Sustainable System Design

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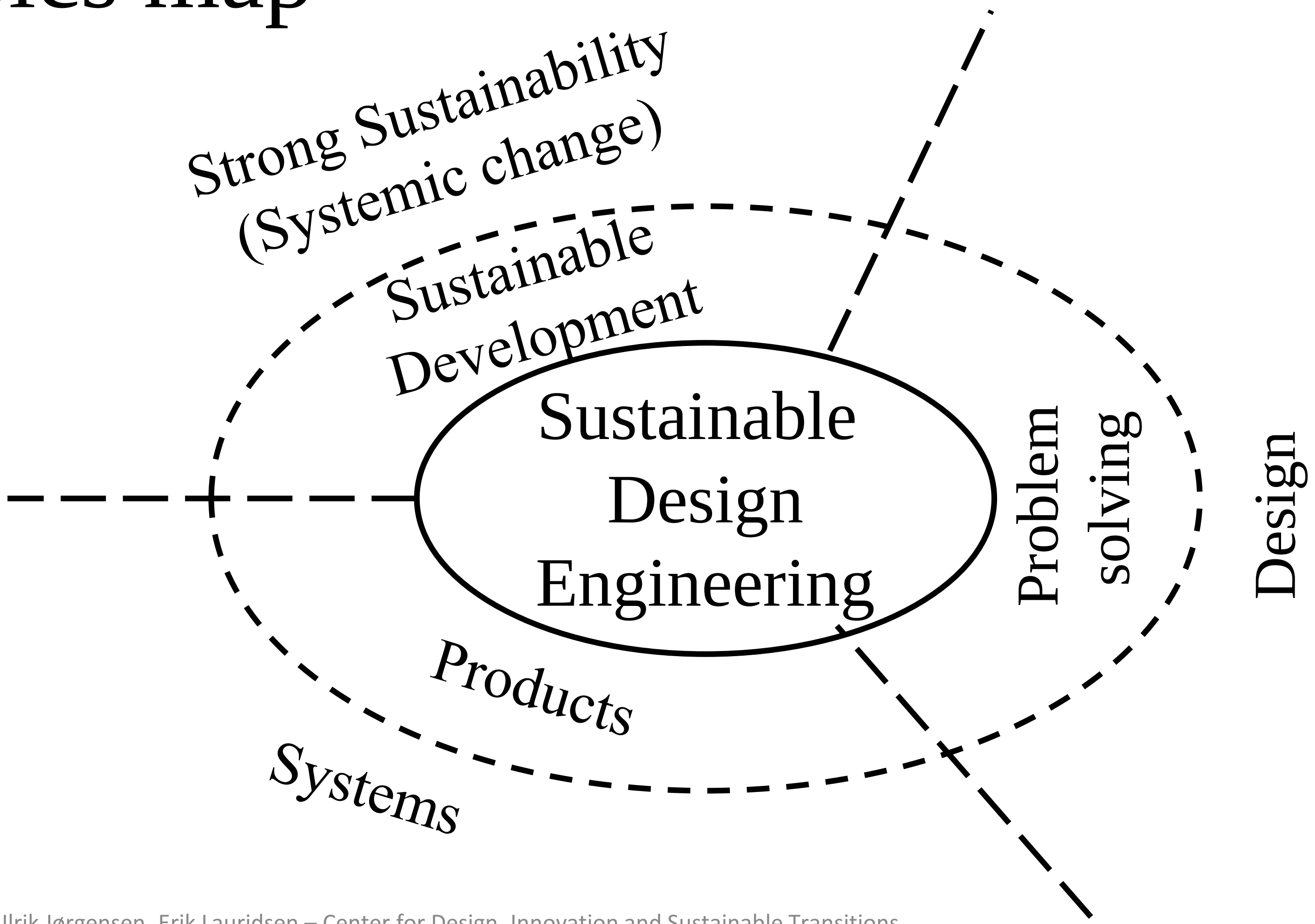
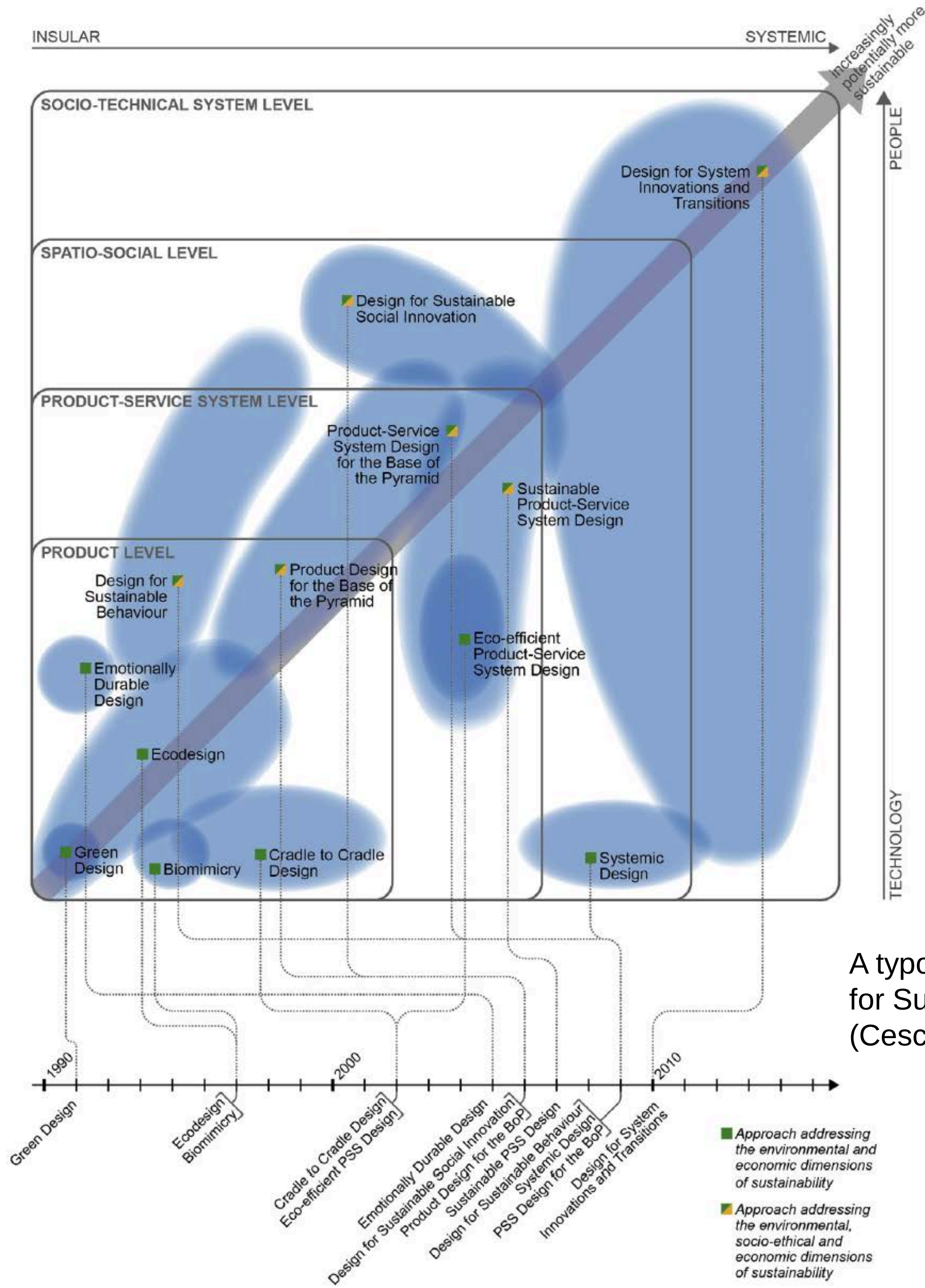
Topics map



Strong Sustainability
(Systemic change)
Sustainable
Development
Sustainable
Design
Engineering
Problem
solving
Design
Products
Systems



A typology and evolution of Design for Sustainability (DfS) approaches (Ceschin and Gaziulusoy, 2016: 144)

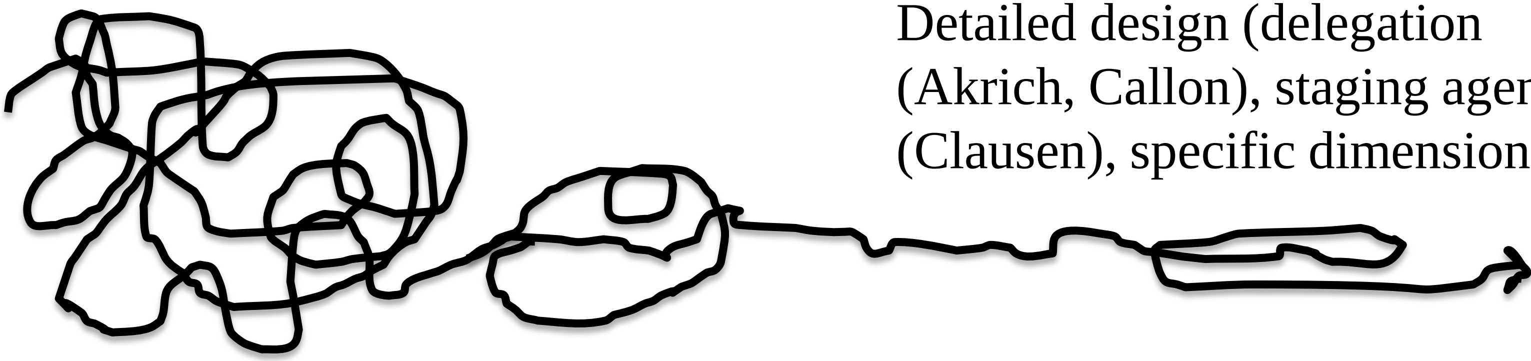
	5 ECTS	5 ECTS	5 ECTS	5 ECTS	5 ECTS	5 ECTS
1	Actor-oriented Design	Design processes and visualization		Fieldstudies and socio-material analysis	Modells, mechanics and materials	
2	Re-design for sustainability			Products, use and context	Vibrations and regulation	Thermodynamics
3	Design and use of prototypes			Co-design and user involvement	Logic and programming	Signal analysis
4	Design of product service systems		System visualization	Network and change	Science Theory	LCA
5	Design of sustainable systems			Sustainability and Society	Light, fields and flows	Data analysis and statistics
6	Final Project			Creative project leadership	Strategic concept development	Information gathering on physical and material phenomena

Process/timeline

Socio-technical systems mapping (Hughes, Meadows, Callon, Storni)

Concept development (Andreasen – system transition, contemporary state)

Detailed design (delegation (Akrich, Callon), staging agency (Clausen), specific dimensions)



