

# The role of digital solutions in enabling cities' energy transition towards climate neutrality

## Challenges, Solutions and Impacts

**Prof. Dr. Sami Kazi**

Research Team Leader, Smart Cities & Intelligent Buildings  
VTT Technical Research Centre of Finland Ltd



# What I would like to share today

- ▶ The challenge of global significance
- ▶ Cities: the challenge or opportunity
- ▶ SPARCS
  - ▶ What the project is about
  - ▶ How we are enabling cities' energy transition towards climate neutrality
- ▶ The importance and role of digitalization in enabling cities' energy transition towards climate neutrality
- ▶ SPARCS Cities
  - ▶ Challenges, solutions, impacts
  - ▶ Some examples of how our cities are enabling their energy transition towards climate neutrality
- ▶ Some key takeaways





# The challenge of global significance





**Cities  
consume  
75% of the  
world's  
energy and  
emit almost  
60% of global  
greenhouse  
gases?**

<https://www.worldbank.org/en/topic/urbandevelopment/overview#1>





More than 90% of the world's children breathe toxic air every day.”  
WHO (World Health Organization)

<https://www.who.int/news/item/29-10-2018-more-than-90-of-the-world%E2%80%99s-children-breathe-toxic-air-every-day>



“

We must end fossil fuel pollution and accelerate the **renewable energy** transition, before we incinerate our only home.”

**ANTÓNIO GUTERRES**, *United Nations Secretary-General*, 18 May 2022

<https://www.un.org/climatechange>





**Cities produce around 80%  
of global GDP and most innovations!**

<https://www.un.org/en/climatechange/climate-solutions/cities-pollution>



Can Cities  
save our  
world .....  
Or will they  
destroy it!



# Cities: the challenge or opportunity?



# The challenges Cities face

55% of the world's population – 4.2 billion inhabitants (2020) live in cities.

By 2050, 70% of the global population will live in cities.



<https://www.worldbank.org/en/topic/urbandevelopment/overview#1>



# From urbanism to urban sprawl

- Urbanization brings challenges, including meeting accelerated demand for affordable housing, well-connected transport systems, and other infrastructure, basic services, as well as jobs.
- Once a city is built, its physical form and land use patterns can be locked in for generations, leading to unsustainable sprawl.
- Urban sprawl puts pressure on land and natural resources, resulting in undesirable outcomes; **cities consume two thirds of global energy consumption and account for more than 70% of greenhouse gas emissions!**



<https://www.worldbank.org/en/topic/urbandevelopment/overview#1>





# The opportunities Cities offer

With more than 80% of global GDP generated in cities, urbanization can contribute to sustainable growth if managed well by increasing productivity, allowing innovation and new ideas to emerge.



<https://www.worldbank.org/en/topic/urbandevelopment/overview#1>

# The innovation dilemma

To address global challenges of significance such as **climate change**, **urbanisation**, and **sustainable growth**, cities need to radically rethink how they innovate!





# Cities – making sense of meaningful innovations

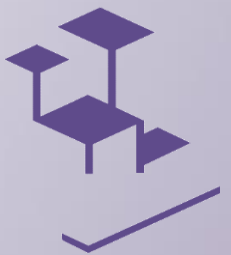


Cities need to transform into innovation ecosystems and living labs where all stakeholders, including citizens, actively participate in developing and implementing innovative solutions that protect the environment, support the economy and promote the well-being of society.

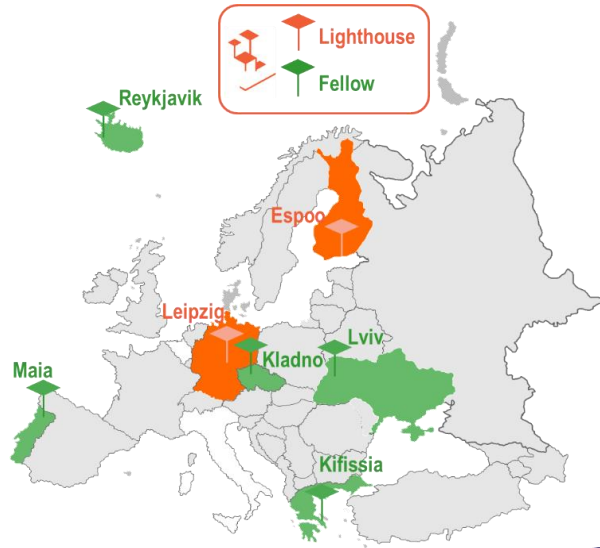


# Sustainable energy Positive & zero cARbon CommunitieS

validate innovative solutions for planning, deploying and rolling out integrated energy systems as an efficient means for the urban transition into a **citizen centered zero carbon ecosystem** enabling a high quality of life



# Who we are and what we are doing



31 partners from Finland, Germany, Portugal, Cyprus, Greece, Belgium, Italy, Ukraine, and Norway, + 27 associated partners

Generate a bold city-vision 2050

Replicate positive energy district solutions in Kifissia, Kladno, Lviv, Maia & Reykjavik

Business models and financing instruments for sustainable PEDs

Share SPARCS learnings & experiences

Community engagement and citizen-centric approach

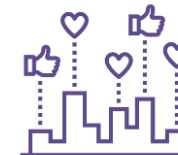


Enable and support urban transformation

Demonstrate 44 innovative positive energy district solutions in Espoo & Leipzig

Monitoring & evaluation of implemented PED solutions

Cooperate with various projects, networks & initiatives





# Ambitions and goals – our lighthouse cities

## Espoo, Finland



Carbon neutral by 2030



Carbon neutral district heating by 2029



Use of coal in district heating ending by 2025



Collaboration with citizens, companies, research & educational institutes, NGOs.



