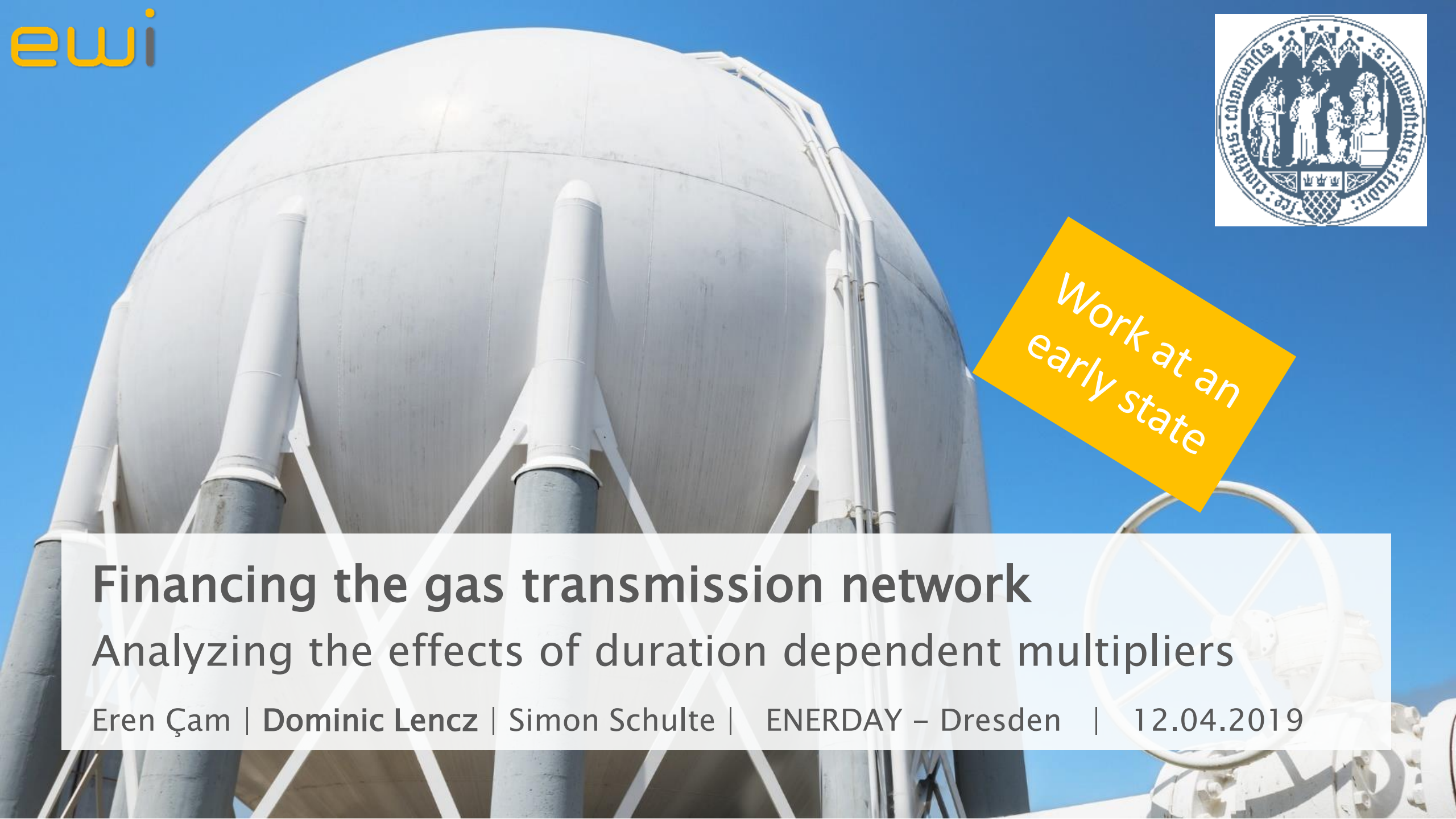


Work at an early state

Financing the gas transmission network

Analyzing the effects of duration dependent multipliers

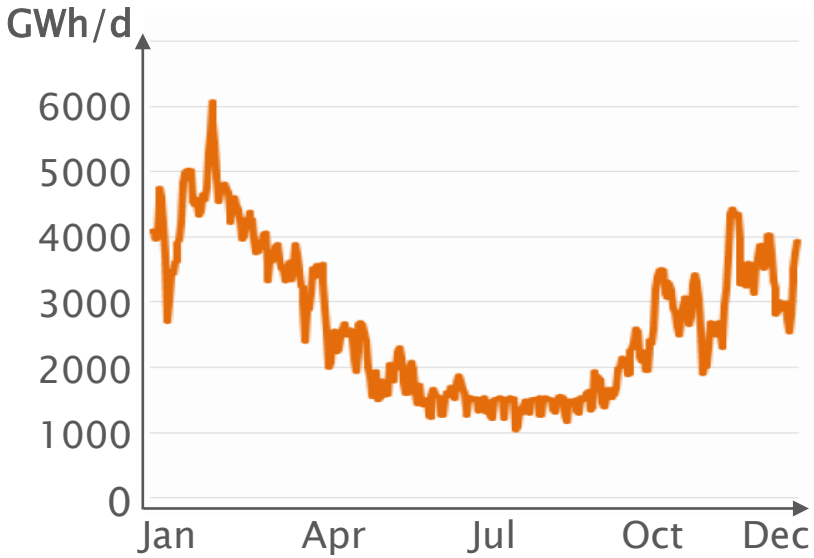
Eren Çam | **Dominic Lencz** | Simon Schulte | ENERDAY – Dresden | 12.04.2019

Agenda

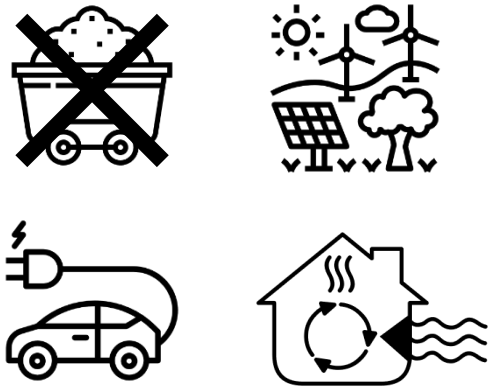
- Motivation & Background
- Research question and methodology
- Preliminary results

Introduction
Motivation

Current German gas demand

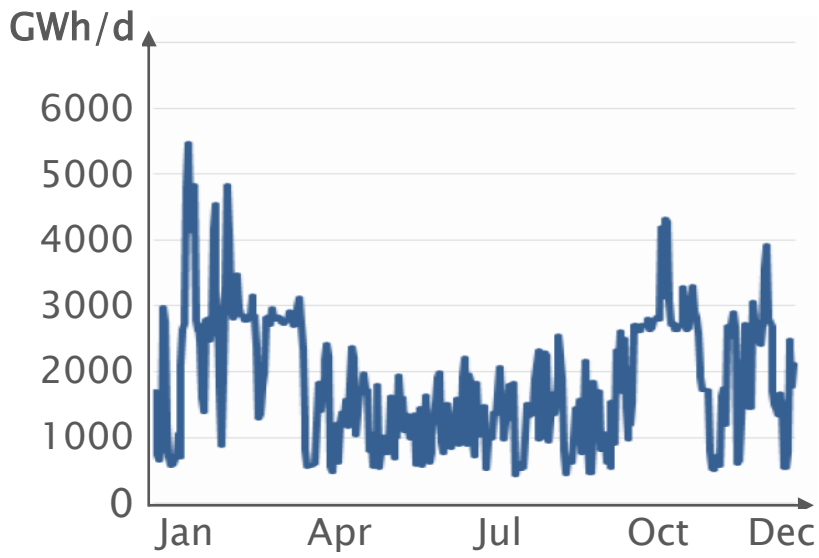


Energy transition



Indicative German gas demand for 2050

Electrification scenario – dena EL95



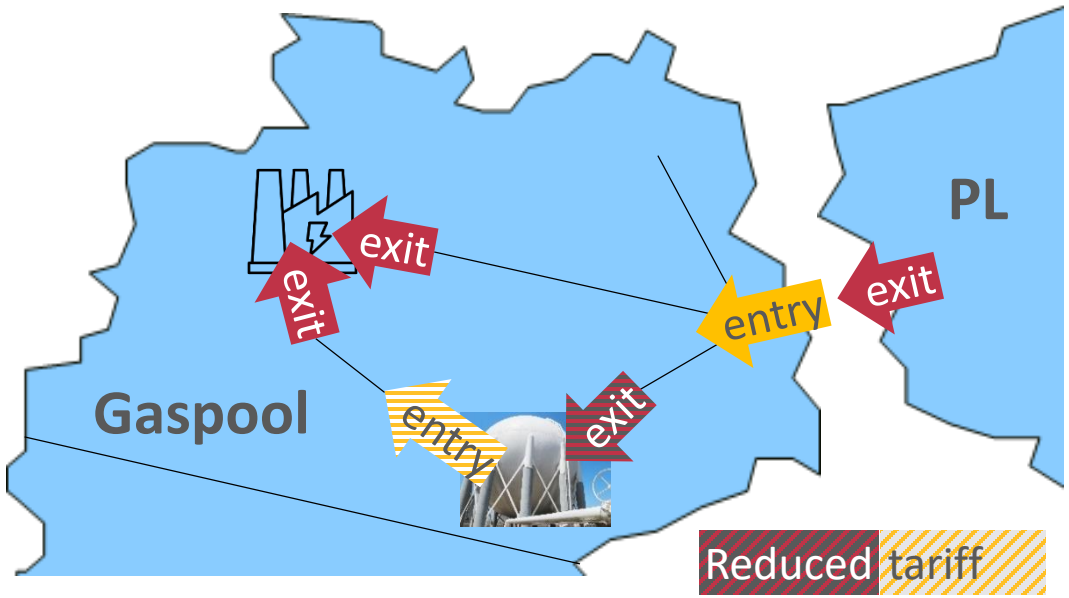
Consequence

- Decreased demand for long-term transmission capacity
- Increased demand for short-term (e.g. daily) transmission capacity

Implication

- Efficient pricing of short-term vs. long-term transmission capacities gets more relevant

Introduction
Background



Financing the gas transmission network

Who: Gas traders who transfer gas using the gas transmission network

What: Entering and exiting a transmission grid market area (entry-/exit-tariffs)

How: Traders need to buy the transmission capacity they require in explicit auctions

How is transmission capacity priced?

duration dependent tariff (reserve price) + auction premium

EU TAR 2017

Multipliers

1 – 1.5 for quarterly and monthly capacity

1 – 3.0 for daily and intradaily capacity

Effect of multipliers

Multipliers increase the relative price of short-term capacities in comparison to long-term capacities → Impact on transport, storage, gas prices …

Impact on 1) short-term efficiency, 2) long-term efficiency and 3) allocation of costs

Introduction
Research question

The big multiplier question

What are the adequate multipliers to balance between

1. facilitating short-term gas trade,
2. providing long-term signals for efficient investment in the transmission network,
3. enhancing cost reflectiveness of transmission network charges?

This question is discussed currently EU-wide within an a consultation (NC TAR 2017 (Article 28))

Question analyzed in this research

What are the effects of multipliers on the gas dispatch?

Intuitive hypotheses:

1. Multipliers increase long-term capacity bookings.
2. Multipliers decrease volatility of gas transports.
3. Multipliers increase storage utilization.
4. Multipliers increase price differences between market zones in most situations.
5. Multipliers increase total costs in the short-term and hence reduce efficiency.

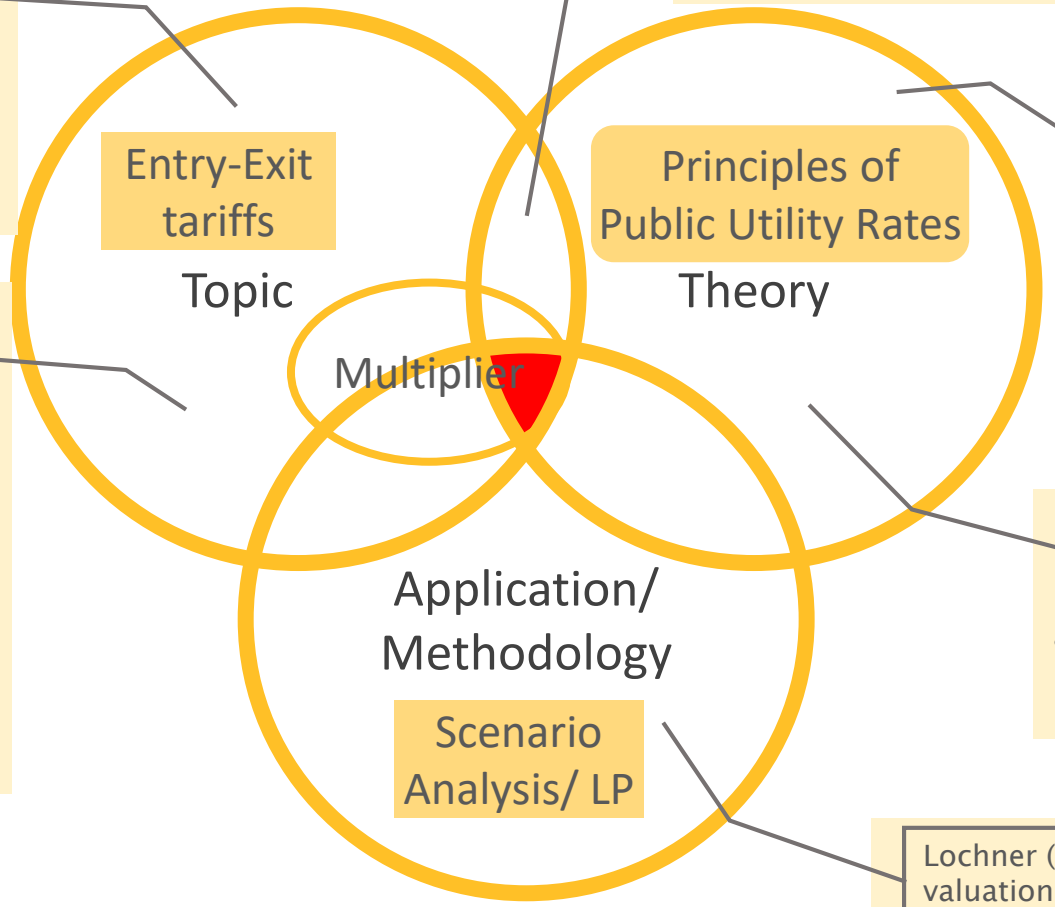
Literature review

Hallack and Vazquez (2013) – European Union regulation of gas transmission services: Challenges in allocation of network resources through entry/exit schemes

- Inefficient offers of network services in entry/exit regulations

Harald Hecking (2015) – Two new tariff models to foster competition and security of supply in the EU gas market

- Recommends differentiating tariff structures between intra EU, domestic exits and EU borders
- Proposed schemes bring with them different distributional effects



Bonbright et al. (1961) – Principles of public utility rates

- Rates based on long-term marginal costs incentivize efficient investments
- Rates based on short-term marginal costs incentivize efficient short-term utilization

Bermudez et al.(2016) – Gas transmission networks in Europe: Connections between different entry-exit tariff methodologies

- Comparison of capacity-weighted distance vs least squares approaches for computing tariffs
- Weighted computation methodologies more suitable for including transmission network features

Borenstein (2016) – The economics of fixed cost recovery by utilities

- Rates based on short-term marginal costs incentivize efficient short-term utilization

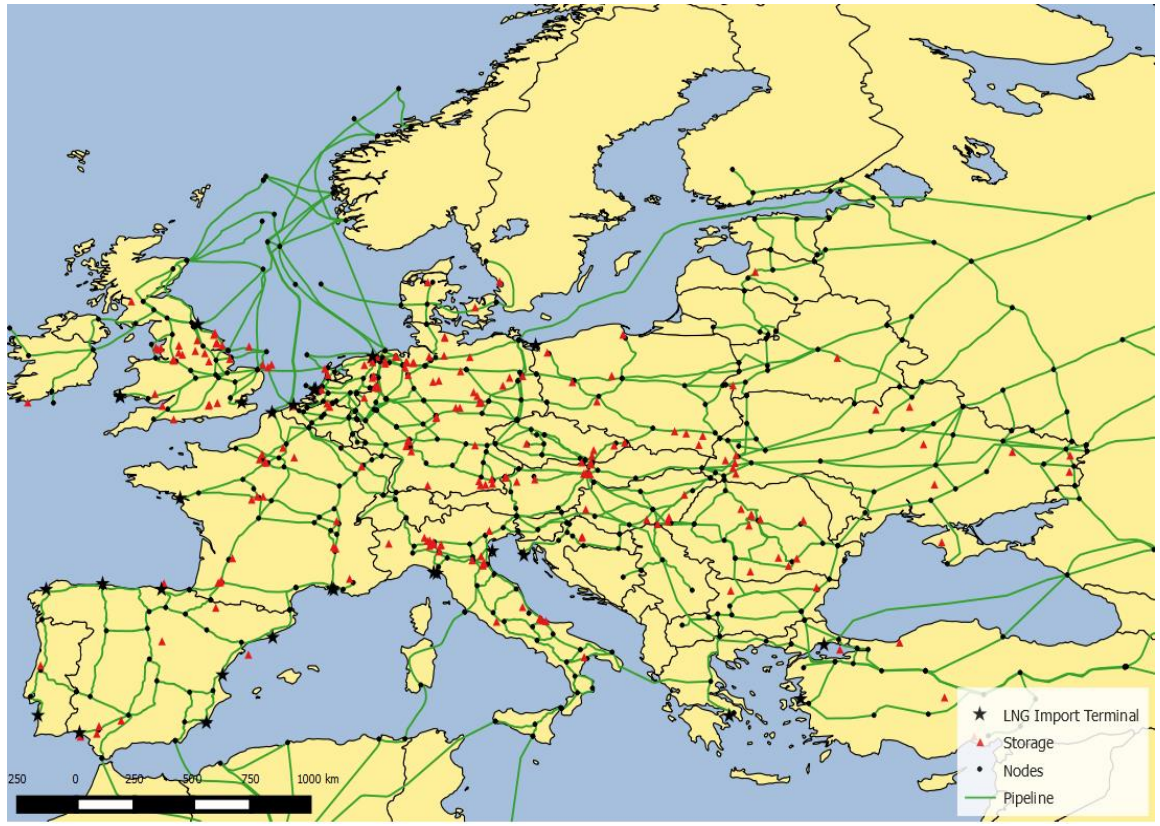
Lochner (2011) – Identification of congestion and valuation of transport infrastructures in the European natural gas market

- High resolution gas infrastructure and dispatch model
- Pipeline gas flow, storage and LNG simulations

Our contribution

Methodology
The TIGER model

Input	Linear Optimization	Output	Implicit assumptions
Gas Supply	Objective function: Cost-minimal demand satisfaction, restricted by available capacities	Natural gas trade	Perfect information (no uncertainty)
Gas Demand		Infrastructure utilization	
Gas Infrastructure		Import costs/ HUB prices	



Geocoded Database
Coverage: Europe > 600 nodes

> 900 pipeline sections
- Based on TSO maps
- Capacity/ pressure/ diameter
- Entry- and Exit-Points

> 200 Storages
- Storage type
- Maximum injection/ withdrawal capacity
- Working gas volume

> 30 LNG import terminals
- Max. hourly/ annual capacity
- LNG storage capacity

Methodology
Model extension

Equation 1 - Modification of cost minimization function

$$\underset{t,n,n_1,p}{\text{minimize}}\ TOTAL\_COSTS = CB\_COSTS_{t,n,n_1,p} + STORAGE\_COSTS + ... \tag{1}$$

Equation 2 - Definition of capacity booking costs

$$CB\_COSTS_{t,n,n_1,p} = CB_{t,n,n_1,p} \cdot tariff_{n,n_1} \cdot multiplier_p \tag{2}$$

Equation 3/4 - Defining required capacity booking

$$CB_{t,n,n_1,p} \geq TRANSPORT\_CB_{t,n,n_1,p} \qquad \forall i(n,n_1) \tag{3}$$

$$CB_{t,n,n_1,p} = CB^{MAP}_{n,n_1,p} \tag{4}$$

Equation 5 - Assigning transported volumes to corresponding capacity products

$$TRANSPORT_{t,n,n_1} = \sum_p TRANSPORT\_CB_{t,n,n_1,p} \tag{5}$$

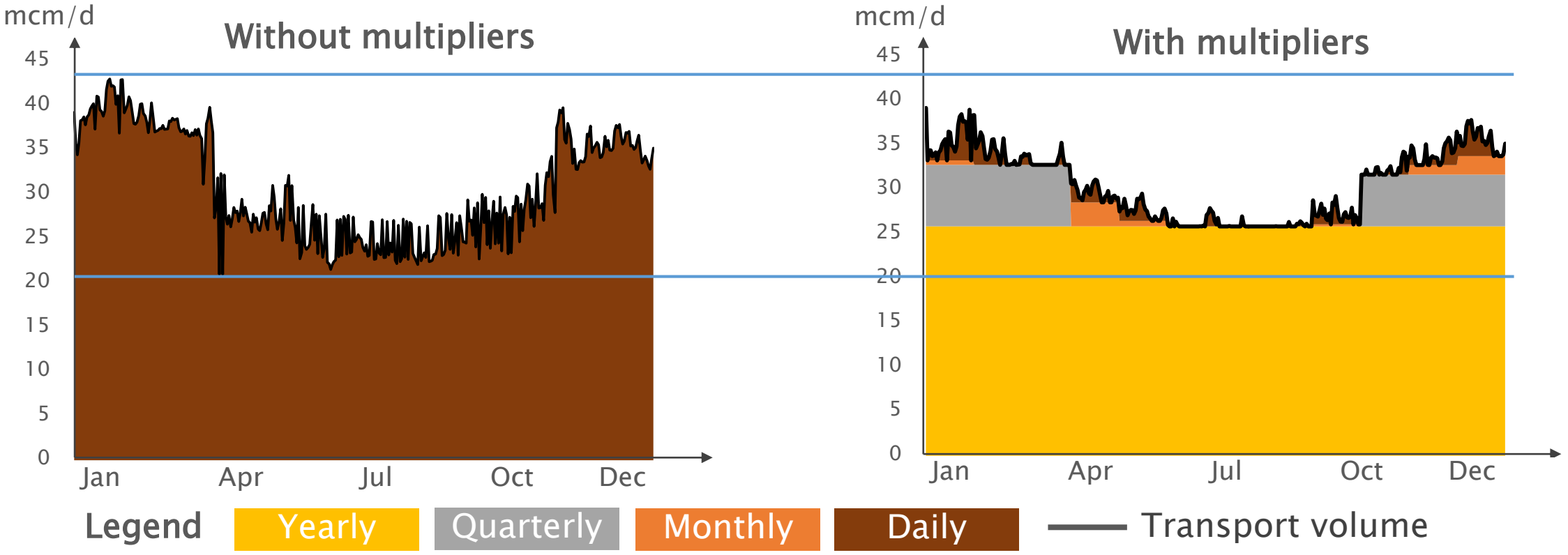
Legend

$t \in T$	points in time
$n,\ n_1 \in N$	nodes in the pipeline network
$p \in P$	capacity products (defined by duration, start and end date)
$i(n, n_1)$	subset of pipeline connections where entry/exit tariffs are applied

Hypotheses testing
Indicative model results

Hypotheses 1/2: Multipliers increase long-term capacity bookings.
Multipliers decrease seasonality and short-term volatility of gas transports.

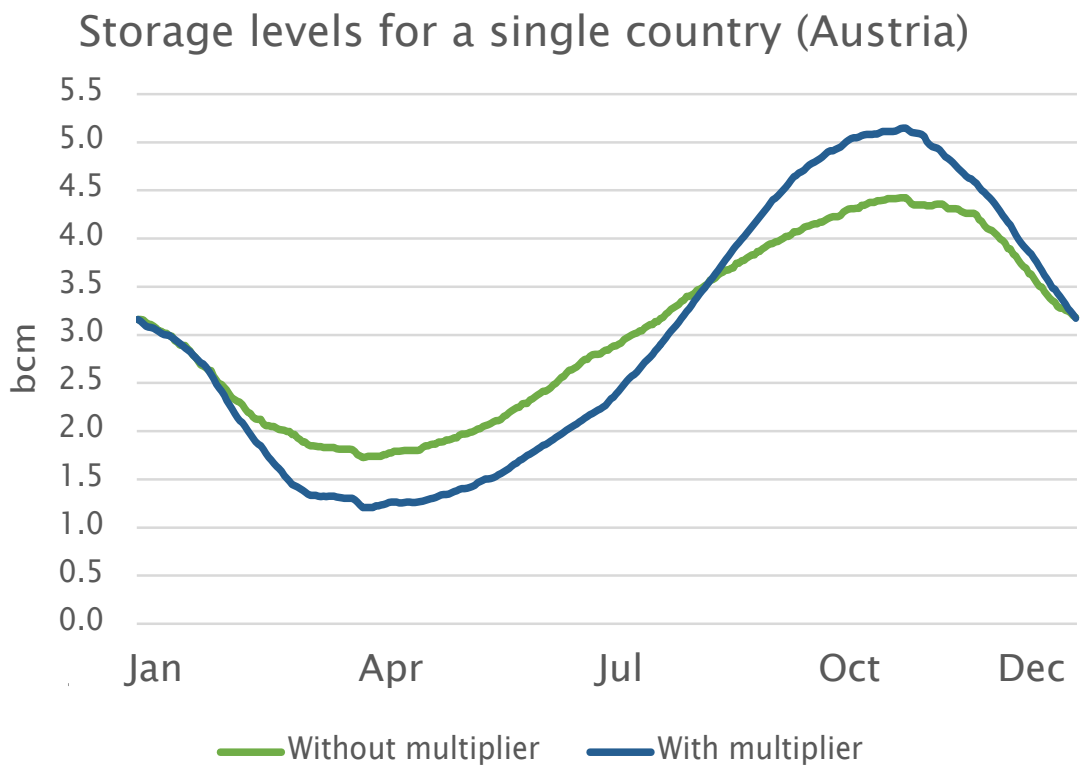
Capacity booking/transport (NCG – Switzerland)



Model results Both hypotheses are supported by our model results.

Hypotheses testing
Indicative model results

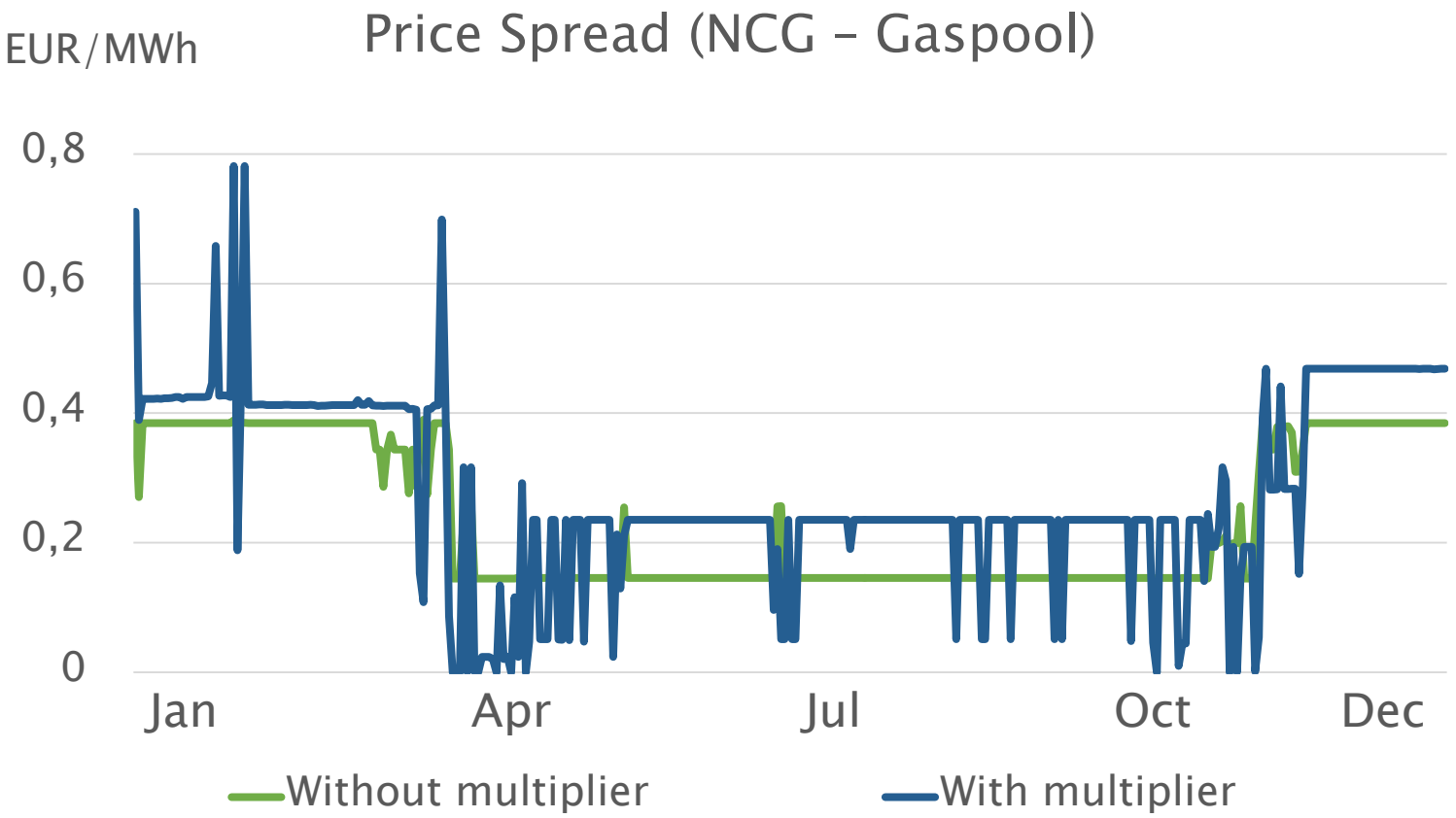
Hypotheses 3: Multipliers increase storage utilization.



Model results When multipliers are in place storages are utilized more.

Hypotheses testing
Indicative model results

Hypotheses 4: Multipliers increase price differences between market zones in most situations.



- Price difference differ with and without multipliers
- On average price differences are higher with multipliers
- When there is capacity which is booked but used (only the case in scenario with multipliers) price differences are zero

Model results Hypothesis is supported by our model results.

Outlook

- Analysis regarding the implications on short-term efficiency (Hypothesis 5)
  - based on the model framework
  - in a theoretical framework
- Analyzing the impact of uncertainty

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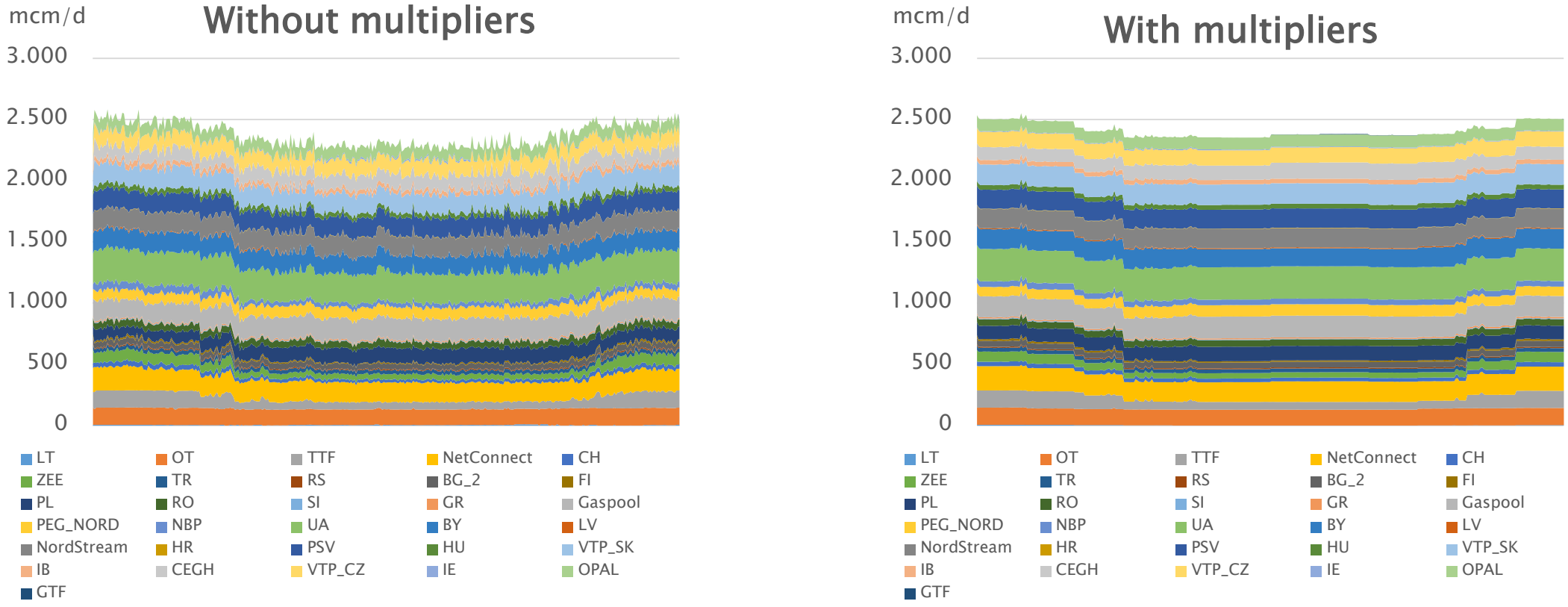
Hypotheses testing
Indicative model results

Hypotheses 2: Multipliers decrease seasonality and short-term volatility of gas transports.

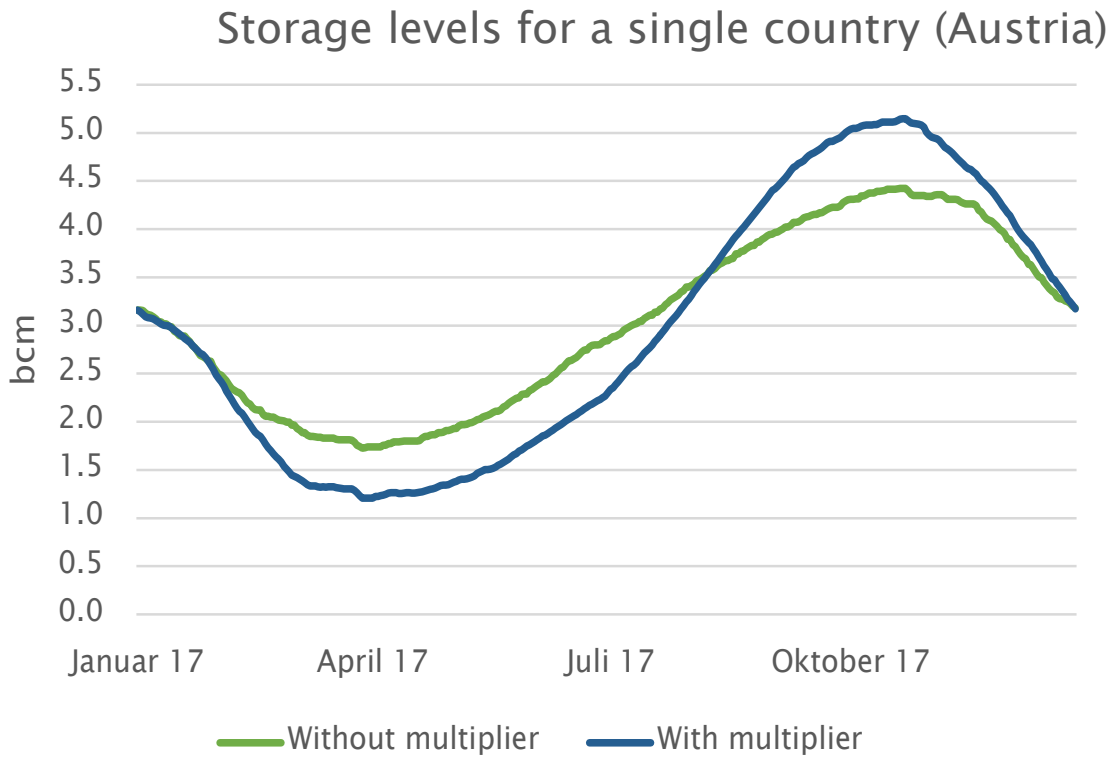
Cross market area transports

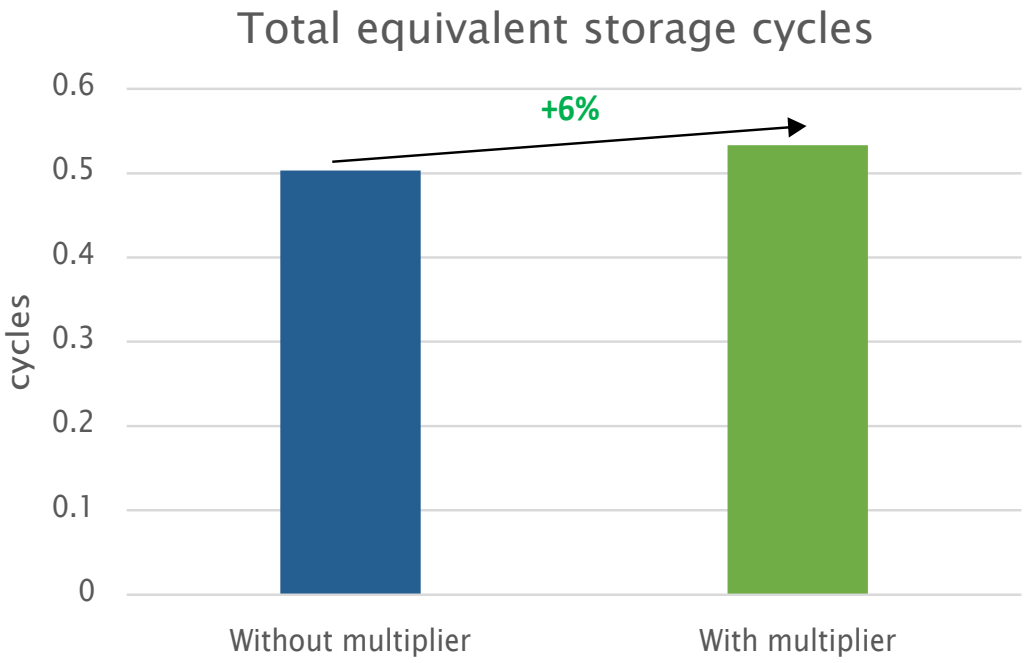


Model results Multipliers reduce volatility as assumed and reduce congestion.

Hypotheses testing
Indicative model results

Hypotheses 3: Multipliers increase storage utilization.





Model results Storages are utilized more when multipliers are in place.

Methodology
Model extension

Equation 1 - Modification of cost minimization function

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Legend

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