Uncertainty / insights
Research

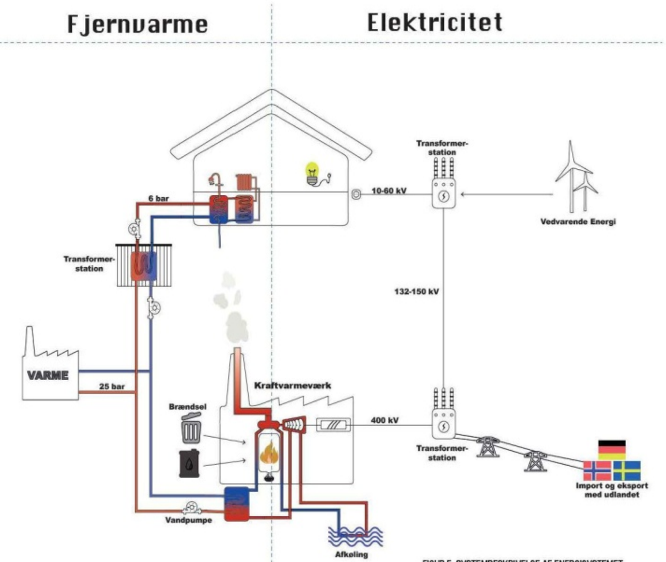
Concepts

Clarity / focus

Design

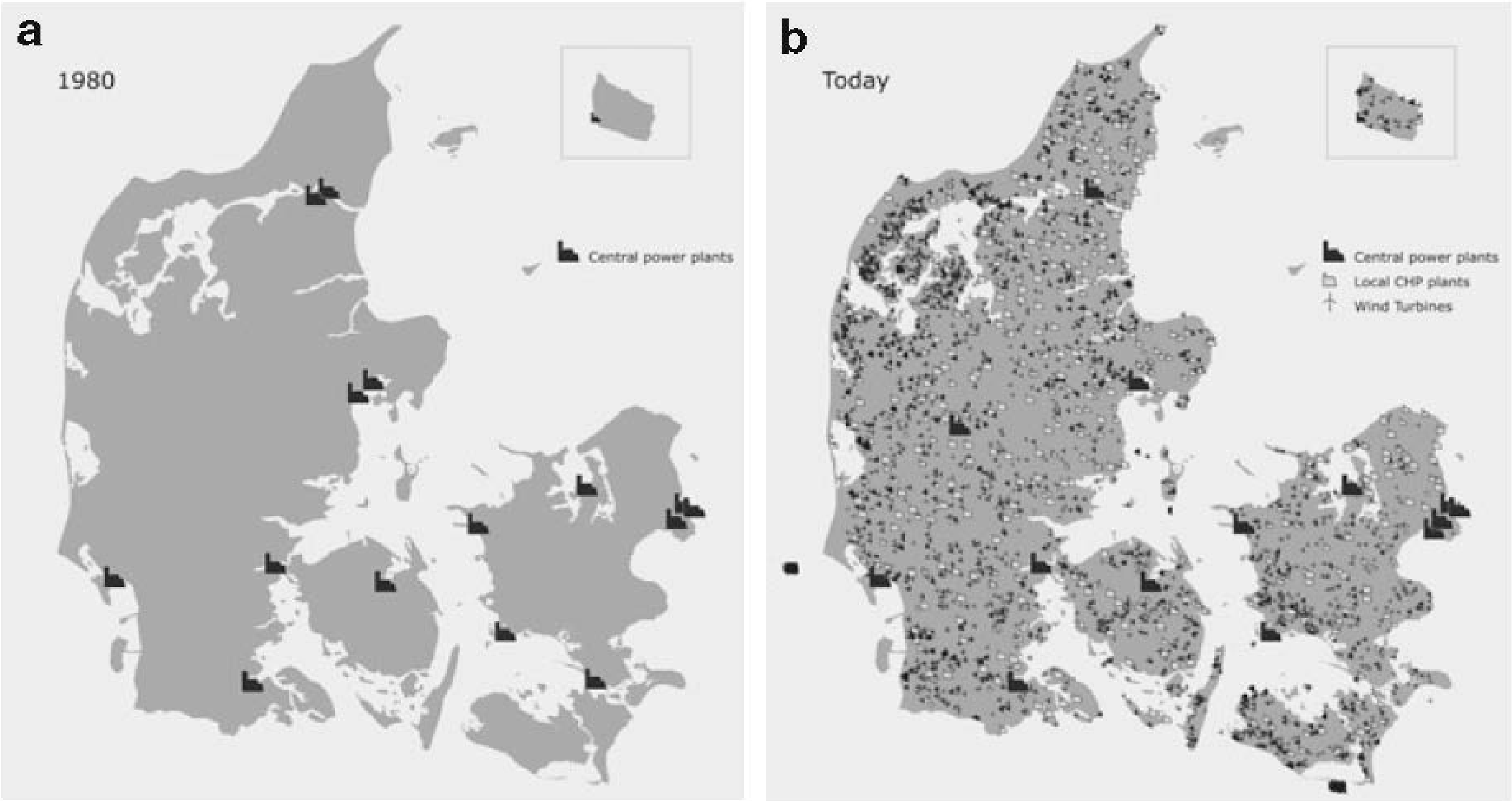
Case: Energy Forum South Harbour

- 5^{th} sem. student projects relate to ongoing research
- picked to illustrates approach
- nexus between heat and power
- co-design with tenant, owners, providers and municipality
- conceptual challenge: energy as modern and invisible
- what is the object of design?



