



# Future Sustainable Cities Through Backcasting Modeling - District Heating and Cooling as a Platform towards Sustainability

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# Outline

- General Idea – Merging of Competences
- Strategic Sustainable Development
- Energy Systems Analysis
- Project Aim and Focus
- Status and On-going Activities
- Questions and Discussion

# General Idea – Merging of Competences



## Combination of two research areas:

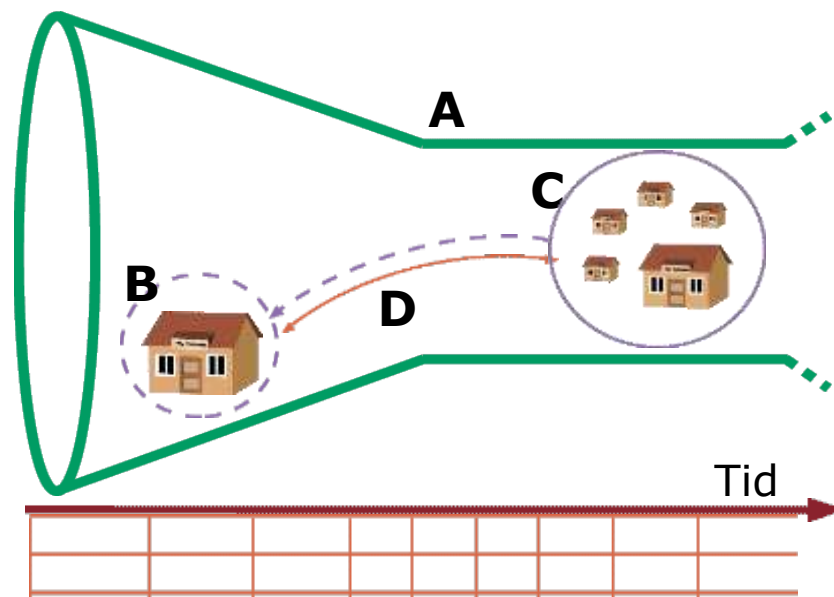
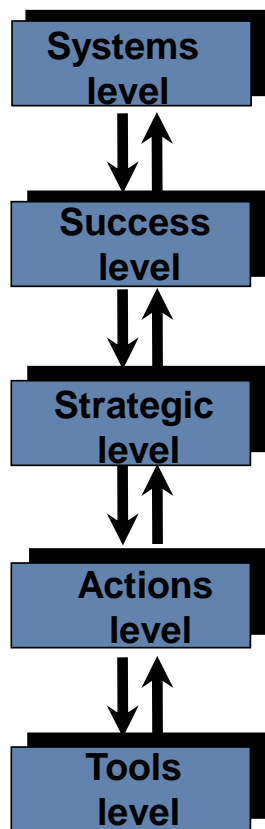
- Strategic Sustainable Development
- Energy Systems Analysis

## Projects:

- Sustainable Cities in a Backcasting Perspective
- Climate Neutral and Competitive Gävleborg 2050
- Green Charge (South East of Sweden)
- Decision Support for Strategic Energy Efficiency in Industry



# Strategic Sustainable Development (FSSD)



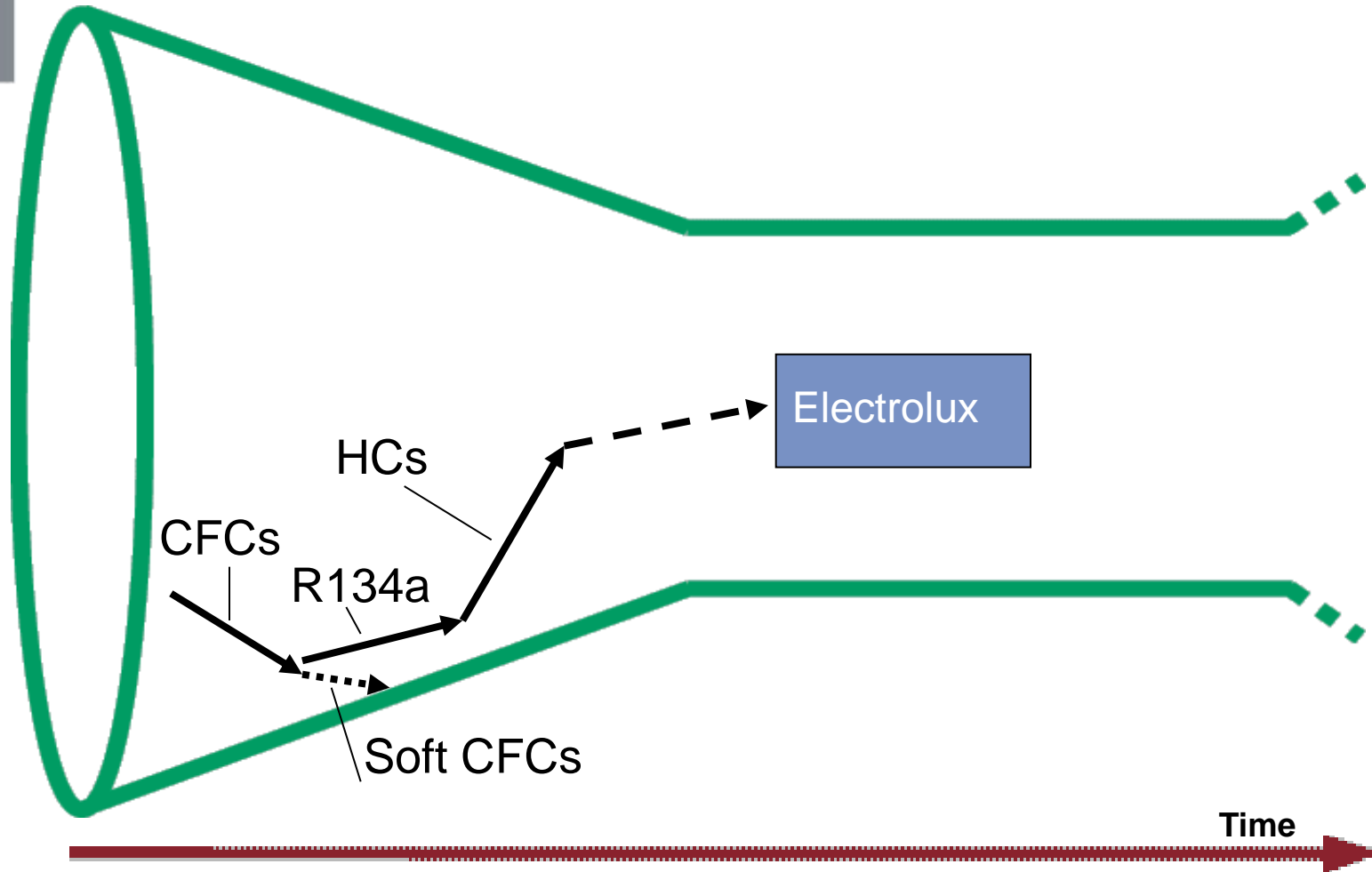
# Theoretical and Observed Benefits



- System boundaries through purpose
- Solving trade-off dilemmas in rational ways
- Establish true resource potentials
- Inform choice, development and use of tools
- Prevent damages (even yet unknown problems)
- Stimulates and guides cross-disciplinary and cross-sector cooperation
- Creating tight and efficient team with common mental models
- Cost reduction, innovation opportunities, talents, image
- Coordination of management systems



# Example



# Testimonial

*"It was not until ten years later we fully understood how much money Electrolux had saved and earned from applying this methodology to foresee changes on the market and in legislation."*



Chairman, Ericsson.  
Former CEO, Volvo Group.  
Former CEO, Electrolux.





