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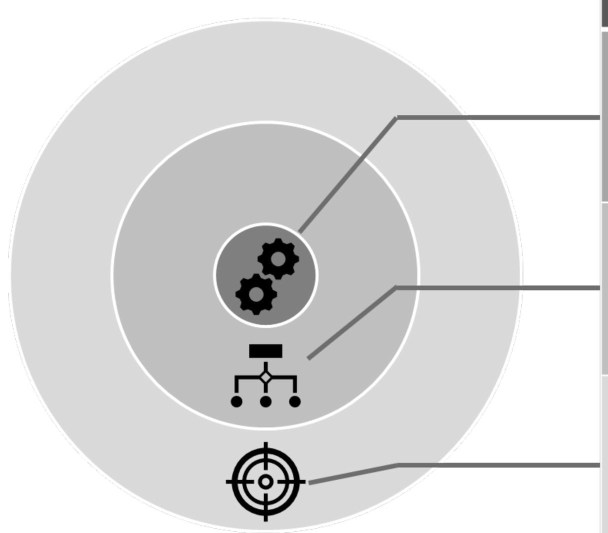
SELECTED RESULTS OF THE IEA DHC ANNEX TS3
HYBRID ENERGY NETWORKS

INTRODUCTION/ MOTIVATION

- District heating and cooling (DHC) networks are **traditionally linking the heating & cooling and electricity sector** (and often also the gas sector) through combined heat and power (CHP) plants. However, **the role of CHP plants will significantly change** (competition for renewable fuels with hard-to-decarbonise sectors + an increasing share hydro, wind and PV, less CHP electricity required)

→We will need other heat (and cold) sources
→We will need other coupling points to provide flexibility

A CLASSIFICATION APPROACH*



Layer	Minimum	Maximum
Technology	Single coupling points, central controls of network and coupling points	Multiple and diverse coupling points, high operational flexibility, advanced controls, automation and analytics
Organization	Minimum permissible ownership of coupling points, traditional business models and services offered	Diverse ownership, high share of prosumers, innovative business models and services offered
Strategic	Central structures, integration of coupling points as a reaction to market pressure	Decentralized structures, integrated planning and design, optimized interaction and decarbonization

**This classification differs from the 4G DHC networks concept (Lund et. al=) → the main characteristic of a HEN is the integration between the different networks, and not the supply temperature or the time period where the different generations were dominating.*

STRENGTH
- Higher degrees of freedom for planning/ operation;
- higher security of supply, resilience, flexibility
- counteract limitations of the el. network + reduce losses
- New business models (ancillary services, markets)
- decarbonization of DHC network
- (booster) HPs support Integrate low temp. heat sources
- economic added value (investment in coupling points)

WEAKNESSES
- additional investments into coupling points
- increasing level of complexity
- Present electricity tariffs and taxes are a barrier
- regulatory restrictions for electricity grid operators
- seasonality of the heat demand
- supply competition in DHC (especially in the summer)
- Only renewable, if fossil-free electricity is used

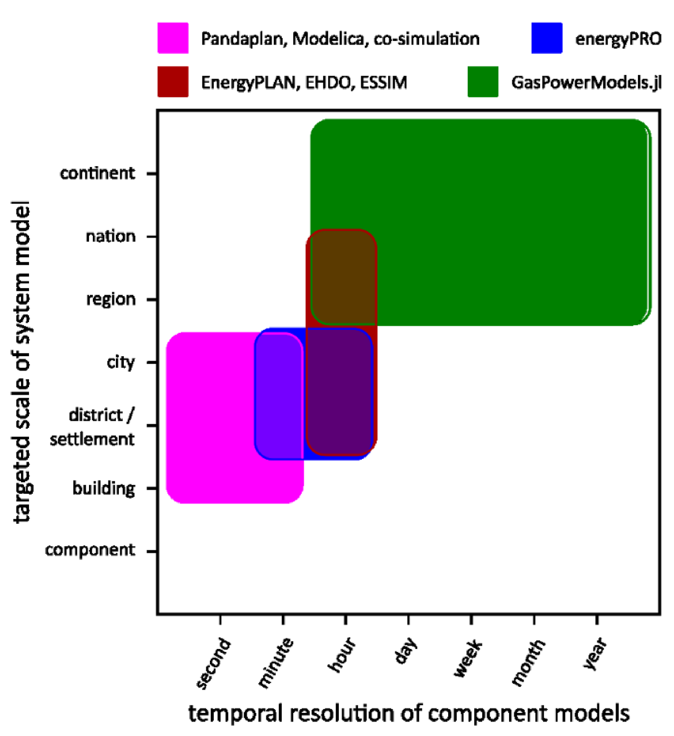
OPPORTUNITIES
- More research, products, demo projects, trainings etc.
- improved performance of coupling points/ controls
- Digitalization supports handling of the complexity
- Increasing PV and wind → more flexibility required
- Green financing options
- tendency for the reduction of DHC temperatures

THREATS
- a possible disruptions of existing business models;
- overall higher electricity demand
- Changing regulatory framework / market design
- market development (alternative flexibility providers)
- availability of waste heat as a source for HPs
- Availability of suitable DHC infrastructures?

