

Perspectives for the Danish energy system towards 2025, 2035 and 2050

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Disposition

- 1. General framework for energy system**
- 2. Scenario for the energy system**
 - 2025, 2035, 2050 (new objects to be controlled by an intelligent system)**
- 3. Intelligent Energy System**
 - Input to R&D&D in CITIES**

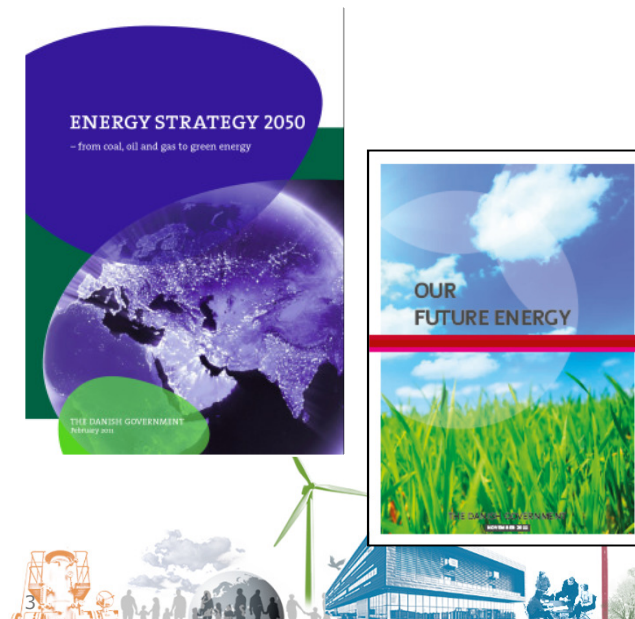


Energy strategy in Denmark

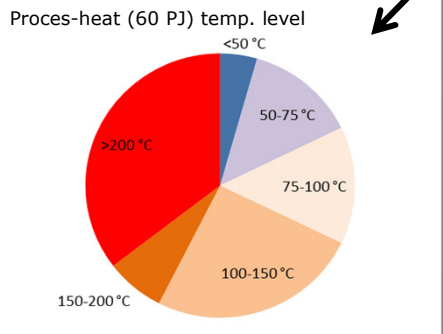
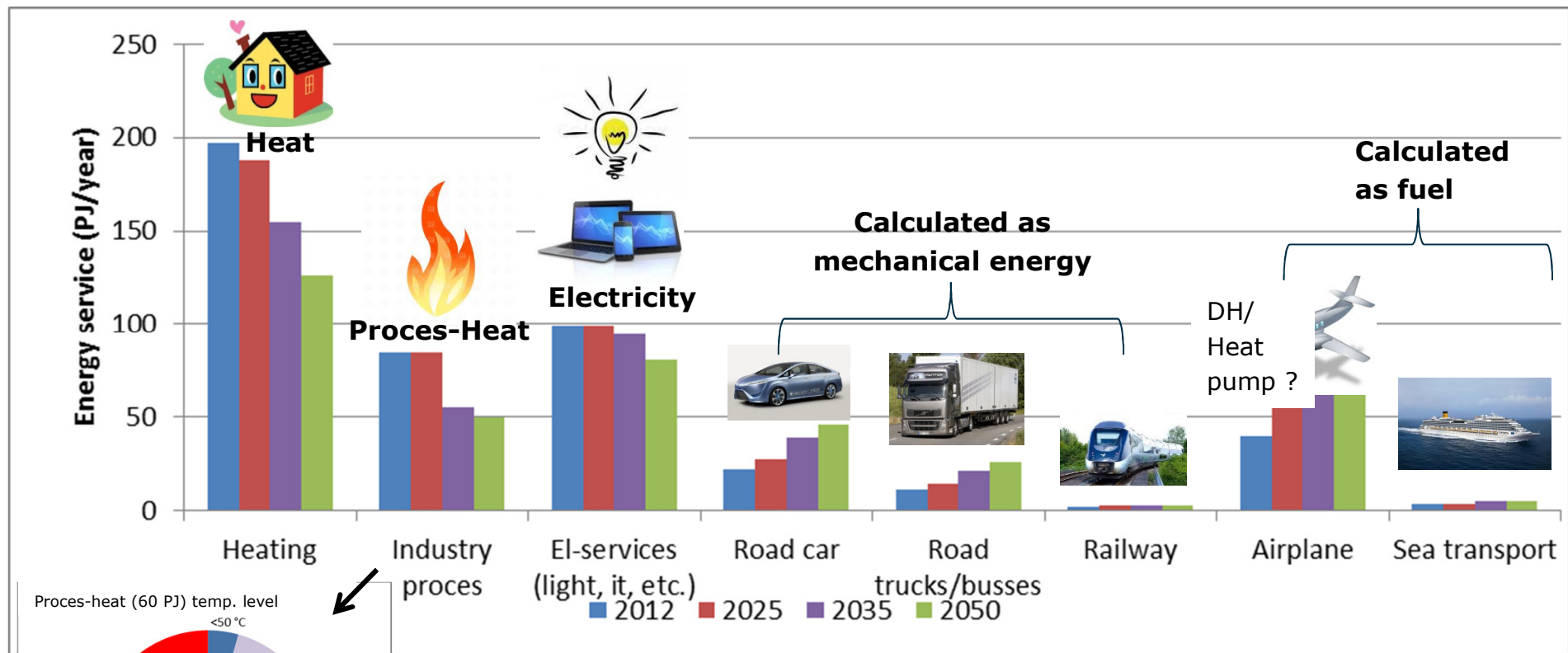
Political targets:

- **2020:** 50% of traditional electricity consumption covered by windpower
(decision supported by 95% of parliament)
- **2035:** All electricity and heat based on renewable energy
(governmental position)
- **2050:** The total* energy supply based on renewable energy
(target supported by 95% of parliament)

*Total energy system incl. transport, industry etc.