# Energy Systems Analysis

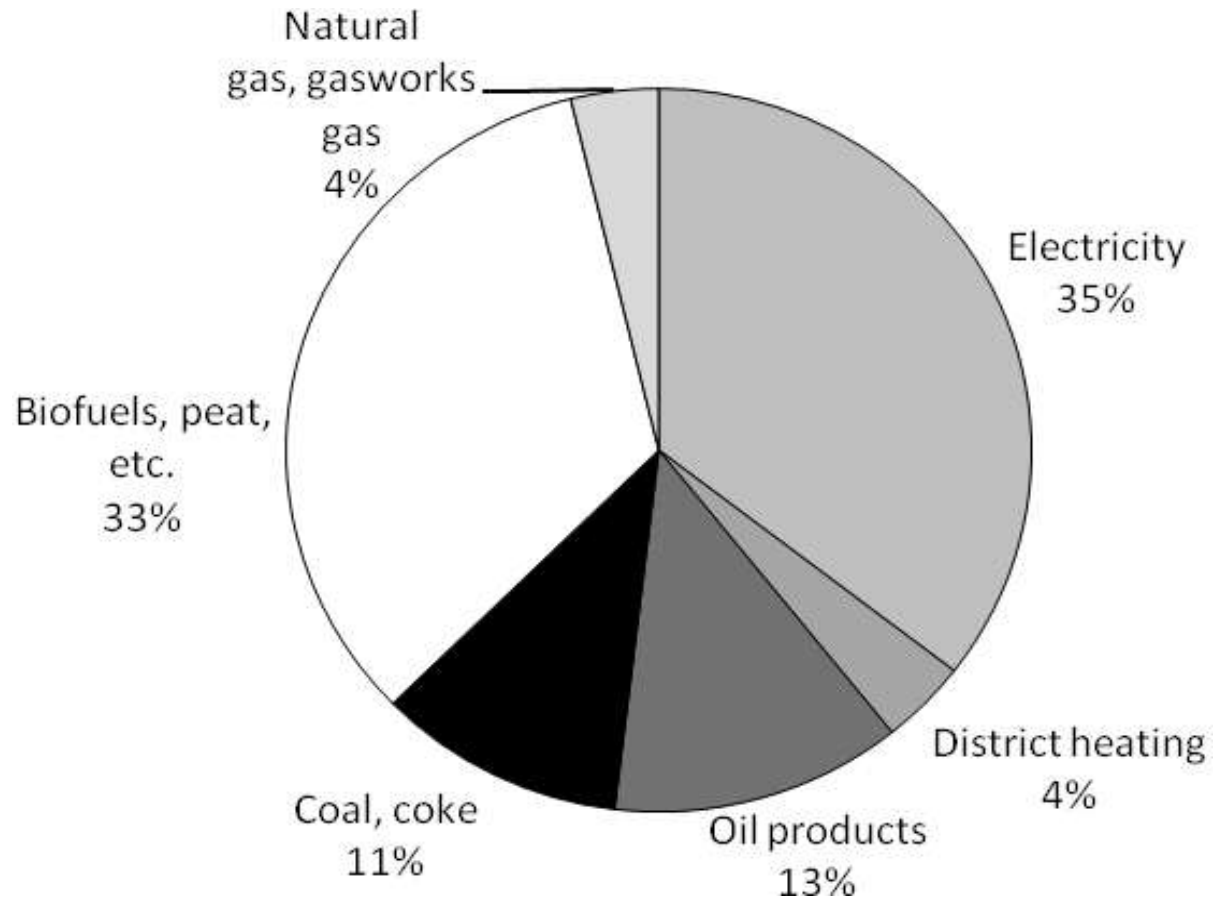


Modeling energy use and energy supply in a systems perspective:

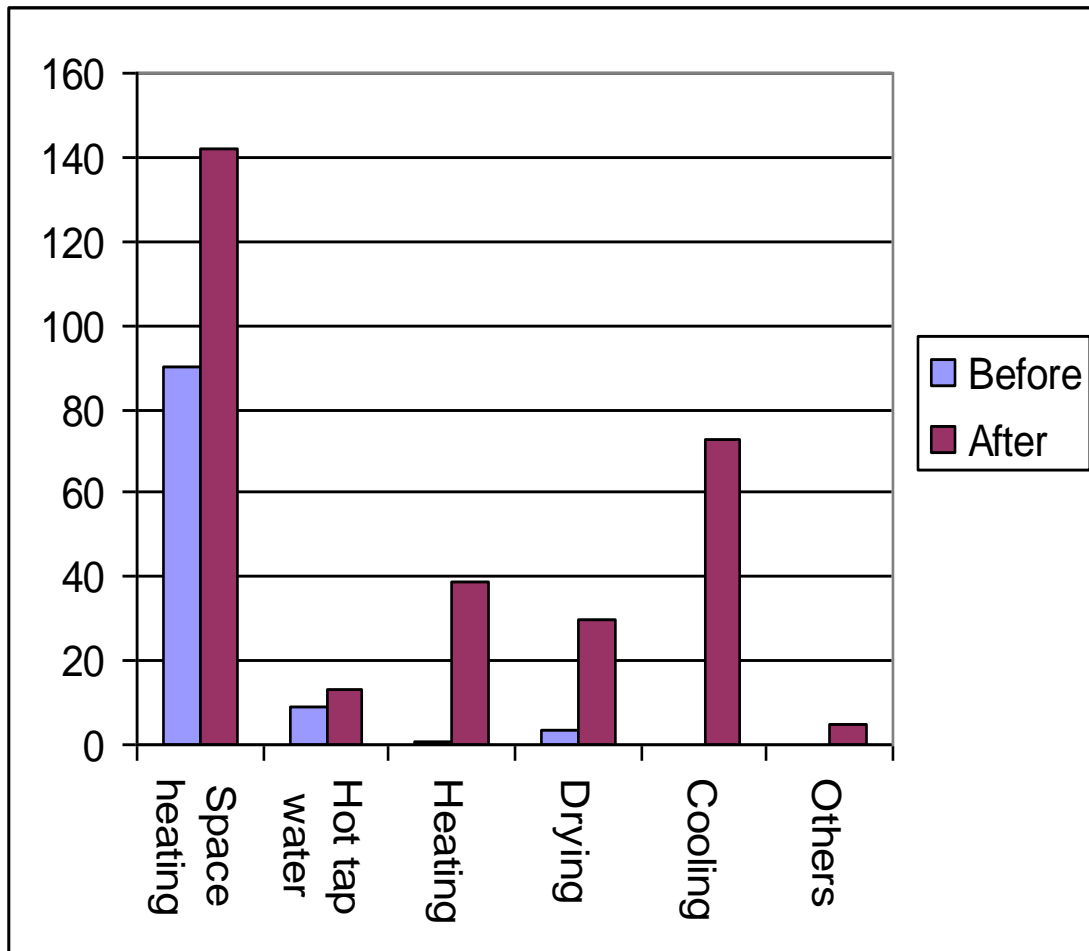
- Municipal, regional or national energy systems
- Building energy systems
- Industrial energy systems
- Transportation