FIGUR 5: SYSTEMBESKRIVELSE AF ENERGISYSTEMET

Backdrop: first decentralisation



Backdrop: then infrastructure transition

- two infrastructures operated differently: HOFOR as heat and DONG/Radius as power providers delivering to end consumers
- power controlled by a regulated market and heat as non-profit with transfer costs to consumers
- futures renewable energy system: fluctuating wind and solar, heat from large co-generation to ecology of producers, prosumers and consumers

The user: a behavioural challenge?

- utilities and grid owners view consumers as objects having ‘behaviours’ and not being ‘actors’
- challenges:

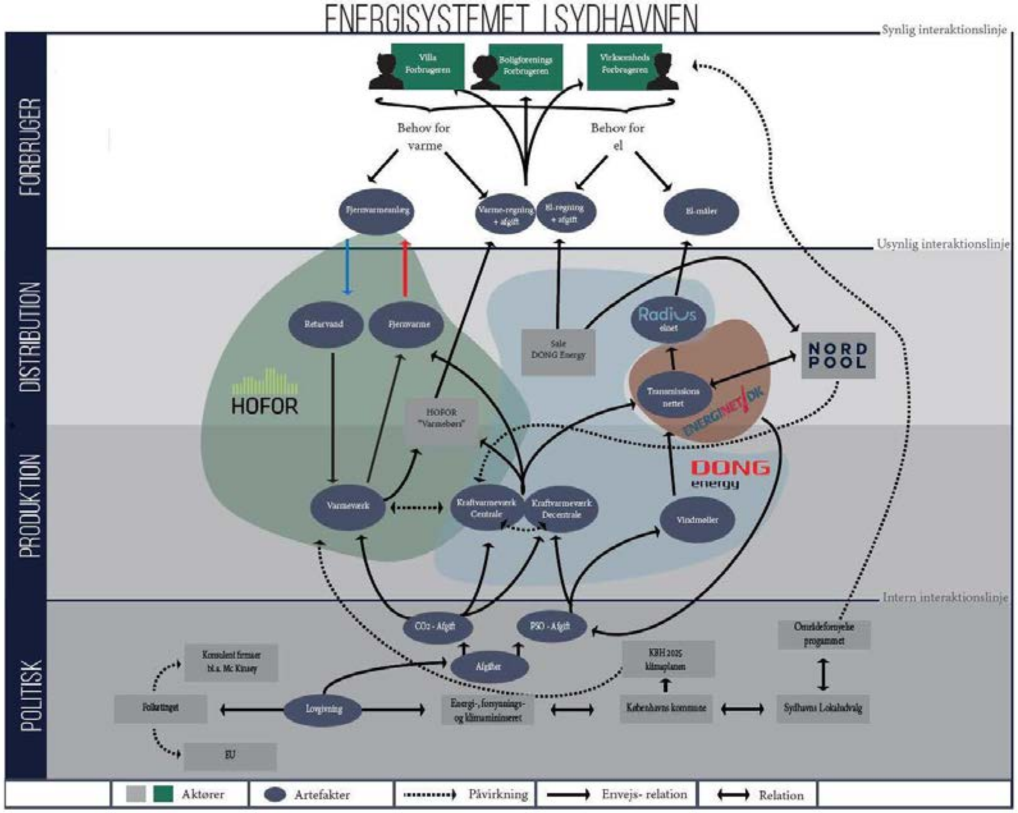
  - new division of responsibility and ‘ownership’

  - energy savings in buildings based on engineering calculation often are not met

  - utilities have limited interest in experimentation due to institutional structures and centralisation

Designing inter-system 'flexibility'