Continue being the most sustainable city in Europe



Reaching UN Agenda 2030 sustainable development goals

## Leipzig, Germany



Become carbon neutral by 2050, achieve a carbon neutral public administration by 2035



As-is analysis of energy availability and use in the areas of economics, communal requirements, household consumption and transportation



Emission balance



Potential analyses for energy conservation, energy efficiency, fossil fuels and renewable energy; trend and action scenarios for 2030 and 2050



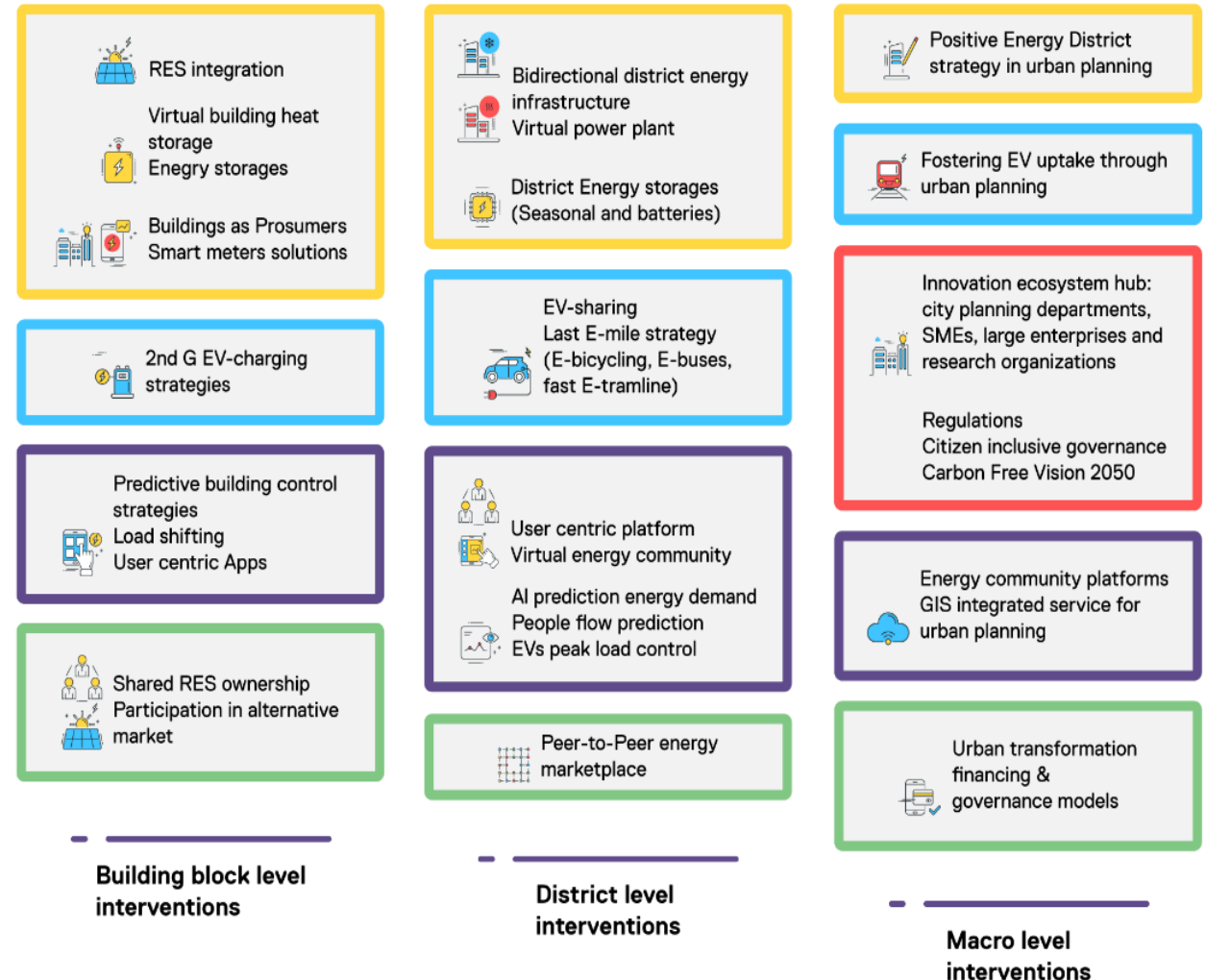
Instruments and measures catalogue



Vision scenario for 100% renewable energy use

# SPARCS: Co-creating impact

- Designing Positive Energy Building Blocks and Districts in the two Lighthouse Cities with 44 innovative interventions / actions
- Hands-on feasibility studies in 5 Fellow Cities to support replication planning



