Integrated and Intelligent Energy Systems

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Akademiet for de Tekniske Videnskaber

CITIES

Driver for changes - Demand by Society

ENERGY POLICIES

The government's energy policy milestones up to 2050

In order to secure 100 pct. renewable energy in 2050 the government has several energy policy milestones in the years 2020, 2030 and 2035. These milestones are each a step in the right direction, securing progress towards 2050.

2020

Half of the traditional consumptions of electricity is covered by wind power

2030

Coal is phased out from Danish power plants

Oil burners phased out

2035

The electricity and heat supply covered by renewable energy

2050

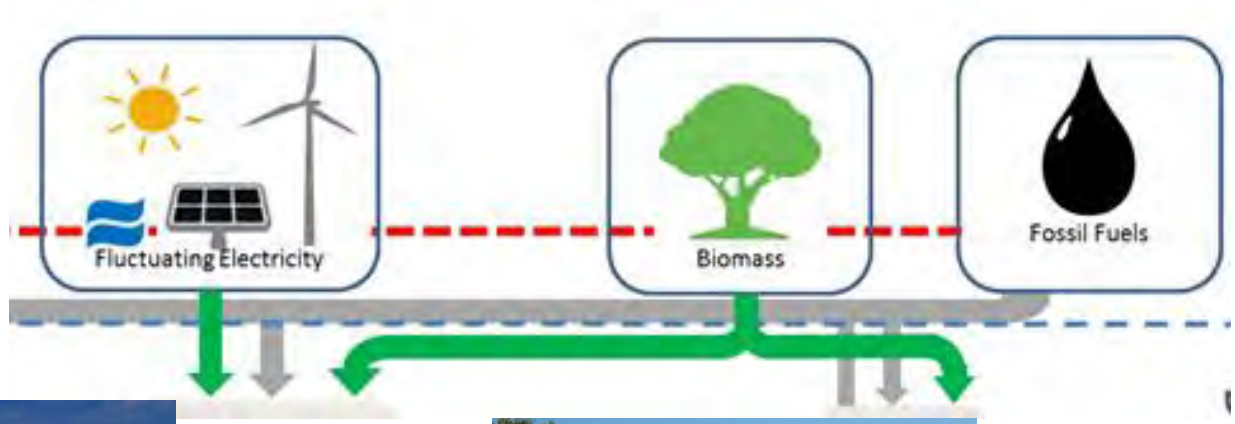
All energy supply – electricity, heat, industry and transport – is covered by renewable energy

The initiatives up to 2020 will result in a greenhouse gas red[illegible]n by 35 pct. in relation to 1990.