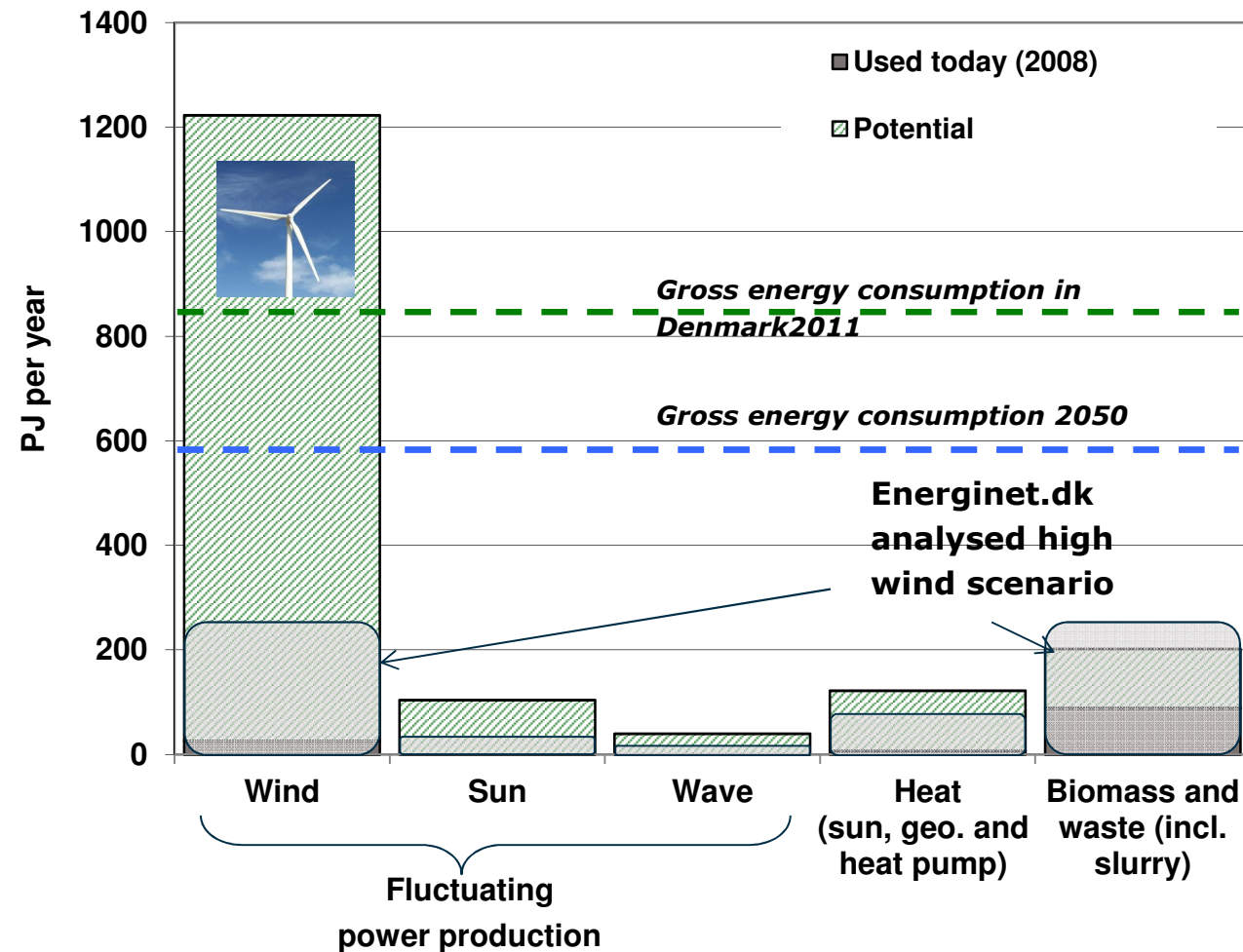
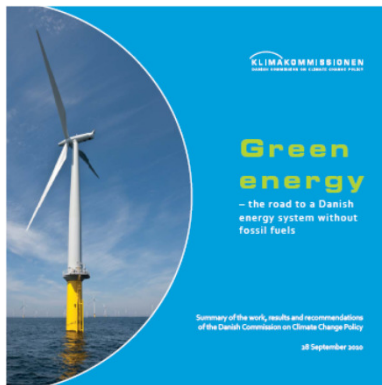
Energy services towards – forecast example (high efficiency scenario)



***A significant increase in transport services !
A decrease in heat demand !***

Domestic renewable resources to reach 100% renewable energy by 2050

Danish Commission on Climate Change Policy, 2010

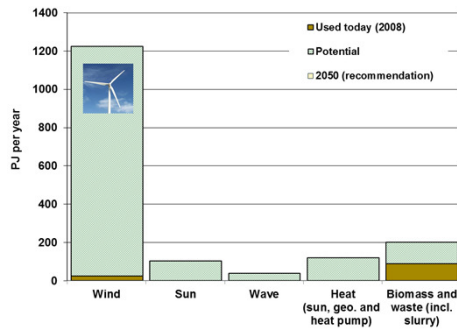


Design of energy system ?