Ralf-Roman Schmidt, Benedikt Leitner, A collection of SWOT factors (strength, weaknesses, opportunities and threats) for hybrid energy networks, Energy Reports, Vol 7, S 4, 2021, Pages 55-61, https://doi.org/10.1016/j.egyr.2021.09.040

CATEGORIZATION OF TOOLS AND METHODS FOR MODELING AND SIMULATING HYBRID ENERGY NETWORKS

- domain-specific tools for energy networks focus on single domain only, at best, only coupling points to other domains can be modelled; established multi-energy modelling tools have no focus on energy networks (capacities, imports/export etc.)
- **Method:** online survey; additional literature review; apply selection criteria, perform expert review
- **Results:** different tools and methods have been identified that focus specifically on hybrid energy networks. They can be grouped in 4 categories (technical assessments; operational optimization; planning on the scale of cities / regions; planning on the scale of nations / continents)

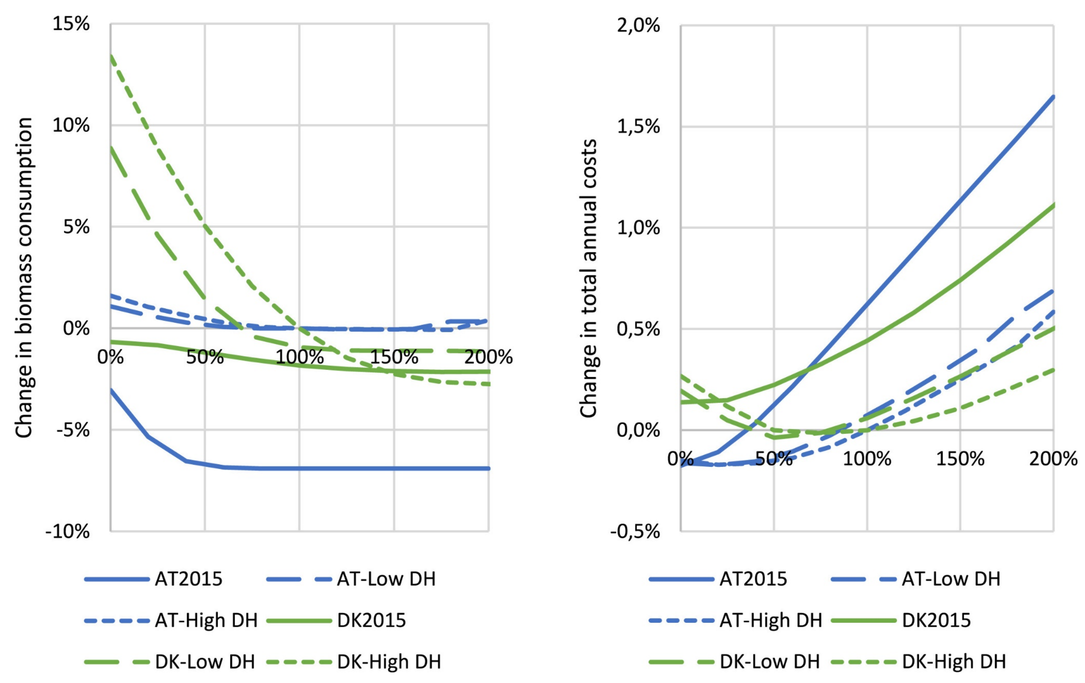


Edmund Widl, Dennis Cronbach, Peter Sorknæs, Daniel Muschick, Maurizio Repetto, Anton Ianakiev, Julien Ramousse, Jaume Fitó: Categorization of tools and methods for modeling and simulating hybrid energy networks; 7th International Conference on Smart Energy Systems; 21-22 September 2021, https://smartenergysystems.eu/wp-content/uploads/2021/10/0036.pdf

ELECTRIFICATION OF DISTRICT HEATING UNDER DIFFERENT ENERGY SYSTEM CONDITIONS

- Different scenarios for the energy systems of Austria and Denmark have been simulated using EnergyPLAN

RESULTS
- electric boilers allow for larger integration of variable RES
- Heat pumps have a larger potential to reduce the biomass consumption compared with electric boilers,
- The total annual costs of the energy system are mostly affected by the capacity of heat pumps, compared with the el. boilers.



Change in the energy system's total biomass consumption and total annual costs at different levels of HP capacity relative to the original high DH market share scenario of the country. Electric boiler capacity is used as replacement technology based on MWe.

Peter Sorknæs, Hybrid energy networks and electrification of district heating under different energy system conditions, Energy Reports, Vol 7, S 4, 2021, Pages 222-236, ISSN 2352-4847, https://doi.org/10.1016/j.egyr.2021.08.152

DRIVERS AND BARRIERS FOR PROSUMER INTEGRATION IN THE SWEDISH DH SECTOR

- Investigation of the different drivers and barriers for the integration of prosumer heat in the Swedish DH system.
- DH-side drivers: cost saving, enhancing the environmental and commercial profile of the DH company, increasing the effective use of energy, and enabling flexibility in their DH system.
- prosumers' drivers: financial benefits, need for self-sufficiency, and raising the environmental profile of the prosumer.
- macro-trends: transition to 4GDH and the move towards high energy effectiveness in energy use in buildings.
- The barriers are still hindering the integration of prosumer heat in the DH system of Sweden
- While cost and technical barriers make up the DH-side barriers, uncertainty about the monetary benefits stop heat prosumers. Policy uncertainties are the other barriers

Sujeetha Selvakkumaran, Lovisa Axelsson, Inger-Lise Svensson, Drivers and barriers for prosumer integration in the Swedish district heating sector, Energy Reports, Vol. 7, S 4, 2021, Pages 193-202, https://doi.org/10.1016/j.egyr.2021.08.155

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Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology