Freedom Gas to Europe? Scenario Analyses with the Global Gas Model

Franziska Holz [a,b]

with Ruud Egging-Bratseth[b] and Victoria Czempinski[c]

[a] Research Area Resource and Environmental Markets, German Institute for Economic Research (DIW Berlin), Mohrenstrasse 58, 10115 Berlin, Germany
[b] NTNU Energy Transition Initiative (NETI), Trondheim, Norway
[c] TU Berlin, Str. des 17. Juni 135, 10623 Berlin, Germany

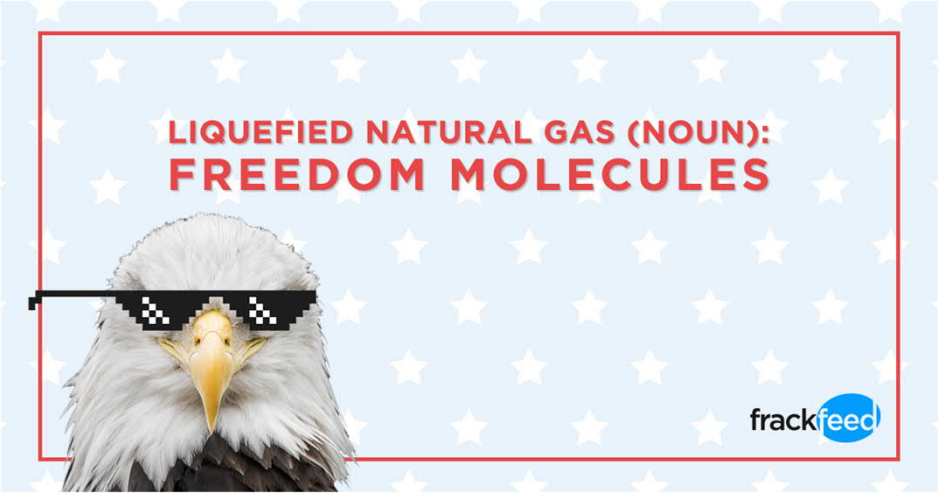
SPONSORED BY THE
Federal Ministry of Education and Research

Paper

- Draft paper available upon request (do not cite)
- Submitted to RIBAF Special Issue „Energy- and commodity-market research: A need for new directions?”
- Some results in a July 2020 policy brief (https://www.diw.de/de/diw_01.c.794645.de/publikationen/diw_focus/2020_0005/no_need_for_new_natural_gas_pipelines_and_lng_terminals_in_europe.html)

Freedom gas?

- Coined by the U.S. Department of Energy in May 2019 (https://www.nbcnews.com/news/us-news/remember-freedom-fries-freedom-gas-now-thing-energy-department-says-n1011706)



Source: https://southfront.org/wp-content/uploads/2019/05/sticky_62.jpg

European LNG Import Terminals

Large EU LNG import capacities of ~200 bcm

Region	Pipeline	LNG
Europe imports	78%	22%
Asia imports	14%	86%
Global	54,3%	45,7%

Source: BP 2019

→ Most EU imports arrive via pipeline

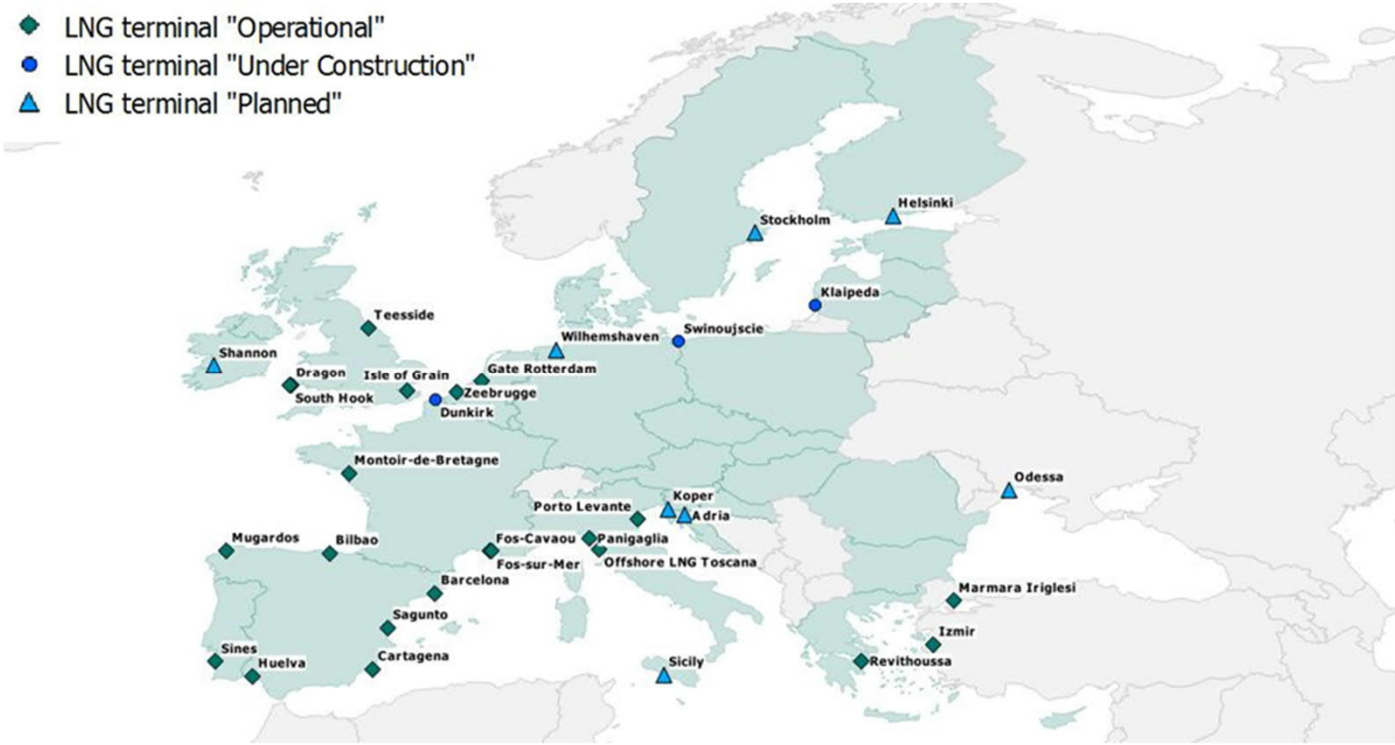


Figure: LNG imports terminals in Europe, which are "operational", "under construction" and "planned".

