Centre for IT-Intelligent Energy Systems for Cities

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Centre for
IT-Intelligent Energy Systems for Cities

Årsmøde CLEAN
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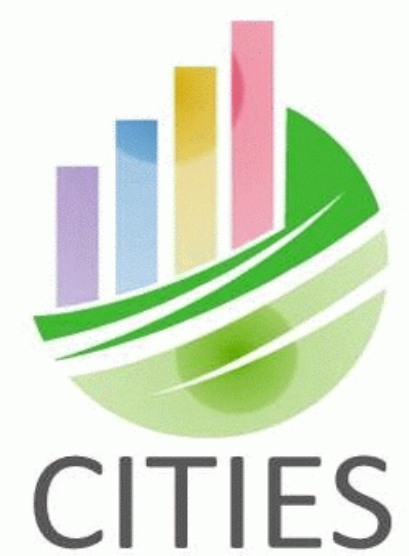


Smart Cities – Hvorfor det?

- Byer's infrastrukturer, IT, organisation bliver mere og mere kompleks.
- Der søges efter en rationale til samling.

- *Smart Cities er rationalet til at samle "alt" i byen*
  - *– organisatorisk som teknisk*
    - *… hvor Big Data er et værktøj af mange*

- Det giver en unikt mulighed for forretning og innovation.

(Al)fred Heller

Smart Cities er seriøst forretning

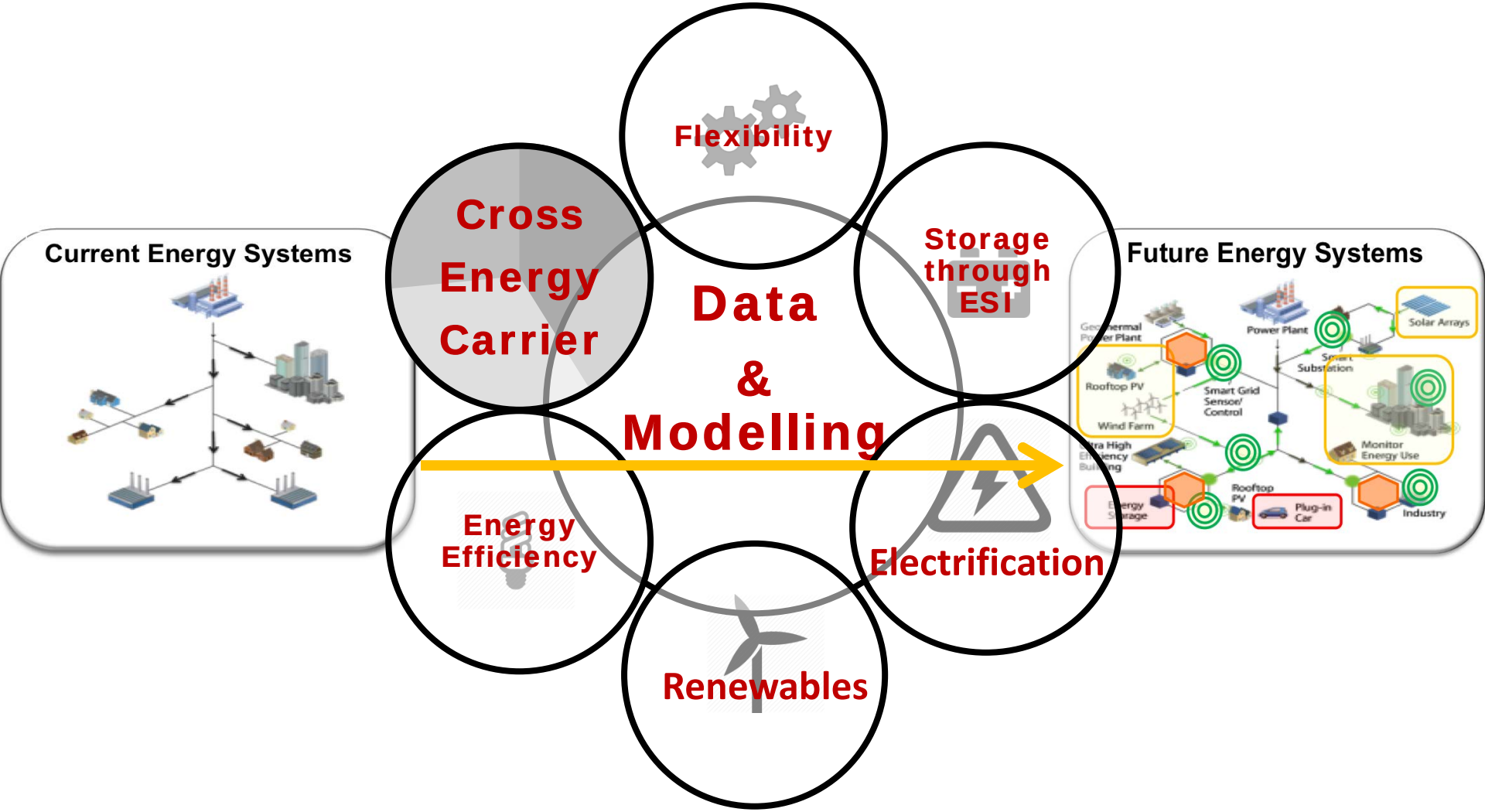
CITIES
- 71 mio
- 44 mio i tilskud DSF
- 40 partner
- 2014-2019 (2020!!!)
- Forskning
- 11 PhD
- 5 PostDocs

EnergyLab Nordhavn
- 129 mio
- 79 mio i tilskud EUDP
- 8 partner
- 2014-2019
- Udvikling og demonstration
- 9 PhD
- 4 PostDocs

Projekterne vokser og bliver flere

International: IEA, EERA, EU, partner fra Korea, USA, … hele verden

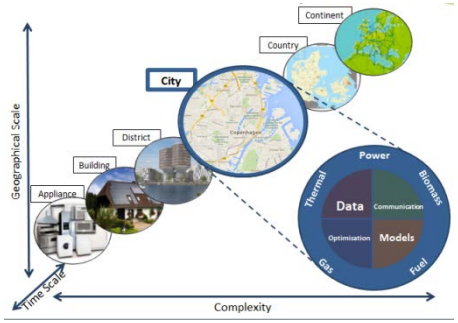
Den grundlæggende ide (bag CITIES)



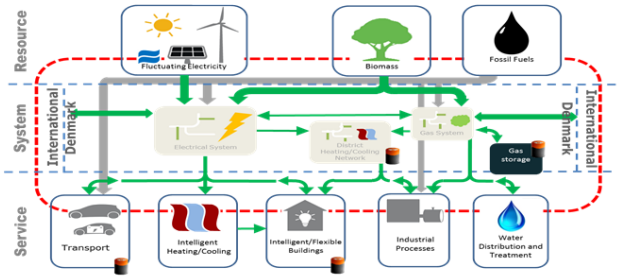
Overgang i verdens energisystemer

Forskningsideen

Dimensioner:



System: (grundtanke)



Vi ønsker at bygge

ÉT MODEL

men

mere realistisk er

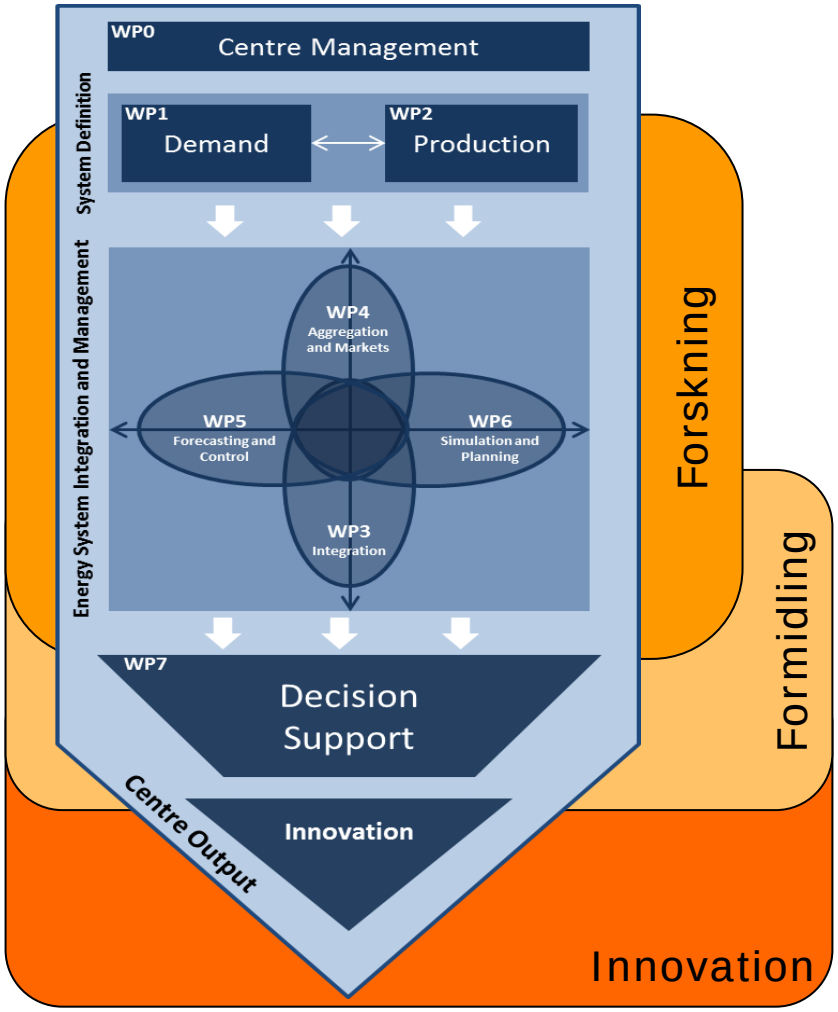
at bygge flere modeller der bygges sammen i

en simuleringsplatform

understøttet af data og en

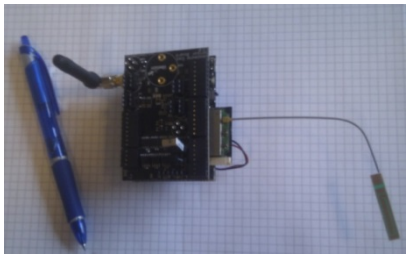
dataplatform

Organisering



Forskningmetoden /r

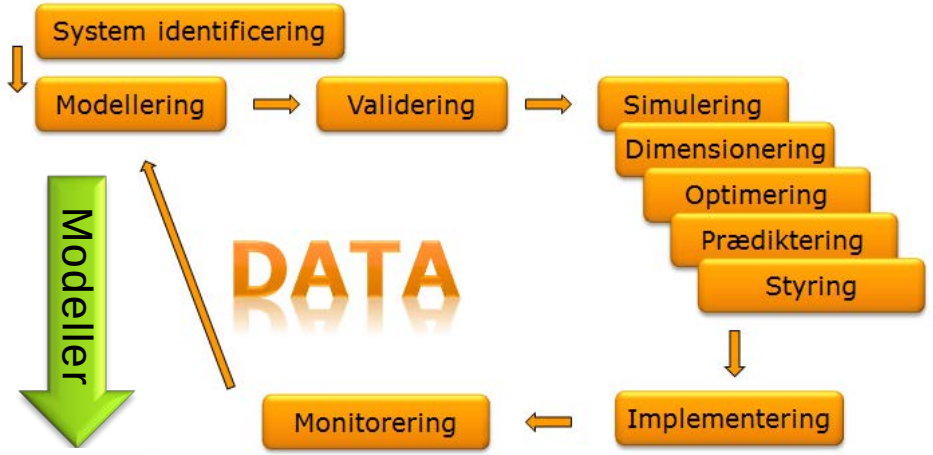
Måling (evidens):

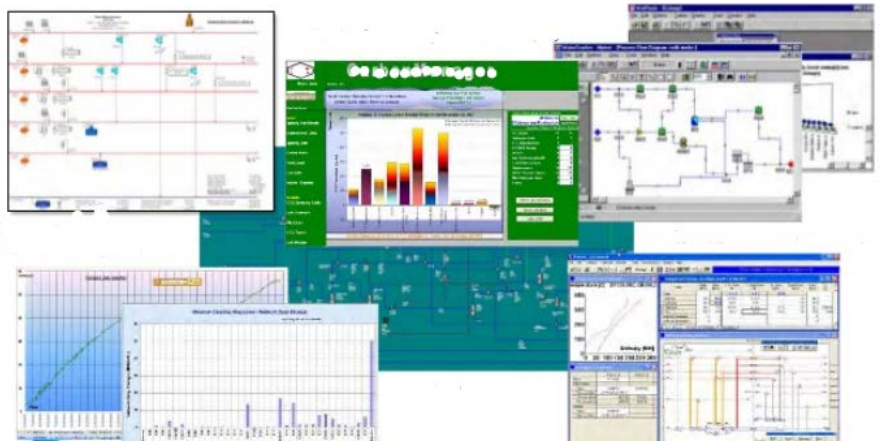


Waspmote Platform

Data

Data som fælles råstof:





Resultater

Metode - Test Labs

- ESIF (NREL, USA)
- Kubic (Tecnalia, Spain)
- DH facilities in S. Korea
- UCD Ireland
- PowerLab.dk (SYSLAB/Bornholm)
- Grundfos test buildings
- Danfoss test facility for supermarket cooling
- DTU's test houses

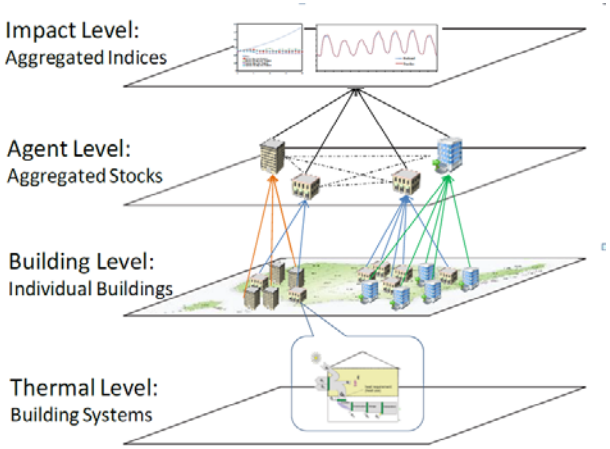
Metode - Living Labs (Byer)

- Modelby: Svendborg
- Odense
- Vinge: Frederikssund
- København
- Århus
- Horsens

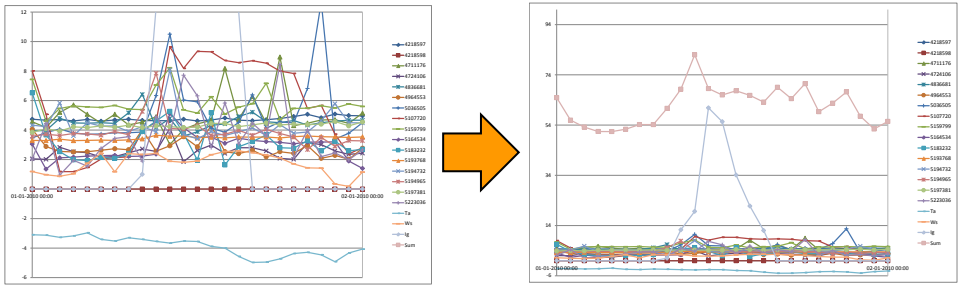
- og flere associeres løbende...

Metode - Cases

Modelby Svendborg



aggregering



Aggregation

One main prerequisite towards the optimization of Smart Cities' energy performance, is the determination of their energy demand. Although significant effort has been placed on the calculation of individual buildings' energy demand, new ways have to be investigated that treat large numbers of buildings as clusters or entities and estimate their energy demand as a whole.

How building energy demand can be determined at aggregated level: streets, neighborhoods or whole cities.

- Numerical methods
  - Simplest calculation of summing all energy demands up
  - Weighting factors

$$E = \sum_{i=1}^{N} (EUI(i)\, WF(i))$$

, where i is the building or building type

✓ Proposed weighting factors: **share of floor area** with respect to the total floor area

- Statistical models → Regression models for short-term heat load forecasting
- Urban Simulation Tools → Parallel processing of individual building energy simulations, while considering the neighboring buildings in terms of shading, wind blockage etc. E.g. *Umi, CitySim*
- Archetype modeling
  - building typologies and databases
  - creation of representative example buildings for every category/type and use these for aggregating energy demands instead of using thousands of buildings in cities.

❖ **Building typologies** serve the need for a wider and more macroscopic assessment of building stocks. The current necessity to evaluate the behavior of several building types in order to determine whether and to what extend they can contribute to more flexible energy demand.

Building typologies rely on **parameters** such as:

Primarily	Secondarily
▪ Energy performance	▪ Existing ventilation and heating/cooling systems
▪ Use of building	▪ Existing Energy systems
▪ Age of construction	▪ Renovation and potential energy retrofitting

Lille suk:

1 års arbejde for at etablere opsamling af data fra 140 bygninger

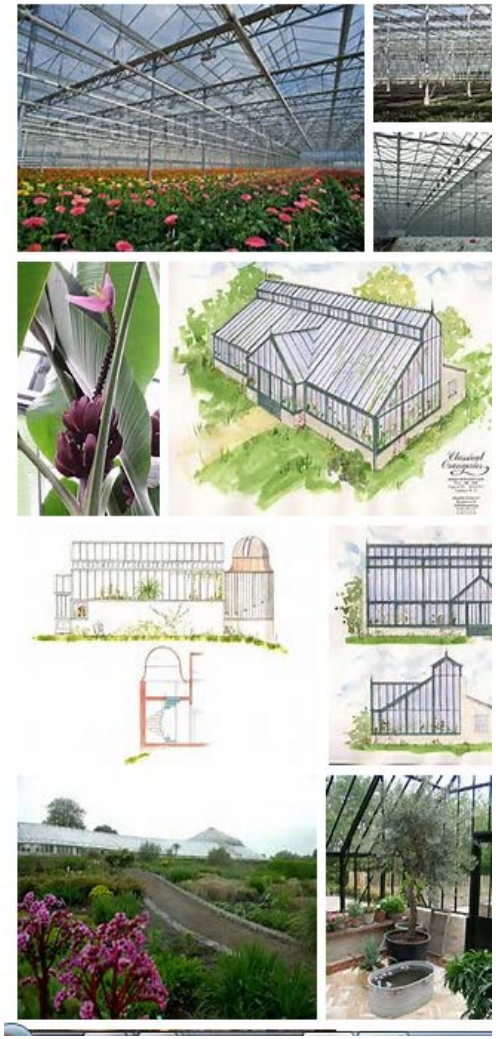
(el, fjernvarme, gas)

Case – Dynamiske Fjernvarmepriser

Erfaringer opsamles

Dynamiske modeller opbygges og simuleringer bruges for at skabe scenarier

Kontrakter defineres of forsøges anvendt



Case – Fleksibilitet i væksthuse

Væksthuse

– særpræget hygrotermiske forhold

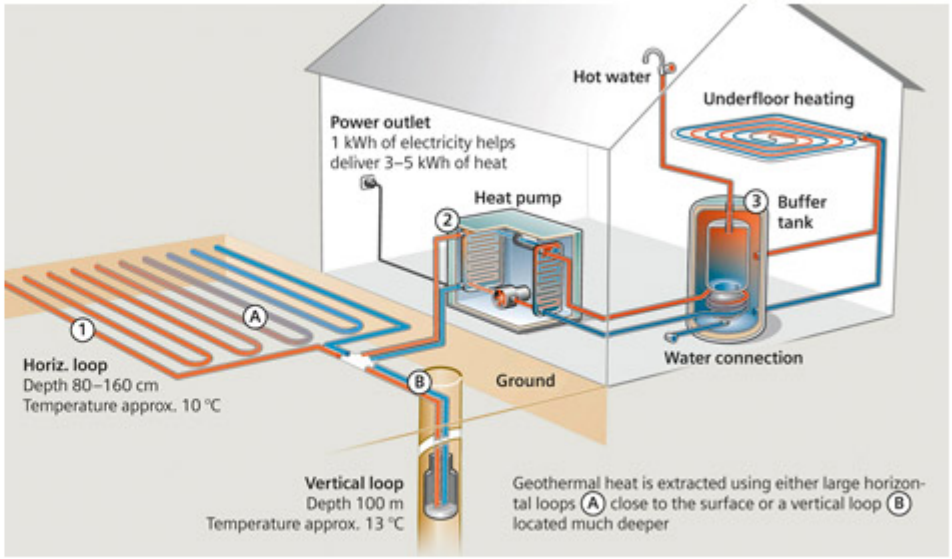
- mulighed for at køre temperaturen op og ned

- mulighed for ekstra termiske buffere

Case – Styring af Heat Pumps

Heat Pumps Extract Heat from the Ground

1) Ground warms cold water flowing through horizontal or vertical loops.
2) Heat pump extracts heat from the water and compresses the gas in order to make it hotter.
3) Heat is stored and is available for heating and hot water production.



Greybox modeller til prædiktering af varmebehov ud fra vejret og energipriser

Innovation: MPC styringer for bygninger, fjernvarme og meget andet