5th International Conference on Smart Energy Systems
Copenhagen, 10-11 September 2019
#SESAAU2019

Coordination of district-level smart energy systems: multi-objective considerations

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Presented by: Edward O'Dwyer

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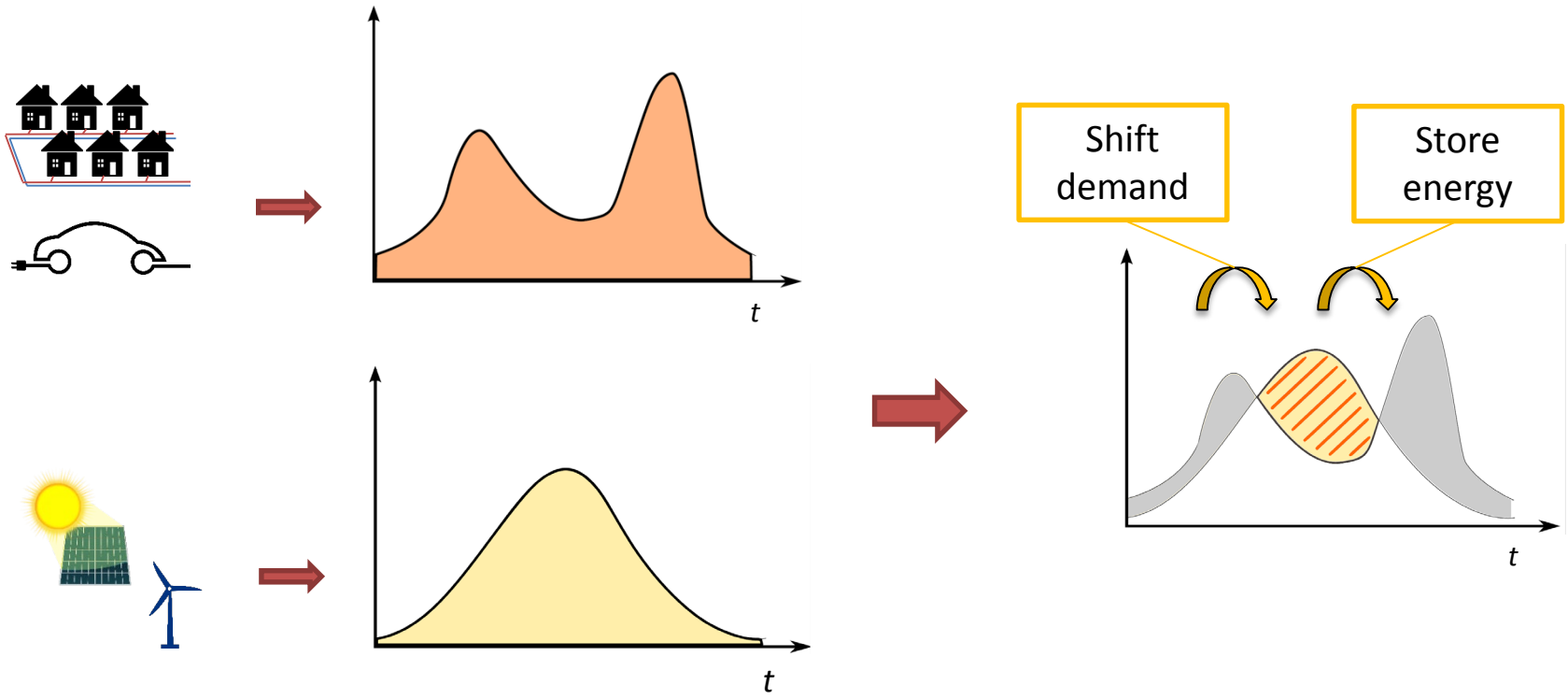
Overview

- Real-time control and coordination potential & challenges
- Energy management aspects of the Sharing Cities H2020 project
- Development of Sustainable energy management tool and open-source simulation environment
- Application in Sharing Cities case studies

