Optimization of resource efficiency in mixed-use quarters

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MOTIVATION.

Why analyzing city quarters?

- Currently 70 % of the worlds resource consumption takes place in cities. This causes 75 % of the worldwide carbon dioxide emissions [1].
  ↳ The large consumption within cities comes along with high saving potentials.
- Only 4 % of research projects covering the subject of energy efficiency deal with the energy efficiency of city quarters, but 44 % focus on the efficiency of buildings and 43 % with power plants [2].[1]
  ↳ There is a research deficit in the field of quarter energy efficiency.

Why Open Source?

- Only 8 % of research projects working in the field of energy efficiency in buildings and quarters are releasing planning tools, which can be used by other users. Merely 3 % of these tools are provided with an open source license [2].[1]
  ↳ The majority of research results are not readily applicable for external users. Given the fact, that the general public pays for publicly subsidized projects, products of these projects should be free of charge. More open source planning tools need to be provided.

[1] This statement is based on a study which analyzed 900 research projects, funded by the German Federal Ministry for Economic Affairs and Energy (BMWi) for the purpose of increasing the energy efficiency in buildings and quarters [2].

THE PROJECT „R2Q" is funded by the German Federal Ministry of Education and Research (BMBF). The scope of the project is to propose improved, more efficient handling of the resources water, space, substance flows and energy in two mixed-use quarters in Herne (NRW, Germany). This poster discusses the idea and methods of the energy resource, including electricity, heat and fossil resources.

R2Q

CHRISTIAN KLEMM. I am a masters student in energy engineering and a research associate at the Münster University of Applied Sciences. I started working in the field of energy system modelling in the project "R2Q" in March 2019. As this is the first time I participate at a network event of the Open Energy Modelling Framework (oemof), I hope to get in touch with other oemof users and to gain insight into various projects using oemof.

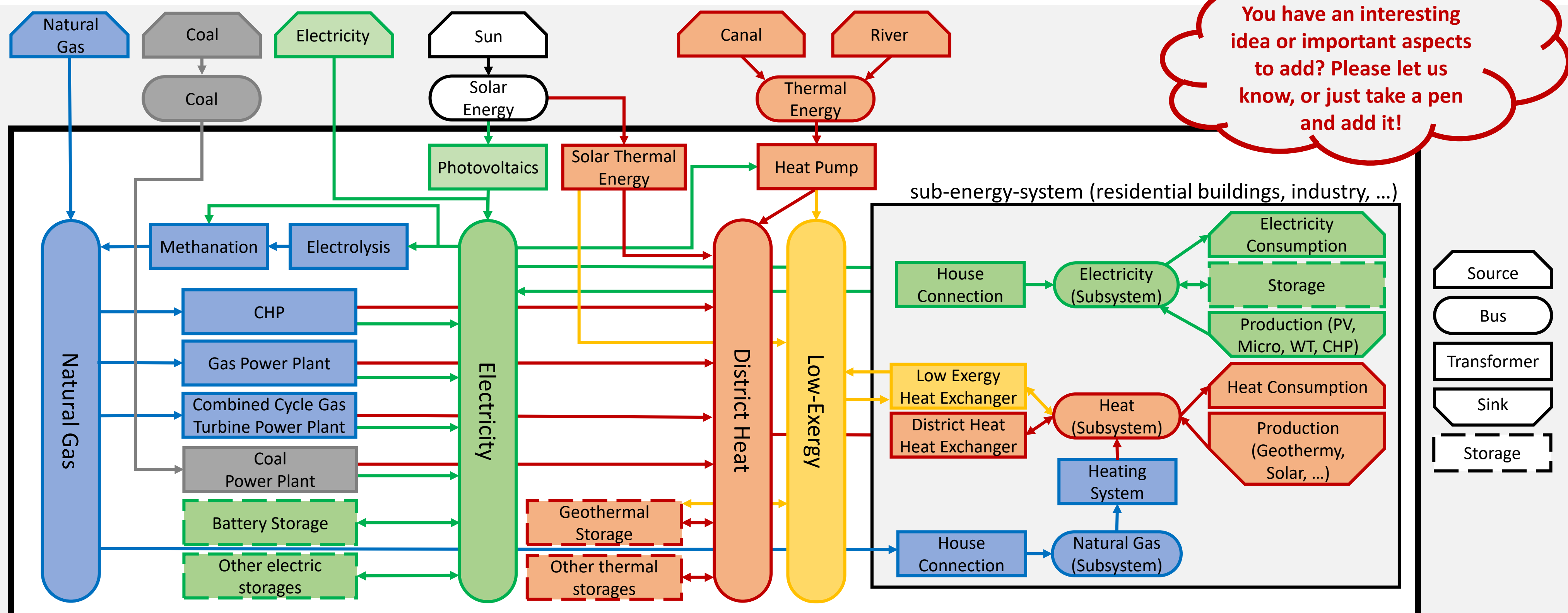christian.klemm@fh-muenster.de
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FIGURE 1: Simplified draft of the planned quarter energy system, including an exemplary sub-energy system.