European natural gas pipeline infrastructure very dense

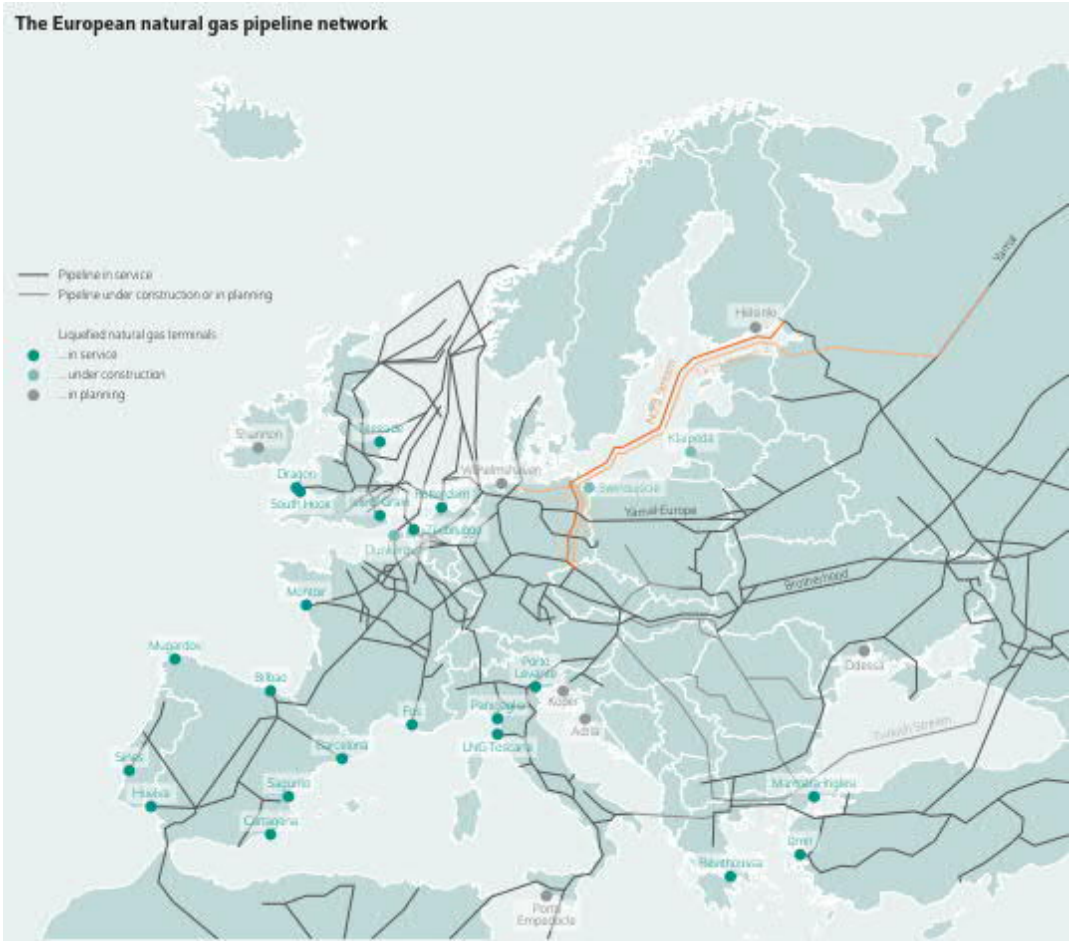


Figure: cross-border pipeline capacities into and within Europe
Source: DIW Weekly Report 27-2018

The role of LNG in Europe in the last decade

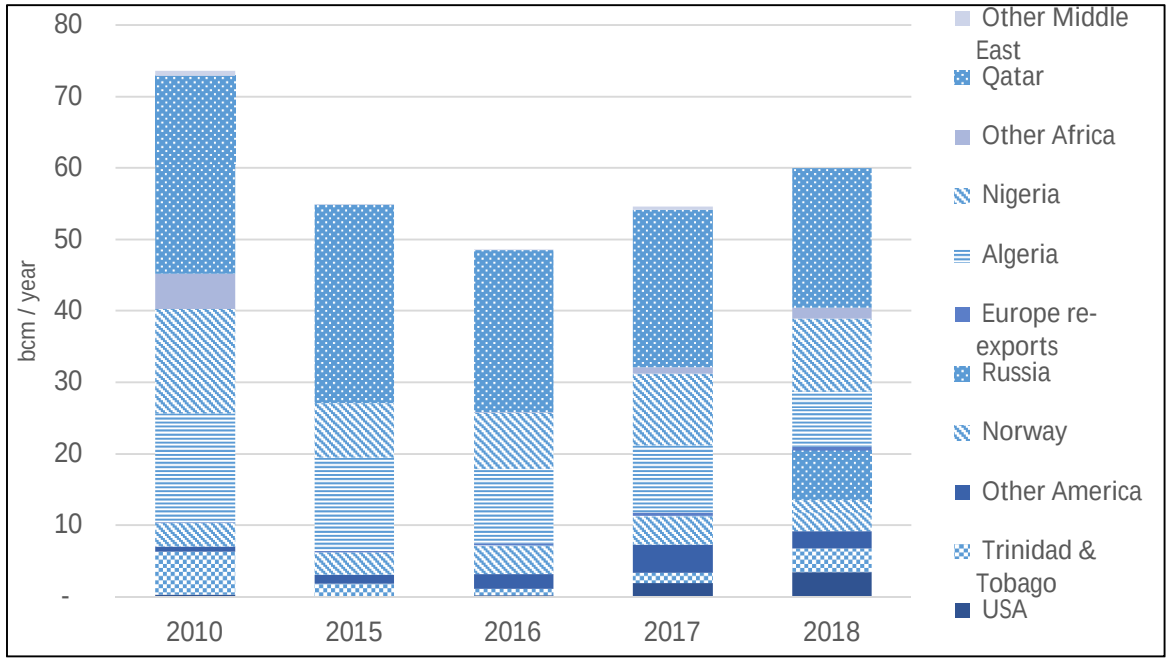


Figure 3: LNG exports to the EU 2010–2018, in bcm per year
Source: Own figure based on BP Statistical Review of World Energy (2011, 2016-2019)