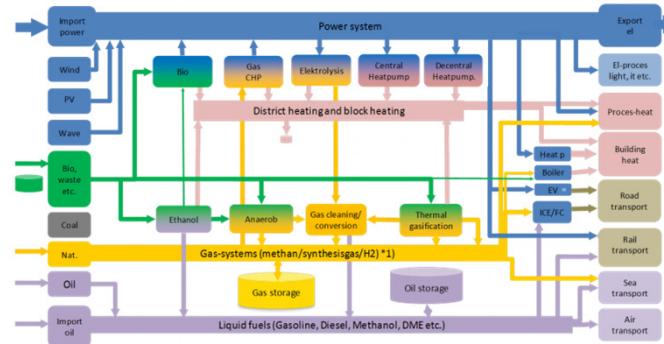
Energy -ressource

Energy-system

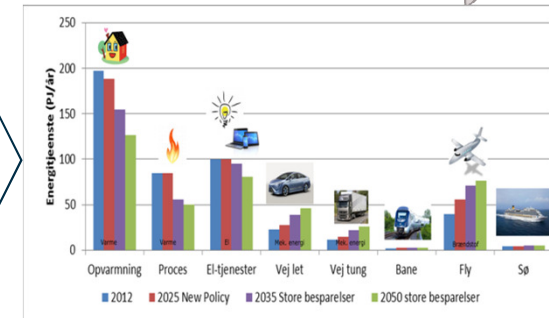
Energy-service



Sustainable energy

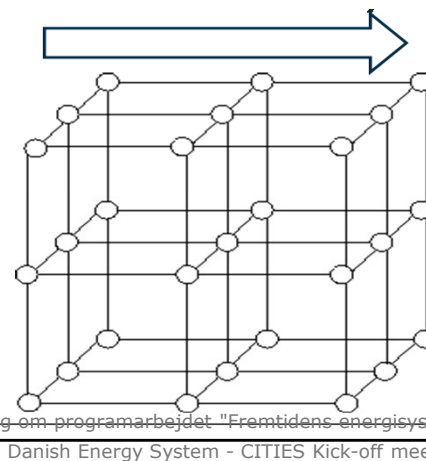
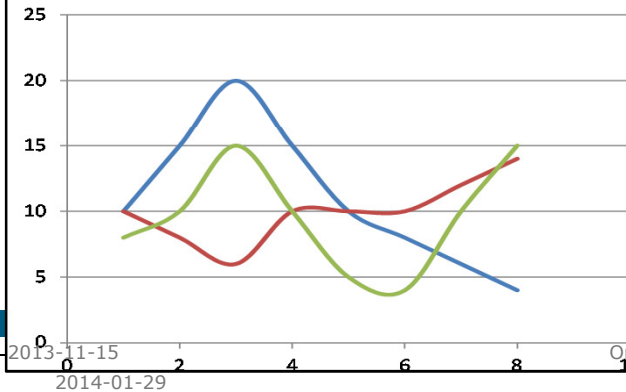


**Integrated system
Flexible and efficient
(economy and energy)**

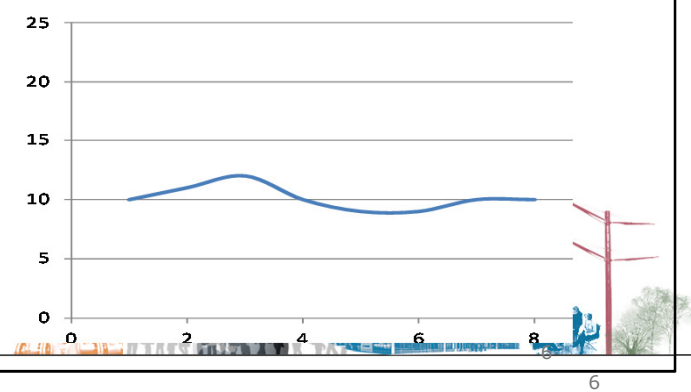


Low and stable costs

Energy resources



Costs energy services



Energy flows in system (not scaled)

Ressource

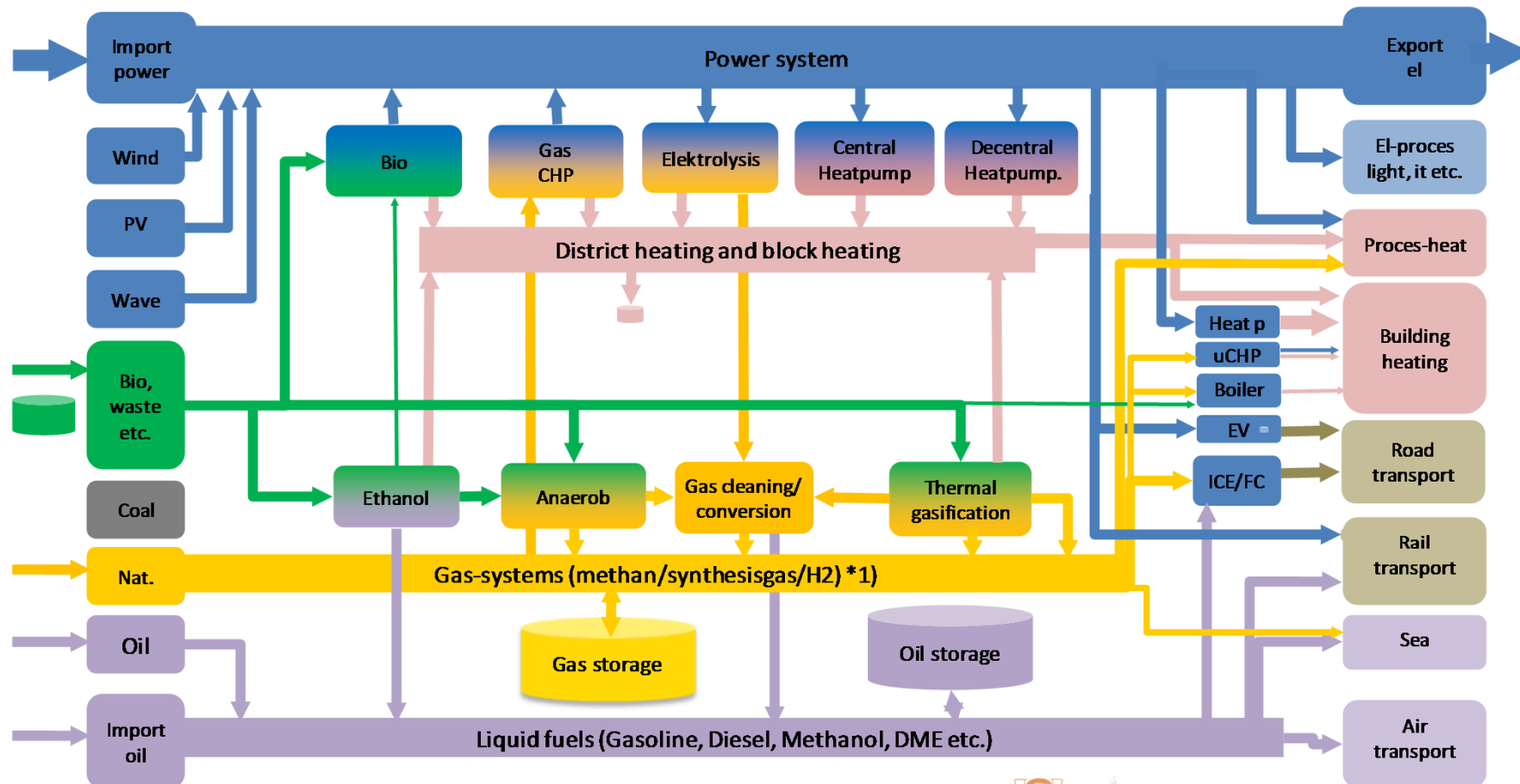
Sustainable energy

Energy-system

Flexible and efficient (economy and energy)