Multi-vector energy systems: real-time control & coordination



Potential for real-time control in energy system transition

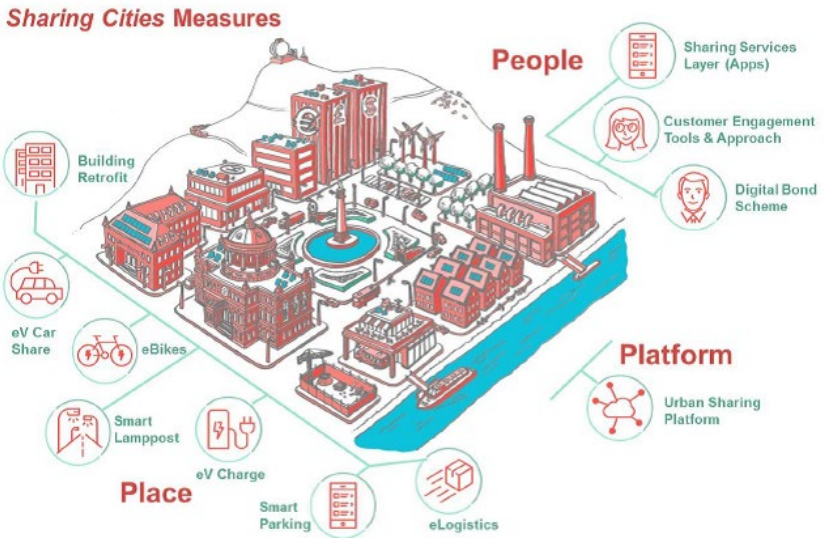
- IoT integration technologies
- Communication networks
- Advanced control (e.g. MPC)
- Data-science/ML/AI
- Big-data & software advances
- Increased technological diversity
- Environmental and economic imperatives

Challenges, considerations and trade-offs

- Resource availability
- Infrastructural limitations
- Complexity and context
- Enacting optimal control actions
- System-benefits vs individual-benefits
- Environmental vs. economic
- Robustness & resilience vs. max potential

What is Sharing Cities?

- Sharing Cities is a project funded by the EU's Horizon 2020 research and innovation programme.
- Three lead cities (London, Lisbon and Milan) and three follower cities (Bordeaux, Burgas and Warsaw).
- It will provide a better, common approach to making smart cities a reality.
- Total cost is €25million



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Greenwich Assets & Smart City Architecture

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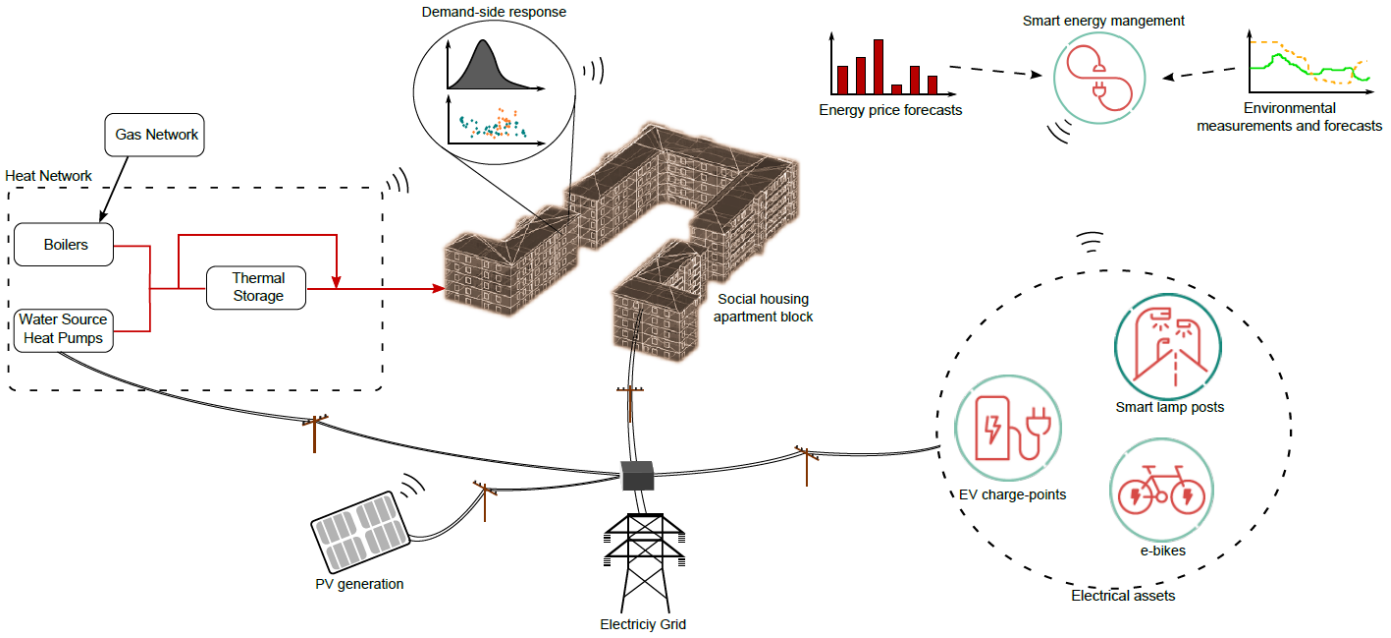