- Small share of total imports (< 25%)
- Main problem: pipeline transport from LNG import terminals to consumers across Europe
- National natural gas markets in Europe are still quite segmented
- However, hub development in some places has increased liquidity and made these markets attractive to LNG suppliers, in particular TTF in NW-Europe

U.S. LNG exports: Recent developments

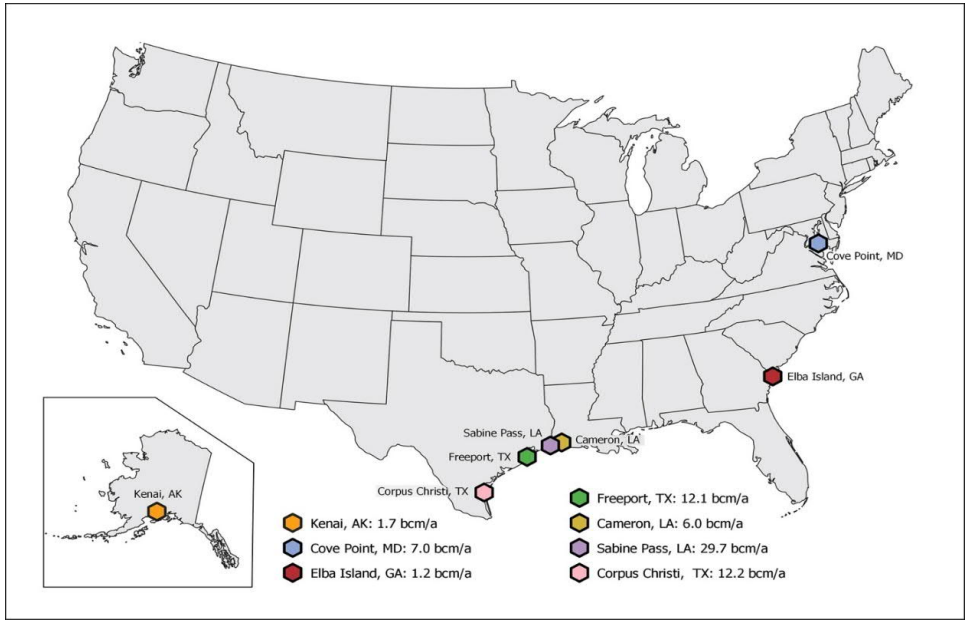


Figure 1: Existing U.S. LNG export terminals and their capacities in bcm/year
Source: Own figure based on FERC North American LNG Export Terminals (Released November 21, 2019, https://www.ferc.gov/industries/gas/indus-act/lng.asp)

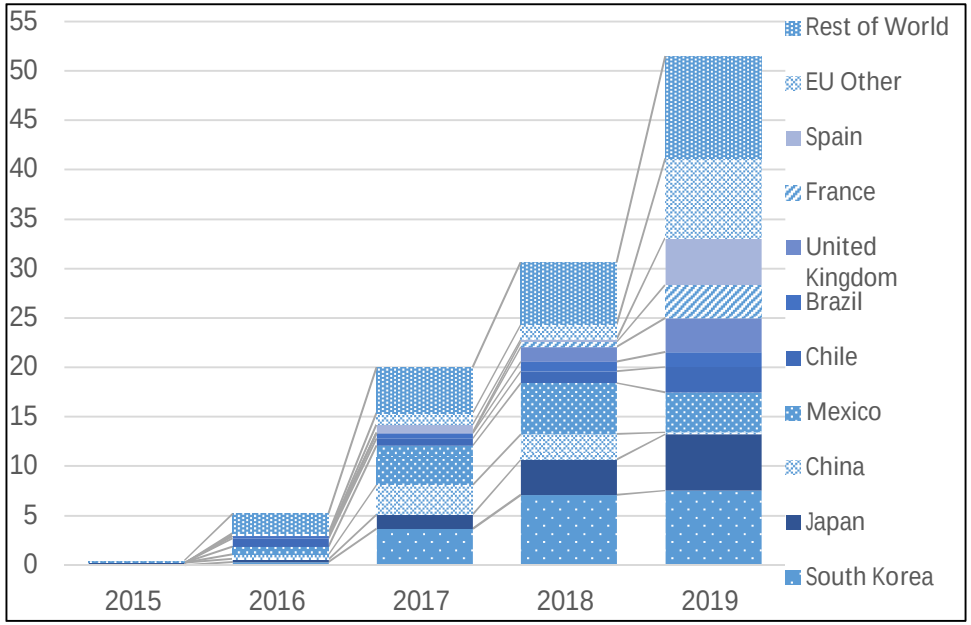
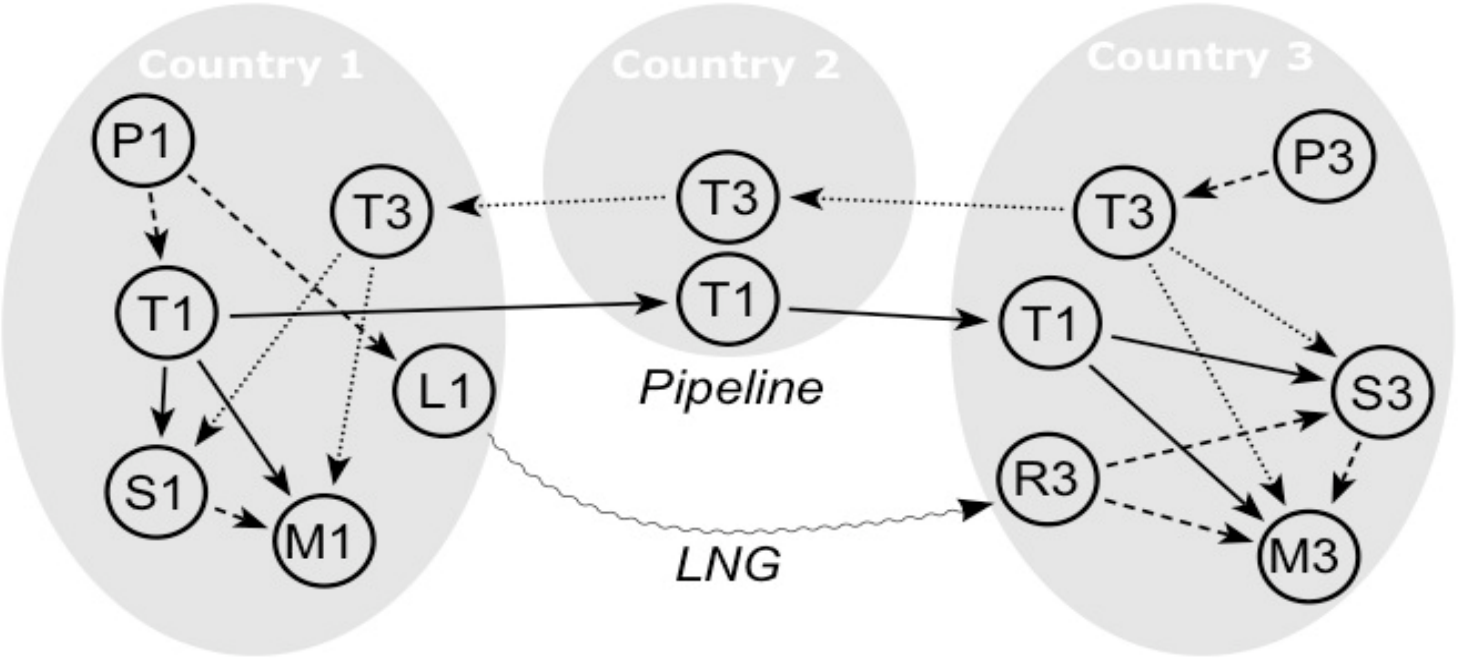


