Global Natural Gas Markets

Between Climate Policy and the Renaissance of Gas

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NTNU – Trondheim
Norwegian University of Science and Technology

Agenda

1. Future demand for natural gas in a global context of climate policies
2. Some perspectives on the natural gas infrastructure in Europe
3. Supply (security) challenges
   - EU: Netherlands, Norway, Russia, LNG, …
   - Asia: China, India
4. Brief summary

Climate policy: uncertain demand outlook for natural gas

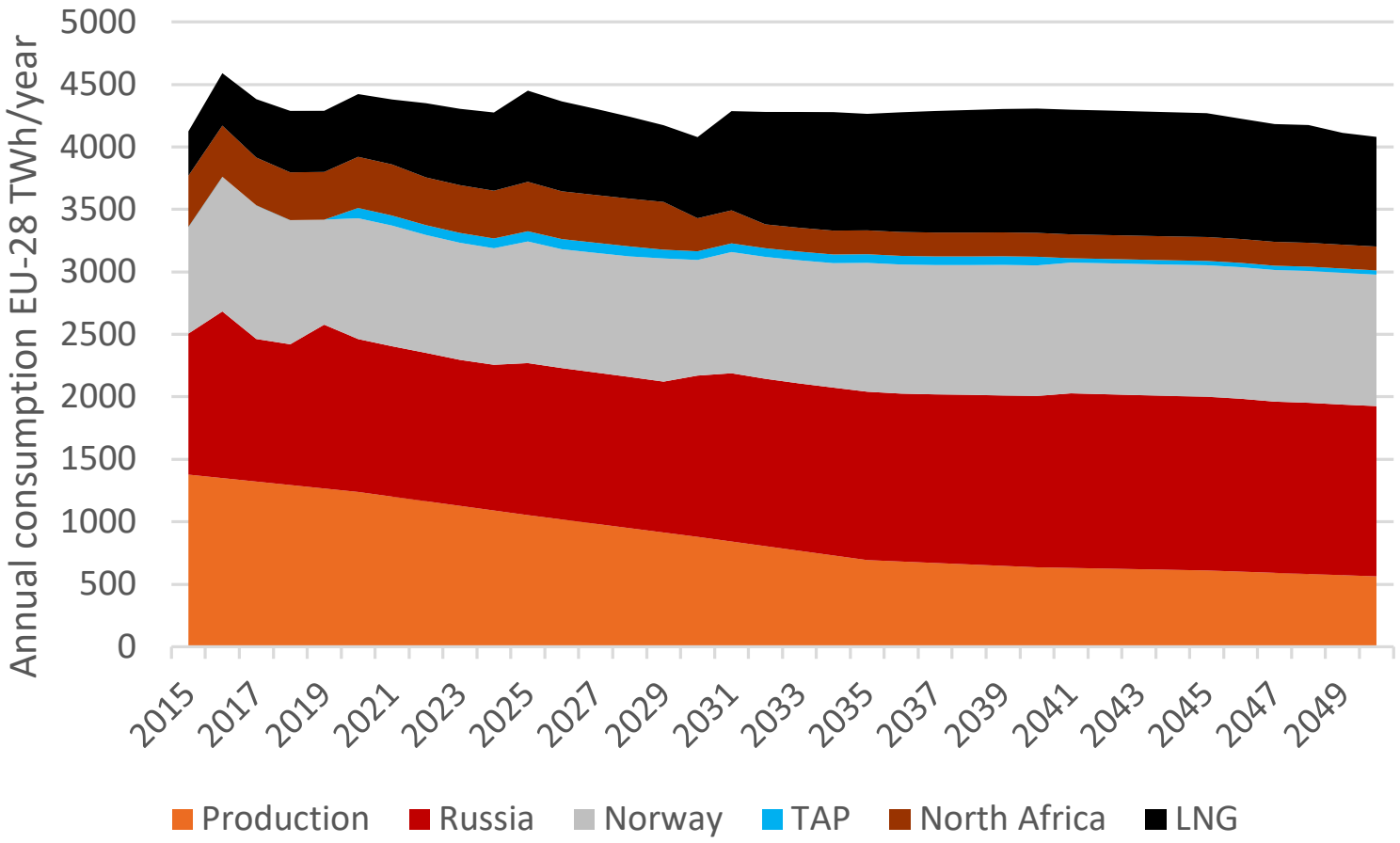
Competition with coal?

Gas exit policies?

Which (niche) uses for gas remain?