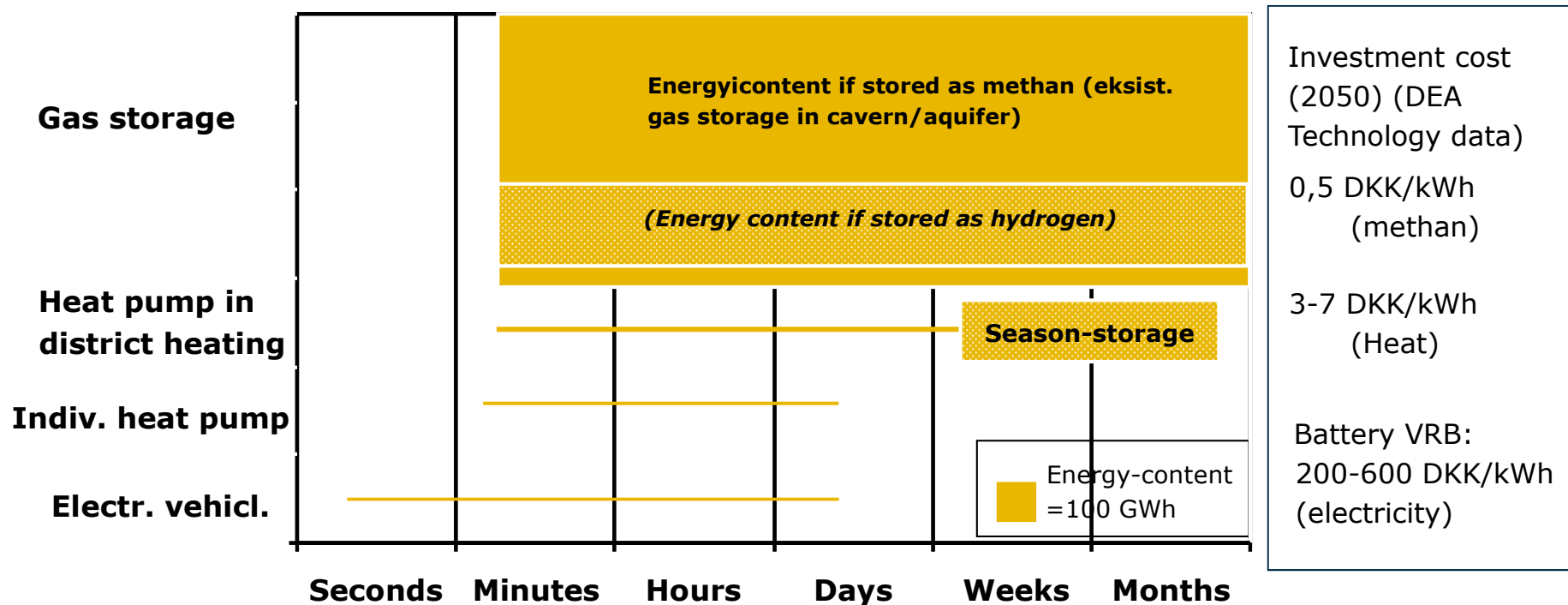
Energy service

Low and stable costs



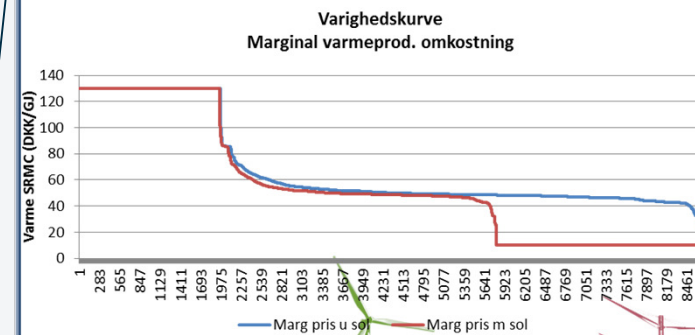
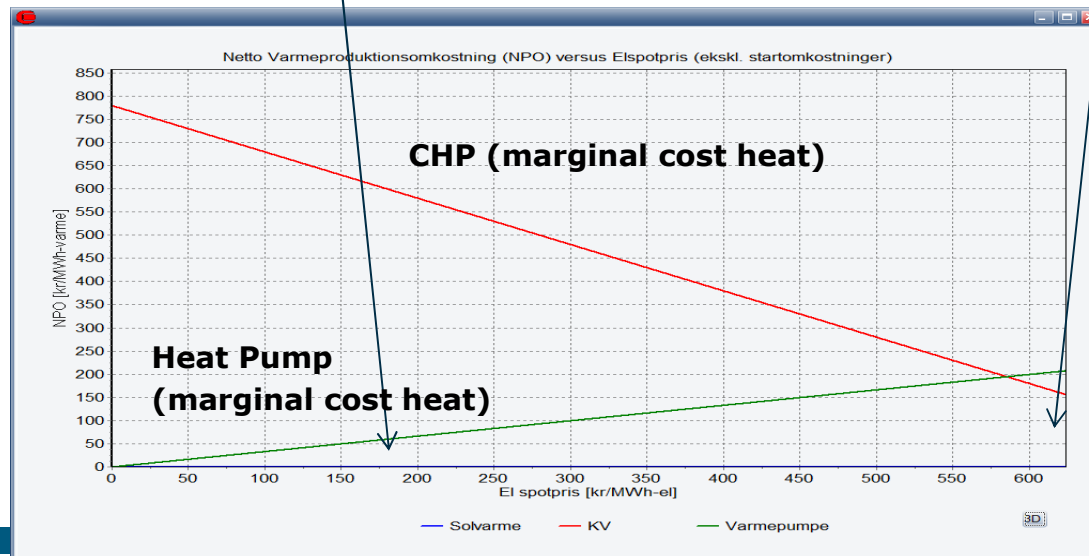
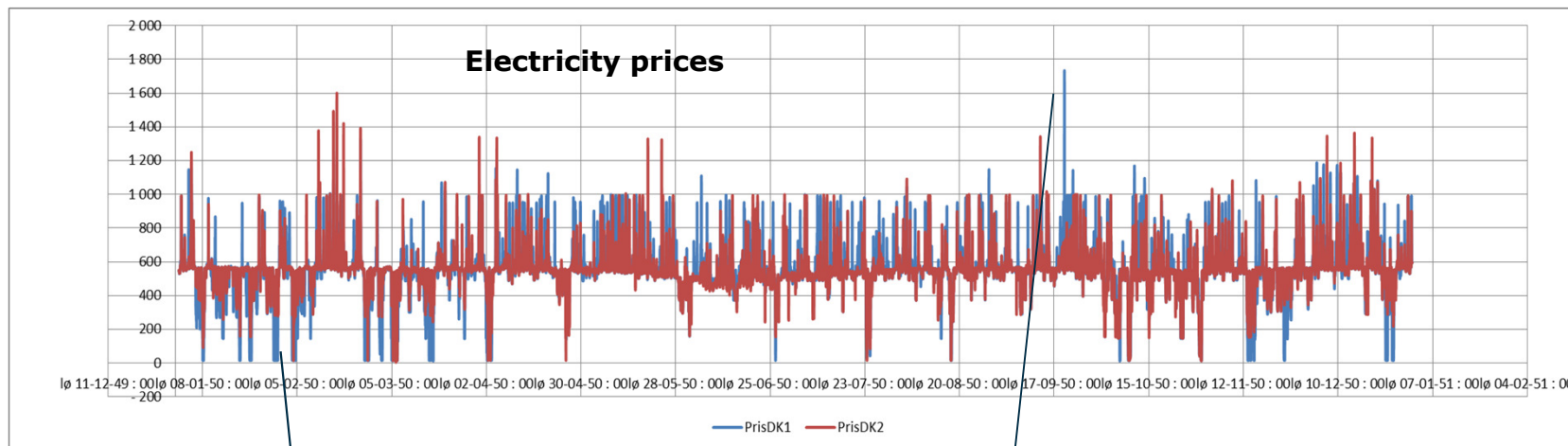
Flexibility in energy systems to integrate wind power (scenario 2050)

Storage capacity (input of electricity)

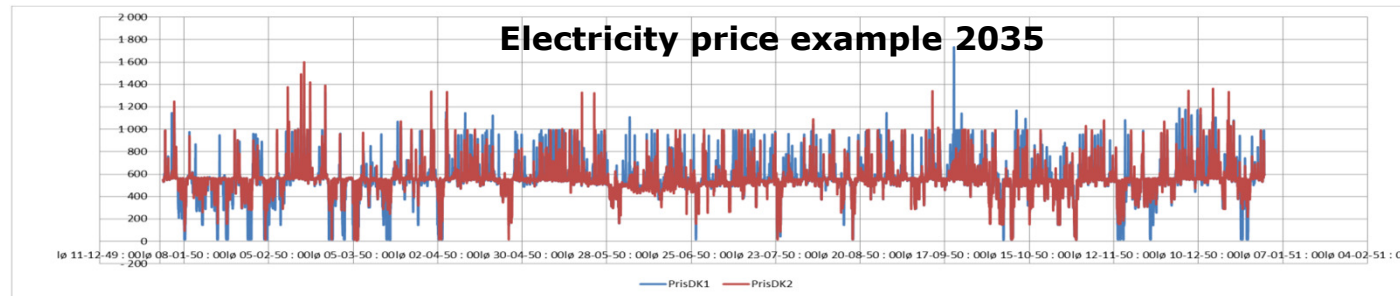