Figure 2: US LNG exports 2015-2019, in bcm/year
Note: Countries receiving largest U.S. LNG exports are indicated in the chart.
Source: Own figure based on EIA U.S. Natural Gas Exports by Country (Released May 29, 2020) www.eia.gov

Research question

- Which role for U.S. LNG in Europe until 2050?
  - Are the very large U.S. LNG exports to Europe in 2019/2020 the „new normal“ or an exception?
  - Is it rational to build new LNG terminals in Europe, e.g. in Germany?
  - Does the long-term role of U.S. LNG change under some specific scenarios?
  - Which role for Asian markets (in particular China) for U.S. LNG?

Global Gas Model

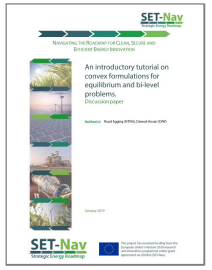


- Multiple players:
  - Producers
  - Traders
  - Pipeline operators
  - LNG liquefiers
  - LNG regasifiers
  - Storage operators
- Net present value optimization 2015-2050
- Profit maximization problems under constraints, linked by market-clearing conditions

Available open source: https://www.ntnu.edu/iot/energy/energy-models-hub/ggm

Modeling approach

- Original model: mixed complementarity model (MCP), solved in GAMS
- MCP allows to …
  - … solve optimization problems of multiple players types simultaneously
  - … include market power by suppliers (traders)
- Yet, large model size made reformulation as convex optimization problem more attractive (run time, solvability) while advantages of MCP approach remain
- Cf. Egging-Bratseth et al. (2020, EJOR) and Egging and Ansari (2019, SET-Nav Discussion Paper)



Global Gas Model

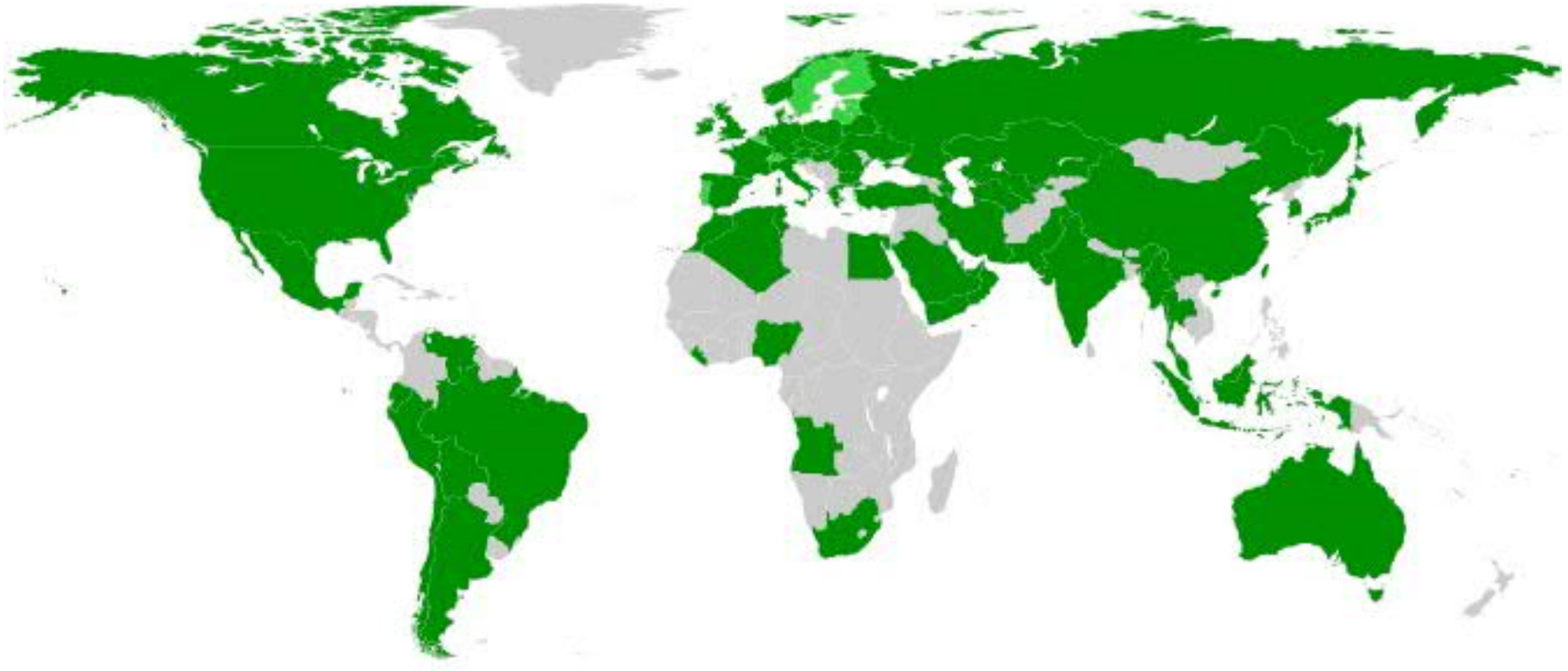


Figure: Countries included in GGM
(light green: consumption only)