# Industrial Energy Use in Sweden



# Potential to Increase DHC in Industry

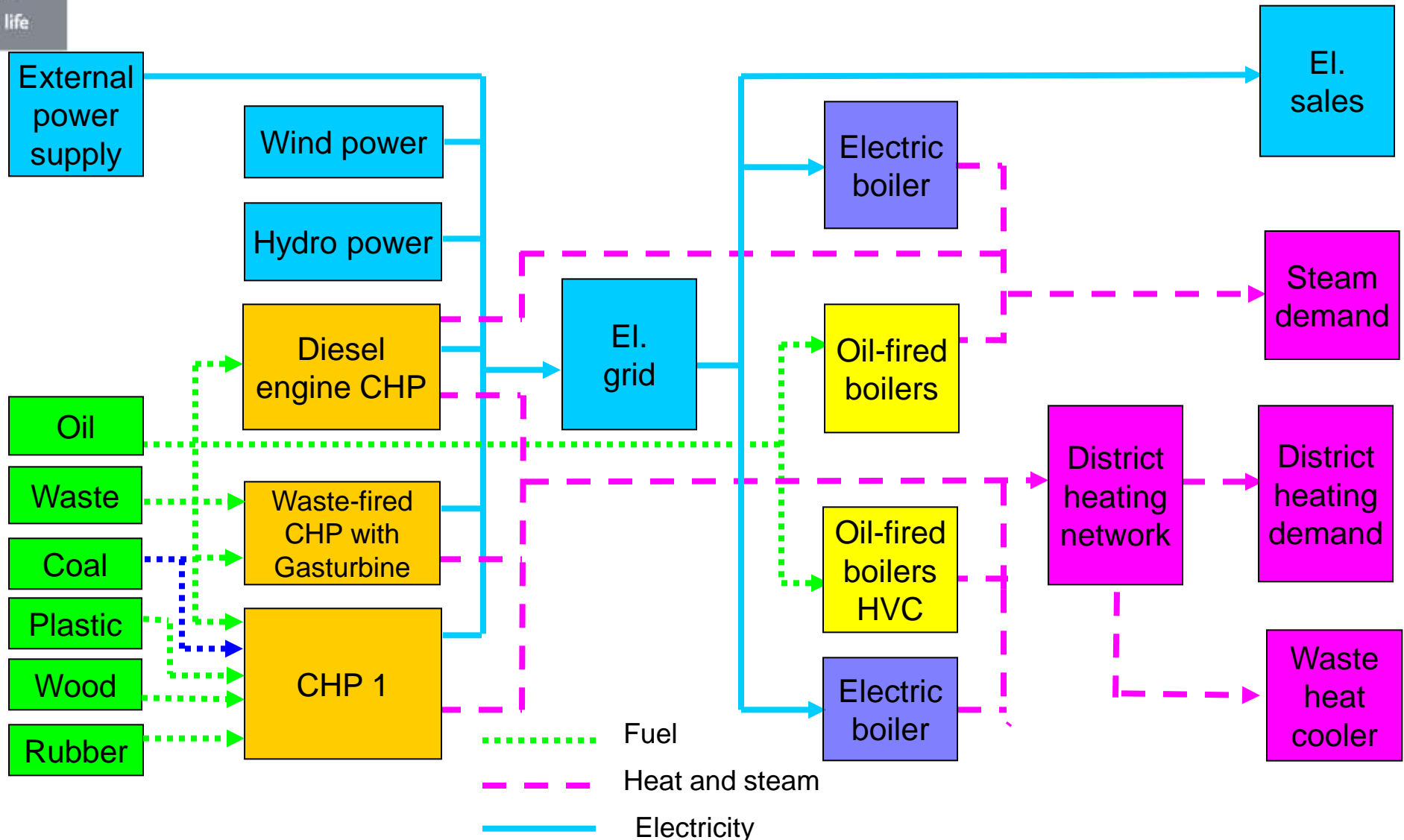


Result for 34 SME:  
200 GWh → 196%

Reduced global CO<sub>2</sub>:  
112 000 tonnes/year

# MODEST

- **M**odel for **O**ptimisation of **D**ynamic **E**nergy **S**ystem with **T**ime-dependent components and boundary conditions



# Results from DHC Co-operation

## - Industry and energy utility

Electricity price	Reduced energy costs	Possible reduced global emissions of CO <sub>2</sub> for the combined system*
Level of today	<b>48%</b>	<b>69 ktonnes/year</b>
Higher European level	<b>64%</b>	<b>80 ktonnes/year</b>

\*) Coal condensing as marginal power production

# Project Aim and Focus



The project aims to find ways of how to do business model generation and energy systems analysis within a backcasting from sustainability principles perspective. The focus is on district heating and cooling systems in region Blekinge in Sweden.



# Examples of Overall Issues



- How can district heating and cooling investments be **assessed from a full strategic sustainability perspective**?
  - How can early **smart measures** (that support sustainable development of society and strengthen utilities) be found?
- How can new district heating and cooling measures be **introduced and made attractive** to customers and other stakeholder (e.g. through new business models)?
  - How can economic, ecological and social **benefits of district heating systems be communicated** to customers and other stakeholders?



# Status and On-going Activities

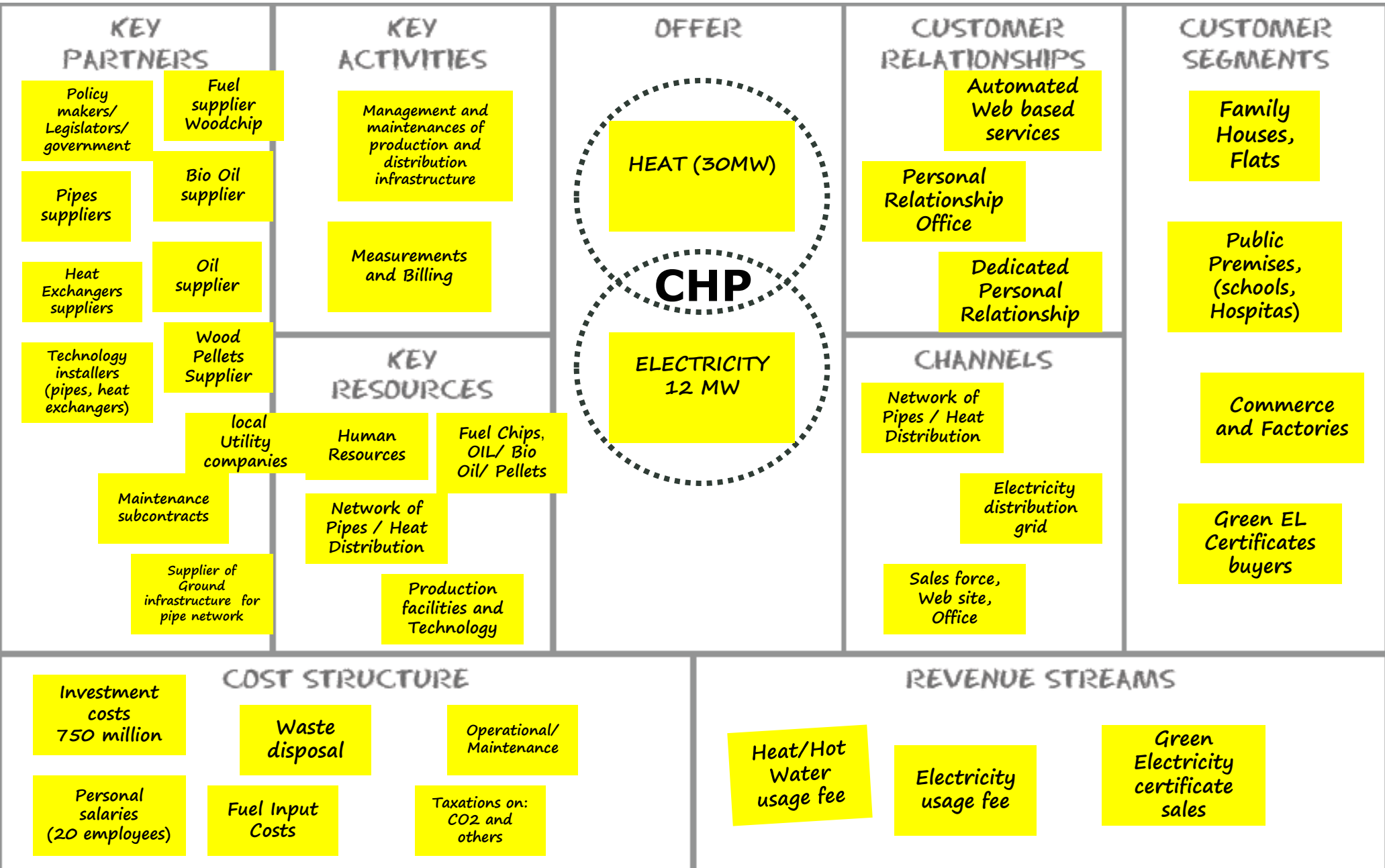


- Knowledge transfer between researchers and between researchers and utilities and other stakeholders and studies of renewable energy scenarios (IPCC, Greenpeace, WWF) 2050 (A-step)
- Mapping of current business models and technical, geographical and organizational conditions (B-step)
- Sustainability self-assessment among utilities (B-step)
- Strategic life-cycle assessment of district heating and cooling (B-step)
- Ideation for future solutions and business models of district heating and cooling and for intermediate platforms (C-step)
- Simulation of business models and technical, geographical and organizational solutions for prioritization of smart early moves (D-step)



