Centre for IT-Intelligent Energy Systems (CITIES)
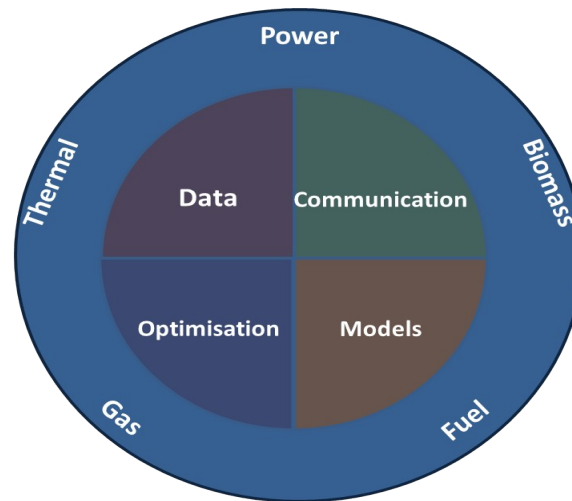
Henrik Madsen, DTU Compute

http://www.henrikmadsen.org

Quote by B. Obama at the Climate Summit in New York:

(a couple of weeks ago)

*We are the **first generation** affected by climate changes,*

*and we are the **last generation** able to do something about it!*

Potentials for renewable energy

DTU

- **Scenario**: We want to cover the worlds entire need for power using wind power.

- How large an area should be covered by wind turbines?

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Potentials for renewable energy

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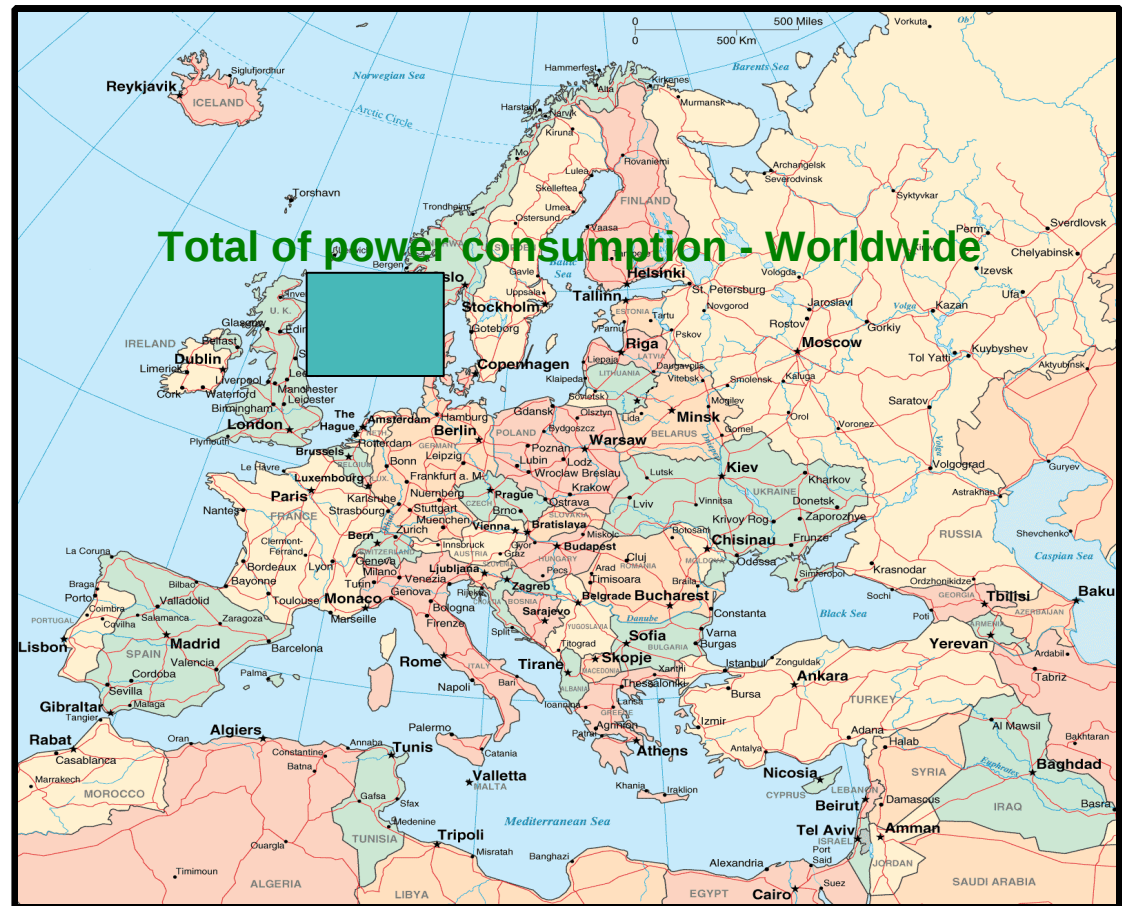
- How large an area should be covered by wind turbines?