- International integration with hydropower a primary issue for flexibility
- Heat pumps and electric vehicles – flexibility for hours
- Gas/fuel system to deliver further flexibility and security of supply

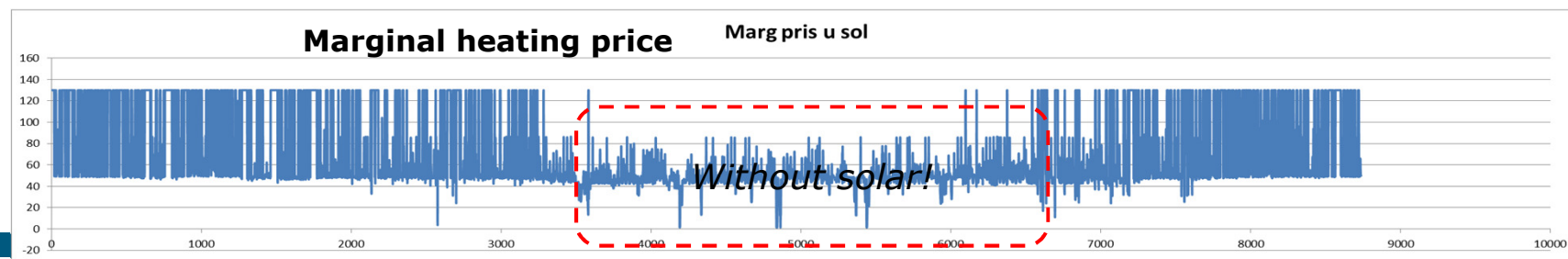
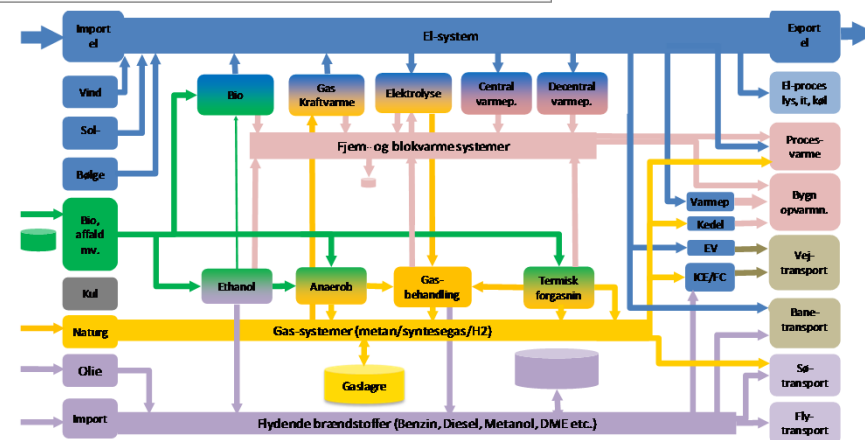
Decoupling of fluctuating electricity price with district heating system (case 2035)



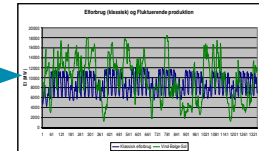
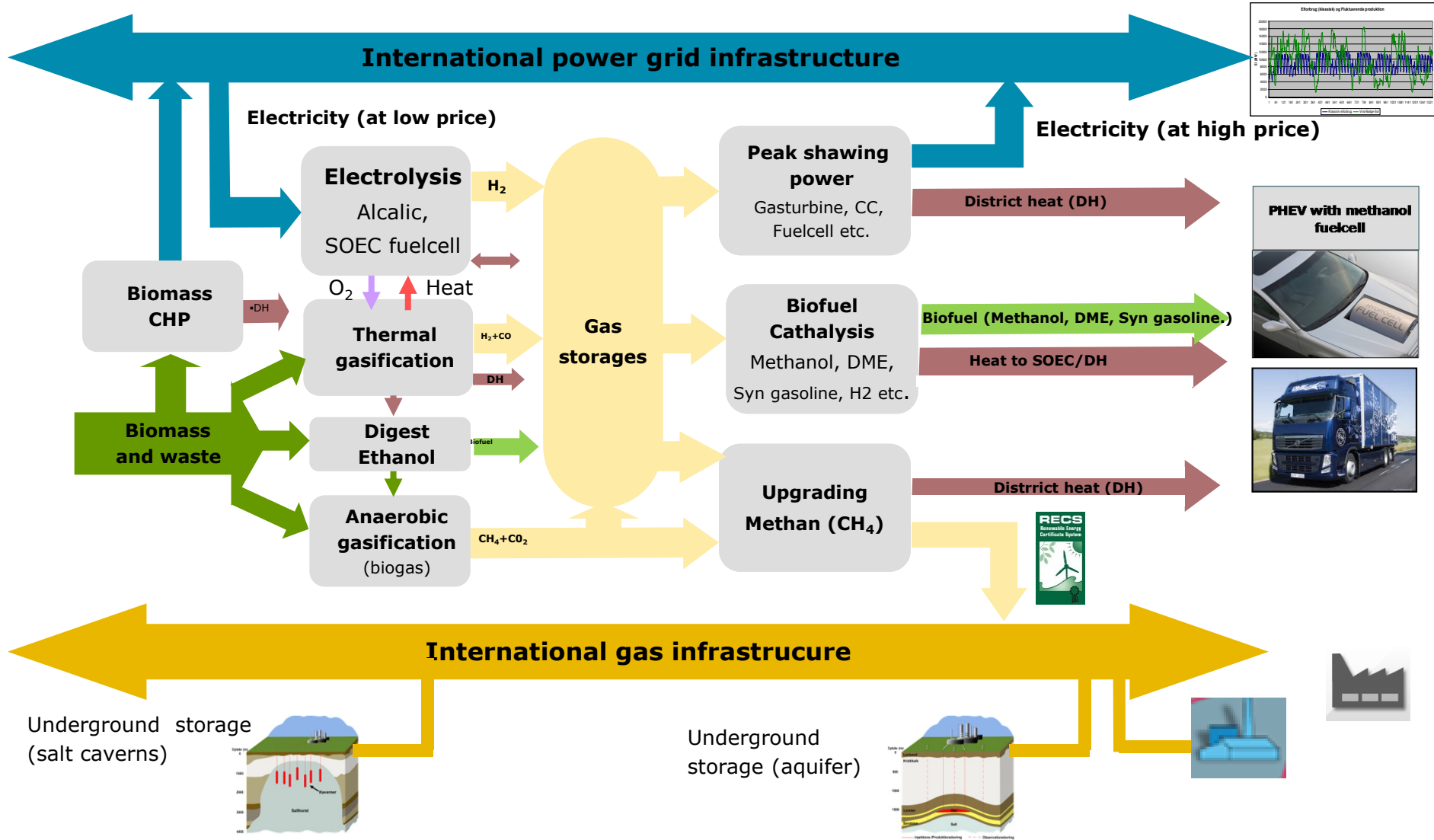
System-dynamics – market simulation 2035