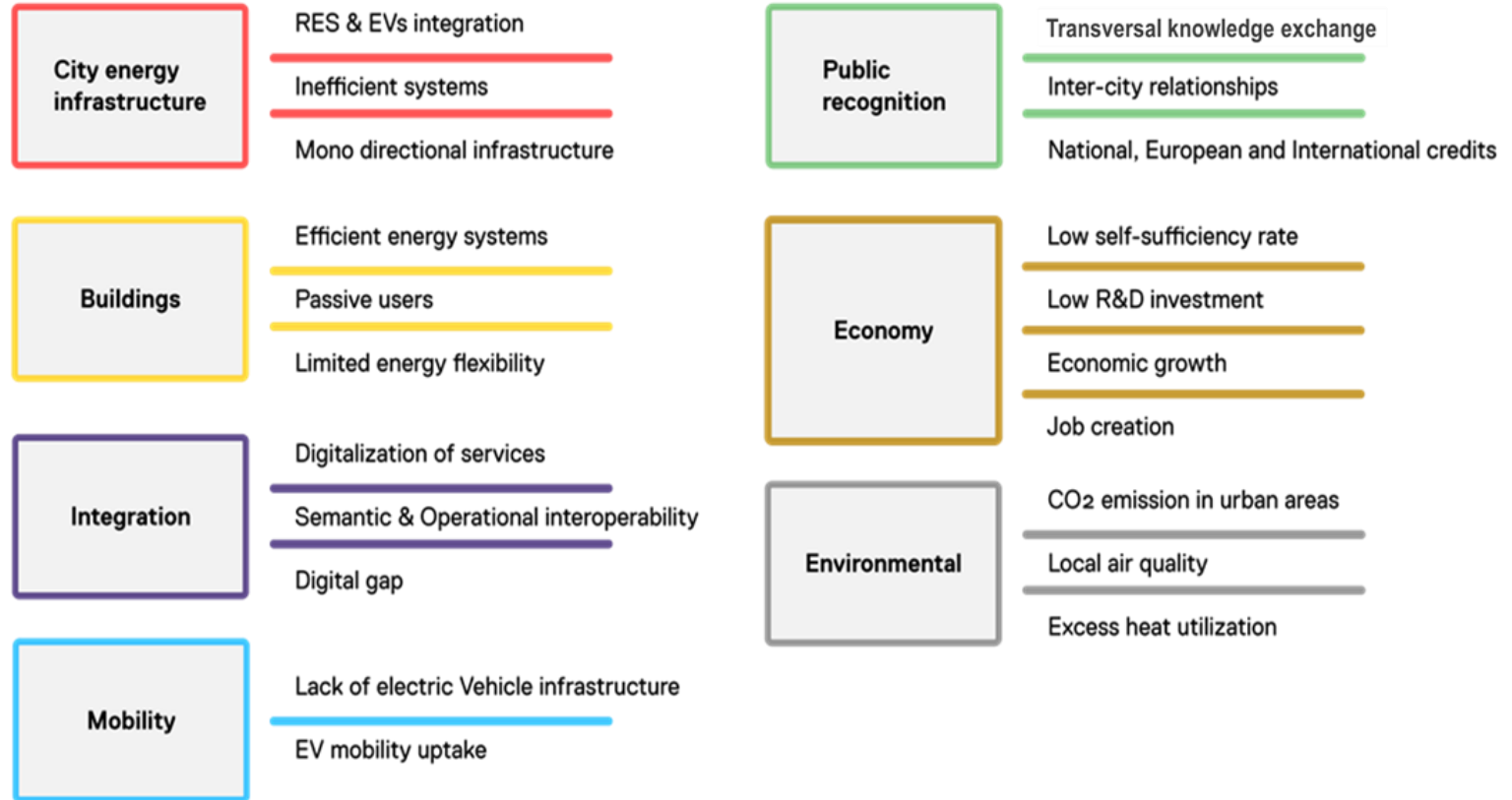


# The importance and role of digitalization in enabling cities' energy transition towards climate neutrality



# The City dilemma

A City has many systems and subsystems that need to be seamlessly interlinked and connected in a holistic and systemic way!