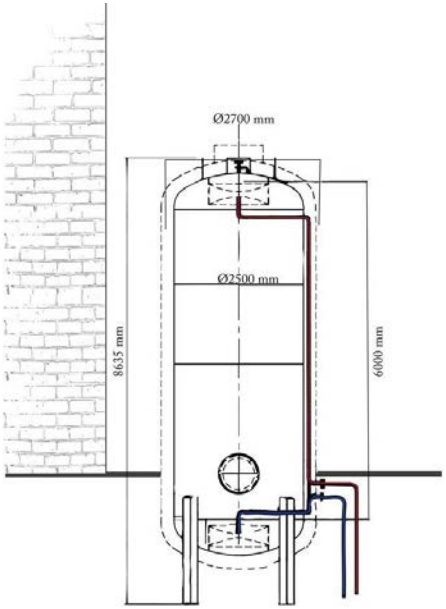
- design challenge: what is the object of design in this context?
- intervention: at what level of the socio-technical system



Choice among concepts

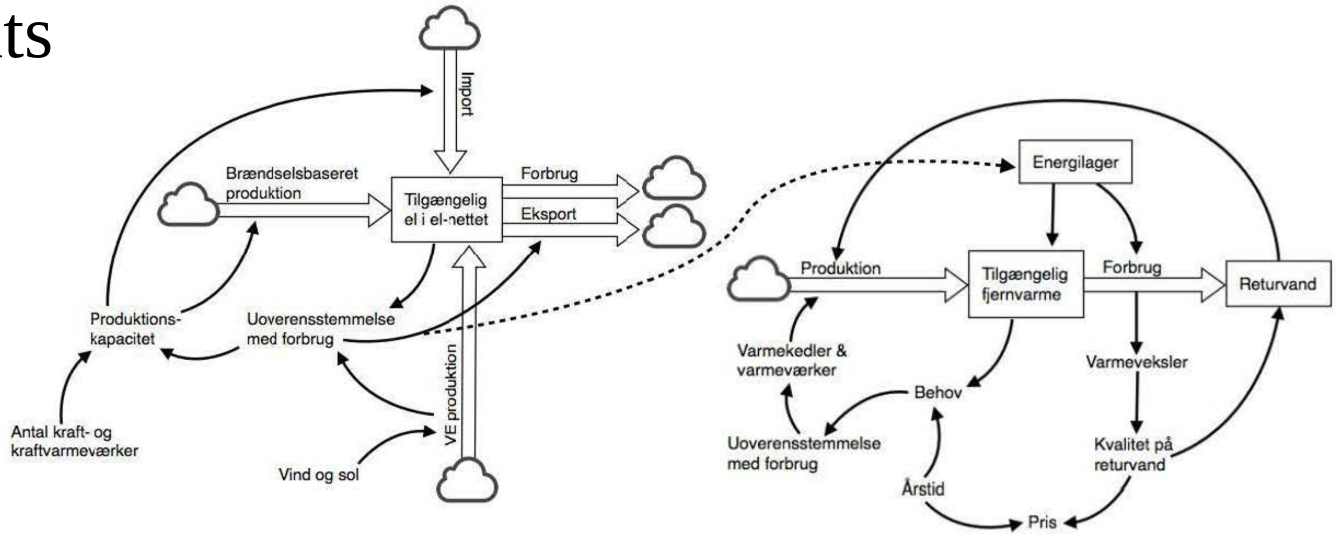
- developing concepts based on the socio-technical analysis (systemic analysis and design interventions)
- focus (delimitation) on storage:

  - heat storage in the district heating system (chosen)
  - batteries (stationary)
  - hydrogen (transformed)
  - heat stored in sand



