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Smart buildings?

– How user behavior is crucial for smart operation of buildings

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Energy Anthropology



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Encounter between people and technology

- Energy efficiency, energy flexibility and indoor environment



Performance gap and rebound effect



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- Discrepancy between expectation and actual performance (indoor environment and energy consumption)



Single family households to LEED certified, smart buildings:

Occupant behavior directly influences energy consumption and indoor environment



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Cases



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Identification of non-technical, behavior related barriers for smart solutions

- Case #1 University building
- Case #2 Day care institutions

Smart interaction between building and users

- Case #3 UN City



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University building



Identification of non-technical, behavior related barriers for smart solutions



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The project

Data-driven building management of energy efficient buildings. Decreasing performance gap.

The building

Newly constructed, smart building. The building meets the requirements for 2020 and is performance tested.

The smart solution – and the challenge

Connection between ventilation and booking system. High level of CO₂ in the building.

Operation managers



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// IoT – it's the future. A lot is gonna happen in that field. **I am dreading it.** //



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Day care institution



Adapting smart solutions to the need of the occupants



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The project

Danish-American COORDICY project concerning energy performance and performance gap.

The buildings

Retrofitted buildings used for day care institutions – renovation included ventilation and lighting.

The smart solution – and the challenge

Automated control of lighting – presence and light level. Lighting not sufficiently flexible for the use of the building.

UN City



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Intelligent interaction between building and users



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The project

Achieving the potential for energy efficient operation of smart buildings – operation and user behavior. Mapping of user behavior in smart buildings and development of recommendations for optimal behavior in relation to building operation.

The building

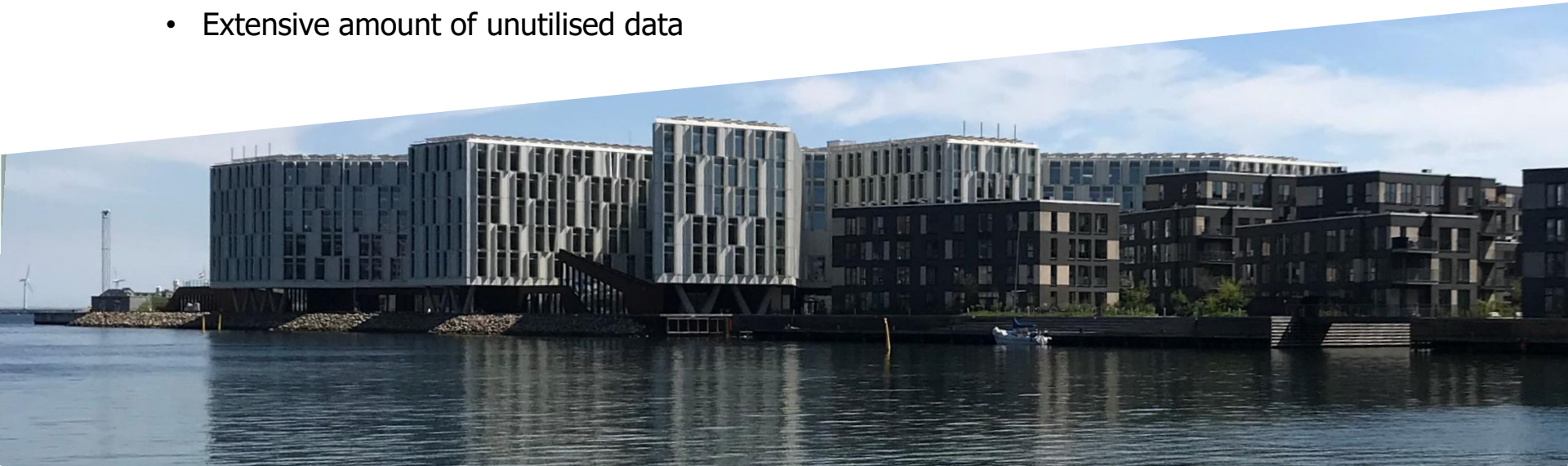
Remarkable on sustainability and smart functions: Solar panels, automatic solar shading, seawater cooling, collection of rainwater, automated control on room level.

Designed to use at least 55 percent less energy than similar buildings. Platinum LEED certified and and European Commissions Green Building Award.



Challenges

- Higher energy consumption than expected
- Minor difference between peak and standby consumption
- Uncertainty on whether installations operate as expected
- Temperature differences between floors e.g. due to design of atrium
- Perceived low air quality
- Extensive amount of unutilised data



Preliminary conclusions



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Operation

- Unclear division of responsibilities
- Energy consumption and indoor environment not a specified work task
- Energy management relies on the individual (education, interest, competence)

End users

- User expectations to the building are not aligned with reality
- Users lack knowledge of their impact on the building



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How can the potential be achieved?

- Smart solutions in practice require improvement on integrating building, occupants and technology.