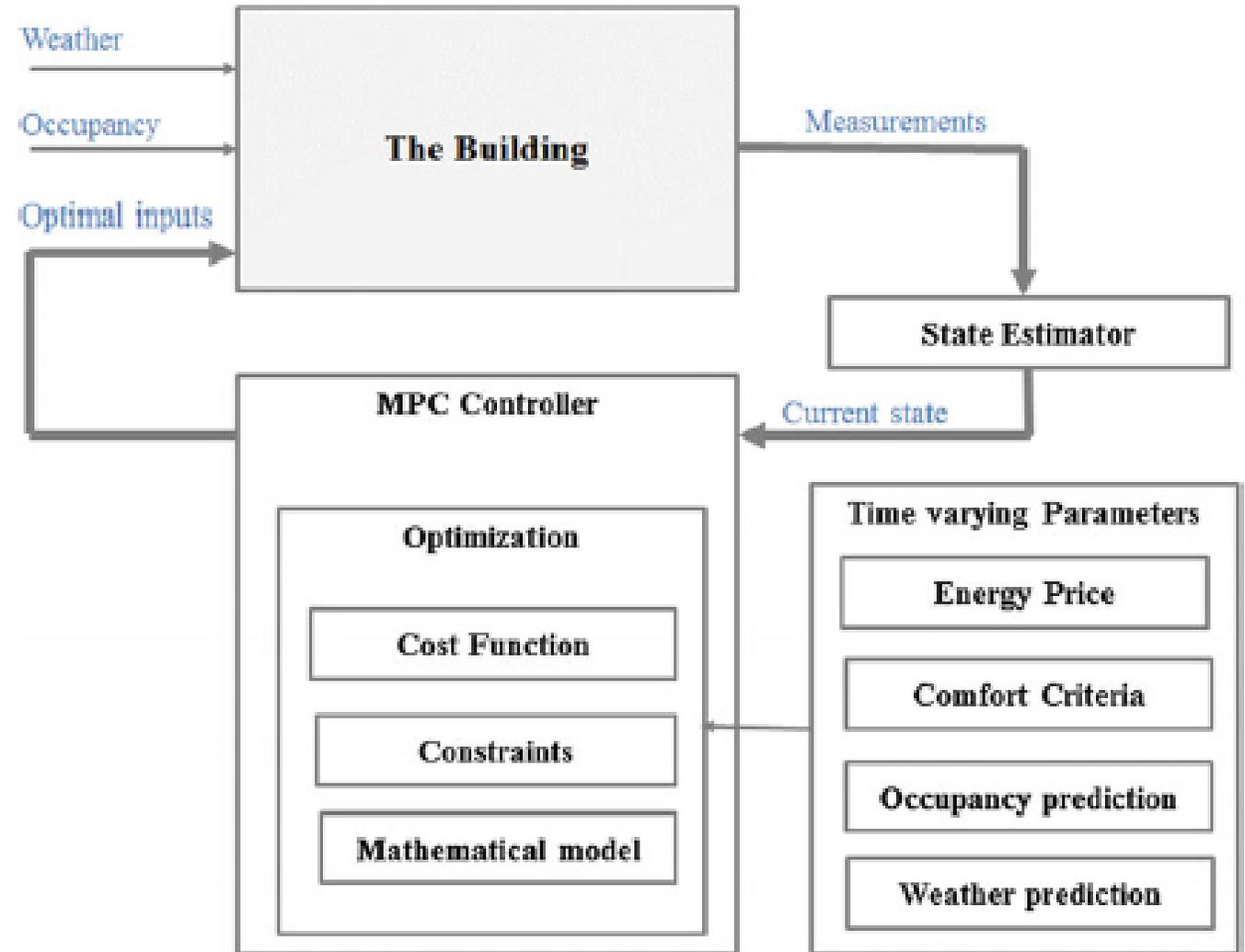
Fig. 4.22 Different types of top (roof-based) lighting techniques



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

# T5.2 Smart Buildings #8

Green Building concept – active design



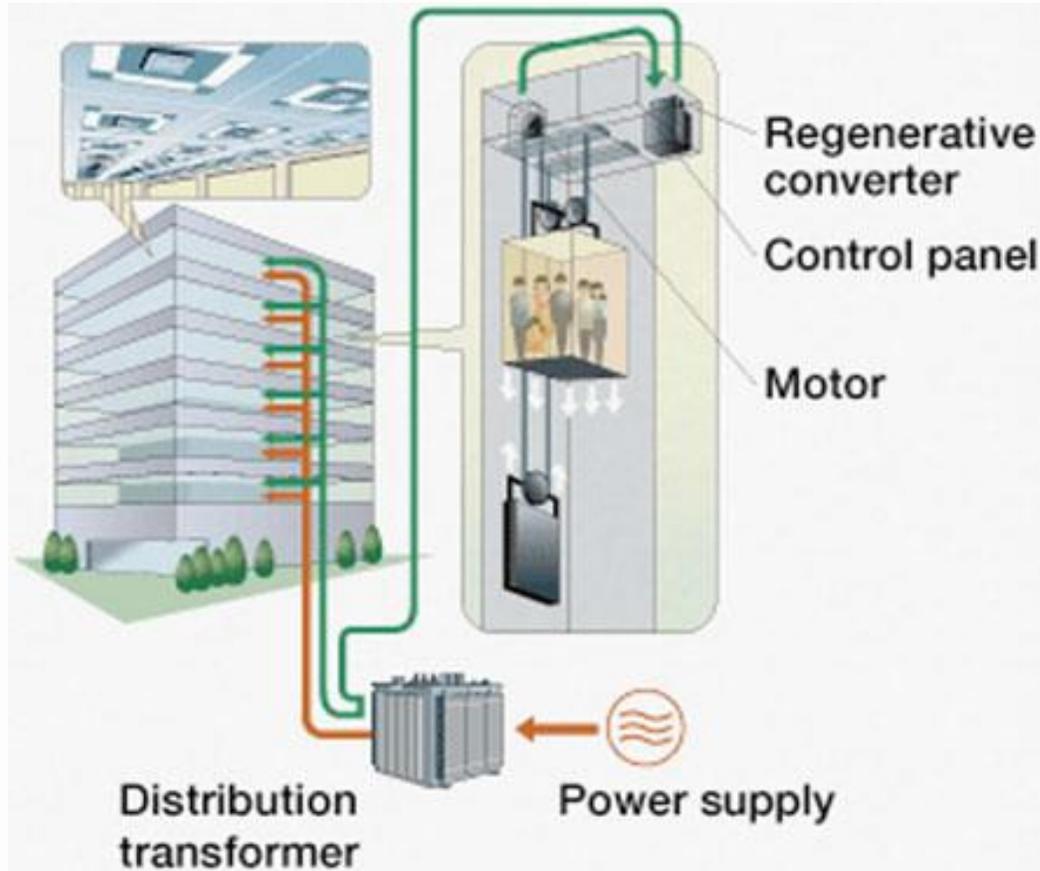
# T5.2 Smart Buildings #9

## Green Building concept – active design



# T5.2 Smart Buildings #10

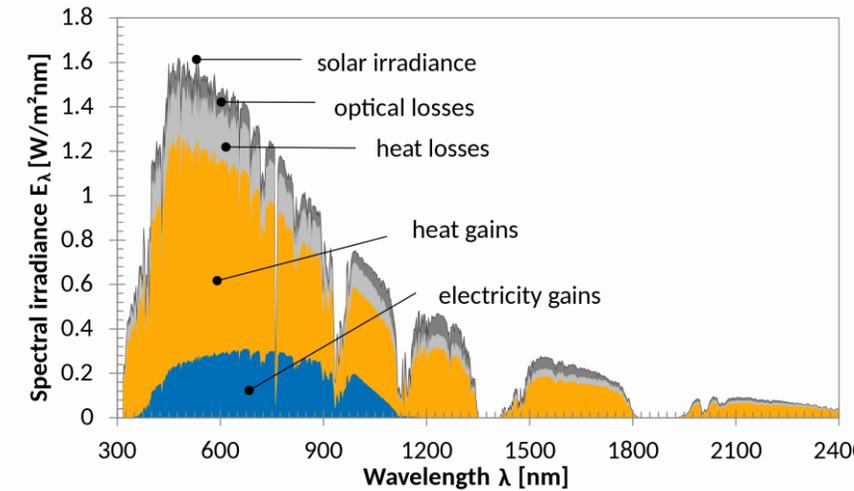
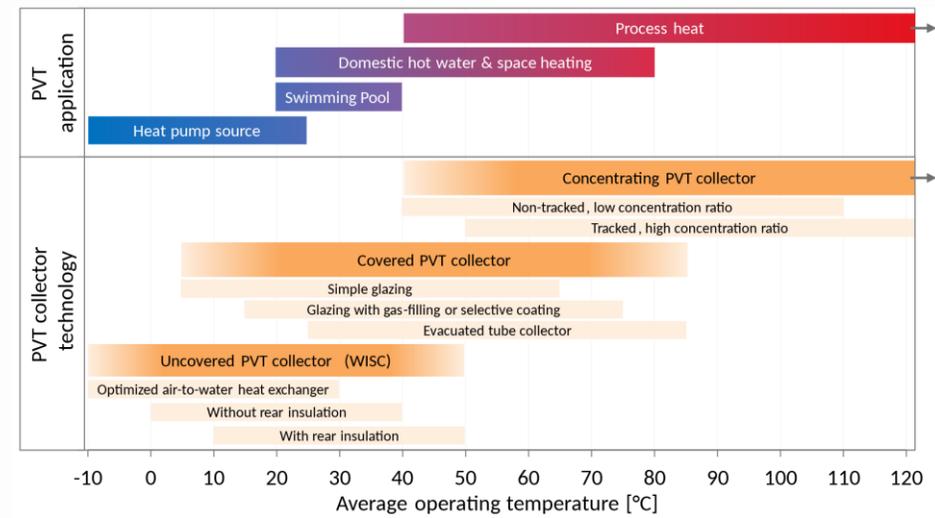
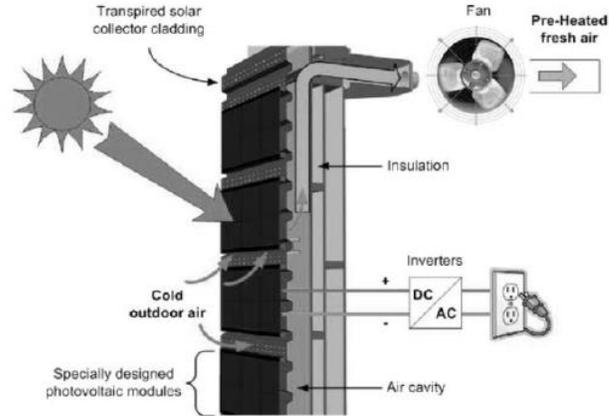
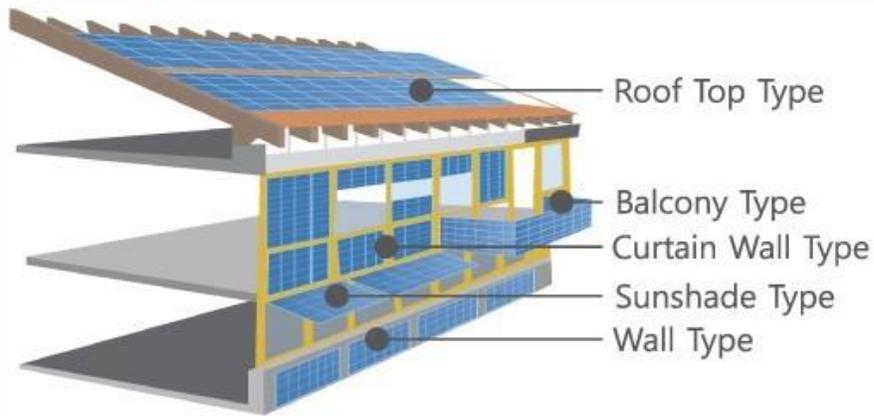
Green Building concept – active design