Source: "Our [illegible]ure Energy", the Danish Parliament, Nov. 2011

100% share of RE in the heating sector by 2035

Solution – Renewable Energy Sources



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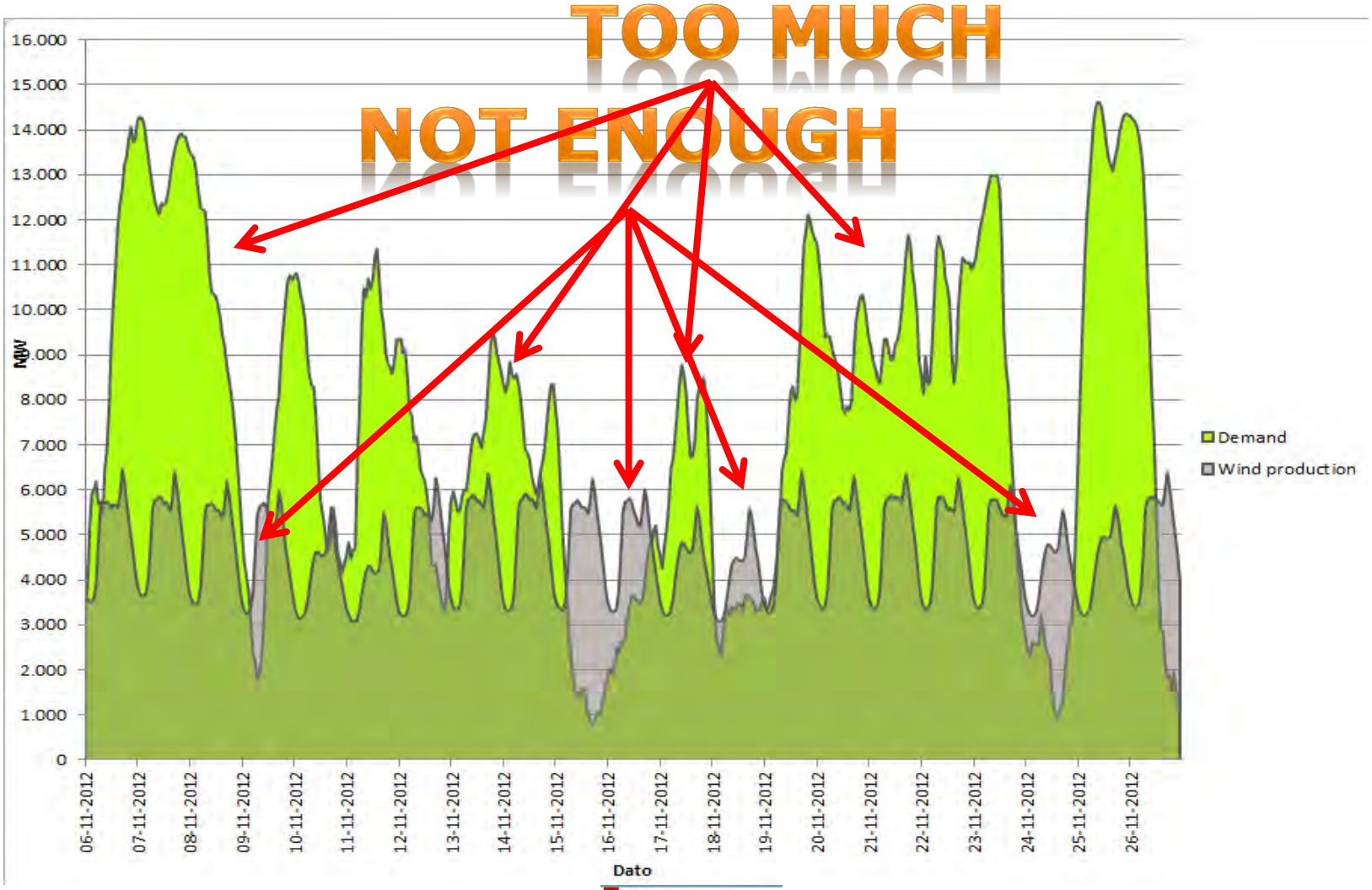
Resulting challenge – Fluctuations



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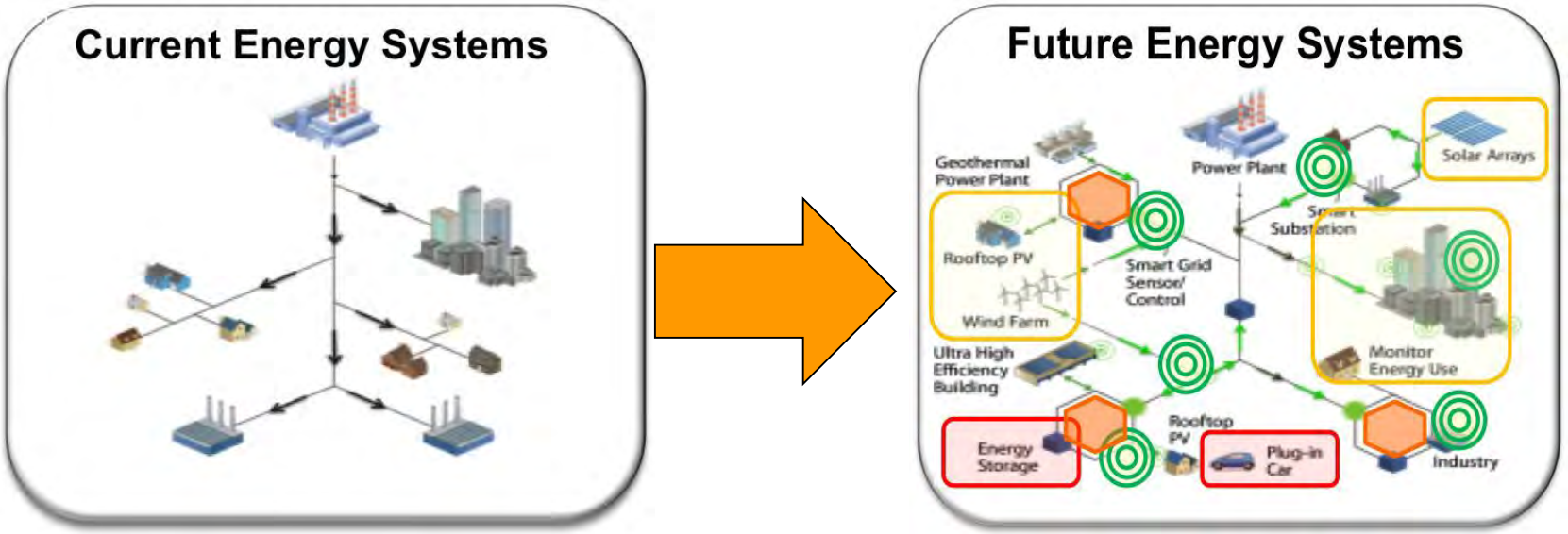
The proposed solution – Smart Grid