O'Dwyer, E., Pan, I., Acha, S., & Shah, N. (2019). Smart energy systems for sustainable smart cities: Current developments, trends and future directions. *Applied Energy*, *237*(January), 581–597

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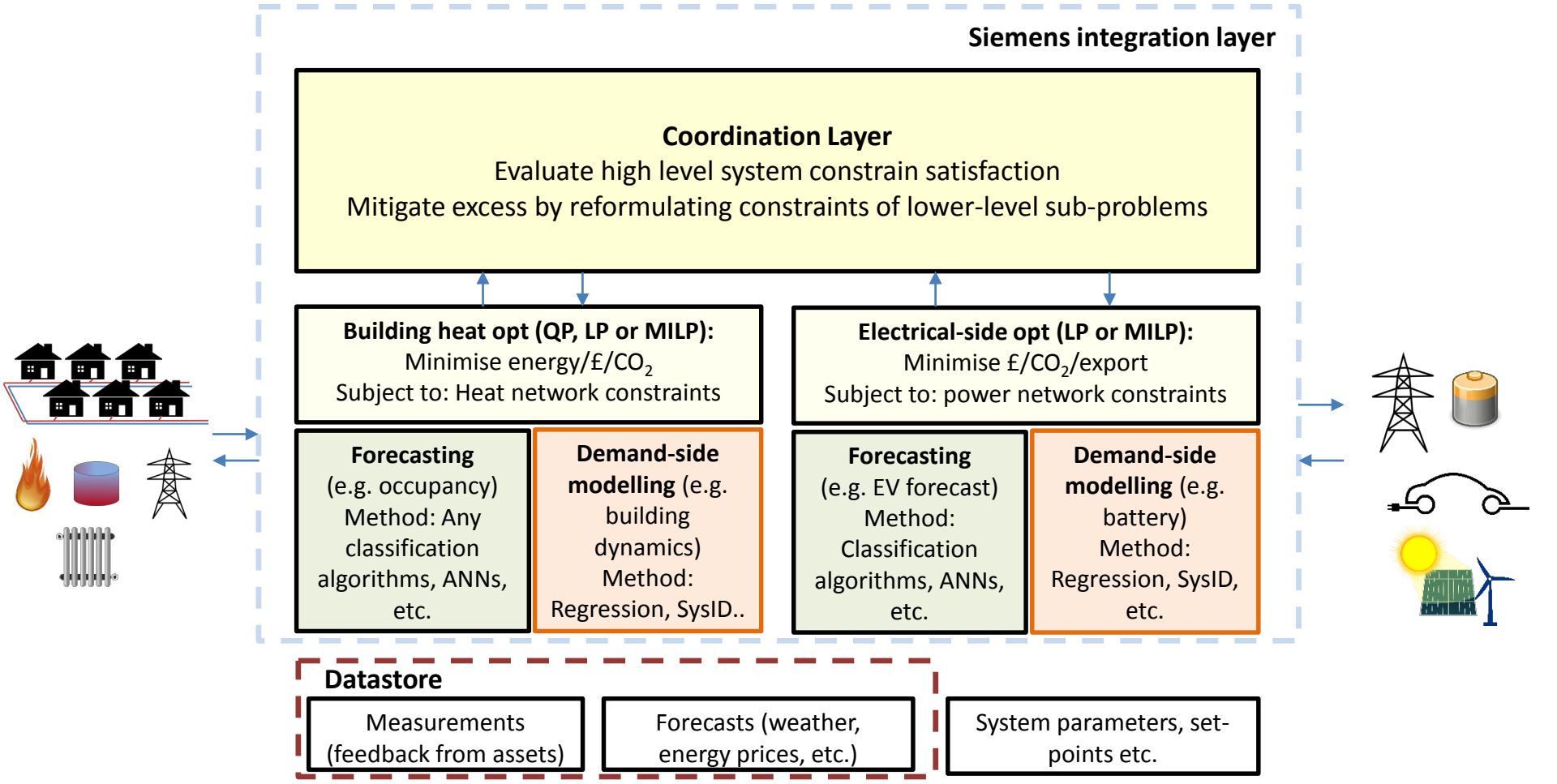

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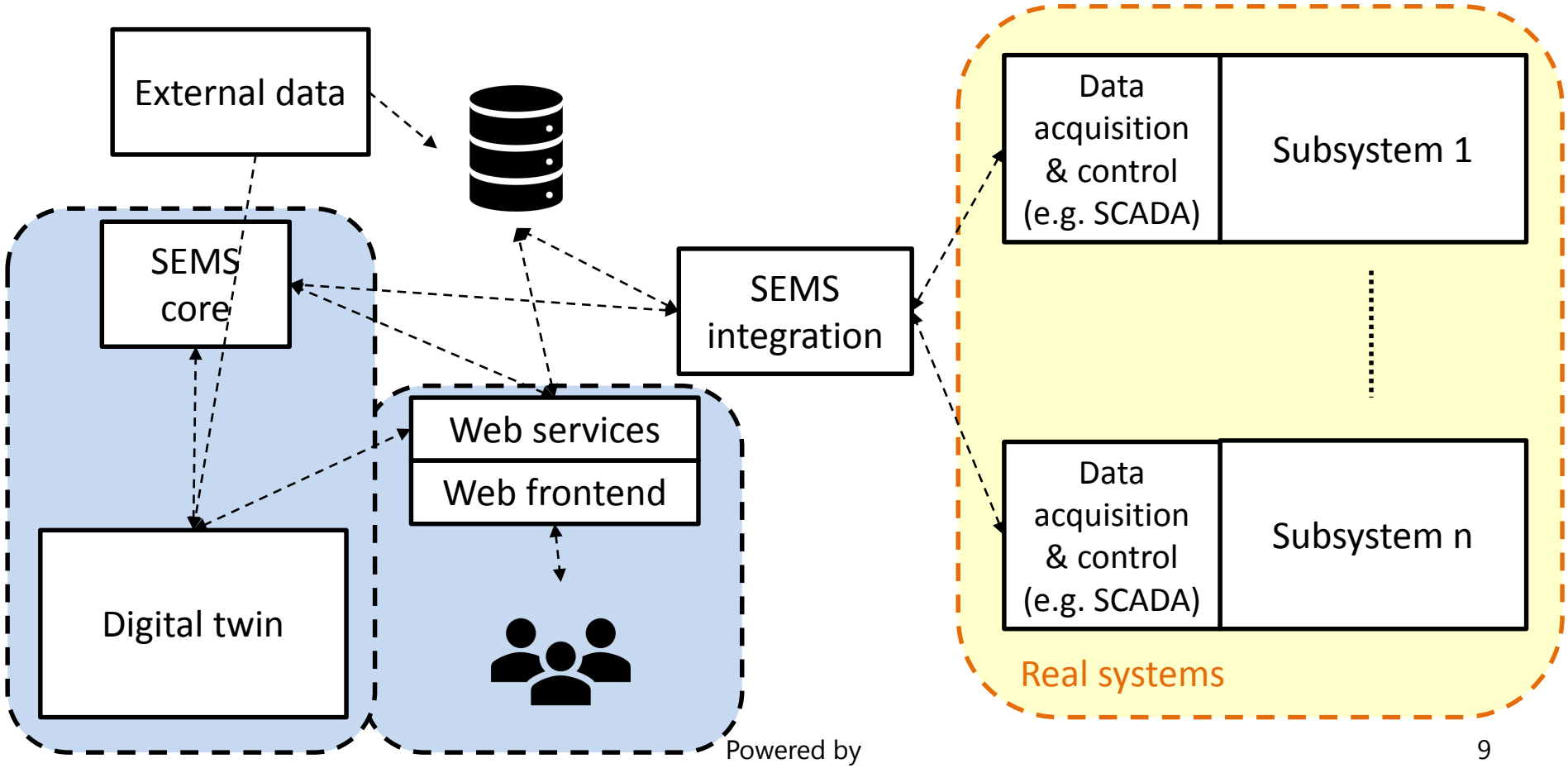