Our scenarios

Scenario	Scenario description	Scenario implementation
„Base Case“	Stable natural gas demand in Europe and continuous demand increase elsewhere	IEA New Policies Scenario 2018 (World Energy Outlook) demand growth rates in the world regions, EU Reference Scenario 2016 for European countries
“Trump”	Financial support to U.S. LNG exports to Europe and sanctions on finishing Nordstream 2 pipeline	Shipping costs U.S. to Europe decreased by 0-100%; Nordstream 2 delayed by ten years
“Putin”	Disruption of all Russian exports to Europe	Russian trader not allowed to sell gas to EU and Switzerland
“Altmaier”	Support to LNG import terminals in Germany	Capital costs and/or operational costs of regasification terminals in Germany decreased by 0-100%
“Jinping”	Support to LNG import terminals in China	Capital costs and/or operational costs of regasification terminals in China decreased by 0-100%

Results: EU supply is diversified and hardly affected by restrictions/subsidies

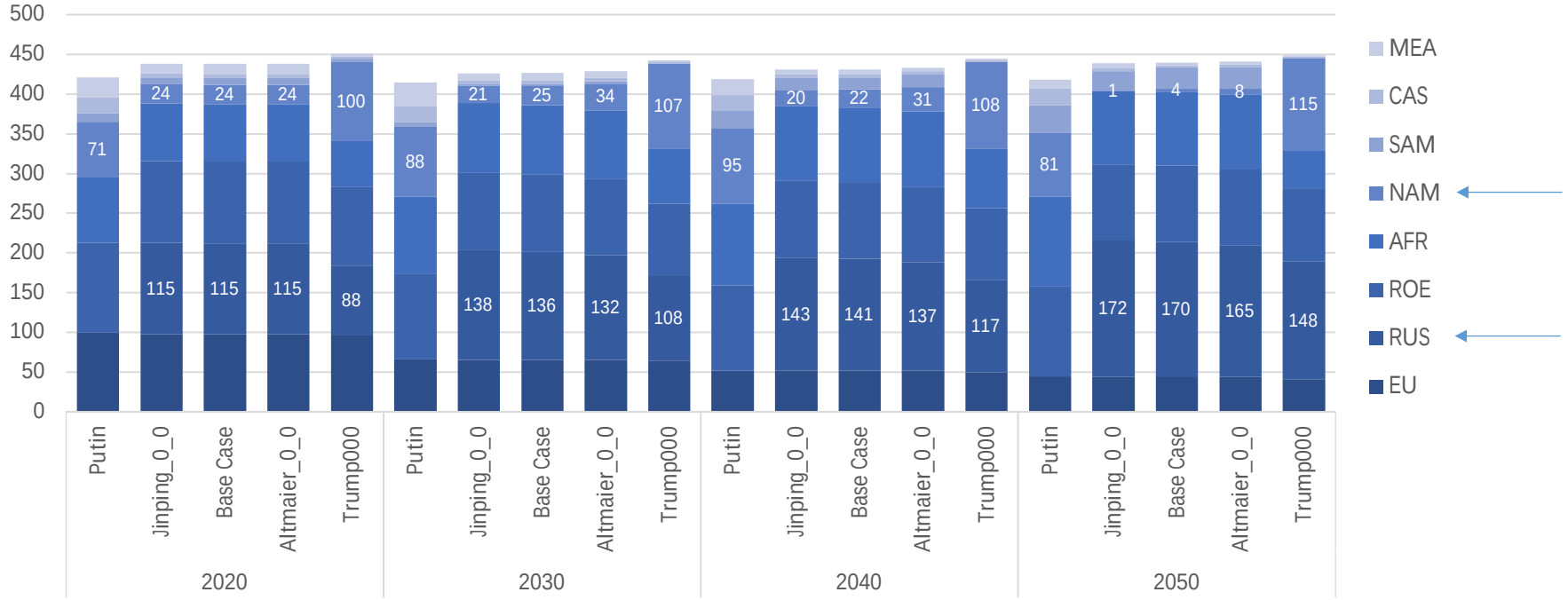


Figure 6: EU supply mix by supplying region, Base Case and selected scenarios 2020-2050, in bcm per year

Note: The numbers succeeding the scenario name indicate the applied percentage of the Base Case cost data (i.e., the opposite of the subsidy rate). In the Altmaier and Jinping scenarios, the first number refers to the operational costs; the second number refers to the investment costs in regasification capacity. In the Trump scenarios, the number is the share of Base Case LNG transportation costs between U.S. liquefaction and European regasification nodes. E.g., “100” means 100% of the Base Case cost, hence, a 0% subsidy on the costs.