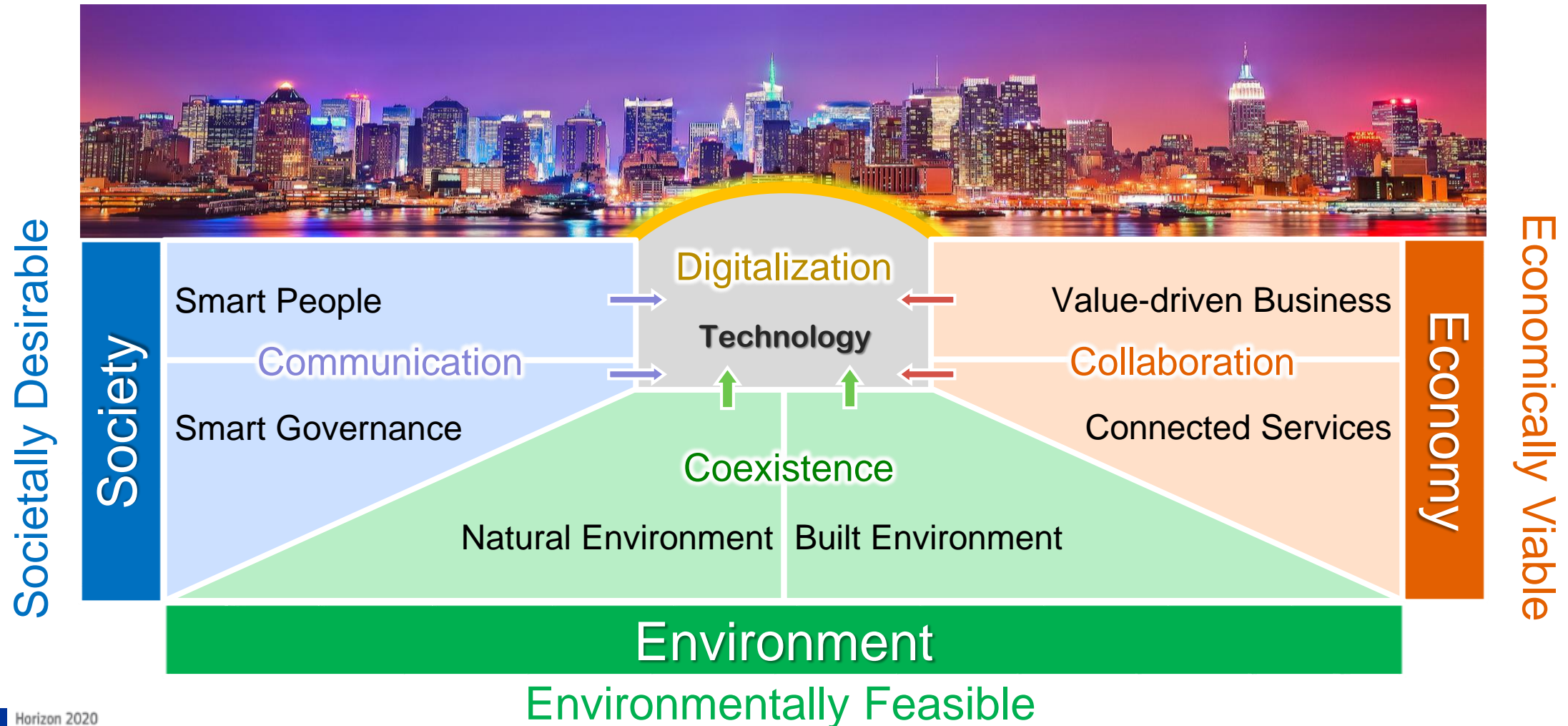


Keep it? Remove it? Optimise it?  
Connect it? Build it? Open it?



