How pricing mechanism for district heating can influence an urban heat energy system: A case study for Vienna

(Work in progress)

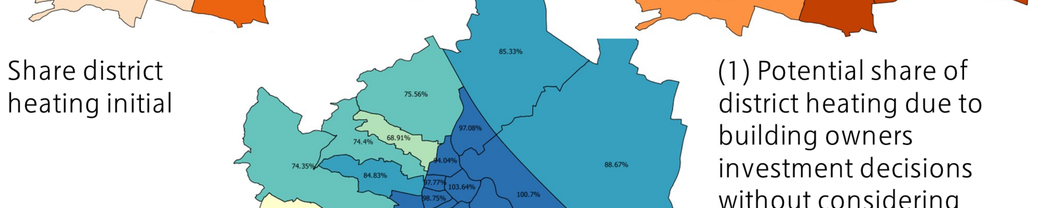
Motivation and Research Questions

Especially for **densely populated** areas, district heating can provide an **efficient** and **ecomic viable** possibility to supply the buildings' **space heating and domestic hot water** demand. The applied pricing mechanisms can also influence the costumers decision for the **investments** in the type of heating system, as **district heating** directly competes with various other heating technologies like heat pumps or gas boilers. In addition, the pricing models may contribute to set incentives for the costumers to change their behaviour, consequently **decreasing** their **heat demand** and thus **reducing CO_2-emissions.**

The following research question can be derived:

- **What are the consequences of different pricing mechanism on the costumers long-term decision up to 2030 for investments in heating systems and enery saving measurements regarding refubirshments?**
- **What are the interdependencies of the development in the building sector and the future investments in the expansion of an existing district heaating network?**

Methodology



The research question is answered by an **integrated approach,** including explicitly the analysis of the costumers' investment behaviour. The economic evaluation of the district heating network, it's expansion and the generation and expansion planning to supply the central district heat demand is also considered to find suitable pricing mechanisms. This analysis is **spatially resolved for building blocks.**

(1) The decision of costumers for investments in heating technologies and refurbishments depending on the district heating pricing models are simulated. Therefore the existing bottom-up model Invert/EE-Lab [1] is used and applies a multinomial logit approach for the decisions. The model considers various subsidies, policies and development of energy prices and points out effects of pricing mechanisms. The results consists of the **space heating and domestic hot water demand** for various building categories (distinguished e.g. in construction year, usage, size, etc.)

(2) The results are **spatially assigned to building blocks** based on its composition of buildings to provide a basis for the investment optimization module. The share of buildings within each building category is known as a result of the simulation model and the demand assigned.

Share district heating initial

(1) Potential share of district heating due to building owners investment decisions without considering distribution costs

(3) Share of connected demand in potential district heating demand considering distribution costs in detail

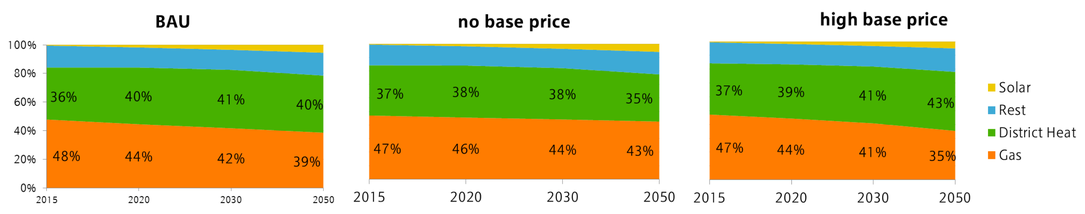
(3) Based on the input from the simulation module, which serves as upper bound for the district heating expansion potential, an **investment optimization** model is used, considering the **investments, re-investments, operation and maintenance costs** [2]. The influence of the change in the district heating demand can iteratively be considered applying and generation and expansion planning model [3].

Results

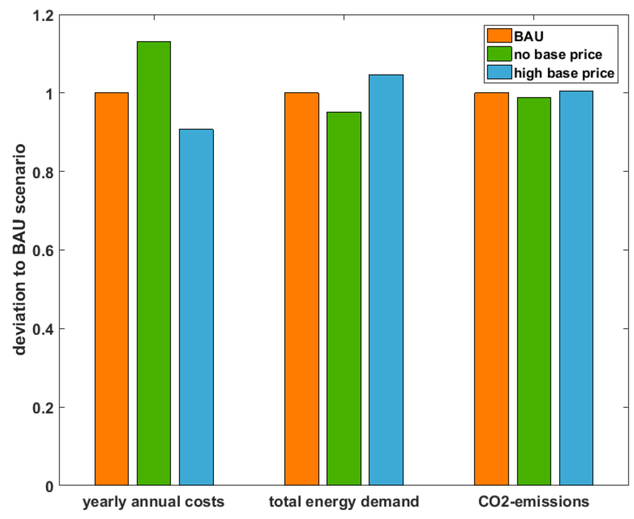
Assumptions:

3 scenarios, varying in the assumptions regarding the District Heating price mechanisms:

- Scenario 1 with the **current district heating household tariffs**, splitted in demand charge (in Euro/MWh) and base price (in Euro/MW)
- Scenario 2 with **no base price**
- Scenario 3 with **high base price** and **low demand price** (1.5 * base price from scenario 1)



The Energy carrier mix for the different scenarios supplying the buildings' space heating and domestic hot water demand considering the building owners' investment decisions and the distribution costs in detail



Indicators regarding the policies.

- The yearly annual costs consists of energy costs for space heating and hot water and the operation and maintenance costs for it
- The total energy demand represents the energy demand for space heating and hot water
- The CO_2-emissions for space heating and domestic hot water

Discussion and Outlook

The results points out that changes in the pricing mechanism can cause changes in the urban heat system. Especially the usage of „high base prices" can influence the system:

- Affordability: The **costs** for the **customers** can be **reduced**. Cost reduction in households exceeds the network operators profit decrease
- Sustainability: **No increase of CO_2-emissions** although the total demand for space heating and hot water is higher

This first analysis shows out further research potential:

- Can these tariffs set insentives for a fundamental change of the costumers load profiles?
- Is it possible to reduce the heat generation costs due to less required peak load capacities?
- What are the consequences, if peak load pricing is applied to the research question?

Acknowledgement

This project would have been impossible without the support of **Wiener Stadtwerke Holding AG**, **Wien Energie** and the PhD course URBEM^{DK} instituted at **TU Wien.** (http://urbem.tuwien.ac.at/home/). Further we would like to thank *Christian Pöhn* (MA 39) for providing us the data set on buildings heat registry.

Literature:

[1] Andreas Müller, „Energy Demand Assessment for Space Conditioning and Domestic Hot Water: A Case Study for the Austrian Building Stock", Dissertation, TU Wien, 2015.
[2] Sara Fritz, "How public interventions in buildings energy efficiency affect the economic feasibility of a district heating network - a case study for Vienna," presented at the 38th IAEE International Conference, Antalya, Turkey, 2015.
[3] Nikolaus Rab, "Long-term investment strategies for power and heat generation portfolios with minimal costs.," presented at the 14th IAEE European Conference, Rome, Italy, 2014.

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