- Electrification
- From centralized to decentralized production



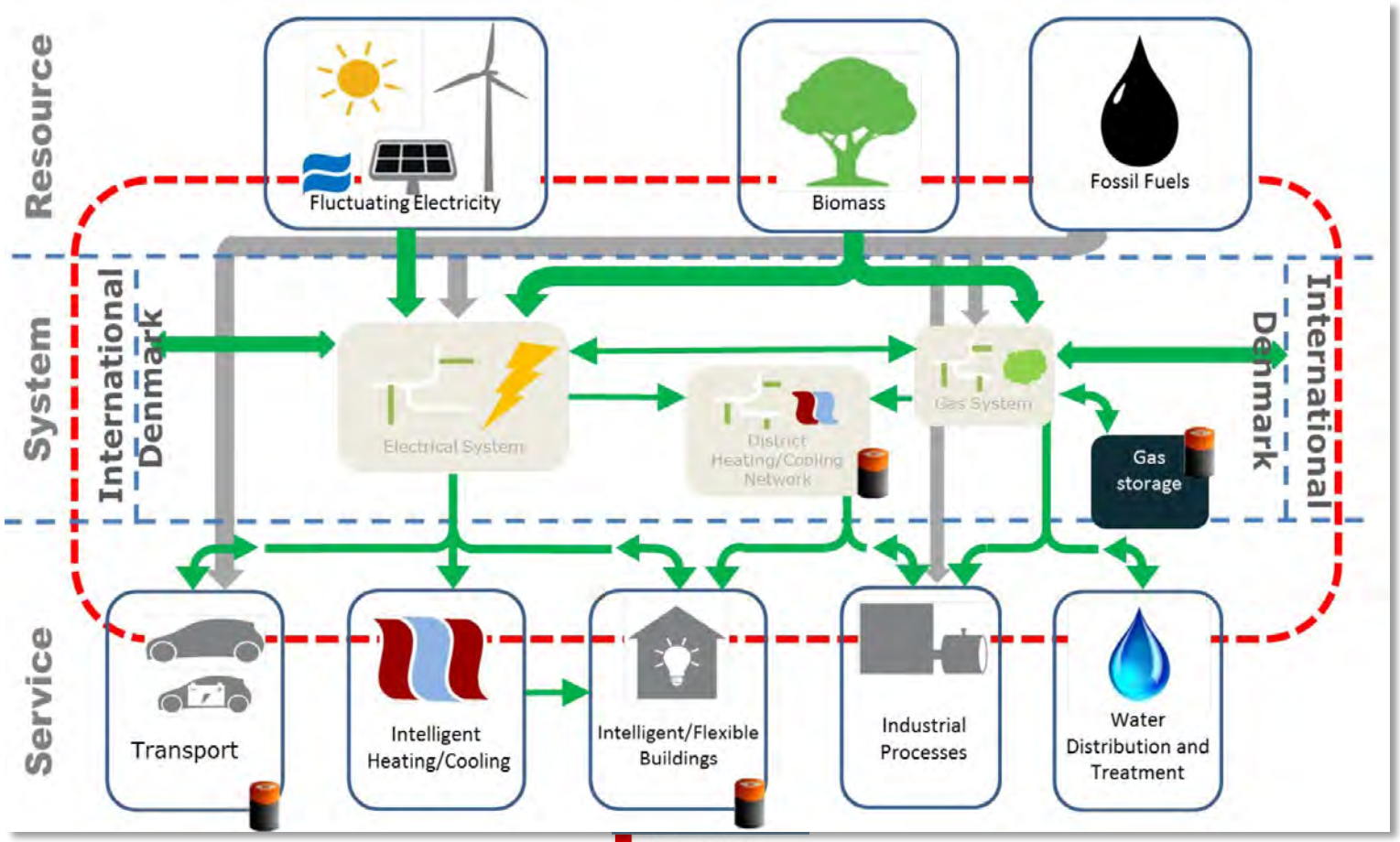
- But still demand for stabilization

Therefore the CITIES Research Centre

The Concept of **Integration** *in CITIES*

... for *operation* and *planning* for future energy systems

Integration



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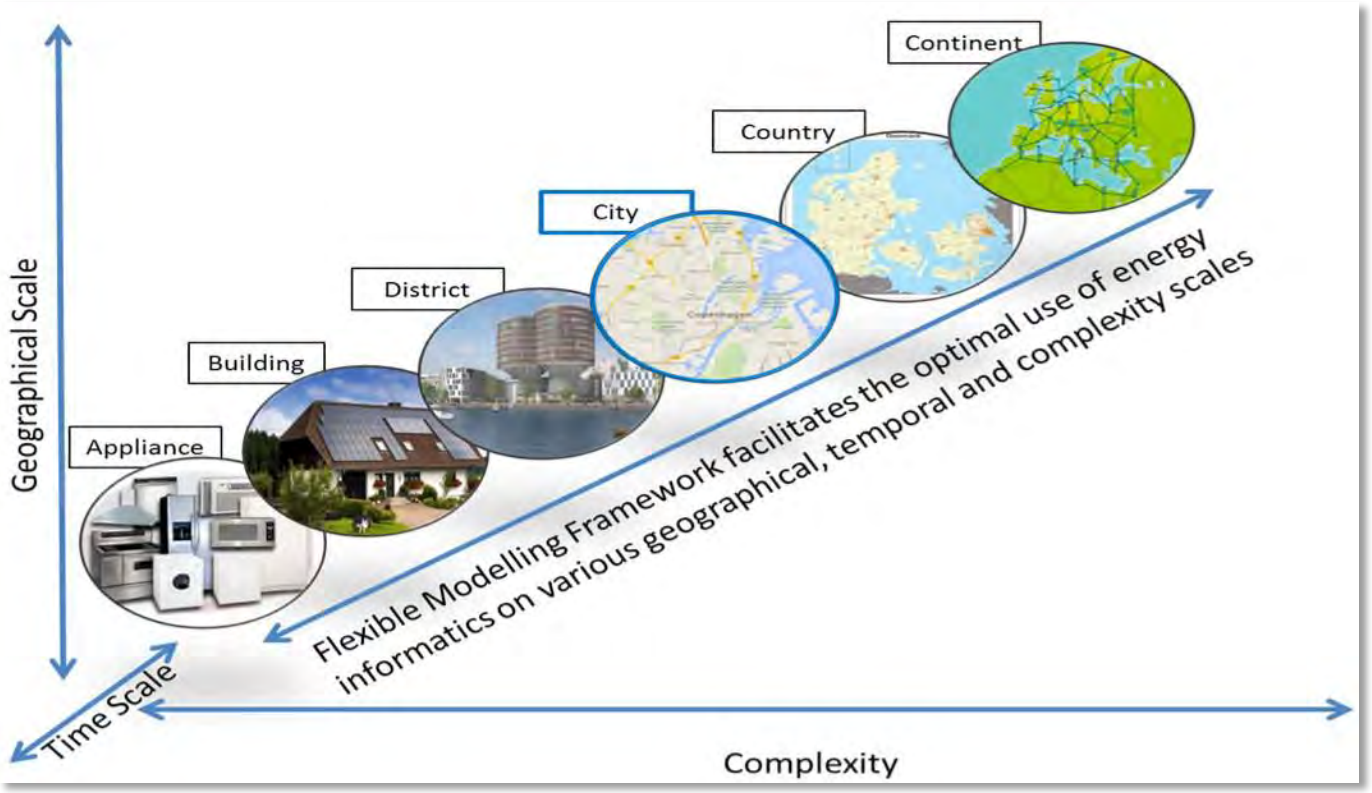
The Concept of Scale *of CITIES*

Scale

Focus on Cities where all grids are close, demand is large

Integration

IT-Intelligence



Why the Scale of Cities?
City = Hub of networks/Grids

Energy System – District Heating (A network)
- Electricity

Communications

City + Network Hub + IT-Intelligence

IT-Intelligence

=

CITIES

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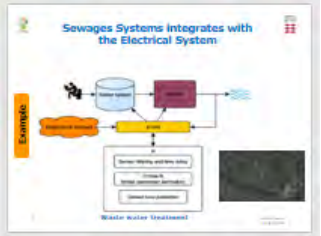
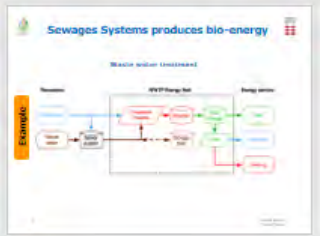
Examples


Buildings deliver
Flexibility to the Thermal System
Example


Sewages Systems integrates with
the Electrical System
Example

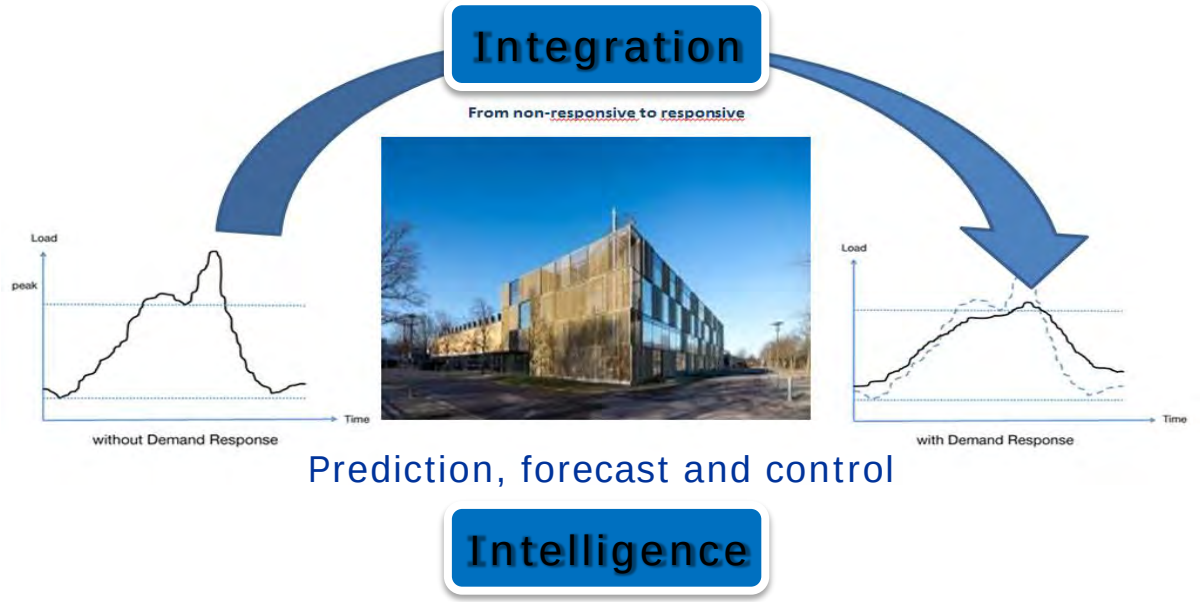

Sewages Systems produces bio-energy
Example


The complete CITIES solution
Example


Even more Grids ...

Buildings deliver Flexibility to the Thermal System

Flexibility from buildings (single and aggregation)



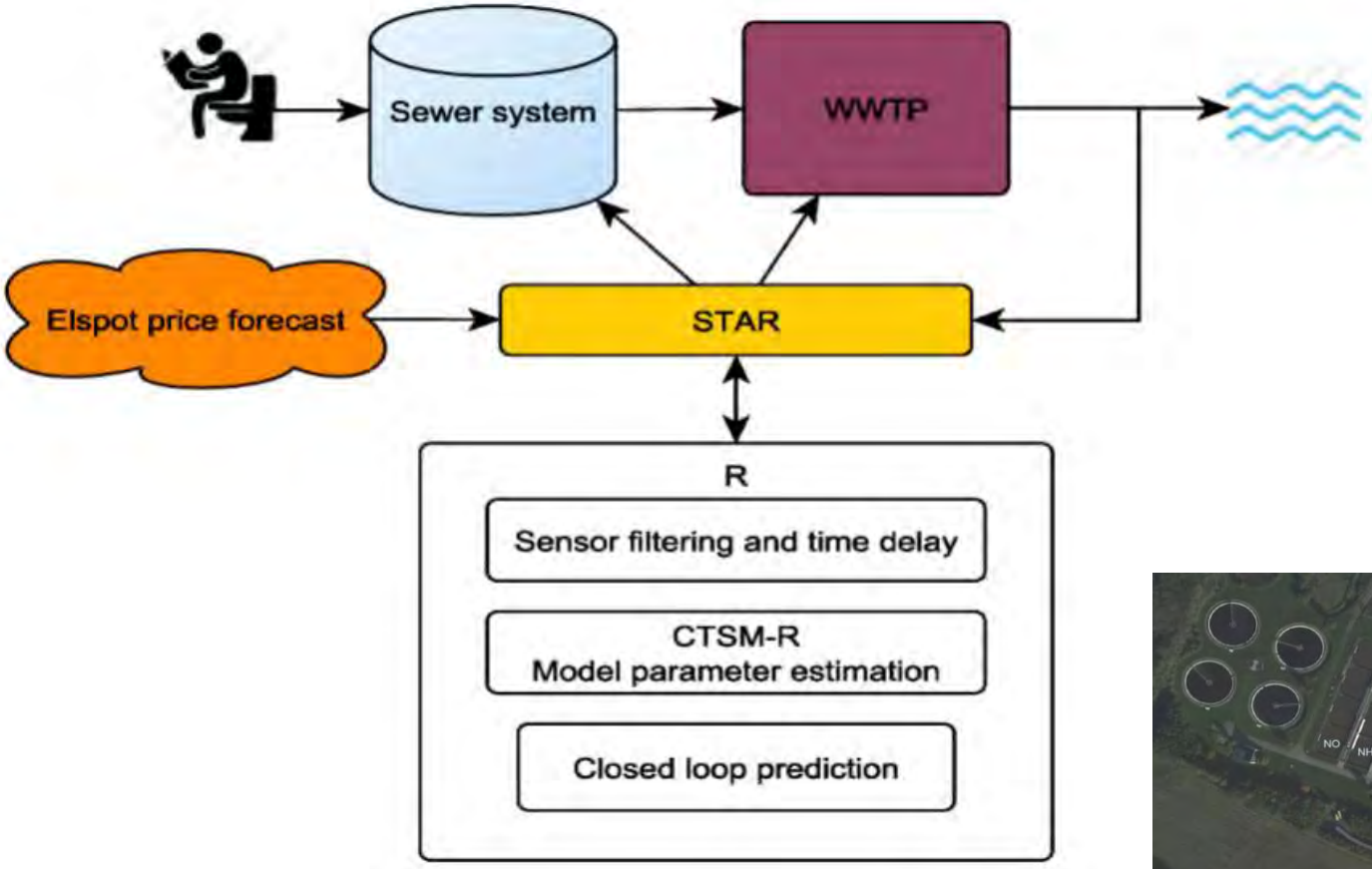
Example

Flexibility though

- heat pumps in district heating
- through storage (expensive, additional costs)

Sewages Systems integrates with the Electrical System

Example

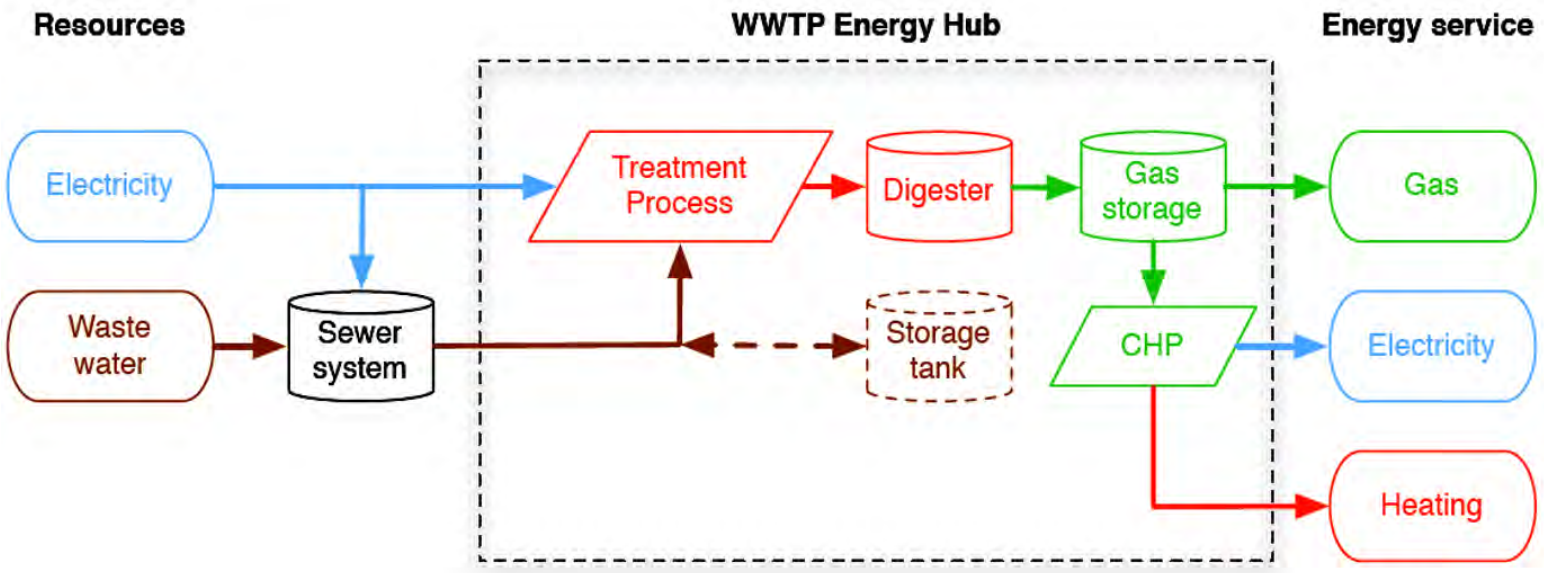


Waste water treatment

Sewages Systems produces bio-energy

Example

Waste water treatment



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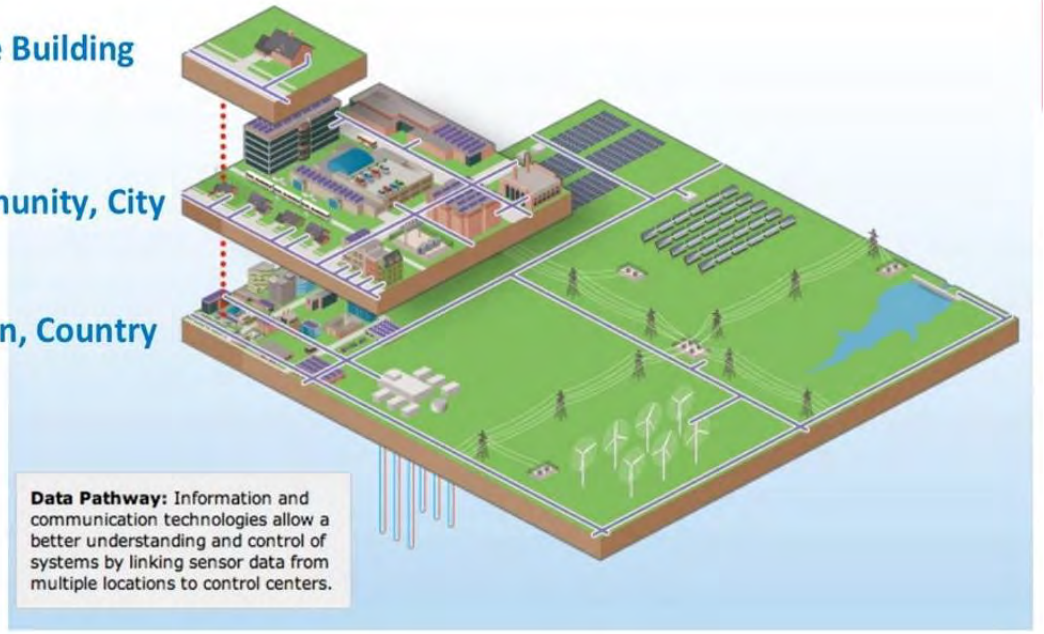
The complete CITIES solution