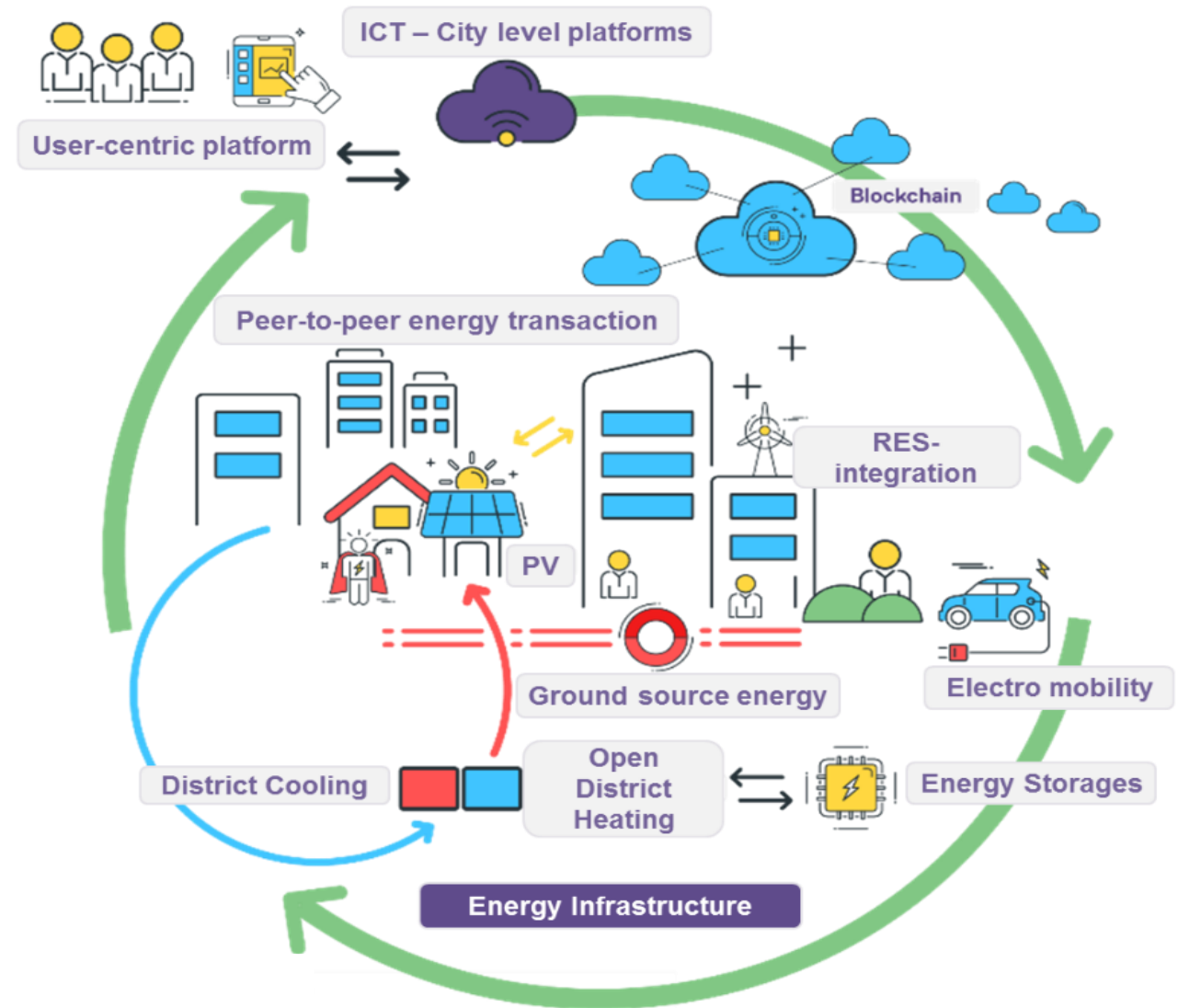
# How digitalisation supports a City innovation ecosystem

Protect the environment, support the economy & promote the well-being of society



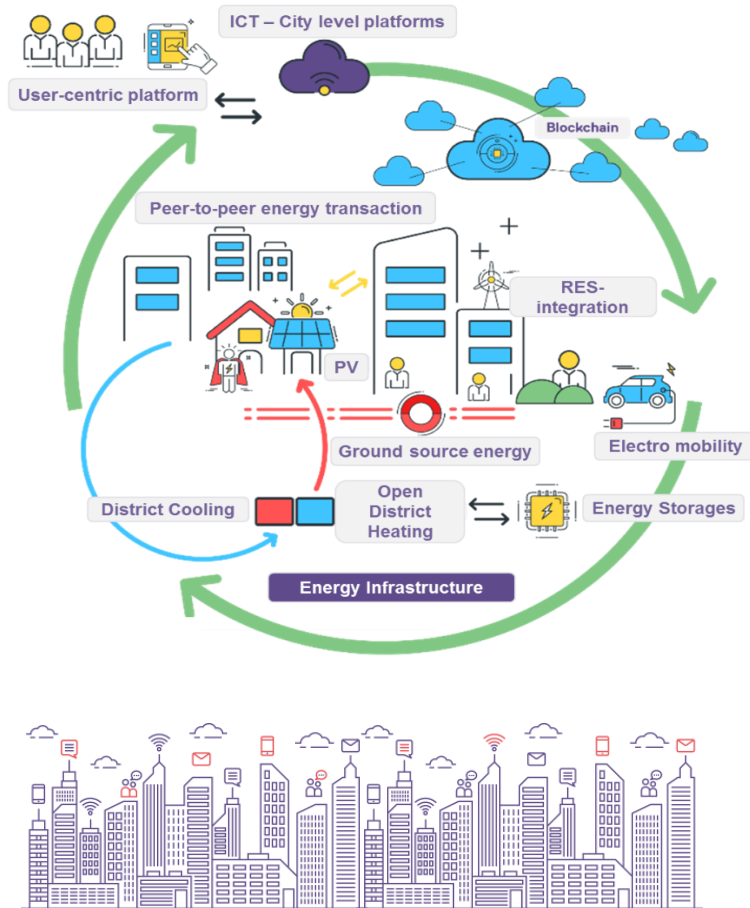
# The SPARCS solution

validate innovative solutions for planning, deploying and rolling out integrated energy systems as an efficient means for the urban transition into a **citizen-centred zero-carbon ecosystem** enabling a high quality of life





# Key considerations towards digitalisation



Value Co-creation

Communication

Secure Data



## Interaction

Dashboards, actionable intelligence, stakeholder engagement



## Shared Services

Visualisation, comparative analysis



## Applications

Application software, demand-response management



## Interoperability

Compliance with standards, APIs



## Communication

TCP/IP, synchronous and asynchronous communication



## Access Control

Access rights, role-based rights management, version control



## Services

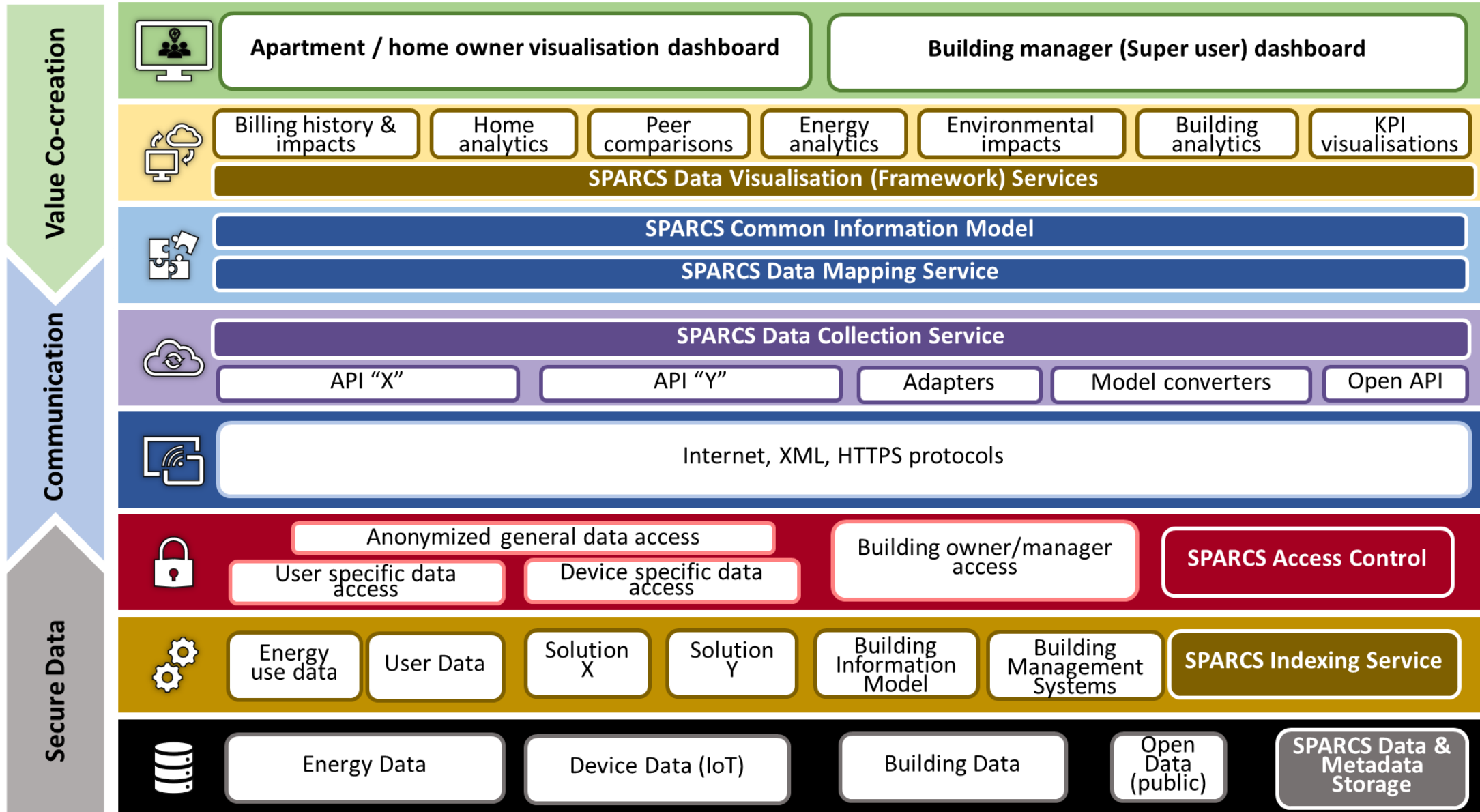
Legacy applications, intra-organisational tools



## Data Storage

Databases, repositories, ERP systems, data sources

## SPARCS ICT reference architecture for positive energy districts (positioning framework)





# How our cities are enabling their energy transition towards climate neutrality





Horizon 2020  
European Union funding  
for Research & Innovation

This project has received funding from the European Union's Horizon 2020 research & innovation programme under Grant Agreement No. 864242 Topic: LC-SC3-SCC-1-2018-2019-2020: Smart Cities & Communities



# Espoo: PED Challenges, Solutions and Impacts

## PED Challenges

- Connecting systems - local energy systems, including RES integration, smart buildings, smart grid, energy storage, electromobility and EV charging
- Improve the overall energy performance and energy efficiency
- Optimize self-consumption and reduce load curtailment
- Enable flexibility of loads by innovative new technologies in energy management
- Citizen engagement, energy citizenship, sustainable lifestyle
- Business models