SmartWins

# T5.2 Smart Buildings #11

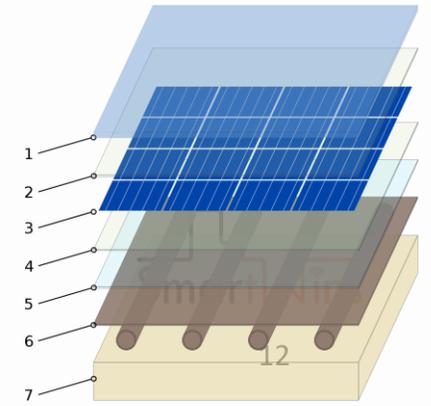
## Green Building concept – active design



Black, monolithic CIGS can be a stylish and powerful addition to building surfaces.  
Image: ZSW

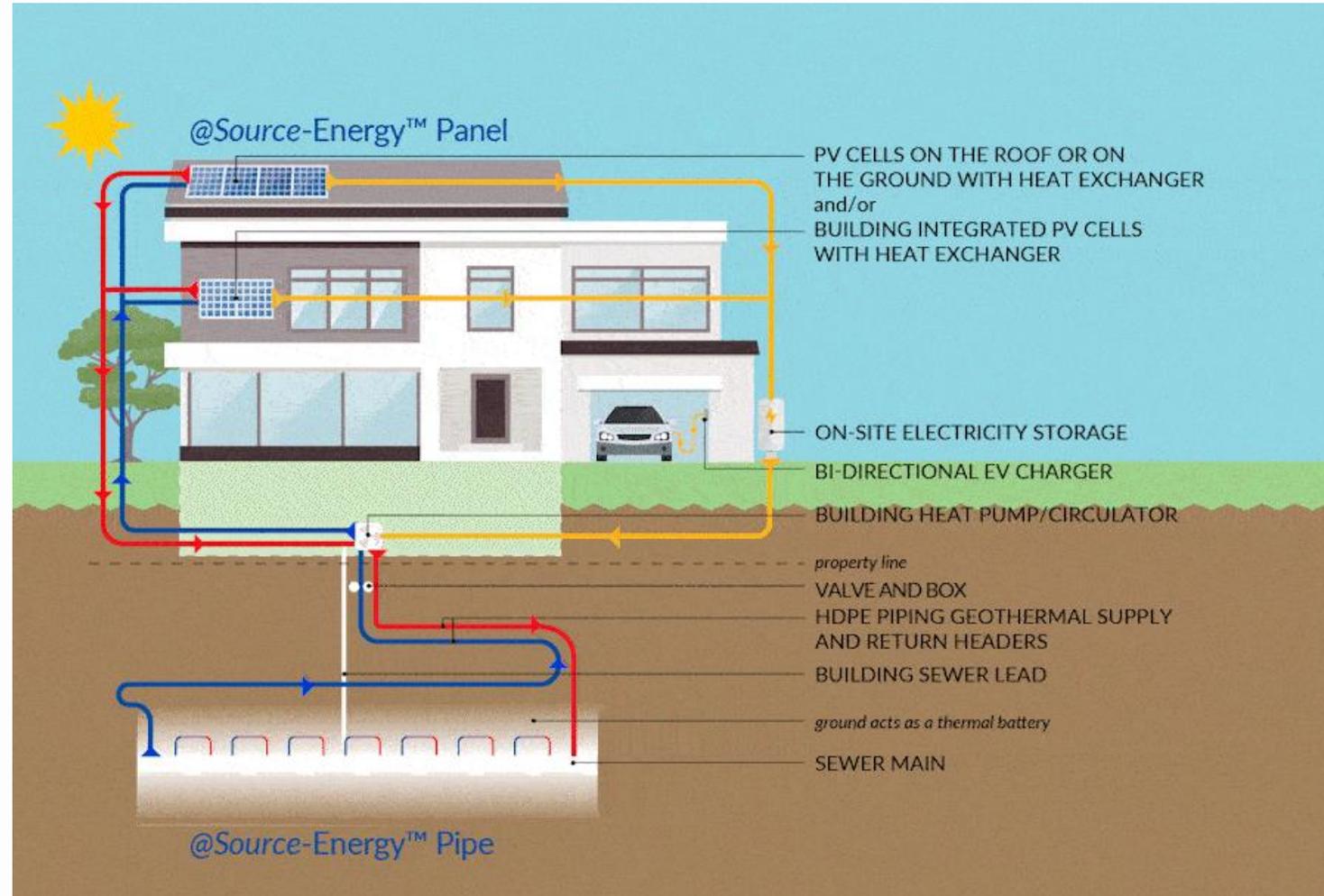


CERTH SmartWins Summer School, Thessaloniki, Greece



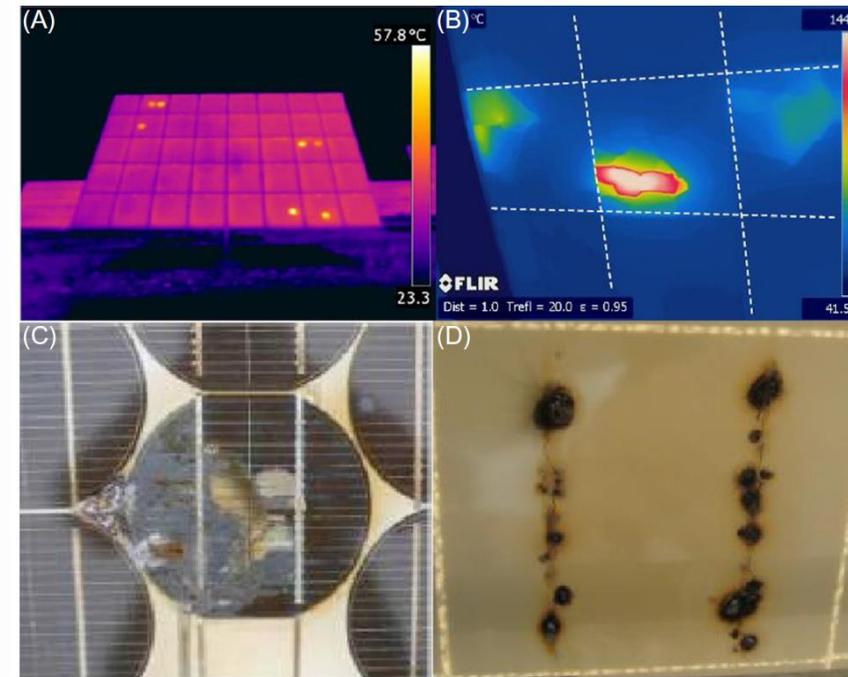
