TECHNISCHE UNIVERSITÄT DRESDEN

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Is the H_2-Backbone Economically Feasible? An Analysis of the Retrofit Potential of the German Gas Grid

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Research Context

Germany's transition to Hydrogen openly relies on pipeline **retrofitting to reduce costs**. However, no peer-reviewed study has data on **actual availability** of these pipelines. The transition period from a gas to hydrogen grid is often overseen, as even by optimistic standards Germany will need to insure a **secure supply of gas until 2040**.

Objectives

1. Understand the changes in gas transmission after the Russian invasion of Ukraine.
2. Measure the present and effective **retrofitting potential** of the German gas grid.
3. Analyze its changes under different conditions such as **reduced demand** or **retrofitting prioritization**.

Results

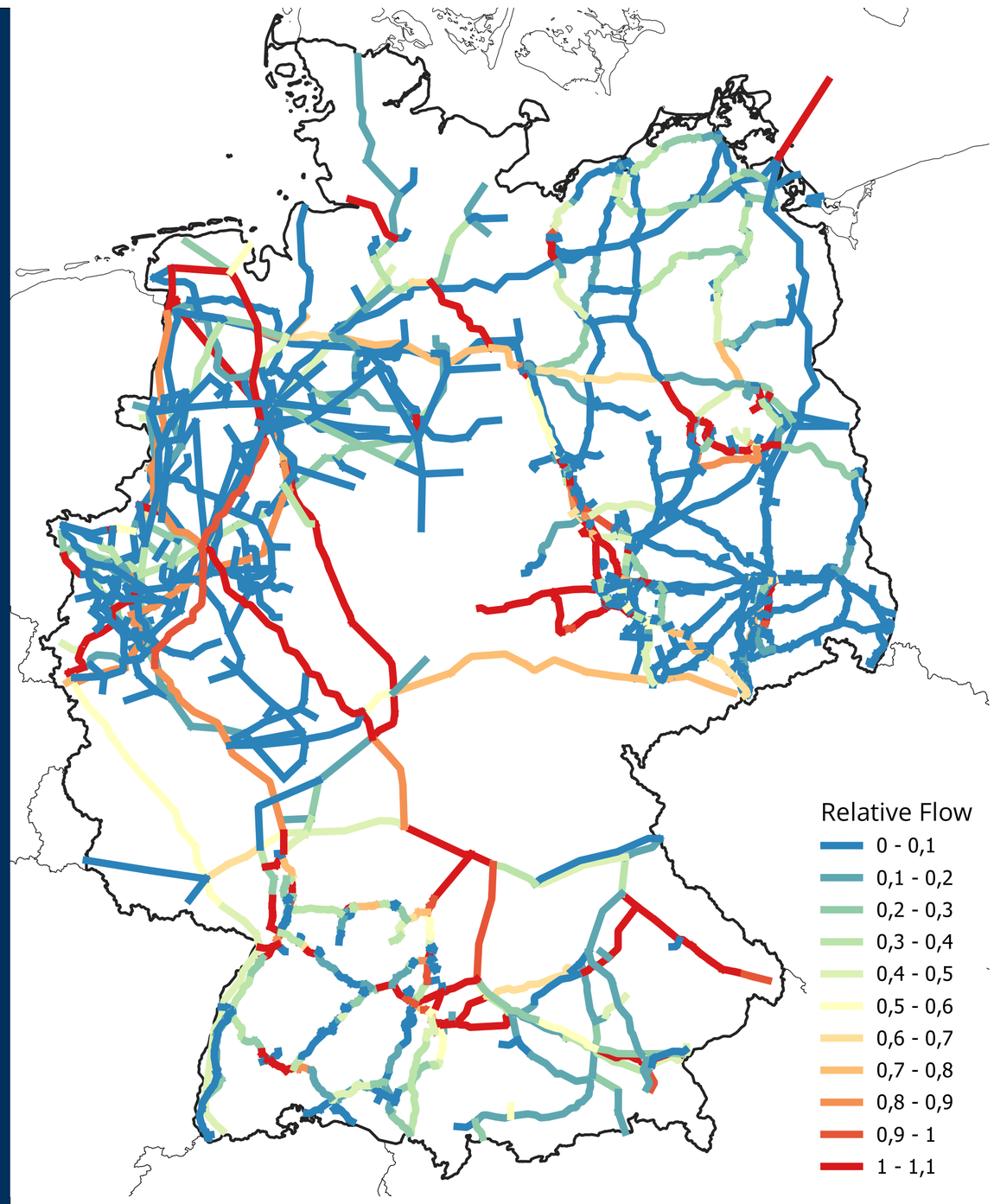

Figure 1: Relative Flow in optimal grid use scenario for Germany in 2023.

Figure 2: Retrofittable gas pipelines when prioratized while also covering demand in scenario Germany 2023.

Optimal Behavior under new conditions:
In simulations from 2023 we can how the change in gas imports has drastically affected the use of infrastructure. Paritcularly we see in **Figure 1** howt the north-west to south-east axis has been overloaded due to **Norwegian imports replacing Russian gas**.

High Retrofitting Potential:
The relative pipeline use seen in **Figure 1** shows the high existing potential of the German grid with about **25.7% of the total length of the grid** available for Hydrogen.

Prioritizing Retrofitting gives more alternatives:
Suboptimal simulations that prioratize retrofitting of pipelines show (**Figure 2**) increased retrofitting potential, specially for **east-west transport**.

Partial gas phase-out will not change the situation: Retrofit potential was stable when evaluating for propionally decreasing demand (**Table 1**), meaning that a slow transition to **hydrogen will require a parallel secure supply of natural gas**.

Methods

The German gas grid was simulated using **GAMAMOD** (**Ga**s **Ma**rket **Mod**el), a bottom-up model that uses an LP optimization to calculate **minimal gas transportation costs**.

GAMAMOD was modified to implement a relaxed binary variable and then MIP in order to optimize for the retrofitting of pipelines.

Gas grid information was made from publicly available sources and **to our knowledge is the most complete open gas data set avaible**.

Gas Phase-out	100%	85%	70%	55%
Retrofittable Pipelines	407	431	443	399
Percent Retrofit	22.7%	24.1%	24.7%	22.3%
Length Retrofittable	5943 km	6021 km	6482 km	6186 km
Percent Length	25.7%	25.9%	28.0%	26.7%

Table 1: Effects of propotional gas phase-out on retrofitting potential.

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