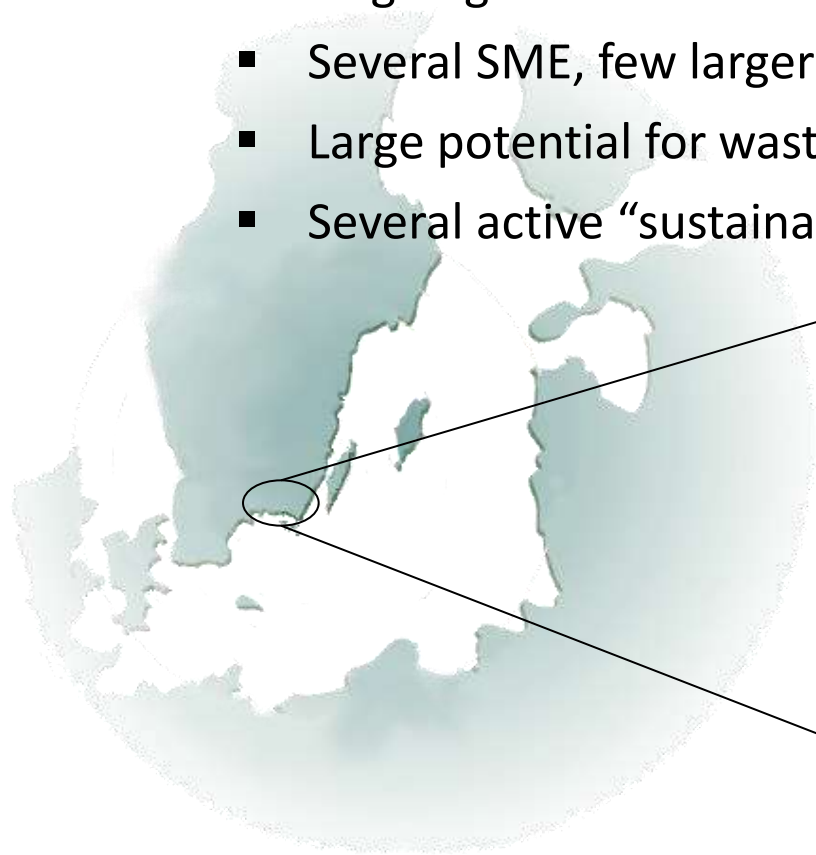


# Example of Business Model Mapping (Karlskrona)



# Examples of Technical, Geographical and Organizational Conditions

- Four separate municipally owned DH systems
- Mainly biomass fueled boilers
- Ongoing construction of CHP for biomass
- Several SME, few larger industries
- Large potential for waste heat
- Several active “sustainability” networks



# Examples of Energy Systems Modeling

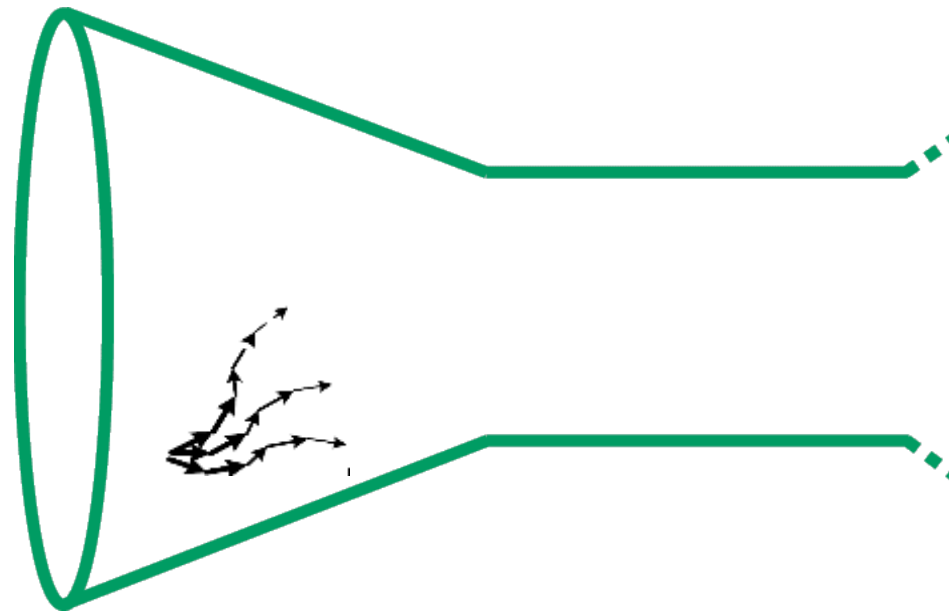
- Possibly smart early moves based on local prerequisites
  - Co-operation between the separate systems
  - Design of one larger regional DHC system
  - Introduction of absorption cooling
  - Introduction of local DC systems
  - Investment in new CHP capacity
  - Conversion to DHC in industrial processes
  - Use of industrial surplus heat
  - Co-operation Energy systems – Transportation systems
  - Urban planning
  - Policy instruments



# Decision Support for Sustainable Energy Systems



## Energy systems analysis in a backcasting perspective





MANGE TAKK!

Questions and Discussion