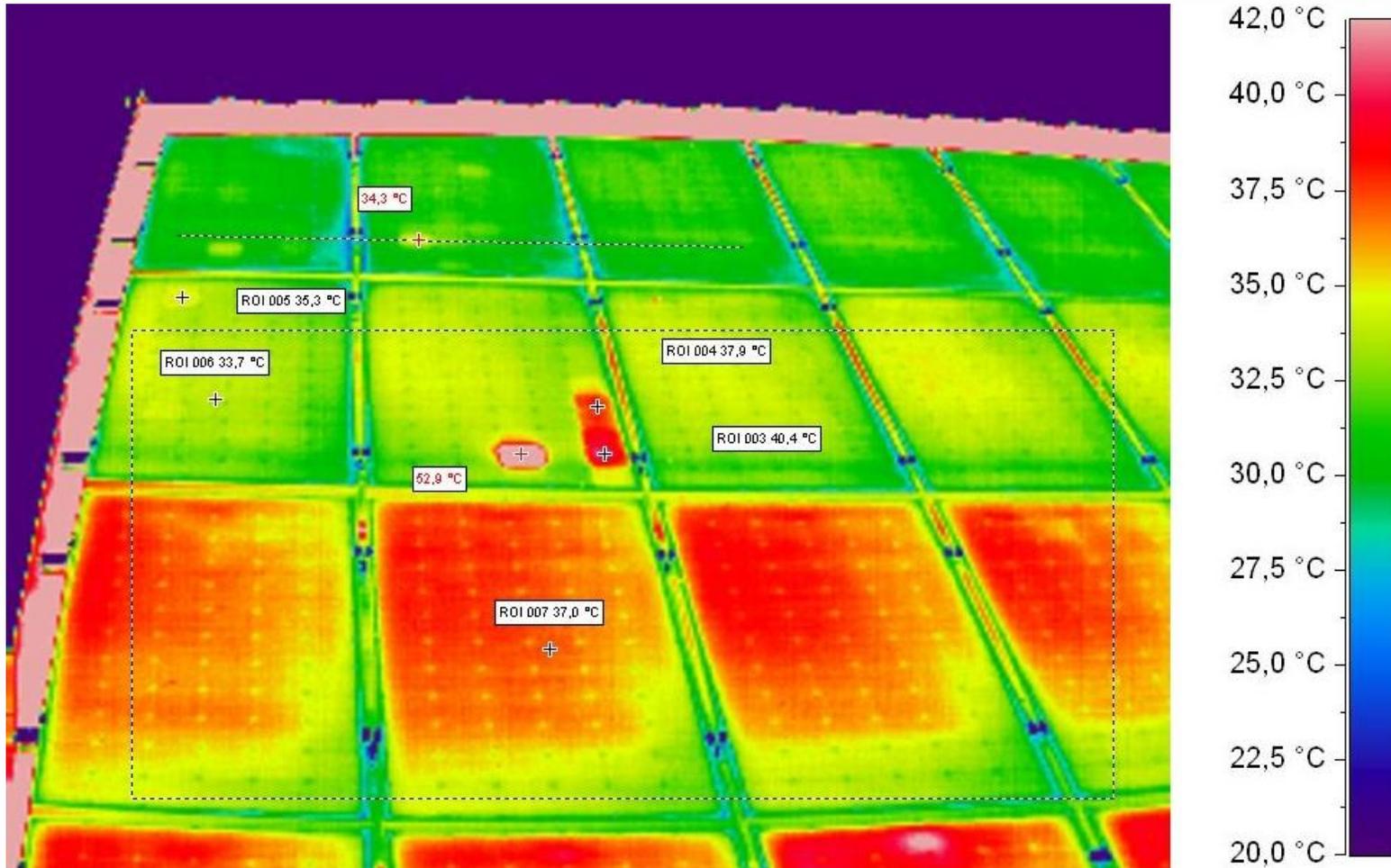
# T5.2 Smart Buildings #12

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

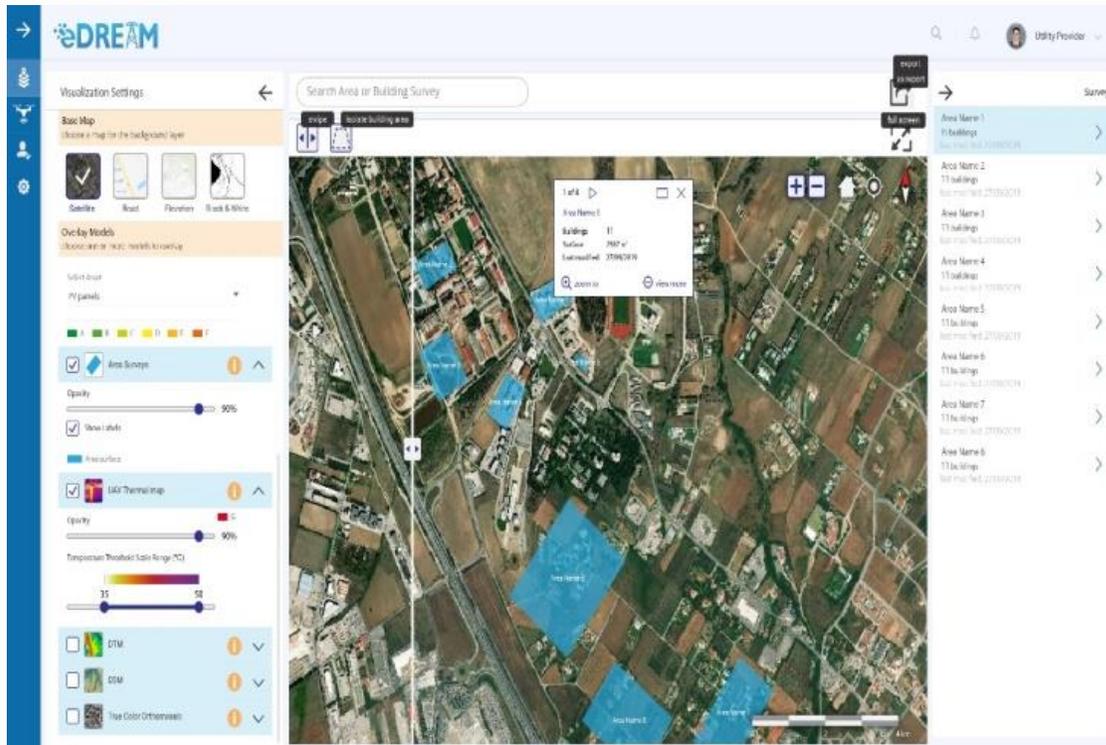
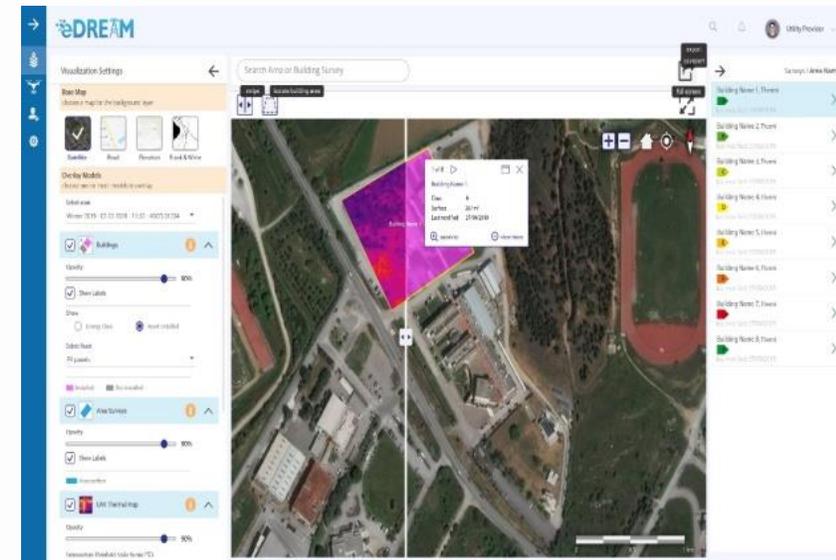
I searched a lot of literature to find all the factors leading to partial shading in photovoltaics. Still missed one. 😊