## SPARCS Solutions

- Integration of energy solutions, virtual power plant, demand flexibility solutions for both heat and electricity
- Sustainable energy solutions, RES as part of systemic approach of energy transition
- Supporting sustainable lifestyle and energy efficient behaviour, various efforts
- District-level and city-level solutions for city development

## Foreseen Impact

- ❑ Replicable solutions for cities regarding energy efficiency, district-level sustainable energy systems
- ❑ Smartness in energy solutions bring savings
- ❑ Percentage of RES in energy production rising steadily, becoming the new “normal”
- ❑ City development process focusing more on sustainable energy solutions, stakeholder engagement, open development

# Espoo: Demonstrating impact

## Kera / Leppävaara District planning demos

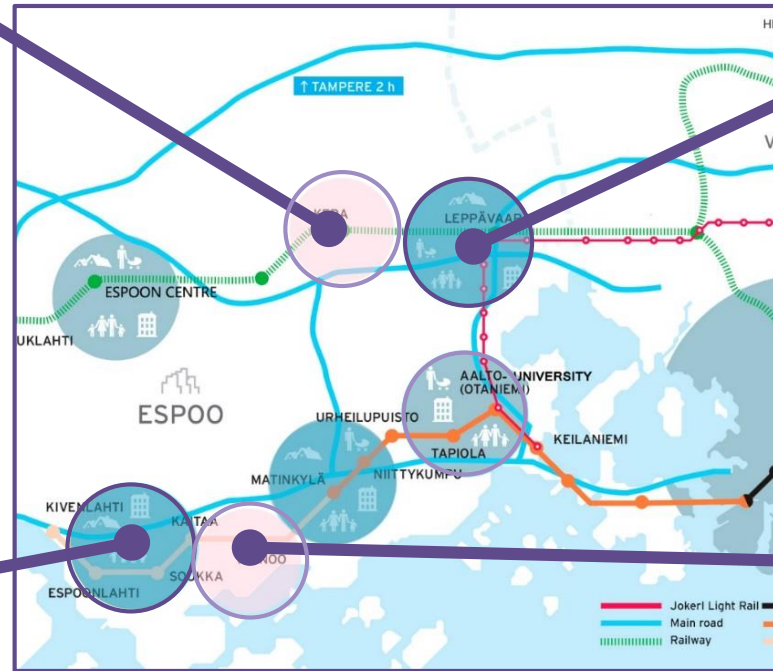
- City Development
- Smart Technologies
- Co-creation
- Mobility solutions

## Leppävaara District: Leppävaara Centre

- Renewable energy systems
- Energy Storage
- Smart Technologies
- E-mobility

## Espoonlahti district: Lippulaiva blocks

- Renewable energy systems
- Energy Storage
- Citizen engagement
- Multi-model transport



## Finno area

- Replication
- Scaling up



# Espoo – Lippulaiva

- ▶ Sustainable energy system with RES
  - ▶ The largest geo-energy plant in Europe for a commercial building (heating capacity 4MW)
  - ▶ PV-plant (roof and façade), production ~580 MWh/a
- ▶ Promoting sustainable mobility
  - ▶ EV charging stations
- ▶ Citizen engagement
  - ▶ Lippulaiva Buddy classes
  - ▶ Co-creation workshops with youngsters
  - ▶ Buddy family actions, 32 families
  - ▶ Promoting a sustainable lifestyle for customers







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# Leipzig: PED Challenges, Solutions and Impacts

## PED Challenges

- Historic or retrofitted building stock
- Heterogeneous owner and stakeholder structures in neighbourhoods
- Conflict of uses: space for additional RES vs. social housing vs. environmental protection
- Democratizing the energy transformation of cities
- Renewable heat & power generation, transport and storage