Example



Electricity

Thermal

Fuel

GRIDS

Communication

Intelligence

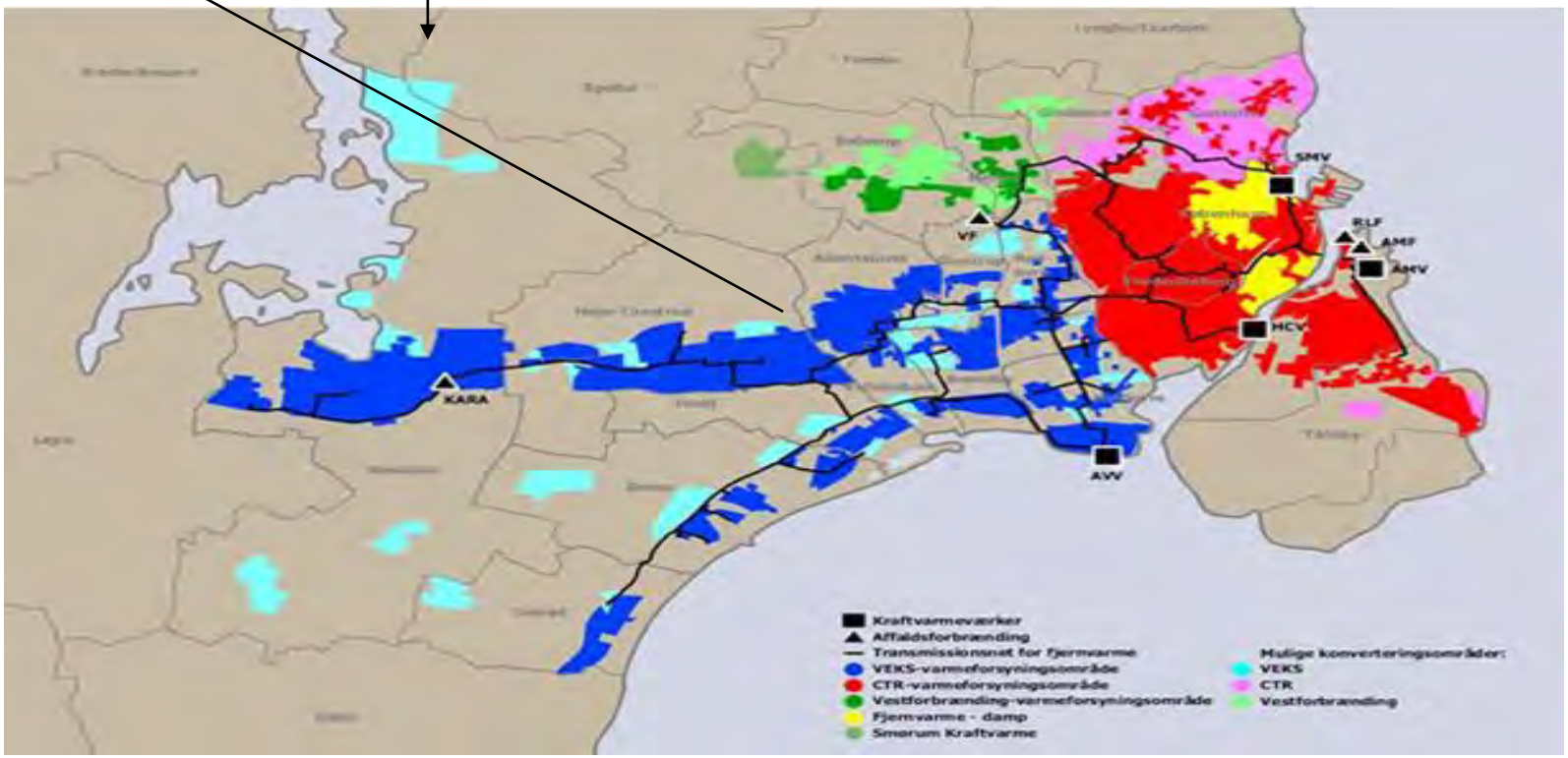
Data

Integration across grids and scales

Even more Grids …

There is much more

+ Organisations + Humans




"... and they all lived happily ever after."

Smart City = Complexity

We cannot handle this complexity to find sustainable and robust solutions

We need Science that can manage these complexities

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From Smart City → To Smart Society

- ✓ We handle the big grids individually quite well
- ✓ We are on the way to handle ”big data” (as shown at this event)

We need to master

- ✓ Integration
- ✓ Intelligence

We need to advance science in it’s own right

We don’t know how-to:

- ❑ combine models, methods and tools
- ❑ do science in this complexity
  - where theories are to be combined in valid ways
  - where numerical methods are scalable
  - etc.

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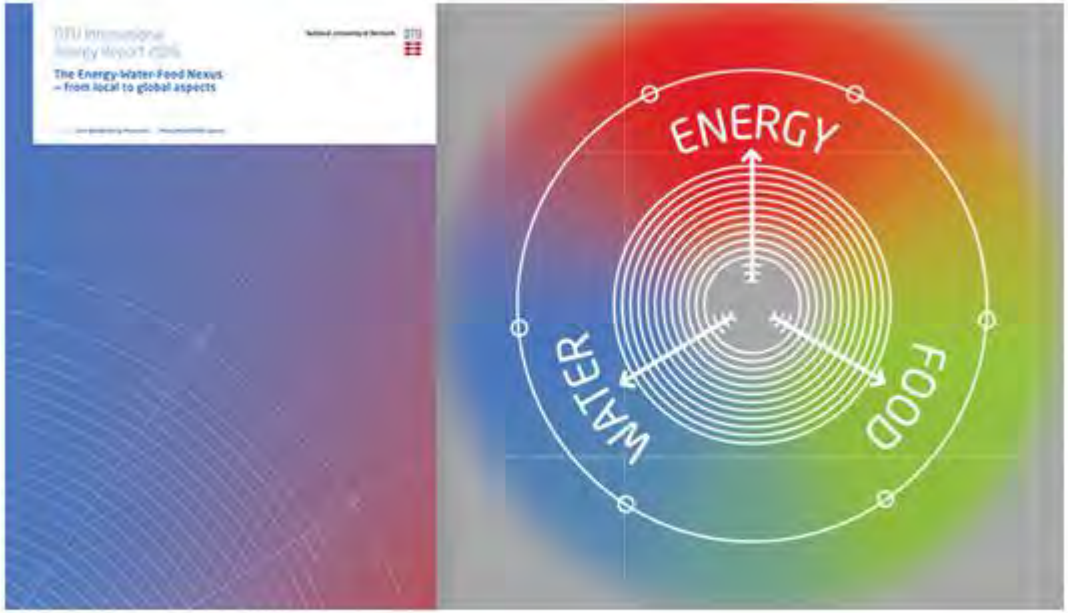
DTU inviterer til præsentation af DTU International Energy Report 2016:

THE ENERGY-WATER-FOOD NEXUS – FROM LOCAL TO GLOBAL ASPECTS



DATO OG TID: 6. december 2016, 13:00 – 17:30

STED: DTU, mødelokale 1, Bygning 101 A, Anker Engelunds Vej 1, 2800 Lyngby

THANK YOU

Alfred Heller
22/11/2016