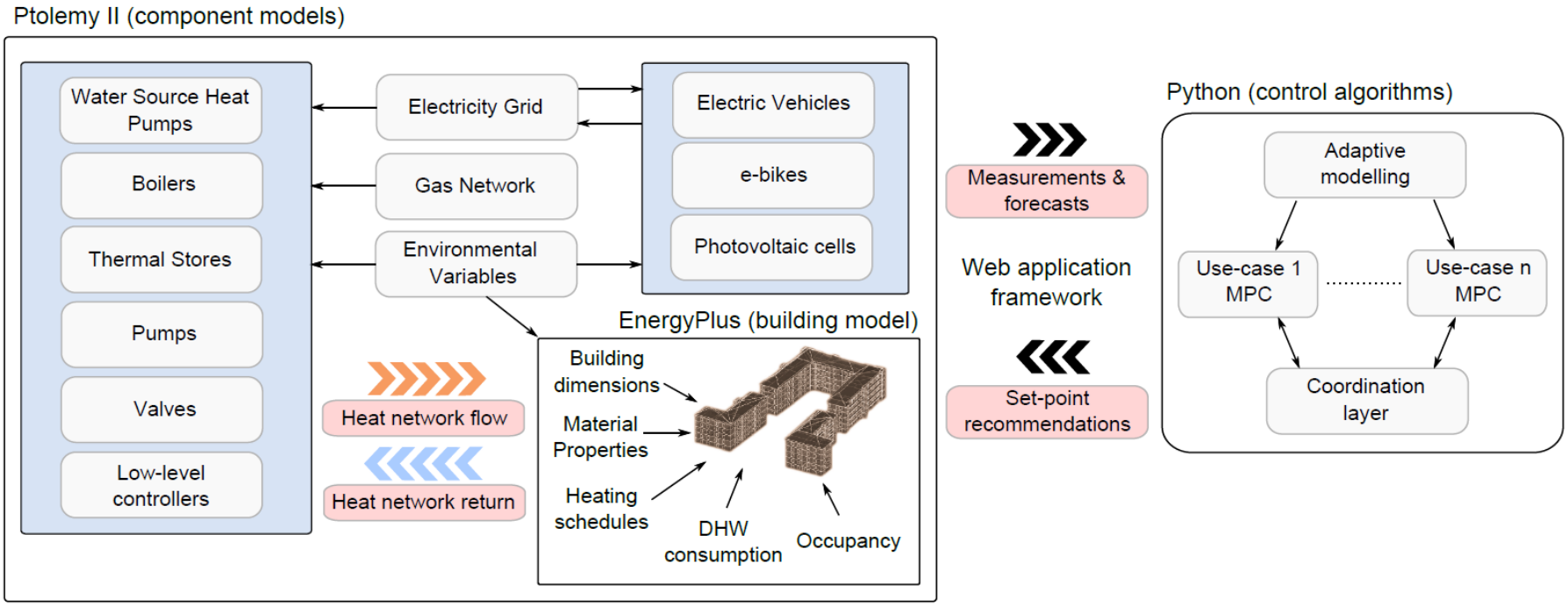
Cloud-based architecture