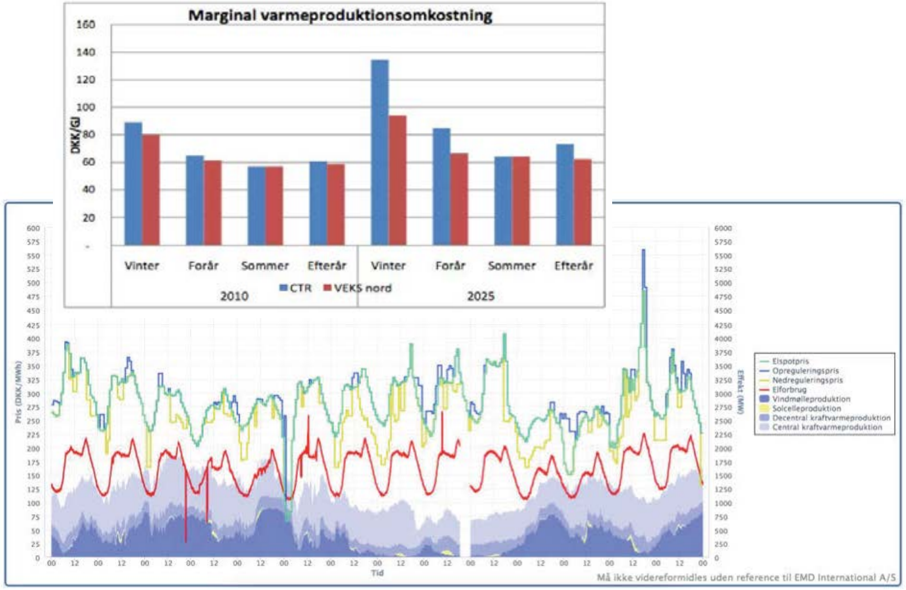
Modeling the system

- having studied systems as complex socio-technical interactions – especially in transition processes
- our students are urged to build a system model to



Identify values and calculate

- moving ideas from the conceptual phase to prototyping comprise analysis of values (for actors) and economies
- storage payback 5 years
- flexibility translation:
  - marginal costs of heat
  - low wind
  - infrastructure costs

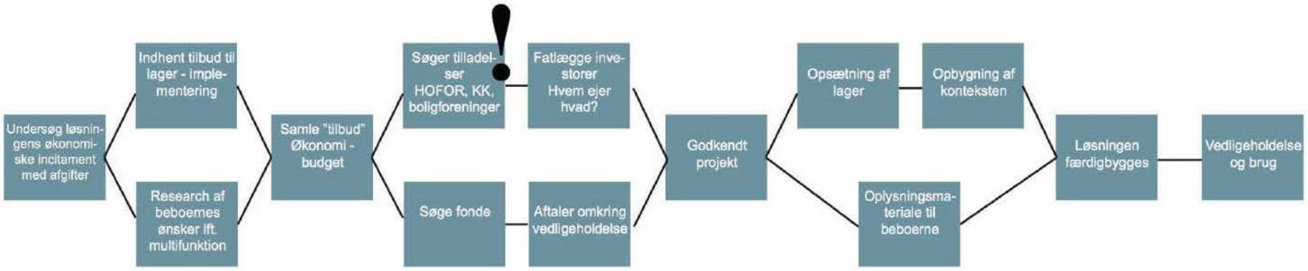


Design as delegation of actor roles

- model demonstration of city integrated 2-days energy storage
- more importantly HOFOR has to change tariffs
- to get lower energy costs tenant must adjust heat practices
- building administrators must care about system optimization

Design as staging change

- co-design beyond designing objects and possibilities
- delegations and create agency among actors
- changing roles and responsibilities – immutability
- seriously dependent of the actors aligning and not installing anti-programs



Conclusion I

- dominance of Product Design oriented knowledge which is not applicable to system design
- dominance of an engineering sciences approach which is simplistic, deterministic and too quantitative oriented
- dominance of a conceptualisation of system as an object out-there that is knowable and subject to quantitative modelling

Conclusion II

- three aspects are core to the way we deal with the complex, ‘wicked’ problems of sustainable systems design
- following the approach of STS we approach the social and technical as closely intertwined implying that time and place are important for the qualities of designed objects
- in systems terms this implies that the institutional and technical flows are interdependent

Conclusion III

- at the same time the assessment of how a design contributed to sustainability cannot be handled with a finite value matrix
- the basic conception and operationalisation of sustainability
- re-thinking the engineering sciences: from Fluid Mechanics to Dynamic System Modelling

Conclusion III

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