MAPPING AUSTRIA'S NATURAL GAS AND HYDROGEN INFRASTRUCTURE PLANS

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Motivation and Subject Area

The transition towards energy systems featuring bulk quantities of renewable gases requires comprehensive infrastructure planning. Energy system optimization models (ESOMs) are widely used to support this planning and inform associated decision-making. For example, Neumann et al. [1] employ a sector-coupled ESOM to study the potential role of a European hydrogen network composed of new and repurposed natural gas pipelines. Such studies commonly use information from European open-source gas datasets such as SciGRID_gas [2]. However, these datasets often simplify complex network structures, for instance, by representing looped pipelines as a single connection (e.g., the Trans Austria Gasleitung (TAG) [3]), lack automatic updatability and capability for adding new infrastructure, and come in formats that are not well suited for straightforward use in ESOMs.

This paper addresses these limitations via three contributions:

(1) We develop a detailed dataset of Austria's gas infrastructure by deriving a network topology from the ENTSOG Transparency Platform [4] and systematically enriching it with open-source data from OpenStreetMap [5] and the Global Energy Monitor [6] via a geographical matching procedure. The resulting dataset represents the status quo of Austria's gas infrastructure as a coherent network, suitable for use in ESOMs.

(2) To enable systematic dataset manipulation and extension, we developed the QGas toolkit [7]. This framework supports graphical operations on the network, such as adding or modifying elements (e.g., pipelines, gas storage, power plants), while preserving the underlying topological structure.

(3) We demonstrate the capability of QGas by integrating plans for repurposing existing pipelines for hydrogen as well as expanding new hydrogen pipelines [8] from the Austrian gas transmission system operator AGGM into the natural gas dataset, thereby creating a forward-looking dataset for integrated hydrogen-natural gas optimization studies.

Methodology

Figure 1 illustrates the schematic workflow. The underlying natural gas dataset is generated by extracting the network topology from ENTSOG, which is subsequently georeferenced and enriched with preprocessed raw data gathered from open sources, while missing information is approximated. The QGas toolkit is then used to create new data layers for repurposed and new hydrogen pipelines. Plans for these hydrogen pipelines are imported into QGas as image, enabling straightforward tracing new routes, assignment of technical attributes, and allocation of both repurposed and new hydrogen pipelines to their corresponding layers, all while preserving the overall network structure of the dataset.

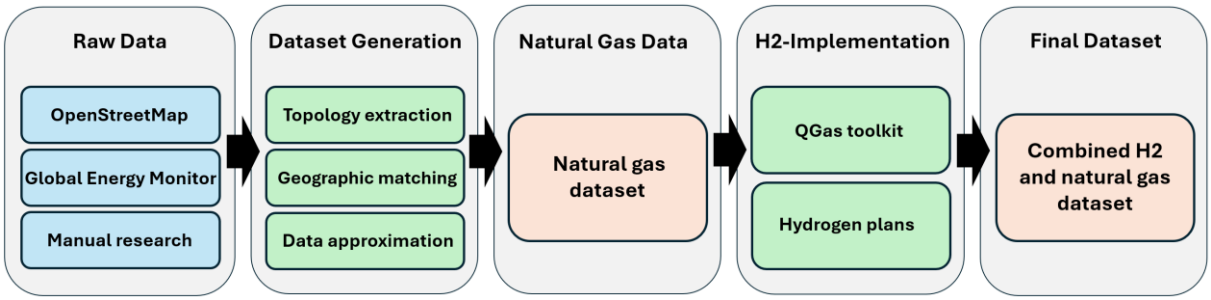

Figure 1: Schematic workflow of gas infrastructure dataset preparation.

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This methodology yields a georeferenced dataset with comprehensive manipulation capabilities. Figure 2 presents the 2040 natural gas and hydrogen dataset as rendered within QGas, demonstrating the spatial resolution and topological completeness of the resulting network representation.

Figure 2: Resulting natural gas and hydrogen dataset of Austria in 2040.

Conclusion and Future Perspectives

This work develops and demonstrates an effective methodology for integrating hydrogen infrastructure into existing natural gas network datasets. The resulting integrated dataset is designed for direct application in energy system optimization models. Future work will extend the dataset to a pan-European scope and make both the QGas toolkit and the dataset publicly available.

References

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