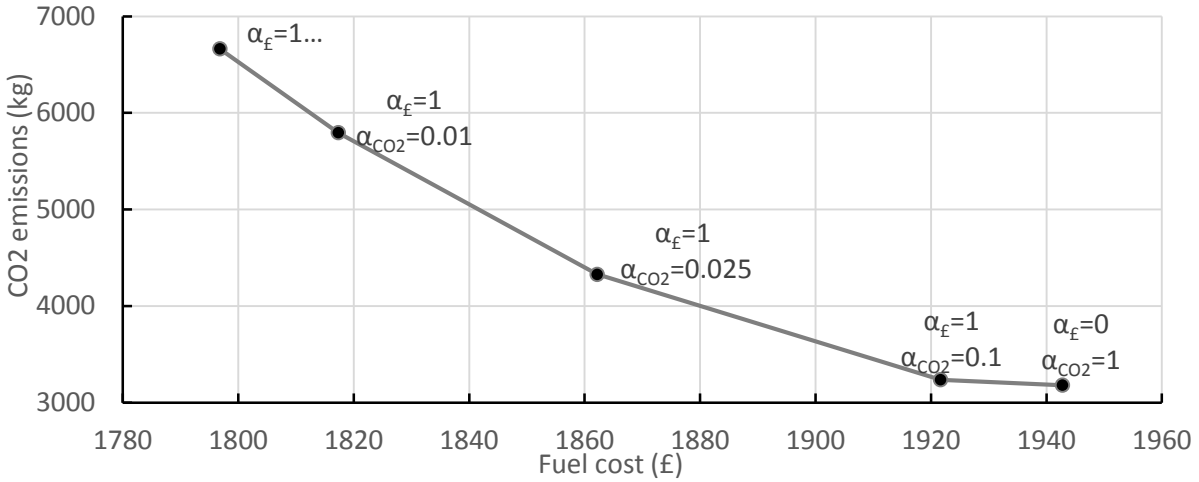


Twin: simulation architecture



Heat network management

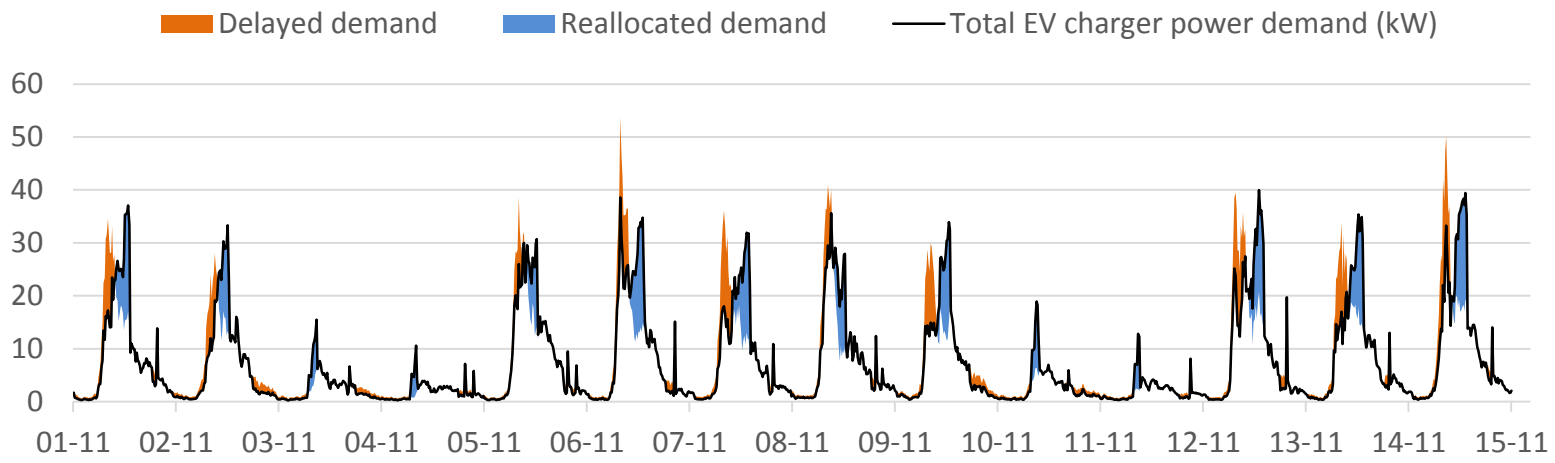
- MPC applied to building energy problem – minimise weighted combination of £ & CO2 subject to soft comfort constraints
- Improved environmental performance conflicts with economic performance
- Digital twin provides decision makers specific information about otherwise arbitrary looking problem