- **Conclusion**: Use intelligence ….

- Calls for **IT / Big Data / Smart Energy Solutions / Modelling / Optimization**
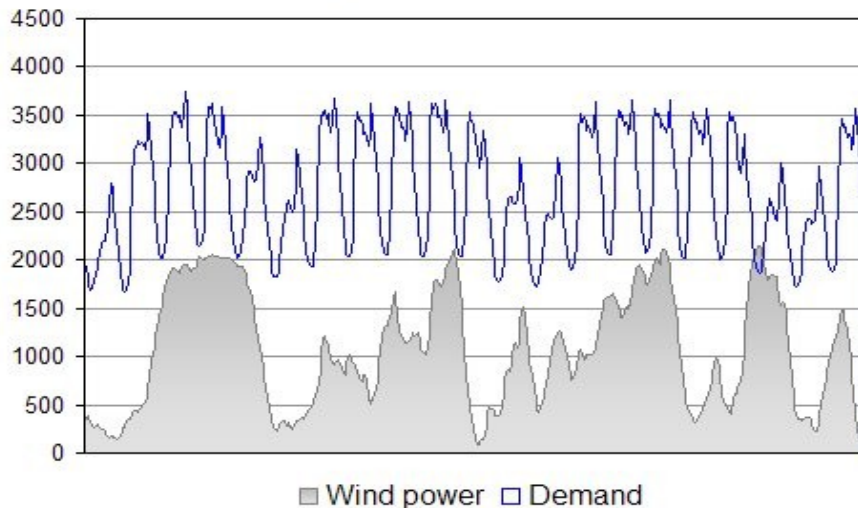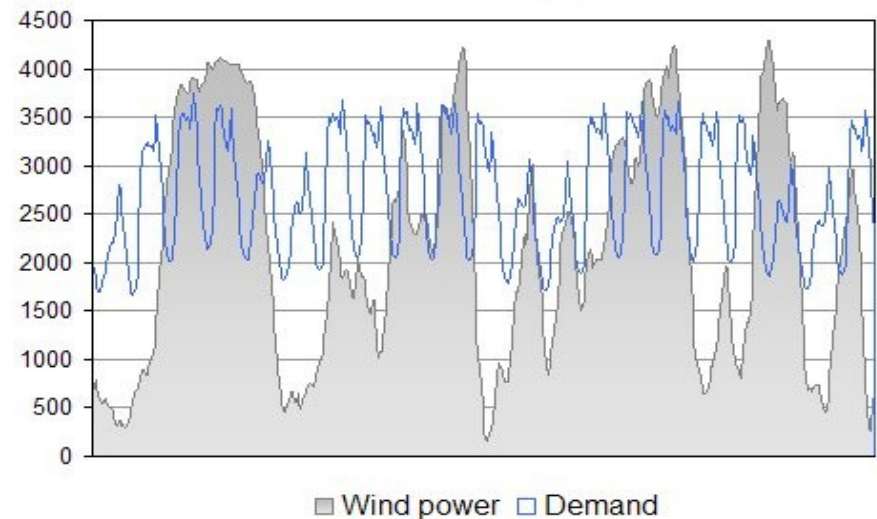

Total of power consumption - Worldwide

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The Danish Wind Power Case

.... balancing of the power system

DTU

25 % wind energy (West Denmark January 2008)


■ Wind power ☐ Demand

50 % wind energy

■ Wind power ☐ Demand

In 2008 wind power did cover the entire demand of electricity in 200 hours (West DK)

In December 2013 and January 2014 more than 55 pct of electricity load was covered by wind power. And for several days the wind power production was more than 120 pct of the power load