Europe in a global competition for U.S. LNG

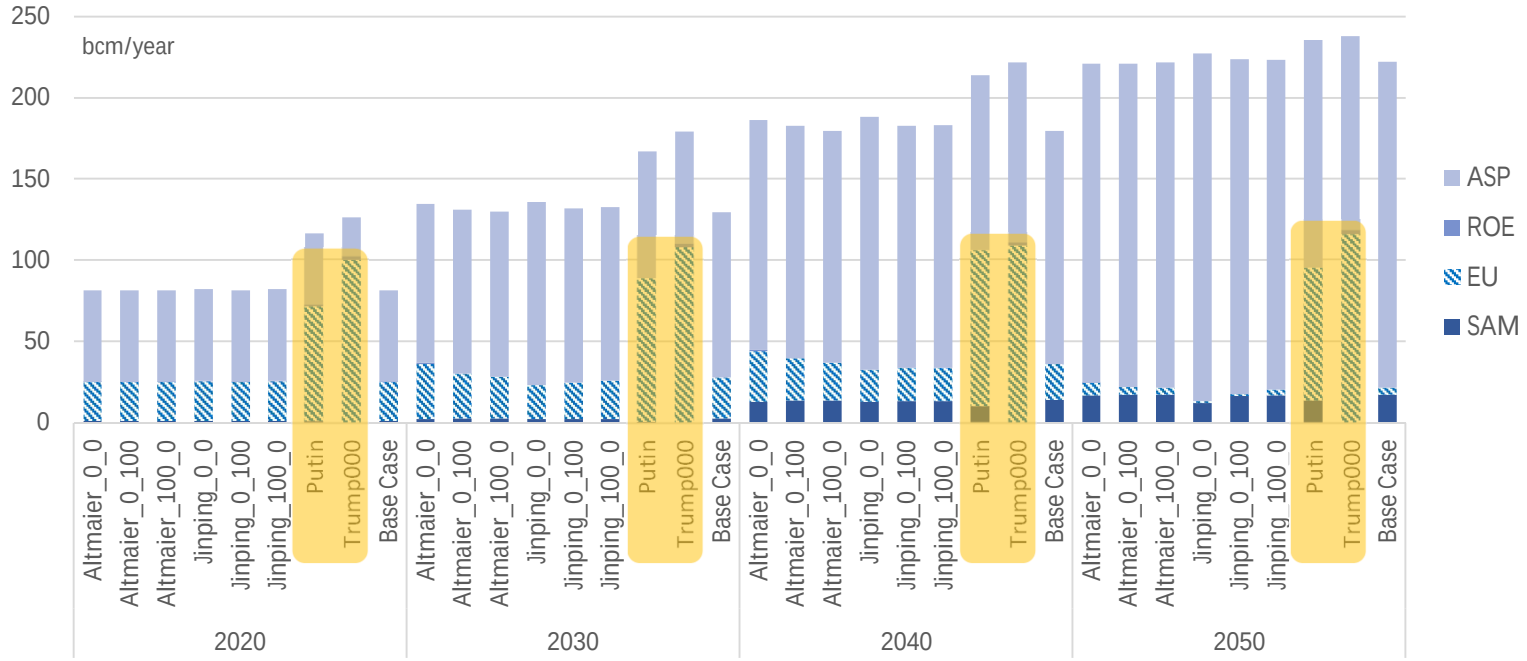


Figure 7: North American exports and their destination regions in selected scenarios 2020-2050, in bcm per year

Note: The numbers succeeding the scenario name indicate the applied percentage of the Base Case cost data (i.e., the opposite of the subsidy rate). In the Altmaier and Jinping scenarios, the first number refers to the operational costs; the second number refers to the investment costs in regasification capacity. In the Trump scenarios, the number is the share of Base Case LNG transportation costs between U.S. liquefaction and European regasification nodes. E.g., "100" means 100% of the Base Case cost, hence, a 0% subsidy on the costs.

Global price divergence

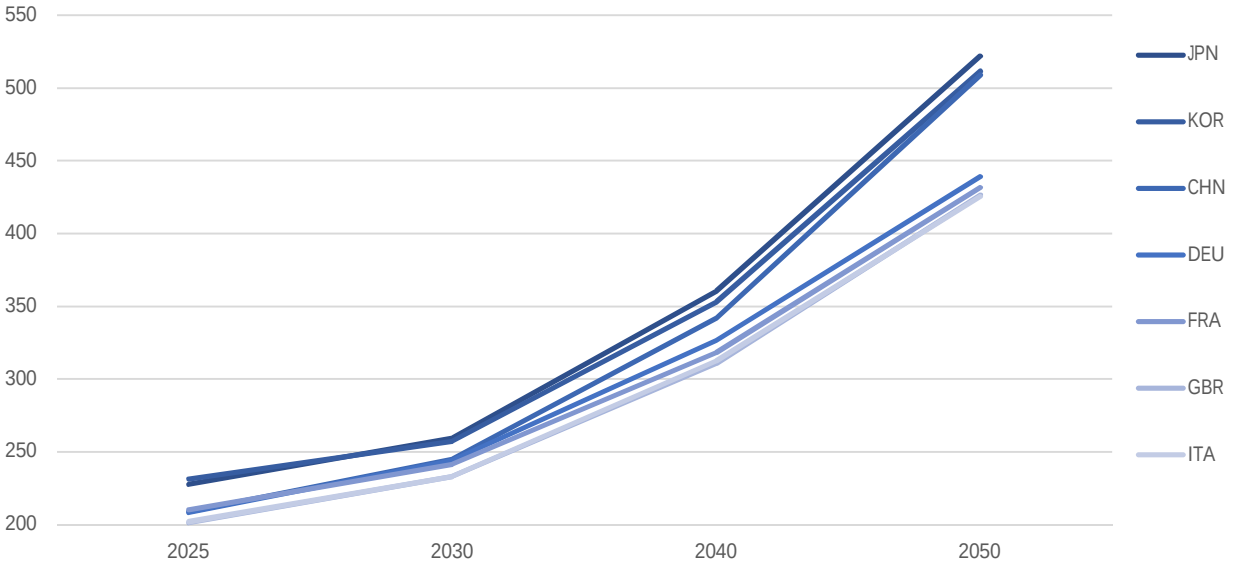
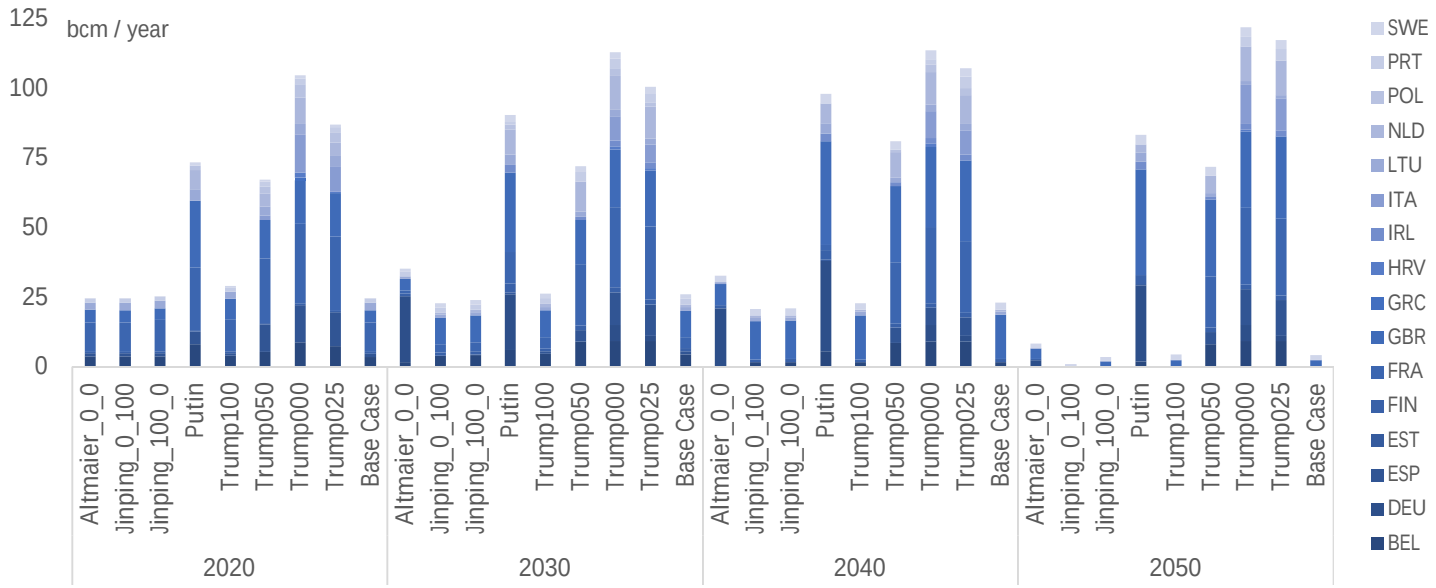


Figure. Price trends for selected countries in the Base Case (€/ 1000 cm)

- Price divergence between Europe and (East) Asia persists
- The widening price gap makes Asia relatively more attractive for global LNG supplies than Europe over time
- Due to strongly increasing demand in China, Chinese prices catch up with East Asian prices over time

U.S. LNG to Europe



Russian disruption („Putin“) has strong effect on LNG volumes

High subsidy levels („Trump“) considerably increase LNG volumes

Hardly any influence of Altmaier scenario

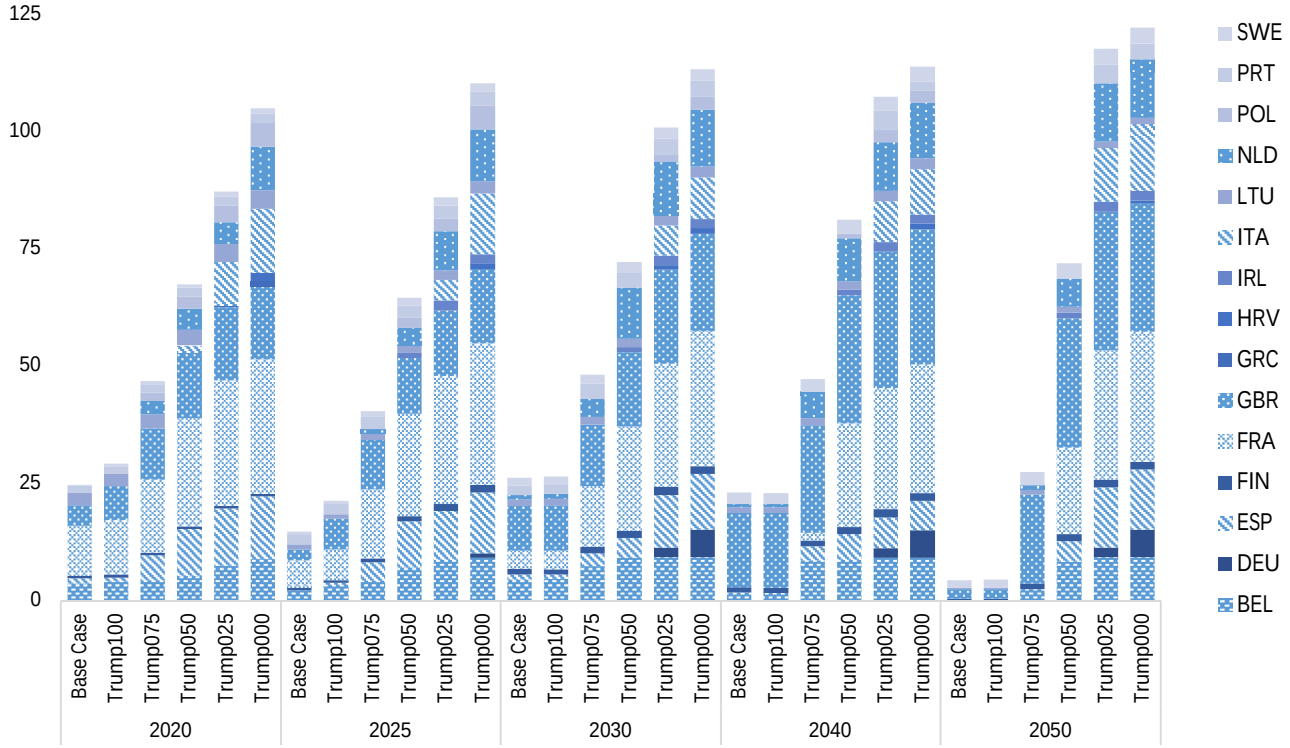
Hardly any influence of Jinping scenarios

Small base case volumes

Figure 5: LNG exports from the U.S. to various destinations in Europe in the Base Case and selected scenarios in bcm/year

Note: The numbers succeeding the scenario name indicate the applied percentage of the Base Case cost data (i.e., the opposite of the subsidy rate). In the Altmaier and Jinping scenarios, the first number refers to the operational costs; the second number refers to the investment costs in regasification capacity. In the Trump scenarios, the number is the share of Base Case LNG transportation costs between U.S. liquefaction and European regasification nodes. E.g., “100” means 100% of the Base Case cost, hence, a 0% subsidy on the costs.

