From costs to wholesale prices for green hydrogen
A case study for Europe and the MENA region

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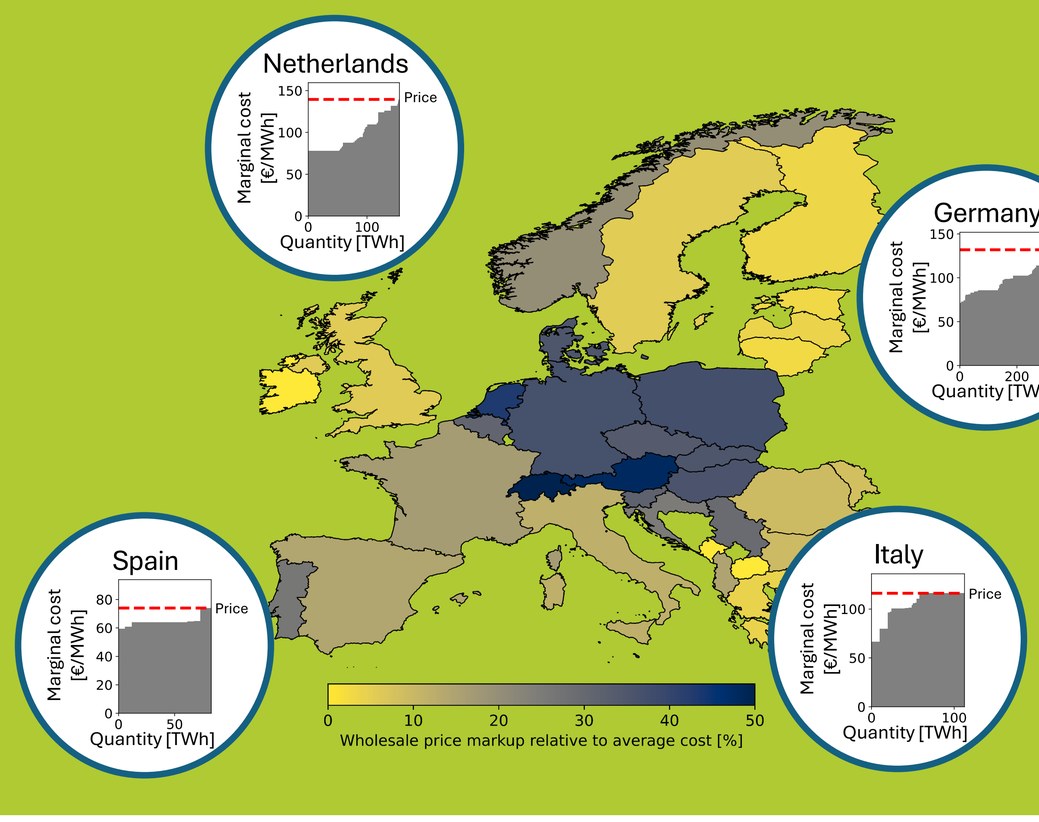
Hydrogen wholesale prices in Europe will be significantly higher than production cost when based on merit order principles

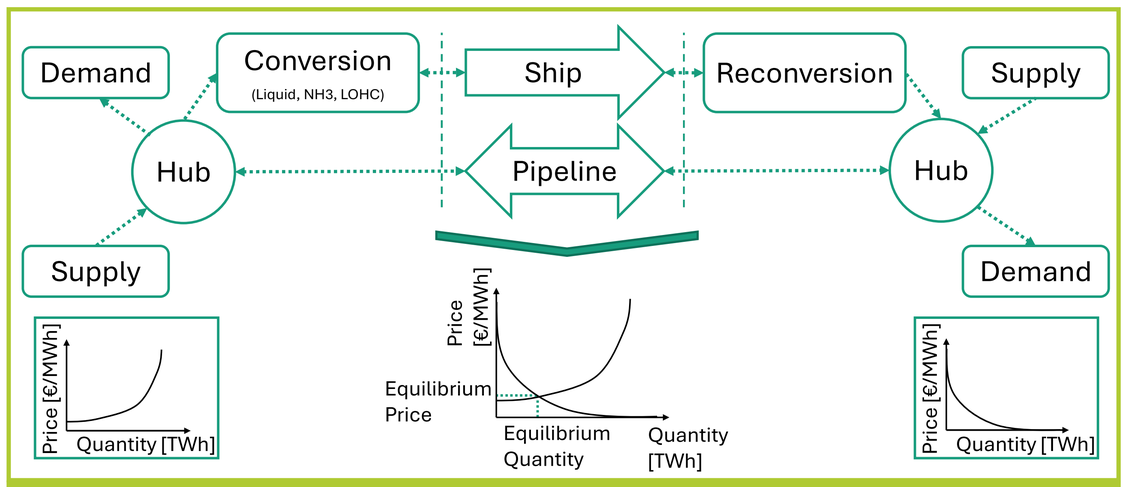


Introduction

- Hydrogen import cost potentials from existing studies [1] are often misinterpreted as import prices, leading to an underestimation of hydrogen prices neglecting market effects [2]
- We use a comprehensive market model for green hydrogen to investigate **how prices might form in a future market based on marginal cost pricing**

Method

- **Harmonized datasets** using hydrogen supply curves based on regional renewable potentials [3], demand scenarios [4], and potential ship and pipeline transport routes including regional geographic and political characteristics [5]
- HyPriM **optimization model minimizing the total system cost** wile meeting demands [6]
- Yearly optimization from **2030 to 2050 for 56 countries** of Europe and the MENA Region
- **Scenario variations** using exogenous infrastructure and hydrogen demand assumptions



Topology of the hydrogen market model HyPriM [6]

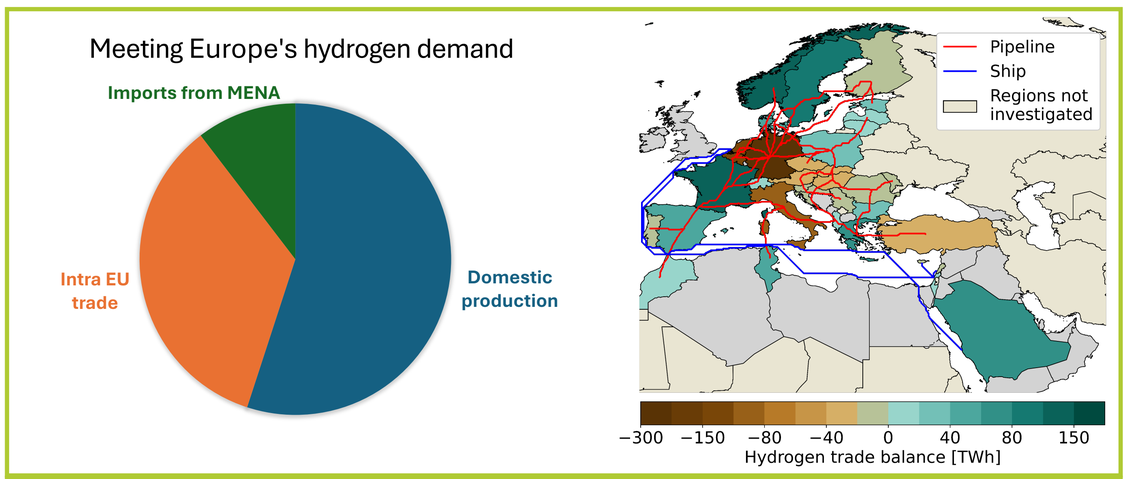
Results for 2050

Hydrogen trade centers on Central Europe

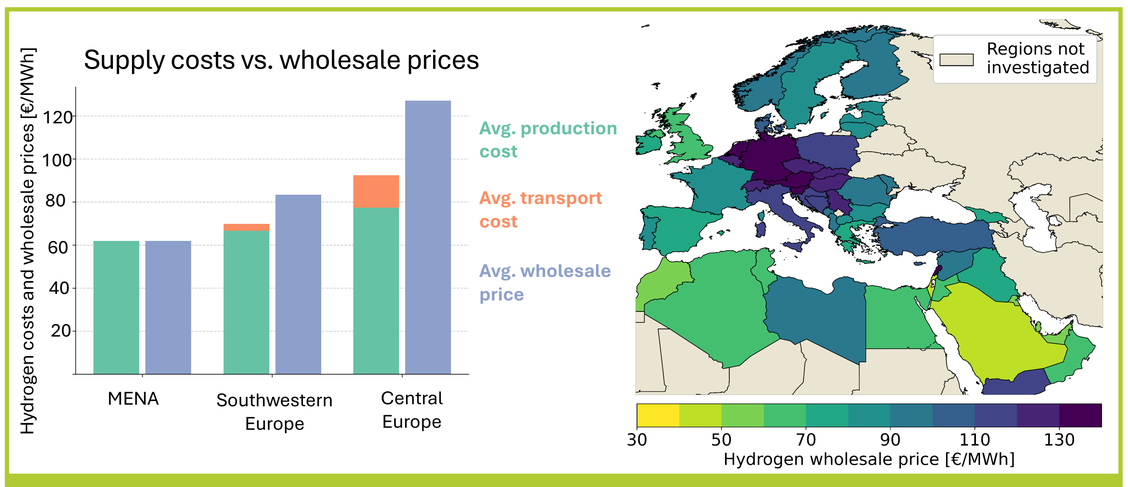
- **Key Exporters** include France, Norway, Sweden and Spain within Europe, as well as Tunisia and Morocco benefiting from direct pipeline connections to Europe, and Saudi Arabia; **Key Importers** being Germany, Belgium, the Netherlands and Italy
- **Pipeline transport dominates** while shipping can provide additional flexibility

Wholesale prices in Europe vary by up to 60 €/MWh

- **High prices in Central Europe** due to high demand and limited cheap renewables, lower prices Southwestern and Southeastern Europe, which are rich in renewable resources
- **The difference between wholesale and average supply cost is highest in Central Europe**, while for renewable-rich countries wholesale prices are closer to average supply cost
- In the MENA region many regions have good renewable potentials, but **favorable economic conditions can lead to exceptionally low prices** (e.g. Saudi Arabia)



Hydrogen trade flows (right) and Europe's supply shares (left)



Hydrogen wholesale prices (right) and comparison with avg. supply cost (left)

Conclusion

- The disparities in wholesale prices are caused partly by merit order effects, so **hydrogen costs should not be equated with wholesale market prices**
- If hydrogen demand establishes in Europe, some will likely be traded internationally, **mainly within Europe via pipeline**; supplemented shipping can provide flexibility to the system and enable imports from competitive but geographically distant locations

Limitations: This analysis does not account for taxes, distribution costs, subsidies, or bilateral contracts. Future research should explore the effects of seasonal demand, price elasticity, and the coupling of hydrogen derivative markets.

References

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