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Jutland - Sweden
Exports: 728 MW
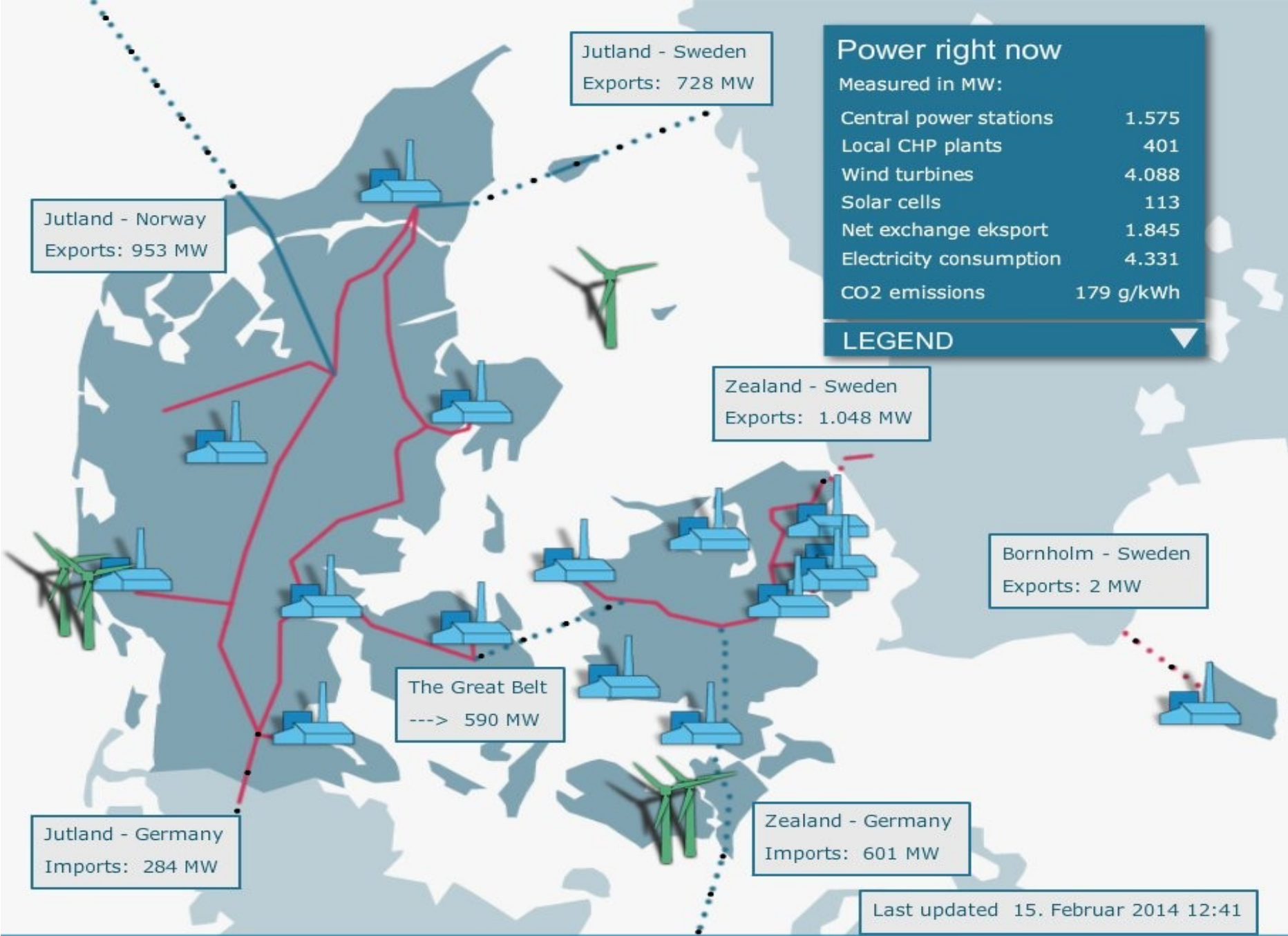
Power right now

Measured in MW:

Central power stations	1.575
Local CHP plants	401
Wind turbines	4.088
Solar cells	113
Net exchange eksport	1.845
Electricity consumption	4.331
CO2 emissions	179 g/kWh

LEGEND ▼

Jutland - Norway
Exports: 953 MW

Zealand - Sweden
Exports: 1.048 MW

Bornholm - Sweden
Exports: 2 MW

The Great Belt
---> 590 MW

Jutland - Germany
Imports: 284 MW

Zealand - Germany
Imports: 601 MW

Last updated 15. Februar 2014 12:41

● Power right now   ● Natural gas right now   ● Locations

Hypothesis

The **central hypothesis of ESI** is that by **intelligently integrating** currently distinct energy flows (heat, power, gas and biomass) in we can enable very large shares of renewables, and consequently obtain substantial reductions in CO2 emissions.