METHODS. The analysis and optimization will be carried out in several steps:

(1) **Modeling the status quo** of the analyzed quarters with oemof (existing infrastructure and consumption structures).

(2) **Verification of the model** on the basis of real-world data.

(3) Expansion of the energy system model by **techniques and measures, which can increase the supply efficiency**. For example the usage of Low-Exergy-Networks, the implementation of renewables in feasible amounts, or the installation of various insulation materials, will be included into the model.

(4) **Identification of the most efficient mix of technologies**, by using the oemofs solph library. Possible evaluation parameters are the need of primary energy, the carbon dioxide emissions, or cost aspects.

(5) **Implementation of a planning tool**, which allows the replication of the described procedure, by automatically creating an energy system model from spreadsheets, without having the necessity of coding.
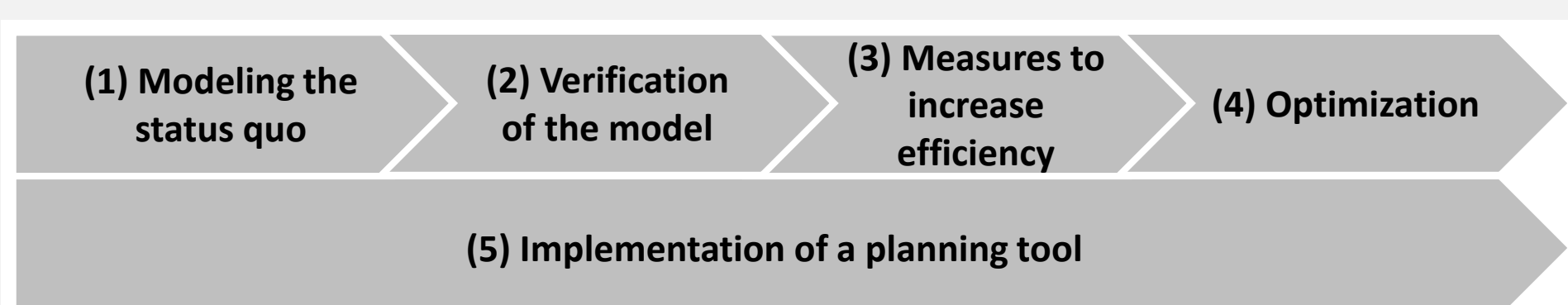

FIGURE 2: Work steps and their chronological sequence.

RESULTS. As the project "R2Q" has just started, there are no appreciable results jet. At the end of the project, the following results are anticipated:

- Preparation of a **resource plan**: Identification of the most efficient technologies with regards to primary energy usage, carbon dioxide emissions, costs, and feasibility.
- Assurance of the **replicability of the results** by creating a detailed user guideline.
- Implementation of an **open source planning tool**, which allows the replication of the methodology without having the necessity of coding. The user input will be entered via spreadsheets.

What experiences do you have with graphical user interfaces and user inputs via spreadsheets in combination with oemof?

REFERENCES.
[1] Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ). Perspektiven der Urbanisierung - Städte nachhaltig gestalten. Berlin, 2014.
[2] Kirnats, L.; Joost, J.-N.; Berg, S.; Frisch, J. und van Treeck, C. „Status Quo bei digitalen Werkzeugen und softwarebasierten Lösungsansätzen". In: Bauphysik 40 (2018), S. 441–448.

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