# T5.2 Smart Buildings #15

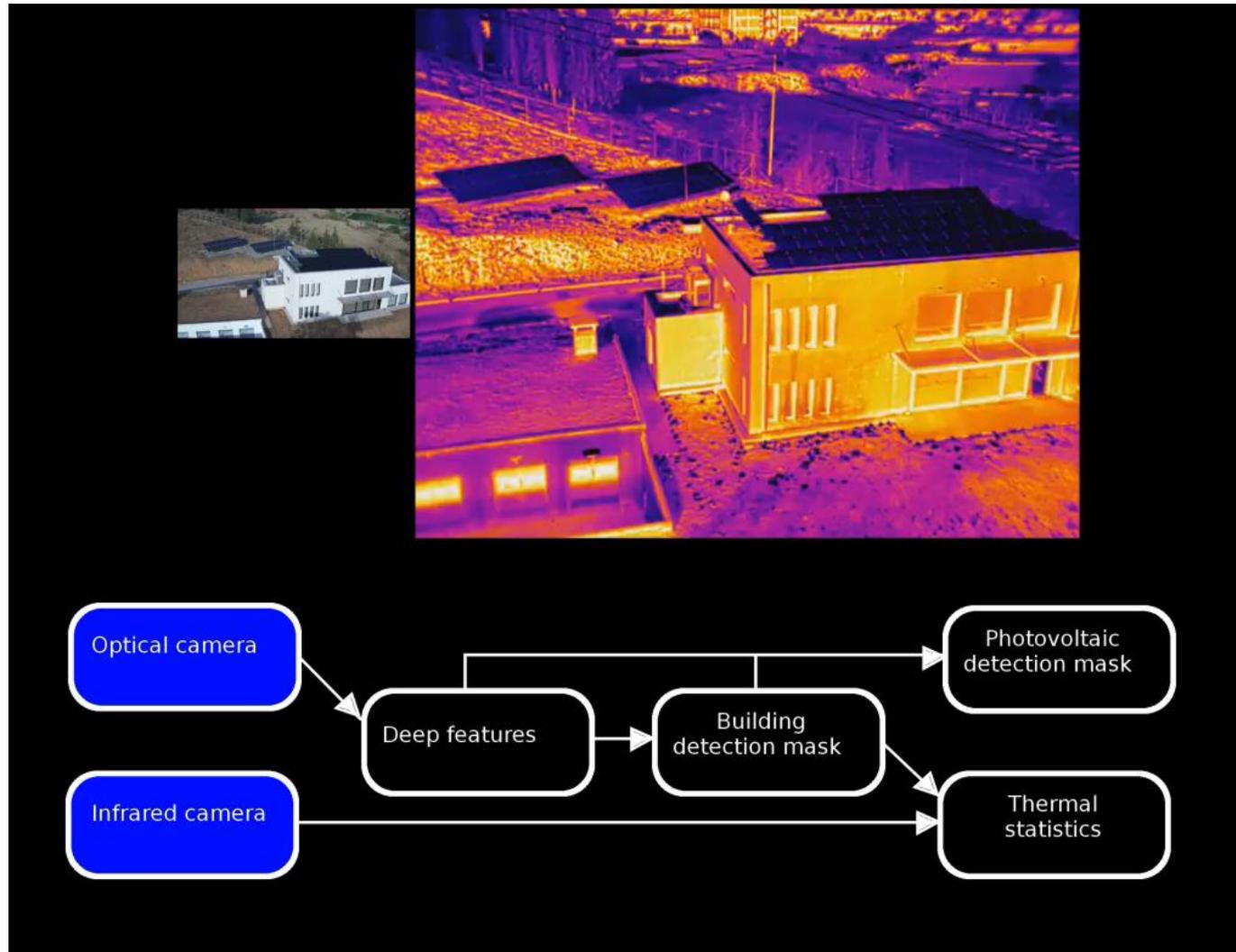
Green Building concept – active design

- 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

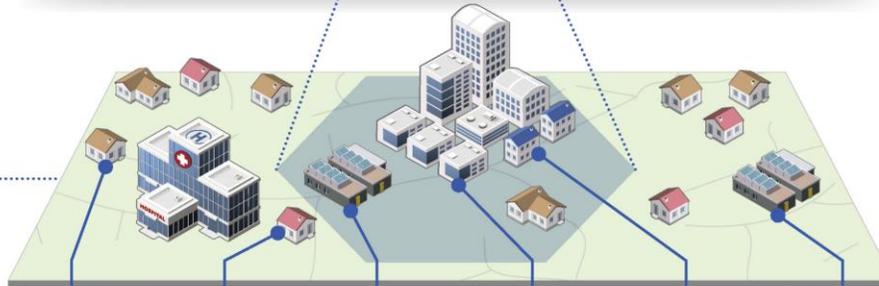
- Transmission Level**
- Capacity
  - Energy
  - Ancillary services
  - Emission reduction



- Distribution Level**
- Non-wire alternative
  - Reliability
  - Loss reduction



- Building Level**
- Energy savings
  - Comfort
  - Resiliency



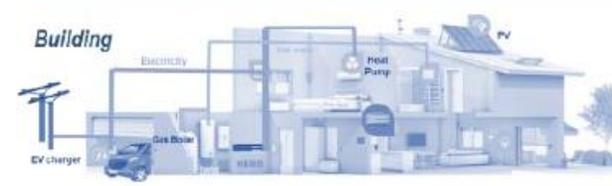
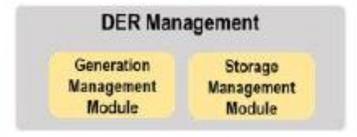
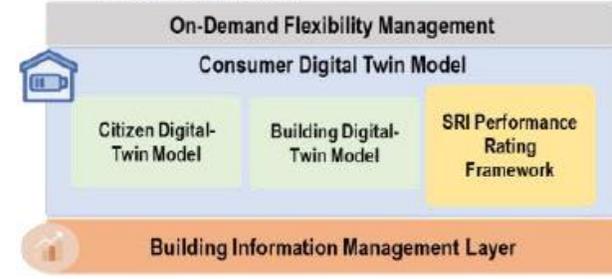
- Building Technologies Level**
- Energy efficiency
  - Demand flexibility



Energy Community / Cooperative tools for energy & flex management



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

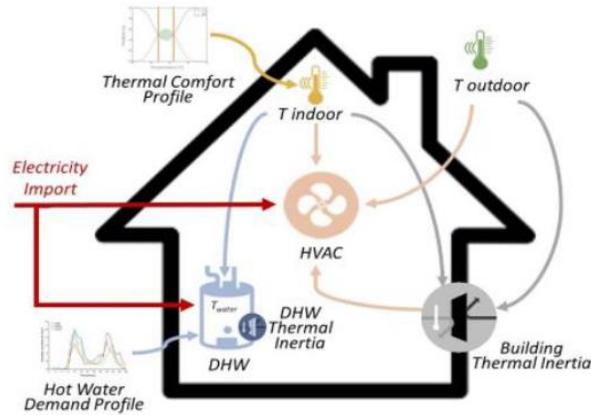


## T5.2 Energy communities #2

---

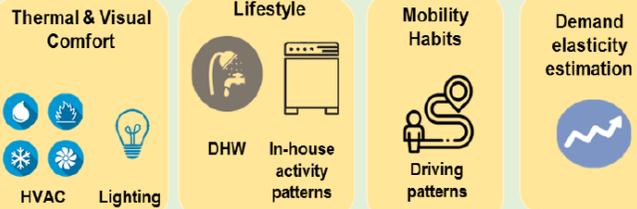
- In 2018 EU acknowledged the right of local communities and citizens to play an active role in the energy sector by defining “energy communities”.
- An Energy Community is a cooperative aiming to promote the social and solidarity economy and innovation in the energy sector, to address energy poverty 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

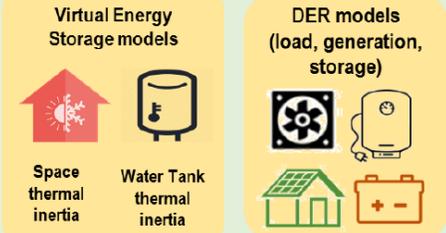


## Consumer Digital Twin Model

### Citizen Digital-Twin Model



### Building Digital-Twin Model



### 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



#### Building Information Management Layer



### DER Management

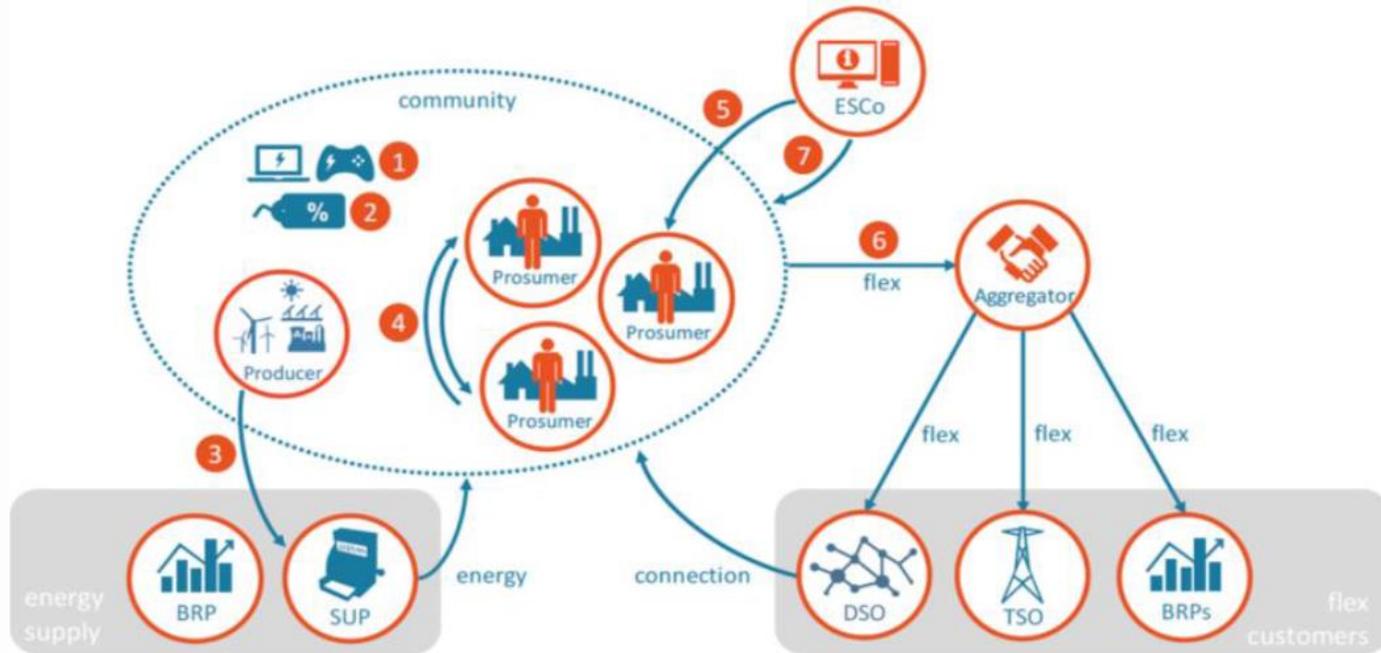


### District Asset



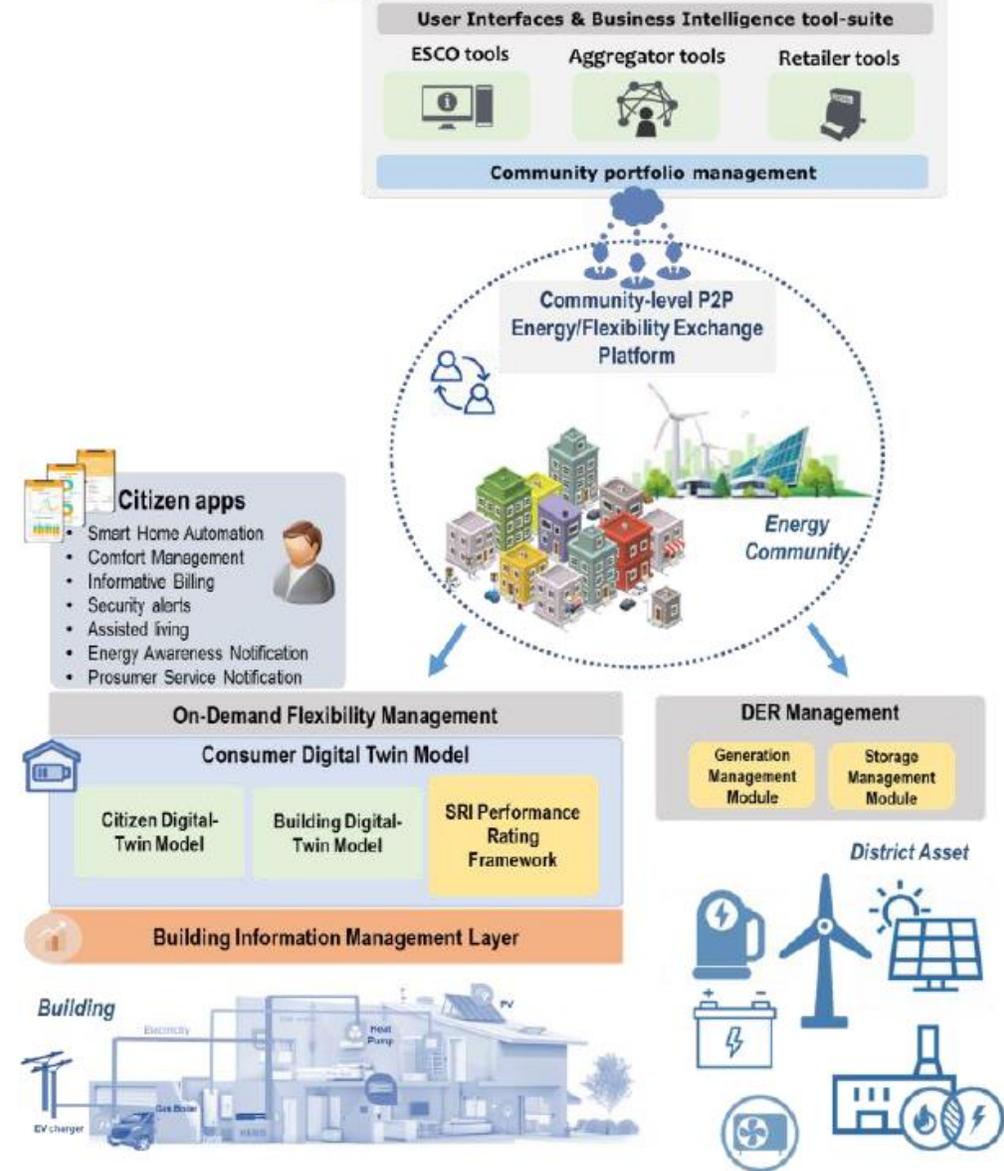


# T5.2 Energy communities #5

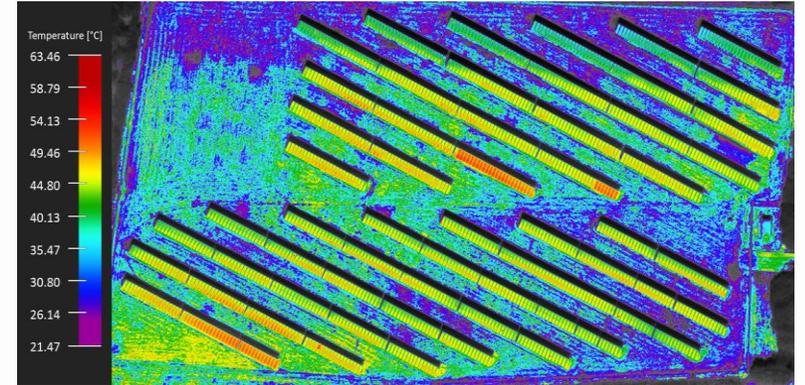
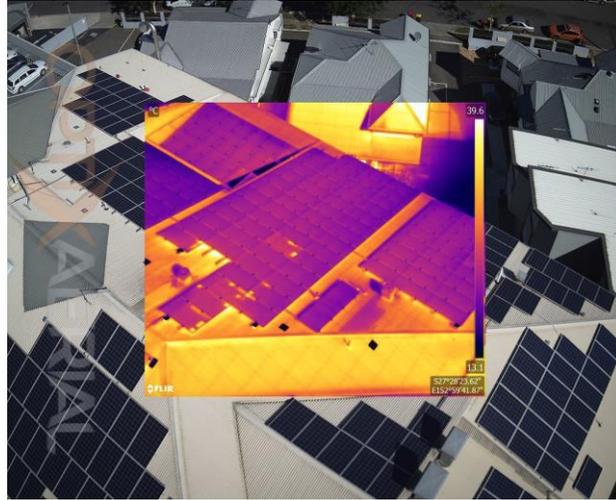


**Energy and flexibility services offered within a Citizen Energy Community context.** ① Services for energy awareness, ② Services related to the shared assets, ③ Supply of community-produced energy, ④ Peer-to-Peer supply, ⑤ Implicit demand-side flexibility services, ⑥ Explicit demand-side flexibility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

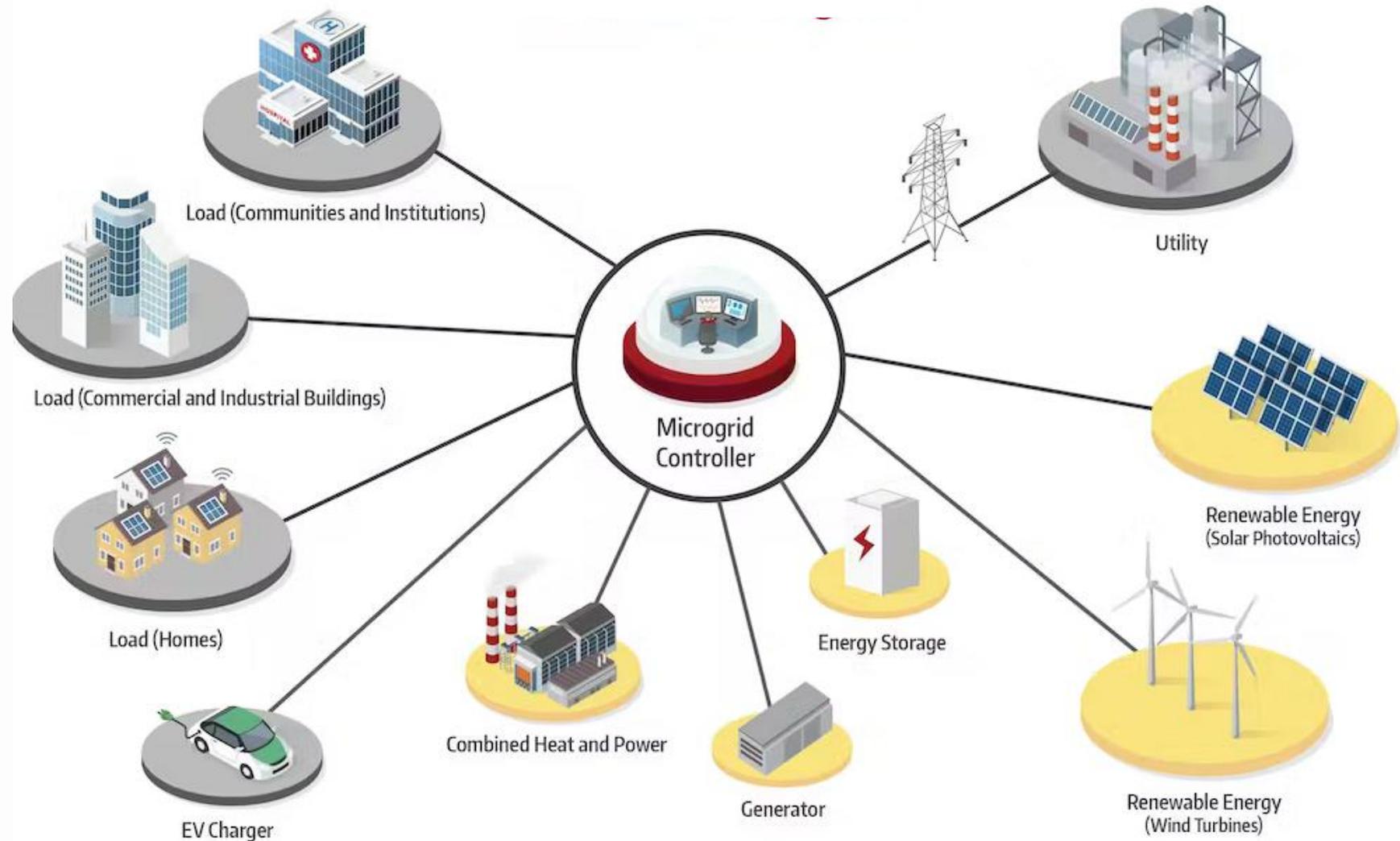
## Energy Community / Cooperative tools for energy & flex management



# T5.2 Energy communities #6



# T5.2 Microgrids #1



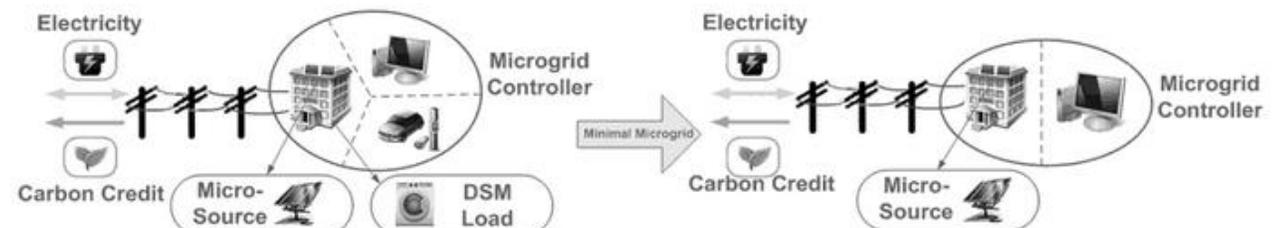
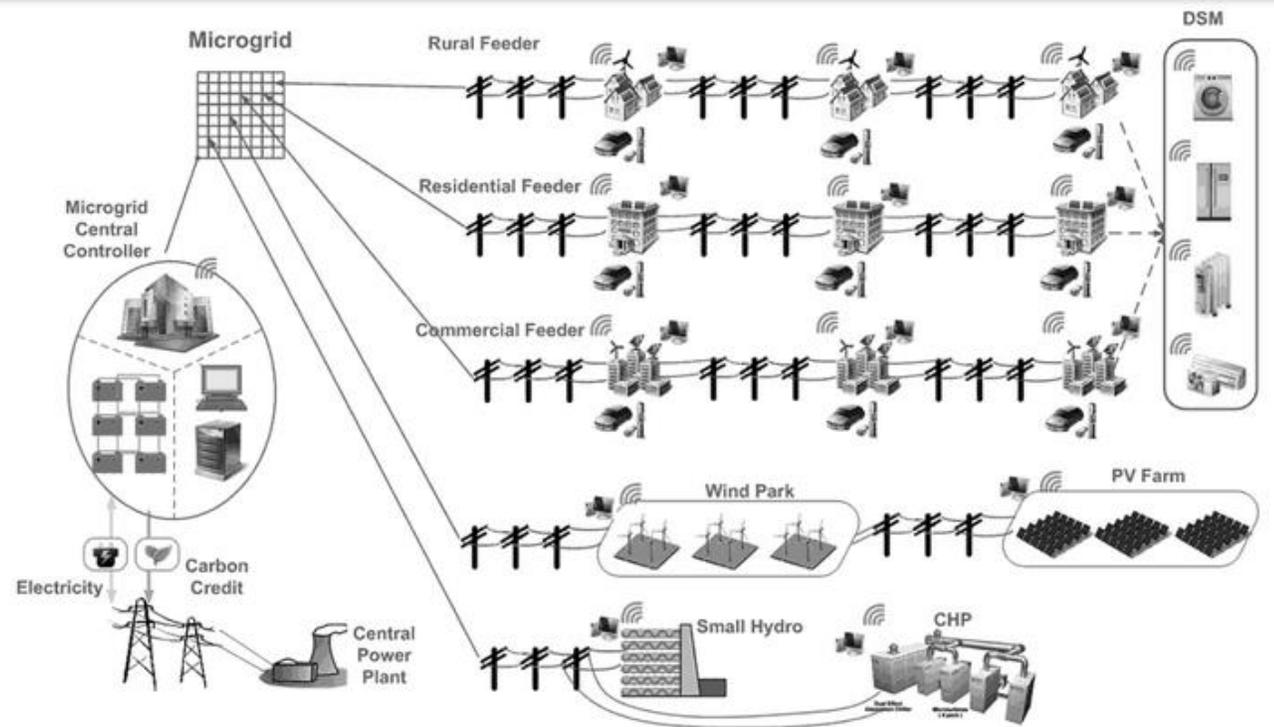
## T5.2 Microgrids #2

---

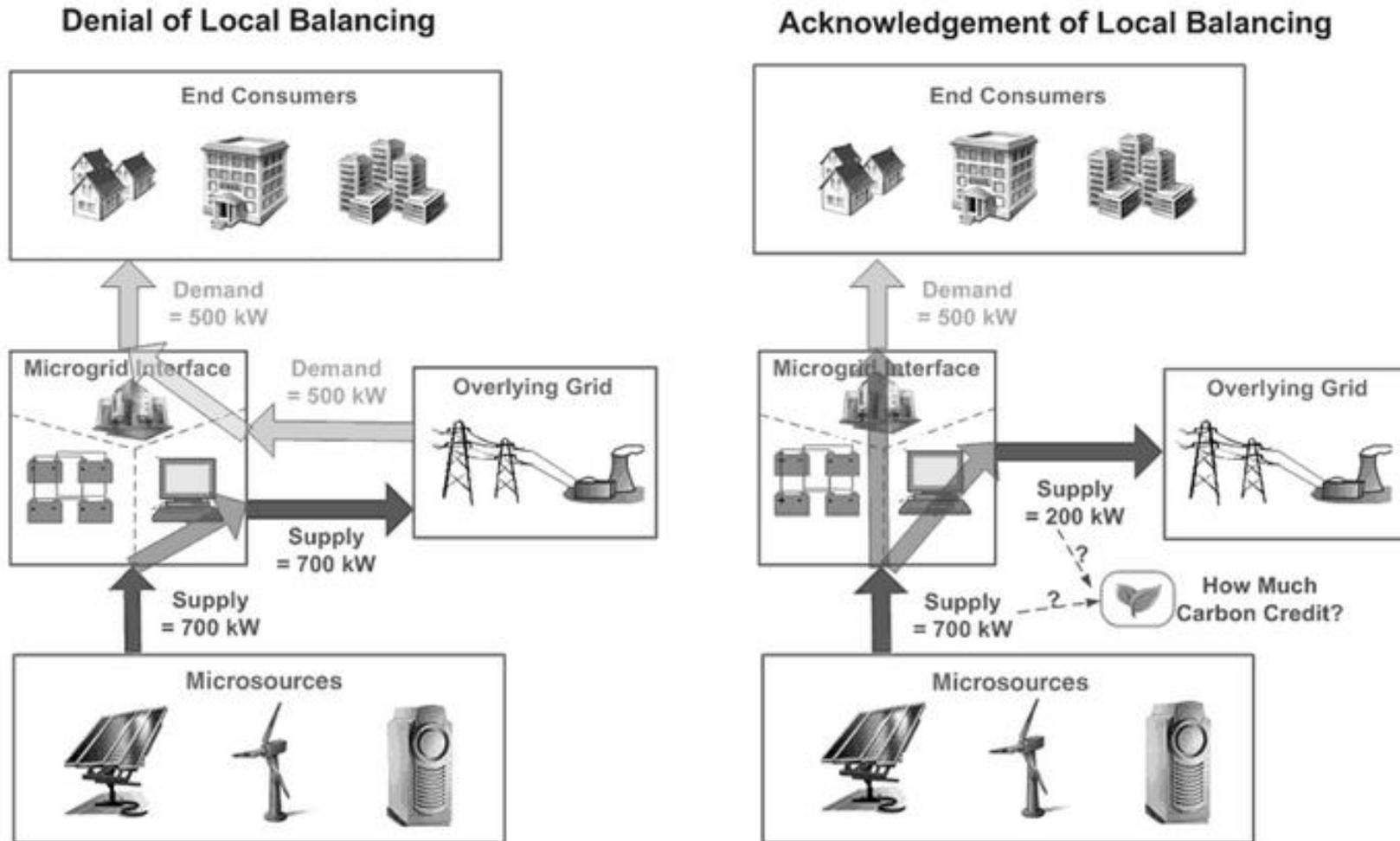
Definition: A Microgrid is a self-sufficient energy system that serves a discrete geographic footprint, such as a college campus, hospital complex business center or neighborhood.

- 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.

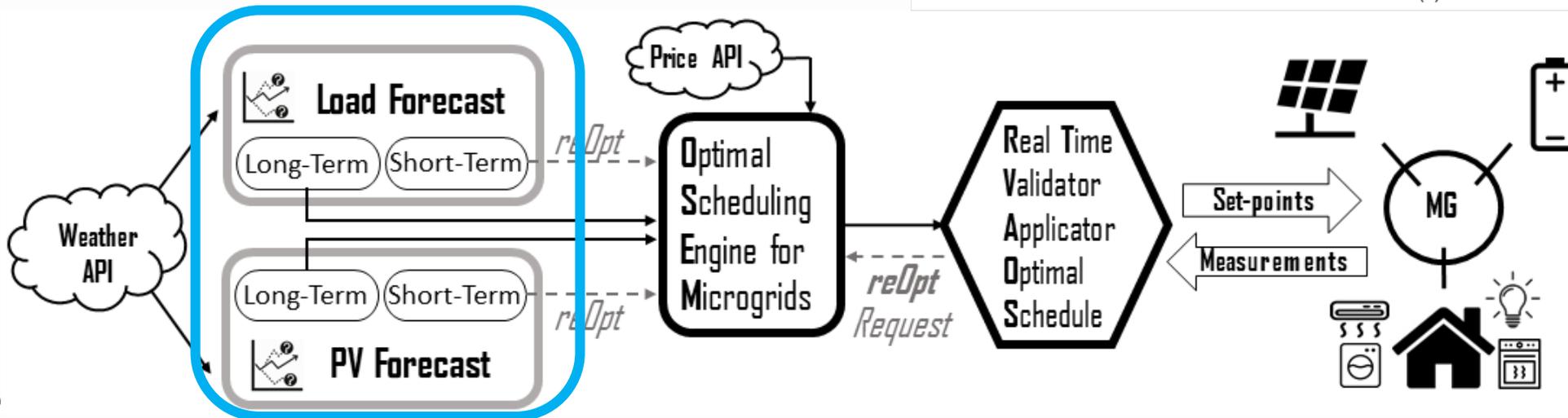
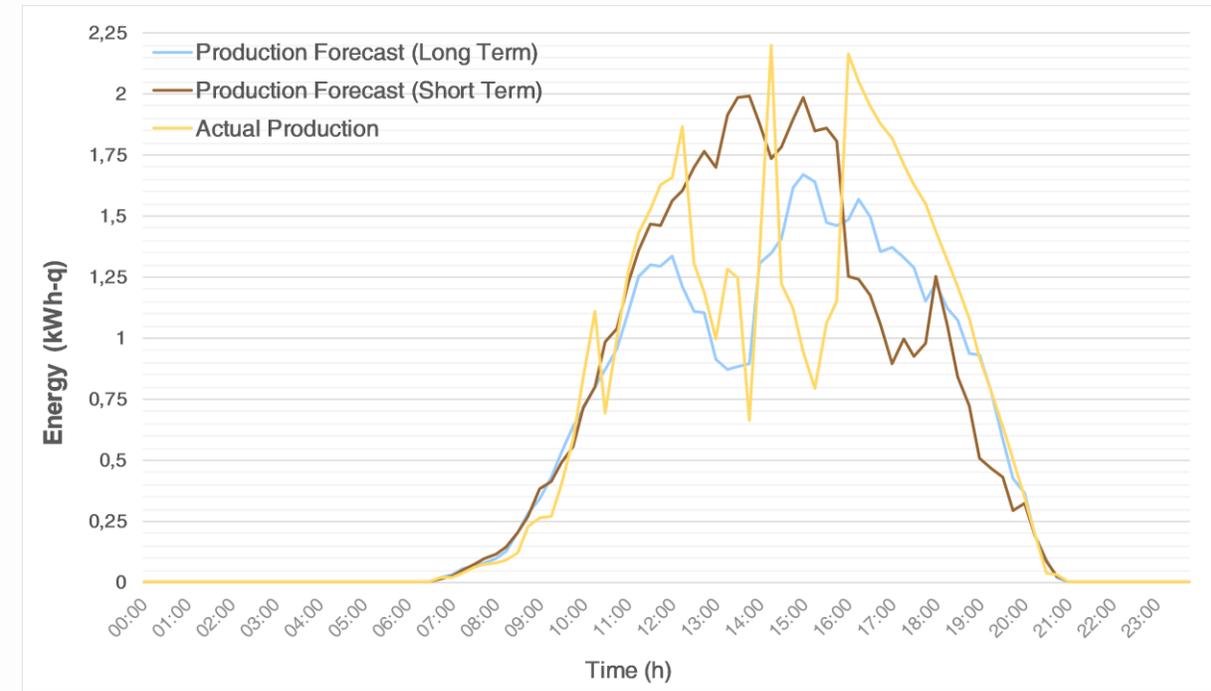
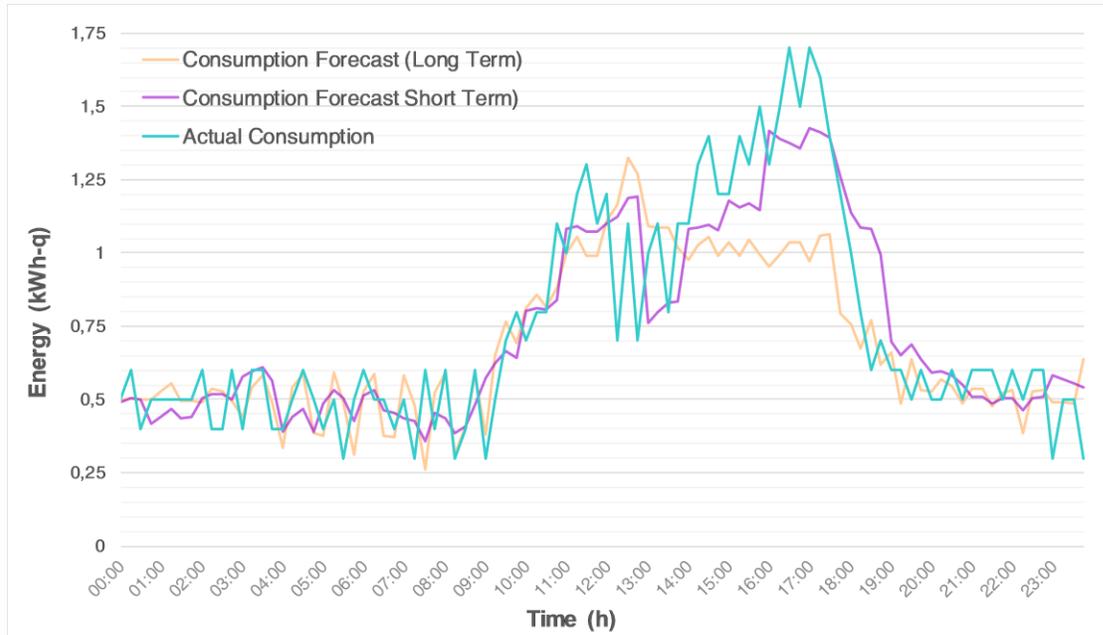
# T5.2 Microgrids #3



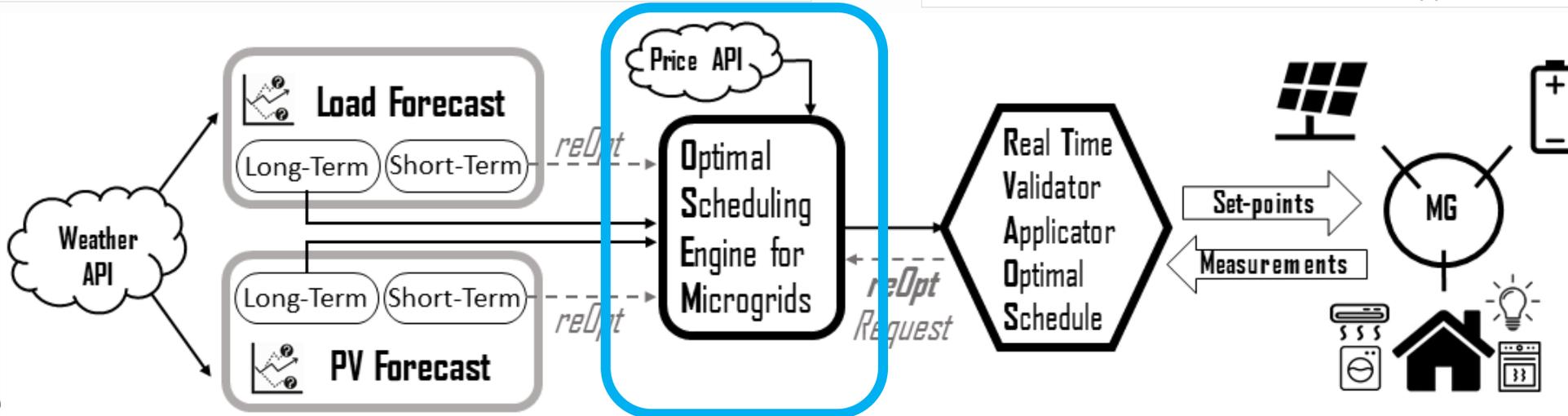
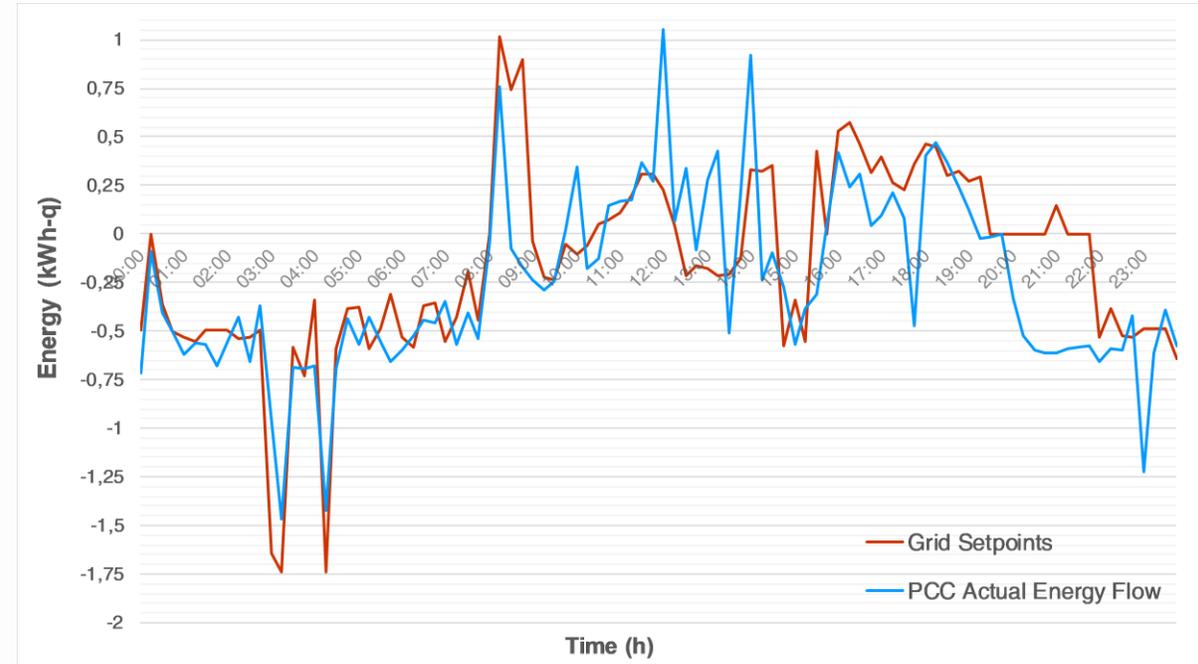
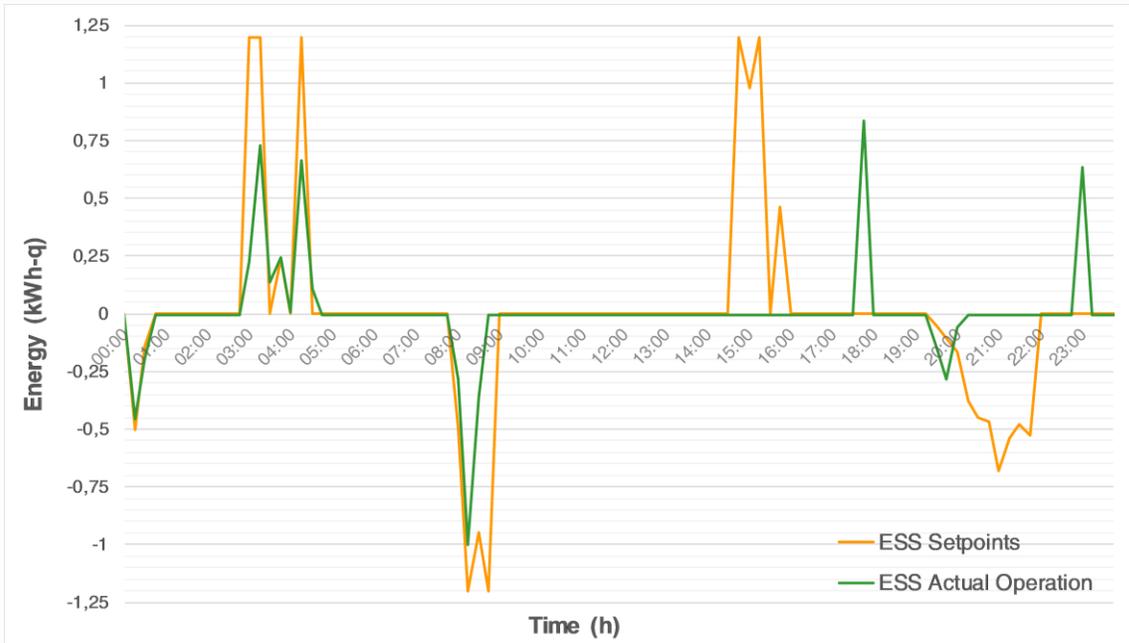
# T5.2 Microgrids #4



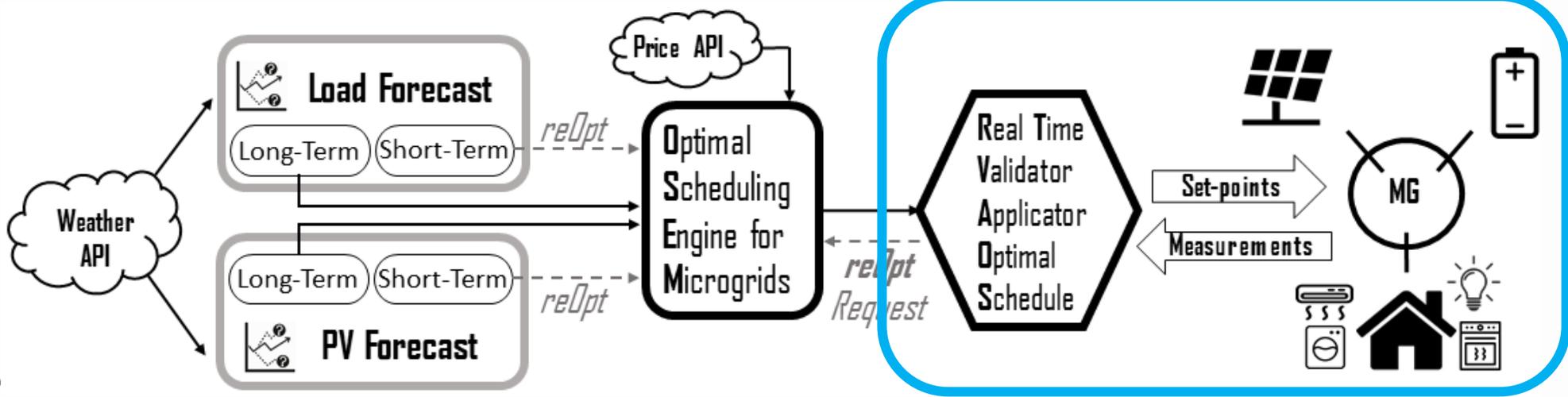
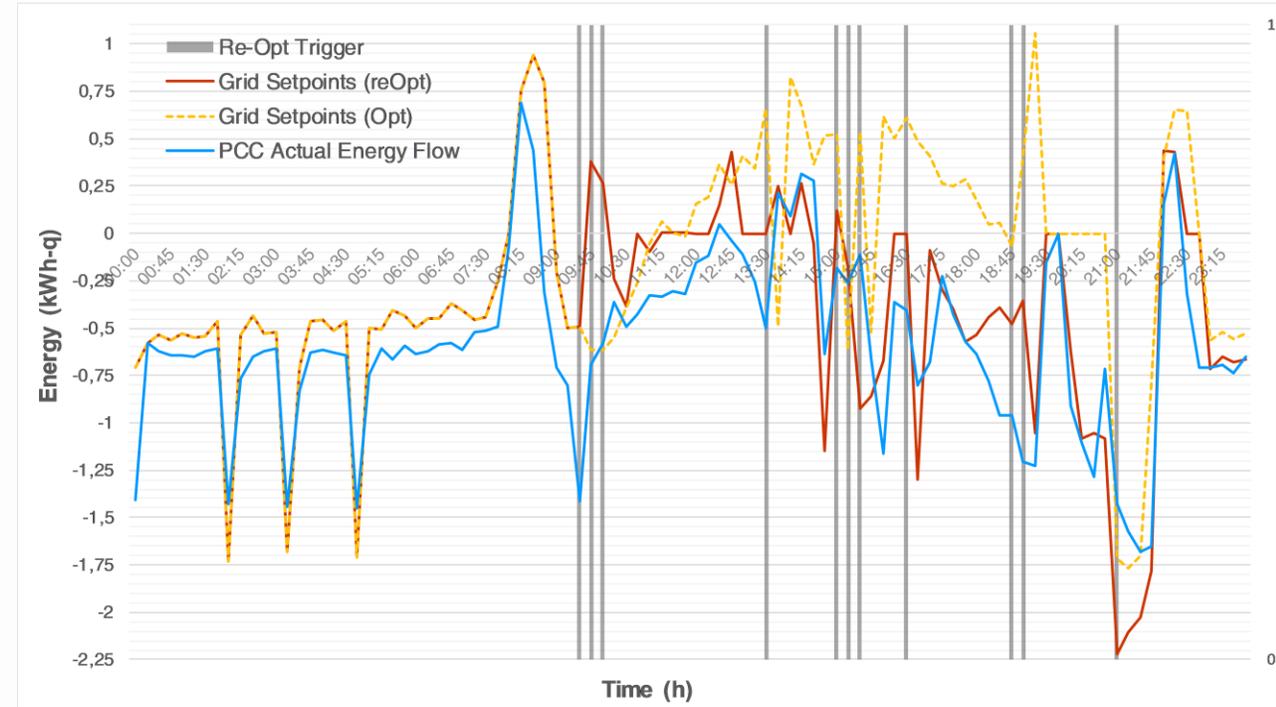
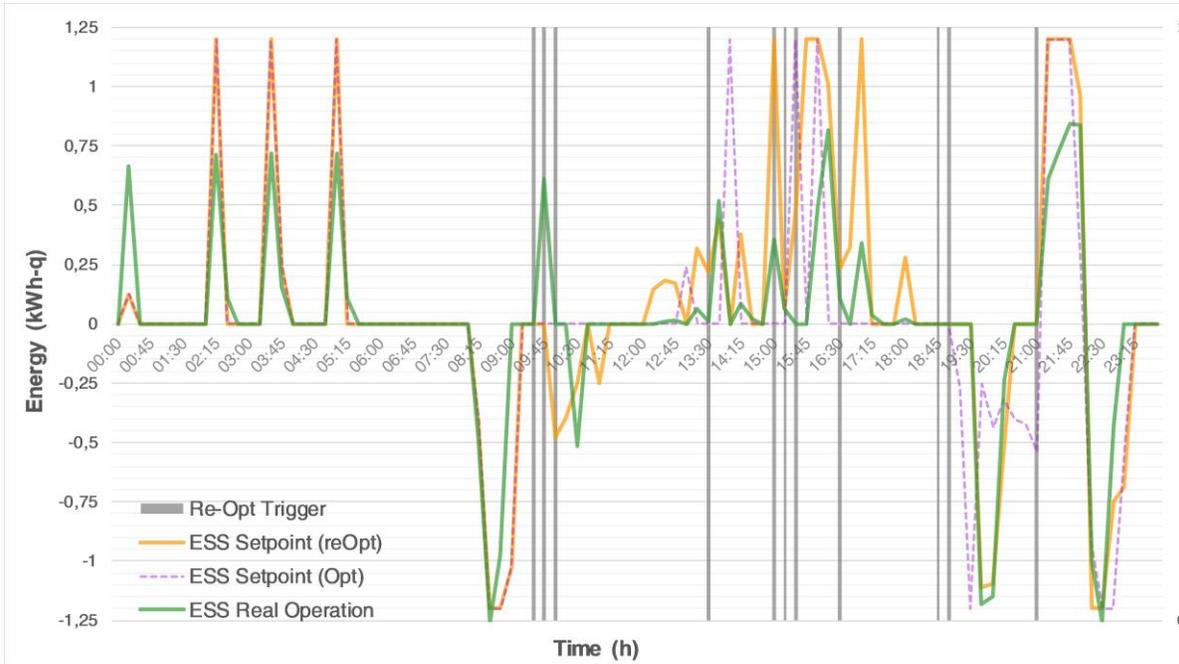
# T5.2 Microgrids – Real-life Application #1



# T5.2 Microgrids – Real-life Application #2



# T5.2 Microgrids – Real-life Application #3

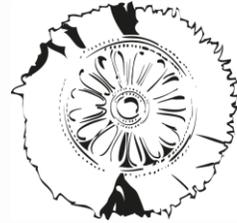


---

**Thank you**

**Questions?**

Project Partners



**POLITECNICO**  
MILANO 1863