Intelligent integration will (for instance) enable lossless 'virtual' storage on a number of different time scales.
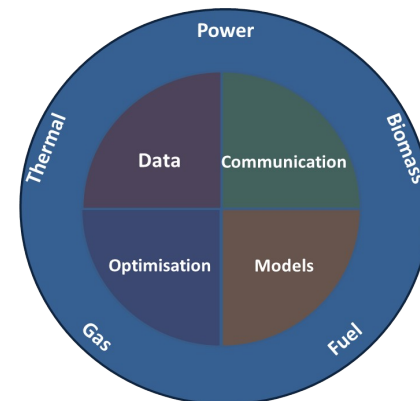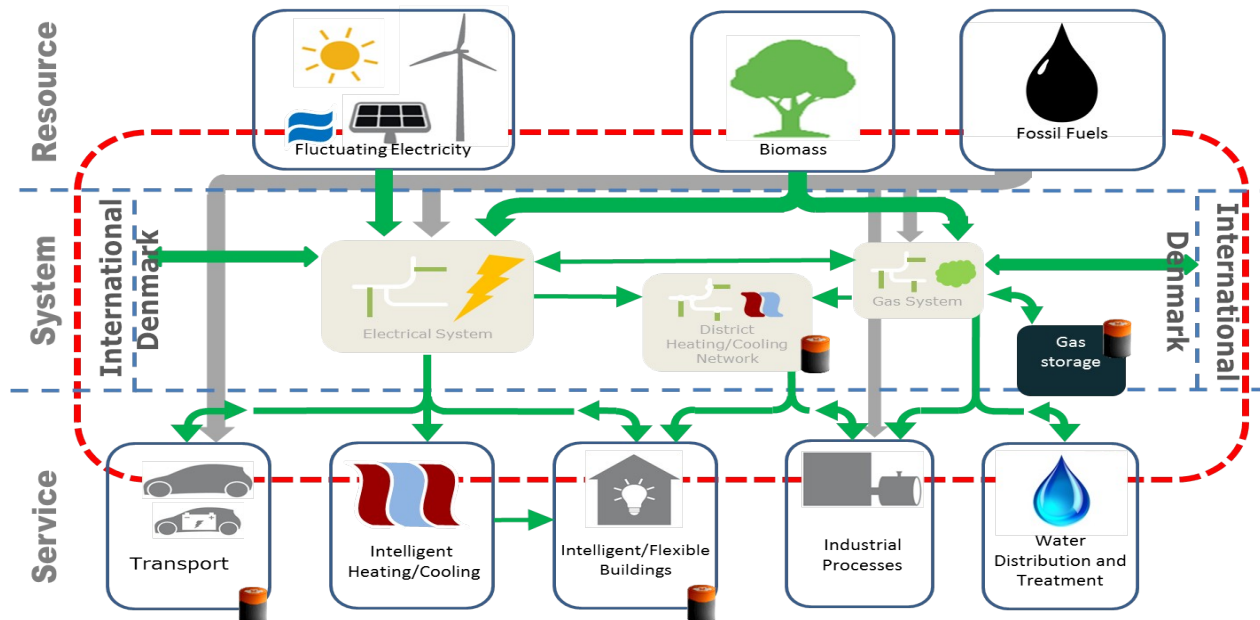
Scientific Objective