U.S. LNG to Europe („Trump“ scenarios)



- Little effect in Trump 100 scenario (no subsidies, delay of Nordstream2 by 10 years): slightly higher LNG imports to Northwest Europe

→ This result questions the effectiveness of current U.S. sanction policy

U.S. LNG subsidies lead to higher gas consumption in Europe

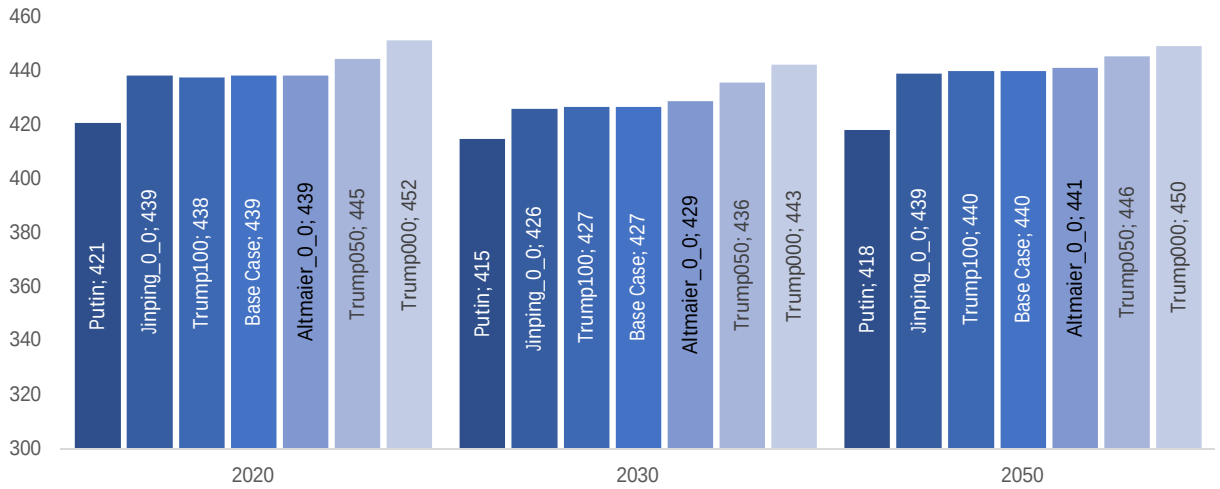


Figure 13: Total EU consumption Base Case and selected scenarios in bcm/year
Note: The vertical axis is truncated at the lower end at 300 bcm per year.

LNG terminals in Germany? Only with subsidies and…

… at the expense of Norway

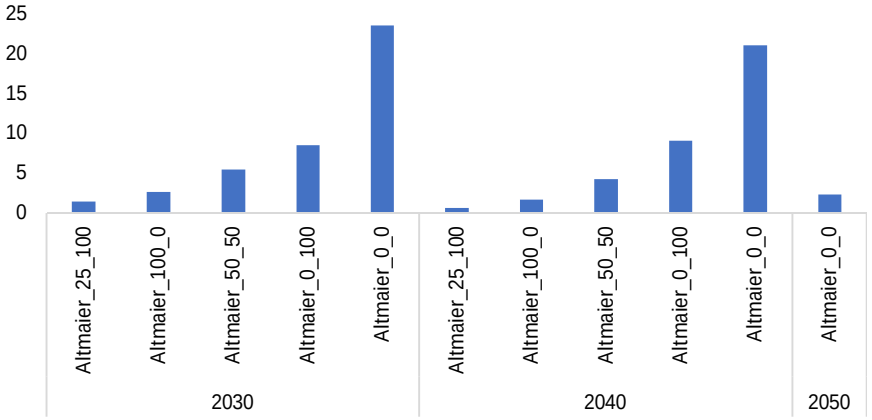


Figure 11: German LNG imports from the U.S. in different scenarios in bcm per year

Note: The numbers succeeding the scenario name indicate the applied percentage of the Base Case cost data (i.e., the opposite of the subsidy rate). In the Altmaier scenarios, the first number refers to the operational costs; the second number refers to the investment costs in regasification capacity.

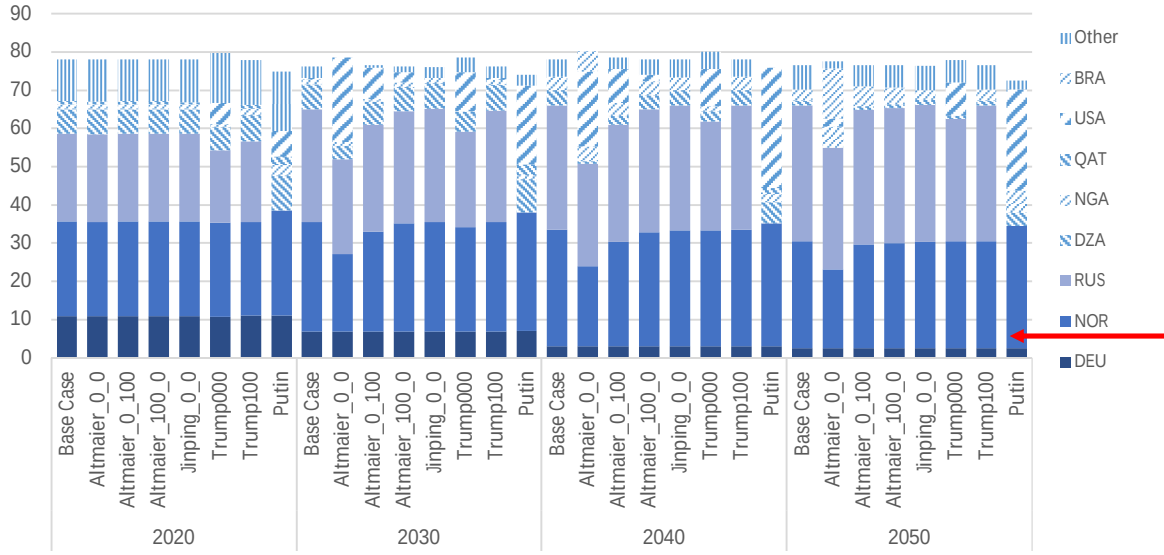


Figure 12: Germany Supply Breakdown in the Base Case and selected scenarios in bcm/year

Conclusions

- U.S. (and other) LNG can serve as „insurance“ for European natural gas consumers, i.e. as gap filler when there is a disruption
- In the long run, Asian markets are more attractive for U.S. LNG
- Liquid spot markets and liberalized storage capacities in Europe make it a destination „of last resort“ in the current times of overcapacities

↔ U.S. LNG has increased flexibility on natural gas markets globally

- There is no economic rationale for new LNG terminals in Europe, unless they are strongly subsidized

Thank you

Contact:
Franziska Holz, fholz@diw.de
https://www.diw.de/de/diw_01.c.11032.de/personen/holz__franziska.html
https://www.ntnu.edu/energytransition/franziska-holz