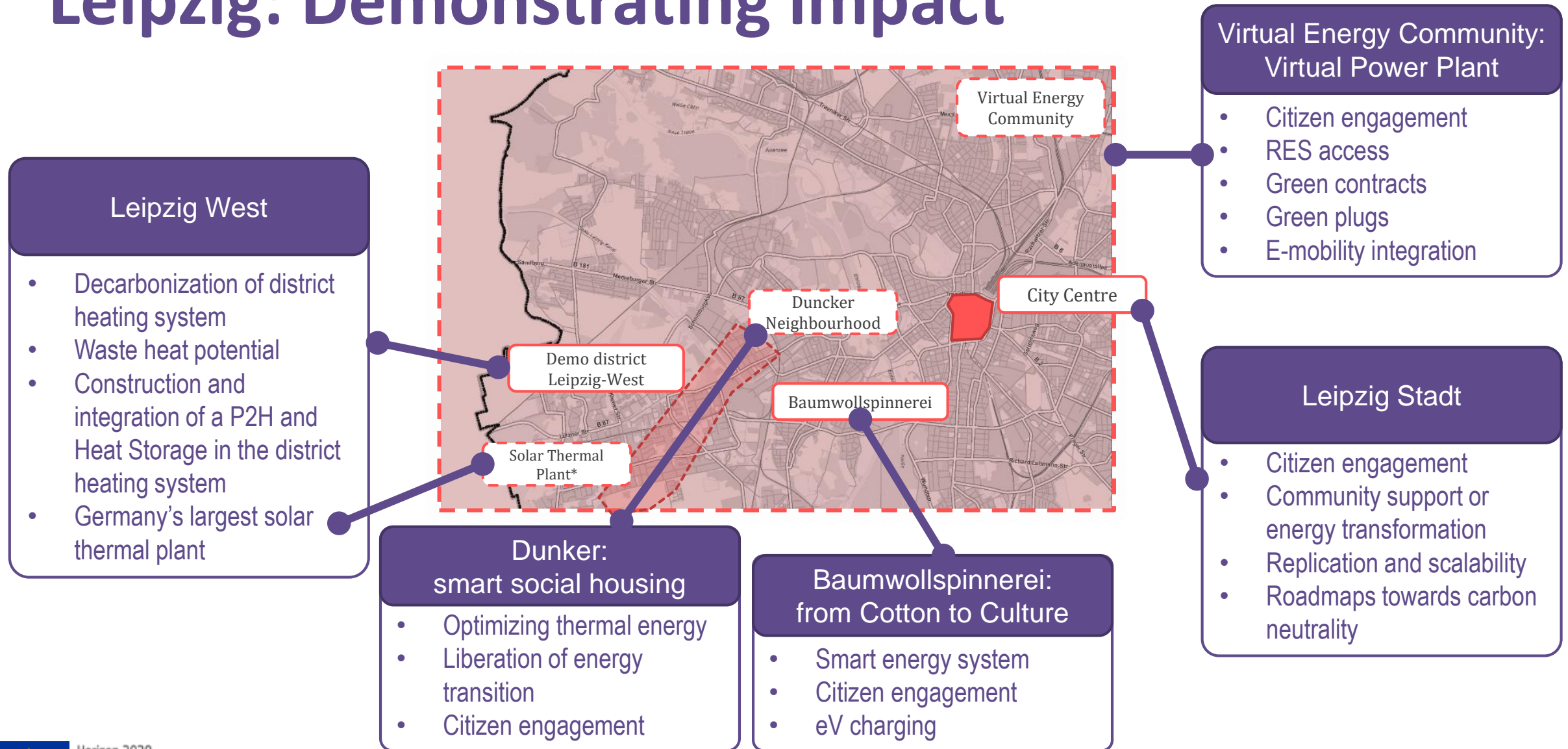
## SPARCS Solutions

- Social, economical & ecological concepts for the construction & operation of the solar thermal plant within the city
- Use of synergies and sector coupling
- Integration and installation of new technologies to save energy as well as carbon dioxide and increase efficiency in established districts
- Show and share improvement information by using apps including with feedback function

## Foreseen Impact

- ❑ Increase of renewable energy generation, reduction of carbon footprint
- ❑ Cross-sectoral increase in energy efficiency
- ❑ Improve RES of PEDs
- ❑ Solutions for existing and historic building stock → greatest amount of all dwellings
- ❑ Design and deployment of citizen-centric services
- ❑ Combination of analogue and digital citizen engagement formats

# Leipzig: Demonstrating impact





# Leipzig – Leipzig West

- ▶ Germany's largest Solar Thermal Plant
  - ▶ 1st stage ~13 GWh/a & 16 MW peak (~31.000 m<sup>2</sup> collector area)
  - ▶ 2<sup>nd</sup> stage ~25 GWh/a & 30 MW peak (~60.000 m<sup>2</sup>)
- ▶ Decarbonization of district heating system
  - ▶ Increasing shares of RES in district heating networks
  - ▶ Integration of a P2H and Heat Storage in the district heating system
  - ▶ District heating via solar thermal heat for Smart Social Housing
- ▶ Citizen engagement



# Some key takeaways

A City has many systems and subsystems that need to be seamlessly interlinked and connected holistically and systemically!

A city is at best, as smart as the people who reside in it and who manage it – give them the correct data and tools to make informed decisions



Innovations in cities require a harmonious balance between:

- Resource efficiency  
(environmental feasibility)
- Quality of life  
(societal desirability)
- Sustainable growth  
(economic viability)



<https://www.sparcs.info/>

  @SPARCSeu



Stadt Leipzig



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KLADNO



ΔΗΜΟΣ ΚΗΦΙΣΙΑΣ



ESPOO



SIEMENS



PLUGIT

CITYCON



ADVEN



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BABLE



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GOPA.com

# Sami (Abdul Samad) Kazi

Doctor of Engineering

Adjunct Prof. Hanken (FI), AIT (TH)

*smart cities, intelligent buildings, innovation ecosystems,  
strategic roadmaps, exploring excellence, valorising great ideas*

- Senior principal scientist
- Research team leader, smart cities & intelligent buildings
- Mentor, coach, facilitator, sparring partner, hack master, webinar / event host, speaker, **creativity evangelist**
- ~60 EU funded projects, ~40 strategic/customer projects
- 100+ publications and books