To establish methodologies and solutions for design and operation of integrated electrical, thermal, fuel pathways at all scales
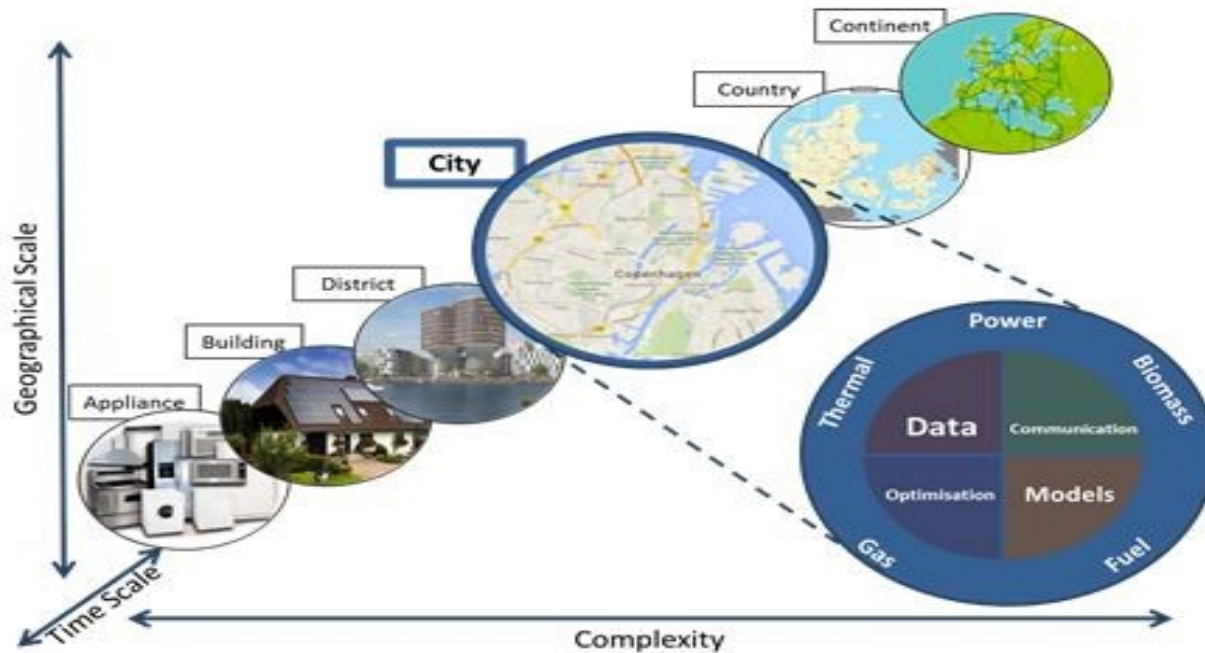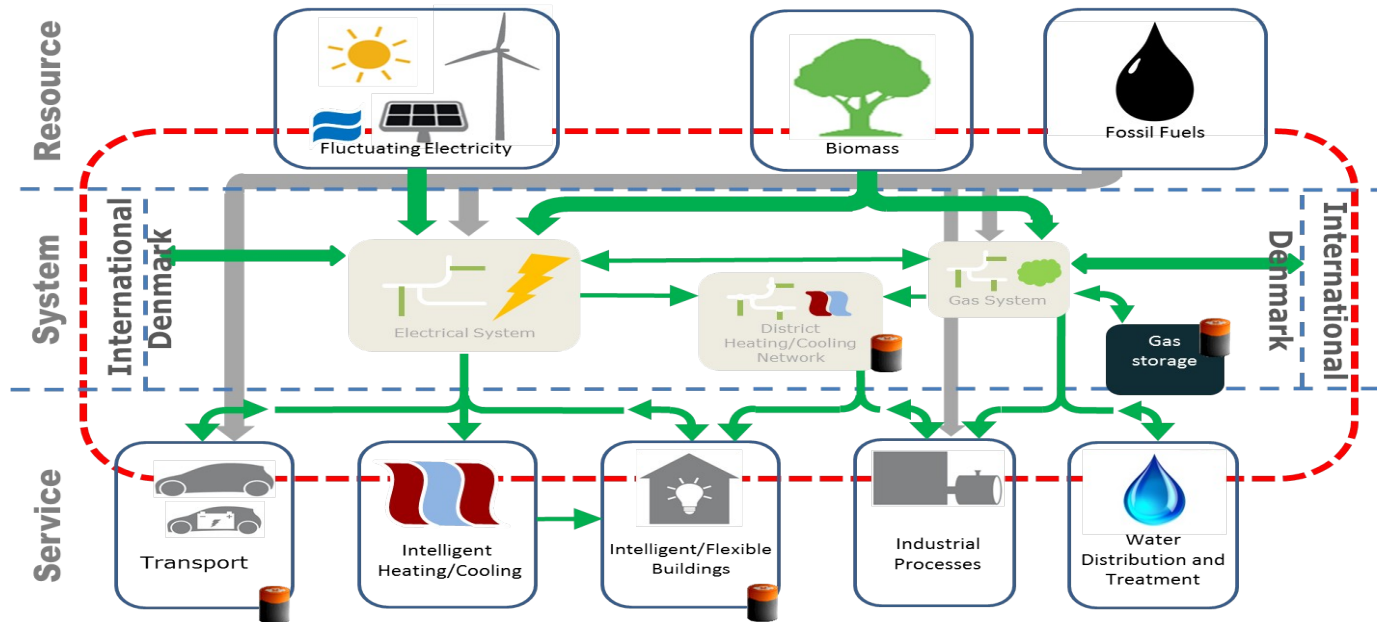
Concepts

Energy Systems Integration using data, models and IT solutions leading to **models and methods for planning and operation of future electric energy systems.**

Example: Storage by Energy Systems Integration

- Denmark (2014) : 48 pct of power load by renewables (> 100 pct at some days in January)
- (Virtual) storage principles:
  - _ Buildings can provide storage up to, say, 5-12 hours ahead
  - _ District heating systems can provide storage up to 1-2 days ahead
  - _ Gas systems can provide seasonal storage