PV/EV coordination

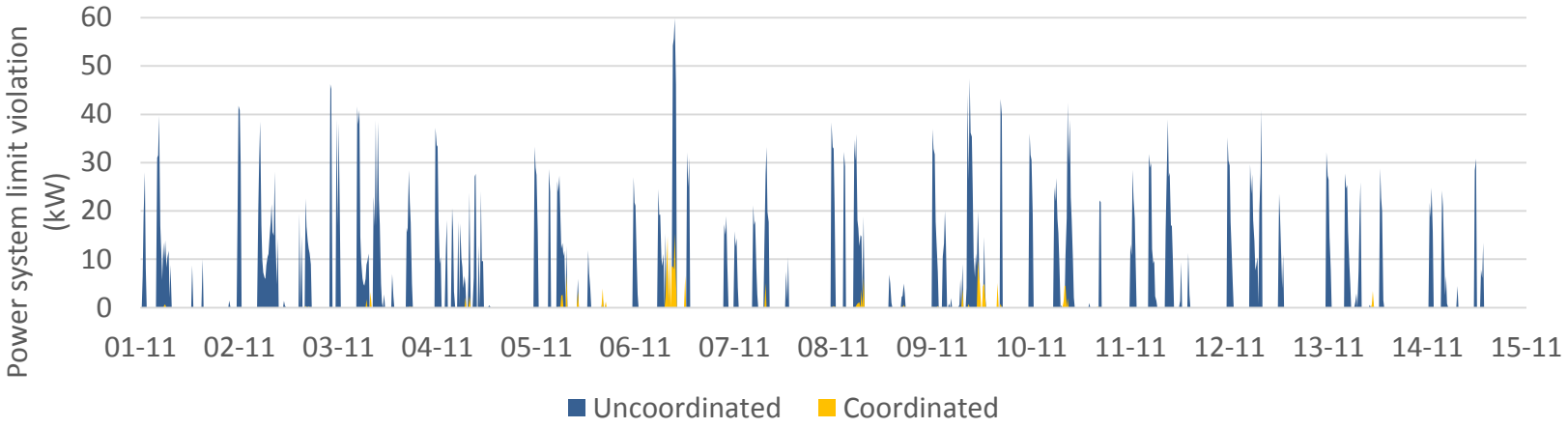
- Delaying charge of fleet vehicles to increase utilisation of local PV resource
- More delay leads to more utilisation: what is the desired balance?

	PV Utilisation %	Renewable %
Uncoordinated	54	45
Coordinated	61	51



Power grid restrictions

- Better coordination can allow for reduced infrastructural development
- This comes at an operational cost



	Limit Violation reduction	Operational emission increase	Operational cost increase
Coordinated	97 %	20.8 %	8.9 %

Conclusions

- Technologies and techniques for real-time of district-level energy systems carry great potential
- Coordination challenge – competing/conflicting objectives
- Integration of intelligent energy management software and simulation environments enable more informed real-time decision-making

Thank you!

Funded by the H2020 Sharing Cities project

www.sharingcities.eu