

# **BUSINESS AREAS**





Trading & sales

Transport

Storage

Biogas







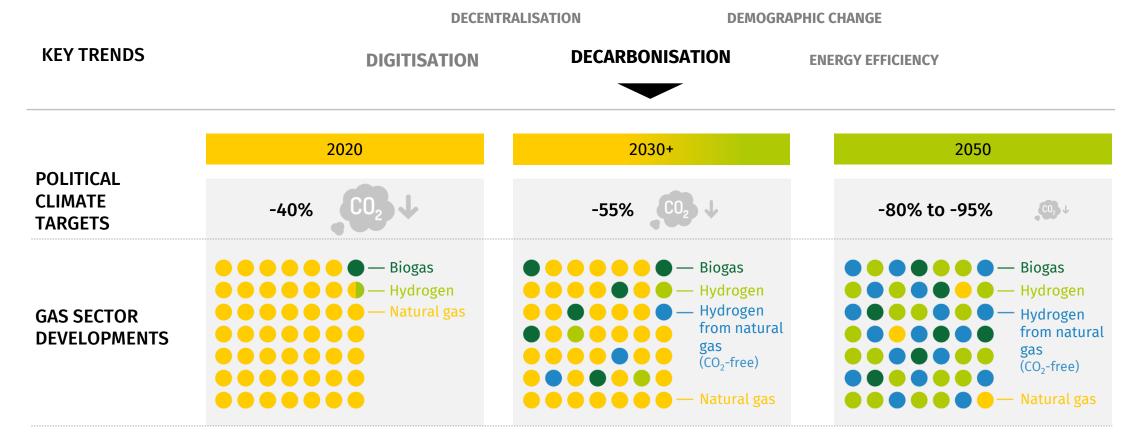
**> BALANCE** 

New business

Green gases | Digital infrastructure

### STRATEGY VNG 2030<sup>+</sup>





WHAT VNG IS DOING

**VNG aims**, within the framework of its core competencies – especially in the field of infrastructure – to play a **significant role** in the value chain for **climate neutral gases**. This will also lead to opportunities for **regions of Eastern Germany undergoing structural change**.





# AGENDA

- ▶ Motivation Green Gas
- ► Methodology GAMAMOD-EU.sto
- Results on investment decisions
- Conclusion and discussion

## **DISCLAIMER**



This talk reflects the view of the author only and does not necessarily represent the view of VNG AG

#### **Erdgas-BRidGE**

Erdgas - Bedeutung und zukünftige Rolle in der deutschen Energiewende; Teilvorhaben: Weiterentwicklung der Modelle ELTRAMOD und GAMMAMOD (FKZ: 03ET4055A)

Partners: Technische Universität Dresden (EE2), Energiewirtschaftliches Institut an der Universität zu Köln (EWI)

Duration: 2018-2020

#### Gefördert durch:



aufgrund eines Beschlusses des Deutschen Bundestages

#### **TransHyDE**

Developing, assessment and demonstration of hydrogen transport technologies.

Partners: VNG AG in cooperation with more than 60 other partners (industry/research)

Duration: 2021-2025





### GREEN GAS AS AN ENABLER



to achieve climate objectives on all political levels



Global

Paris Climate Agreement, 2015



**Europe** 

Green Deal, European Hydrogen Strategy



**Deutschland** 

National Hydrogen Strategy

**Renewables are the main source** for the future sustainable energy system and to achieve the carbon dioxide reduction targets that are proposed on all political levels. However, a pure "all-electric" will probably not ensure a reliable energy system. For that reason, the **integration of climate neutral gases** – hydrogen – into the design of our energy systems is needed.

# RESEARCH QUESTION



The Green Deal provides a strategy to react on gas source dependence in two ways.

- 1. First, it diversifies suppliers as the introduction of Green Gas production facilities enables new supply countries to enter the gas market.
- 2. Second, it substitutes fossil natural gas by a new defossilized fuel, namely hydrogen.



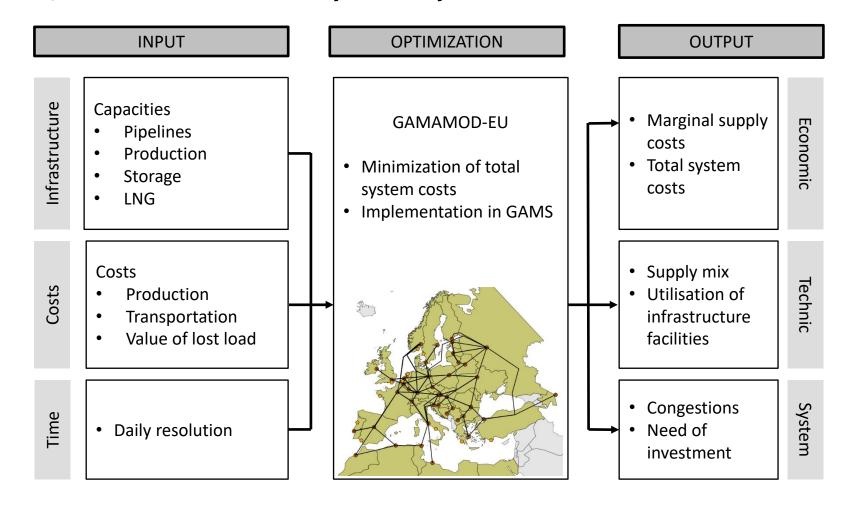
GAMAMOD-EU



### A GAS MARKET MODEL FOR EUROPE



### GAMAMOD-EU, a fundamental bottom-up linear optimization model



### STOCHASTIC OPTIMIZATION



#### **Model extension to GAMAOD-EU.sto**

GAMAMOD-EU

+ Investment Decision

First Stage:
Here-and-Now Decision

Investment in Gas
Infrastructure for 2030
and 2045

Uncertainty covered by
Scenarios (s1 ... sn)

Y<sub>sc01</sub>

Y<sub>sc02</sub>

Y<sub>sn-1</sub>

Y<sub>sn-1</sub>

Second Stage: Wait-and-See Decision

Dispatch in 2030 and 2045

Contents lists available at ScienceDirect Energy Policy Does 'more' equal 'better'? - Analyzing the impact of diversification strategies on infrastructure in the European gas market ARTICLEINFO The paper investigates investments in gas infrastructure considering uncertainties in European gas markets Furthermore, the study addresses the question of whether (more) diversification provides a (better) security or supply improvement. Thus, a stochastic optimization approach is introduced. The uncertainties focus on 200 beyond 2050, gas will be needed at least as a bridge fuel. Compared to lignite or hard coal, natural gas is the fossil fuel that can provide reliable The European natural gas market faces changes in the upcoming regains on nativotal, instantanges is un tools inter than Lea phovate reasonerings supply (is of) in the power sector at lowest CO<sub>2</sub>-emissions. Thus, the security of supply (SoS) in gas markets determines the actions of policy makers for the next decade.

Following the objective of improving the gas markets resilience by decade, mainly driven by two forces. On the one hand, the intensified efforts in transforming the energy system towards more sustainability, institutionalized in the European Green Deal, <sup>1</sup> pose the question of the future role of natural gas in a de-fossilized energy system. In particular, efforts on hydrogen strategies increase globally and the penetration of alternative gases will lastingly change the natural gas market. On the other hand, geopolitical concerns about Russia's reliability as major gas building one single European gas market, the EC established four Gas Directives. One example of the proposed measures is the expansion of cross-border capacities between EU-28 Member States. However, during supplier for the European Union with its 28 Member States (EU-28)2 the last two decades, a series of events stressed the SoS in the EU-28 gas markets. The most critical situation remains the Russian-Ukraine gas dispute culminating in the past in 2006 and 2009, when gas supply give rise to the question whether new infrastructure, i.e. Nord Stream 2 \* The mustly was designed before the 31s of January 2010, the official withdrawals of the UK from the European Union.
\* So is defined by the IT regulation 99/40/10 as sensual for the 12s as well as for in Individual Member States. In order to reduce the impact of potential cricies, riggered by the disruption of gas regulates. Member States should facilitate the deverification of energy sources and gas delivery routes and nuply's sources. \*\* The first Case Device West was established in 1999 and has been reviewed in 2006, 300,000 and 300, Maissanz (2012) general strong in legal sense after in the property investigating the first three Gas Directives. The Gas Directive from 2010 has a strong relation to the NIX peopler and was manify established set to the first that Case and set was a first of the 12st 2010. Received 9 September 2020; Received in revised form 1 February 2021; Accepted 2 March 2021

Hauser (2021) Does 'More' Equal 'Better'? – Analyzing the Impact of Diversification Strategies on Infrastructure in the European Gas Market; Energy Policy, Volume 153, 2021,

https://doi.org/10.1016/j.enpol.2021.11223.

- Investment decision in LNG import terminals, pipelines and storages

Scenario parameters:

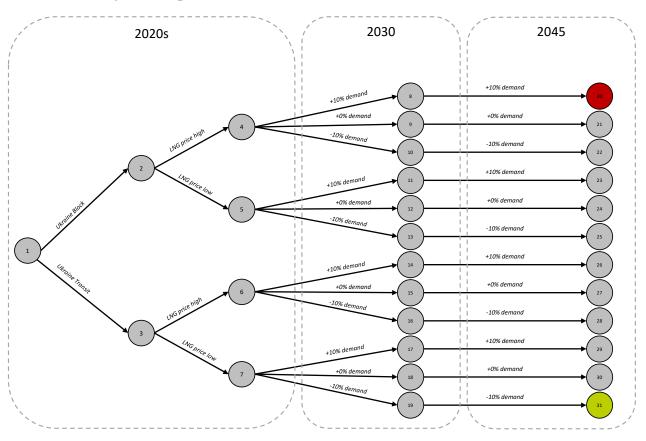
Demand, Ukraine Transit, LNG Price

- New: investment in Green Gas facilities
- Consideration of uncertainties: demand, transport route, LNG price

### **UNCERTAINTIES**



### The European gas market faces a bundle of uncertainties in the upcoming decades.



No Ukraine transit High demand High LNG price

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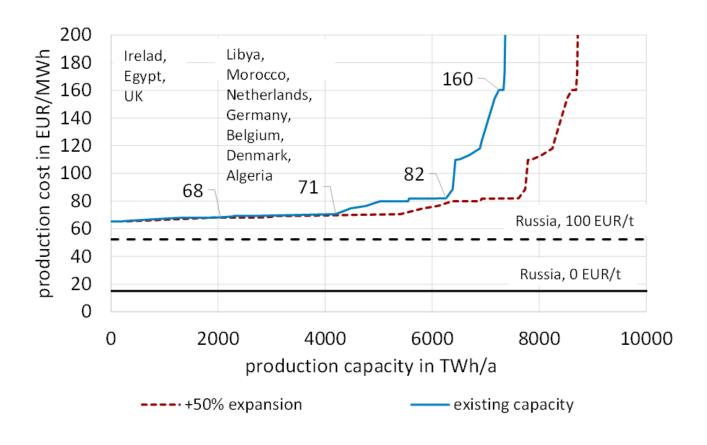
Ukraine Transit, Low demand Low LNG price

- Three levels of uncertainties
- Combination leads to 12 scenario with equal probability
- Model decision considers the realization of all scenarios simoultaneously

### PRELIMINARY CONSIDERATIONS



#### Where will the Green Gas come from?

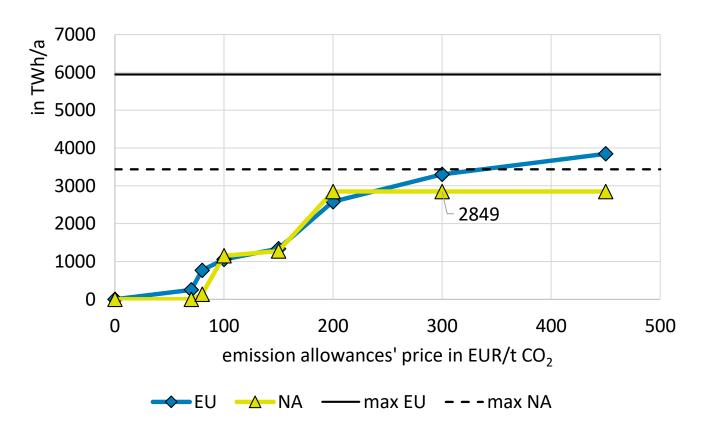


- Consideration of renewable potential in Europe and North Africa
- Limiting factor is a) the RES potential or b) the pipeline capacity
- Green Gas has to compete with natural gas  $\rightarrow$  a high CO<sub>2</sub> price is needed

### RESULTS ON GREEN GAS PRODUCTION



### ... in relation to the CO<sub>2</sub> price

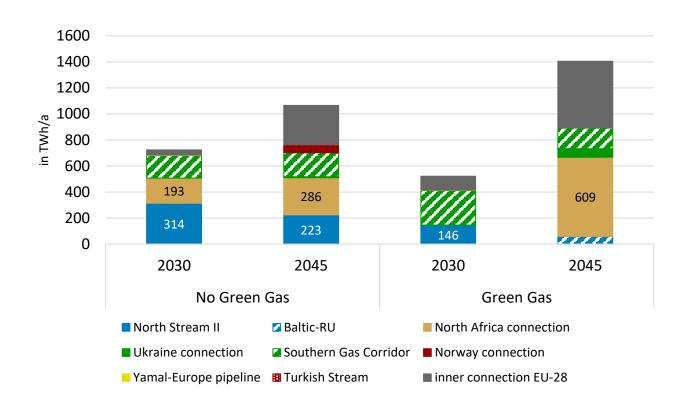


- European RES potential will probably not completely available for electrolyzers
- North African hydrogen can be expected when CO<sub>2</sub> price rises above 200 EUR/t

### RESULTS ON PIPELINE INVESTMENTS



### ... importing Green Gas shifts investments from Nord Stream II to North African pipelines



- Left: without Green Gas option → focus on Nord Stream II
- Right: with Green Gas option → focus on North African pipeline connections

# **CONCLUSION AND DISCUSSION**



- Climate policy activities on all political levels encourage the realization of Green Gas projects
- Future **Green Gas demand** will be supplied also by imports that change the traditional natural gas importing routes and impacts decisions for new gas infrastructure
- The model **GAMAMOD-EU.sto** provides an approach to investigate the impact of Green Gas imports on investment decisions in gas infrastructure and dispatches by taking gas market uncertainties into account
- **The CO2-price** is one of the major driver for Green Gas imports and a price level of 200 EUR/t CO2 will lead to higher shares of imports from North Africa
- Future analysis should extend the analysis to **further potential supply regions**, e.g. the Middle East

Besides the tasks for improving the technology and economic conditions of Green Gas production and using, the major current challenge is **to ensure the social and political acceptance for hydrogen as an enabler in the ongoing energy transition**.