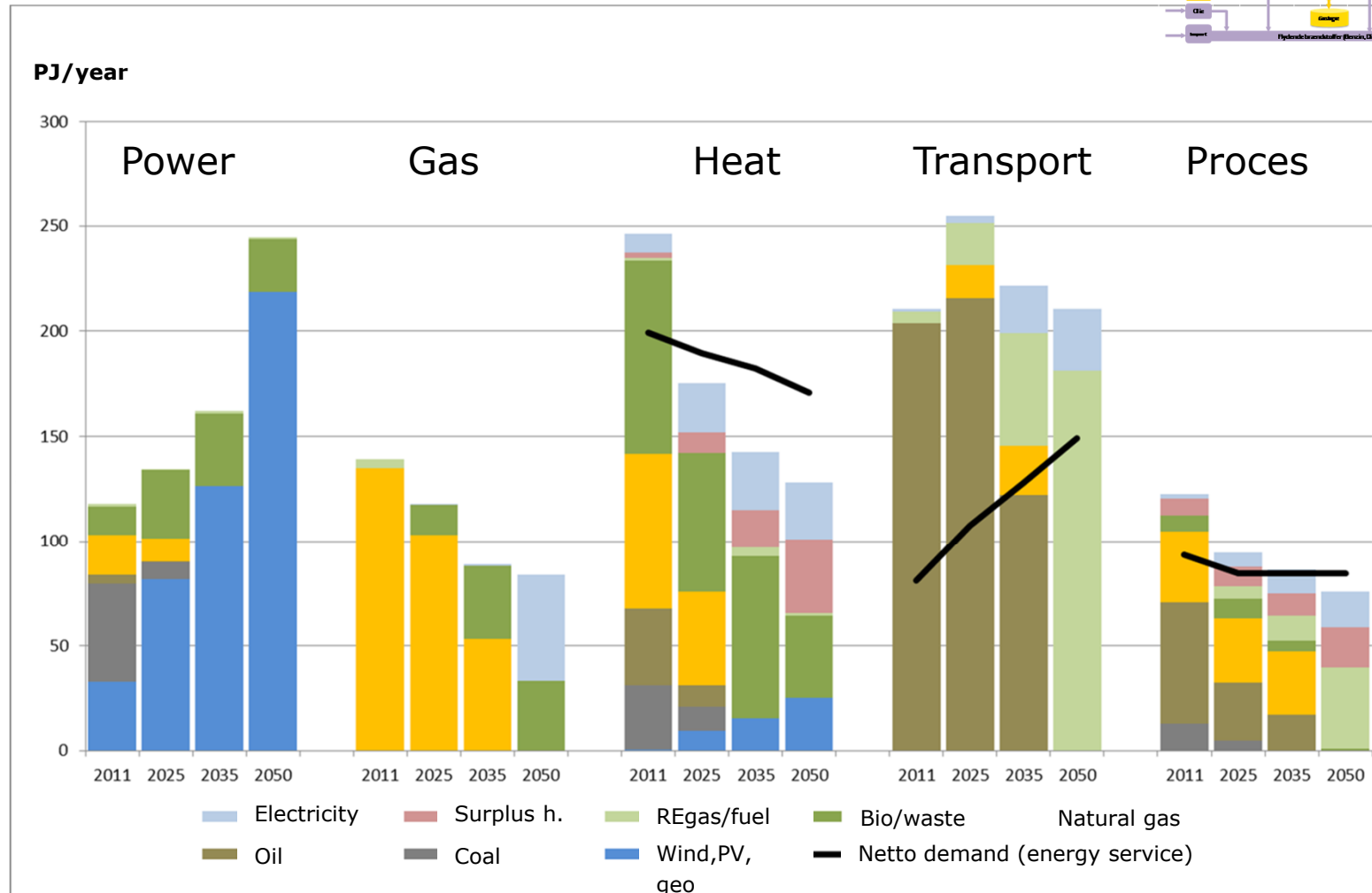
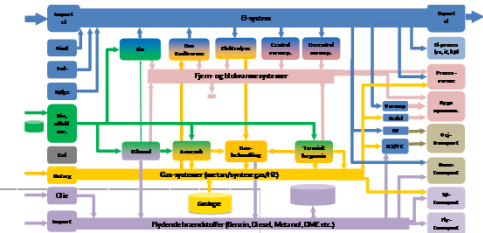
A need for intelligent system to get the benefit of market prices (electricity, heat, (RE)gas) for all market players in the system



Integration of electricity, gas, fuel and heat systems

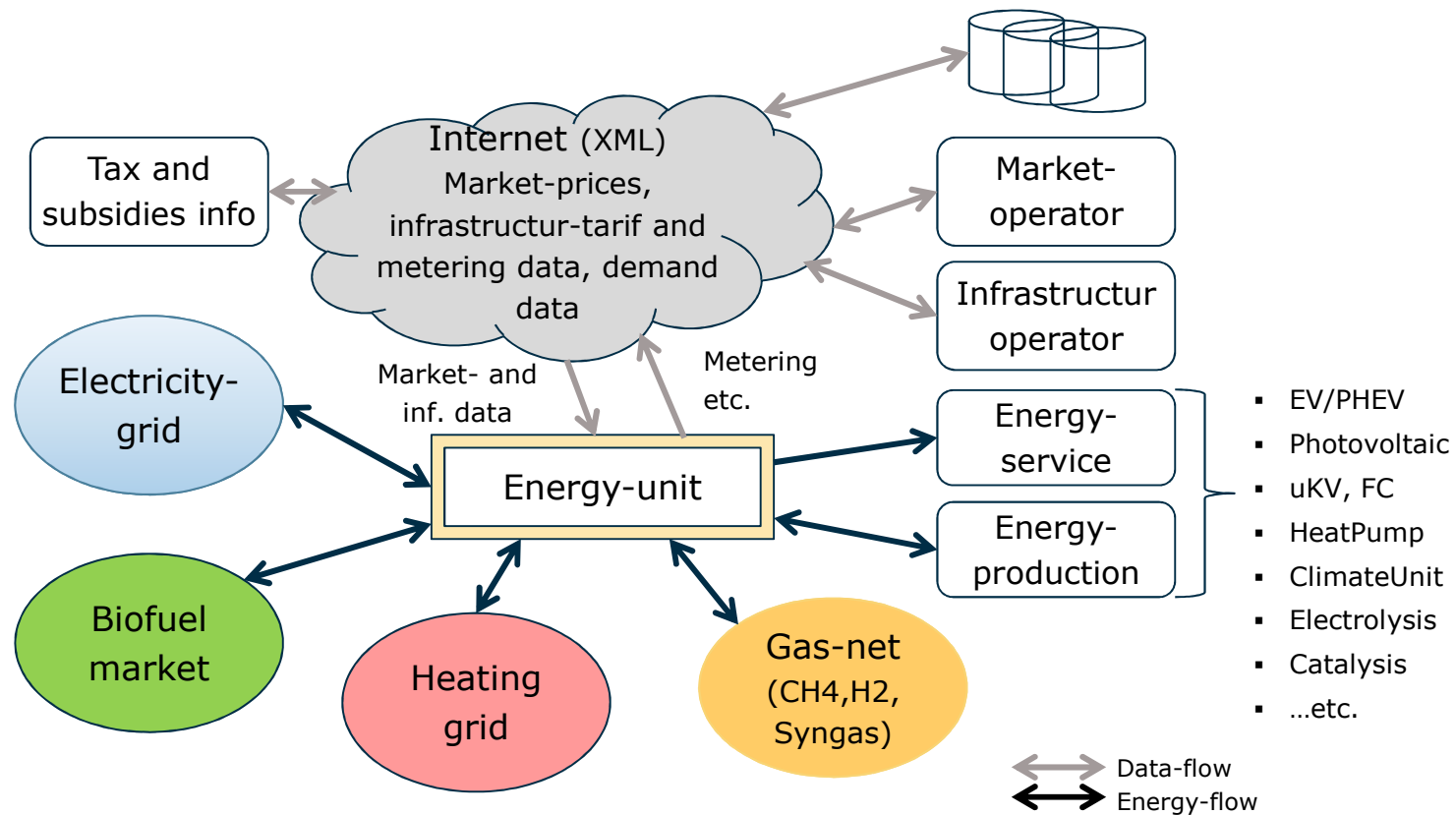


Production and use of energy (example)

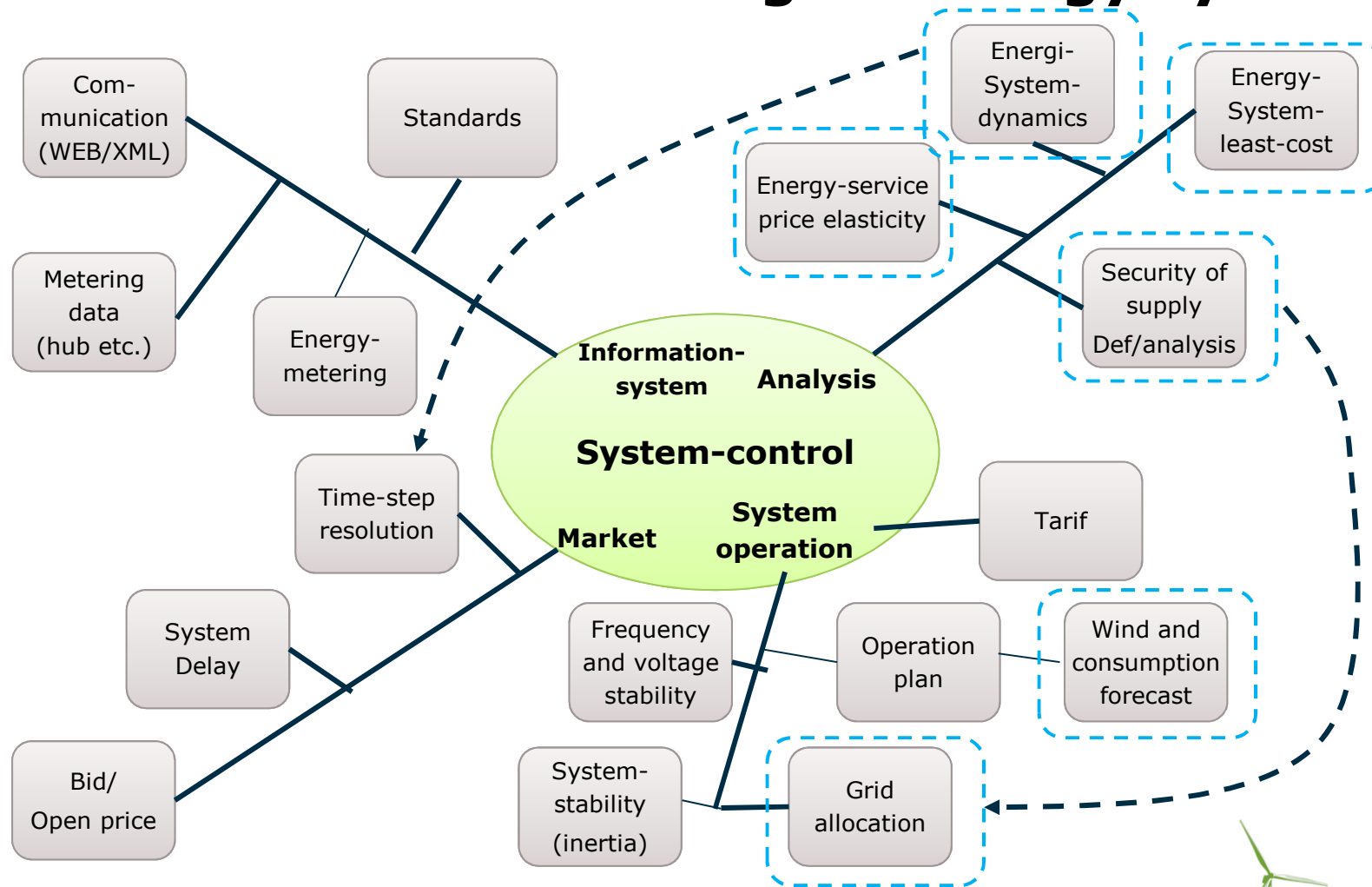


Information and energy flow in intelligent and flexible energy system

An energysystem (el, gas, heat) with open acces for any energy conversion unit can be connected and market operated with informations to optimise operation with respect to market, tarif, tax etc. (XML-service)]



Elements in an intelligent energy system





Thank you for your attention;)