Natural Gas Consumption in the EU Reference Scenario 2016

SET-Nav Strategic Energy Roadmap



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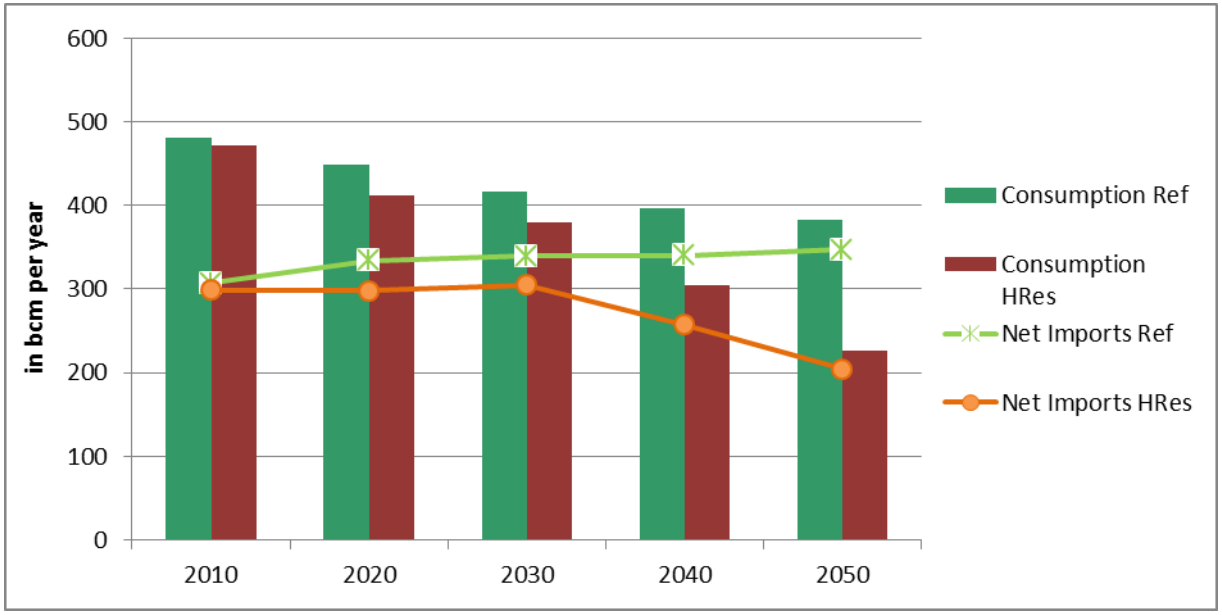
Natural gas outlook for Europe (from Holz, Richter, Egging, 2016)

- Three potential pathways for the future role of natural gas
  - Decreasing consumption (e.g., EMF 28 scenarios based on Energy Roadmap)
  - Increasing consumption ("Back-Up")
  - Role as a transition fuel ("Bridge")



EU Consumption Levels and Net Imports by Scenario (in bcm/y)

- "Ref" based on Energy Roadmap 2050 (2011) with EU 2020 targets met
- "Hres" with EU 2030 targets for RES met and 80% GHG reduction by 2050

F. Holz, P.M. Richter, R. Egging (2016): The Role of Natural Gas in a Low-Carbon Europe: Infrastructure and Supply Security. *The Energy Journa*l, Vol. 37, Special Issue 3, pp. 33-59.

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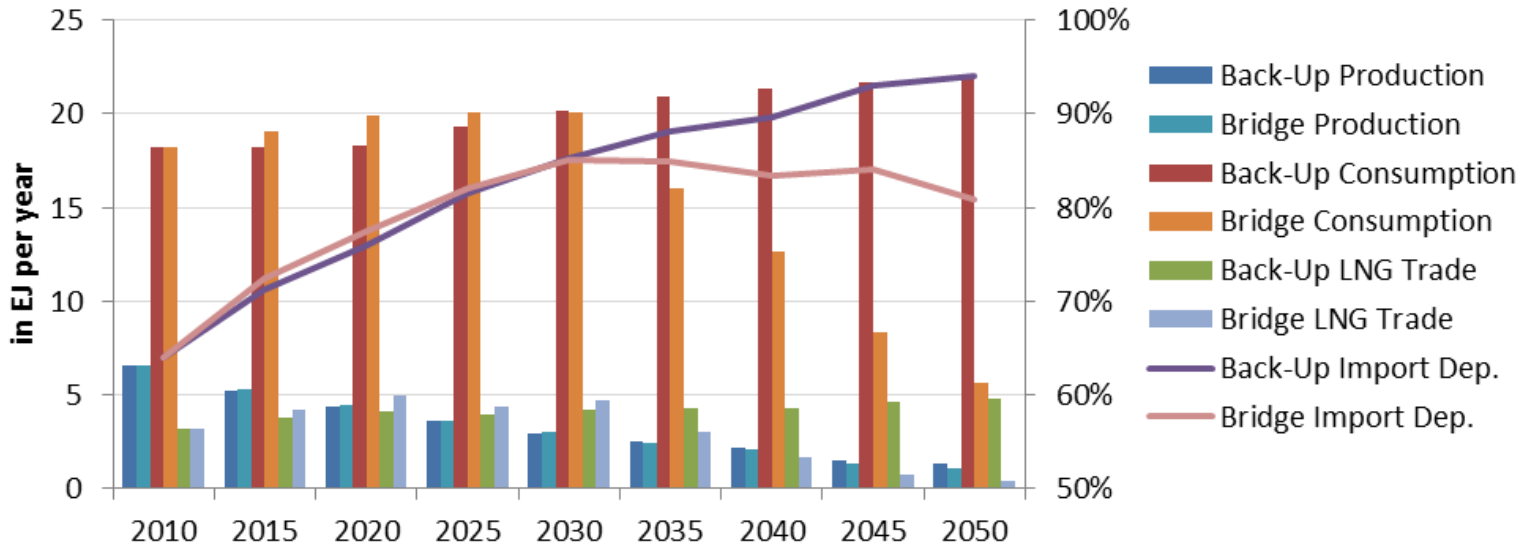
Alternative scenarios with different roles for natural gas

- 40% GHG reduction ("Back-Up"): rising importance of natural gas
  - Based on IEA (2012) WEO New Policies Scenario with slight increase of natural gas demand due to replacement of coal and oil
- 80 % GHG reduction ("Bridge"): natural gas as transition fuel
  - Based on PET model results for the EMF 28 EU7 scenario (strict climate policy w/o CCS)



Volumes and import dependency of the EU-27 in Back-Up and Bridge scenarios (in EJ/y)

F. Holz, P.M. Richter, R. Egging (2016): The Role of Natural Gas in a Low-Carbon Europe: Infrastructure and Supply Security. *The Energy Journa*l, Vol. 37, Special Issue 3, pp. 33-59.

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The Global Gas Model (GGM) – Countries in the Model

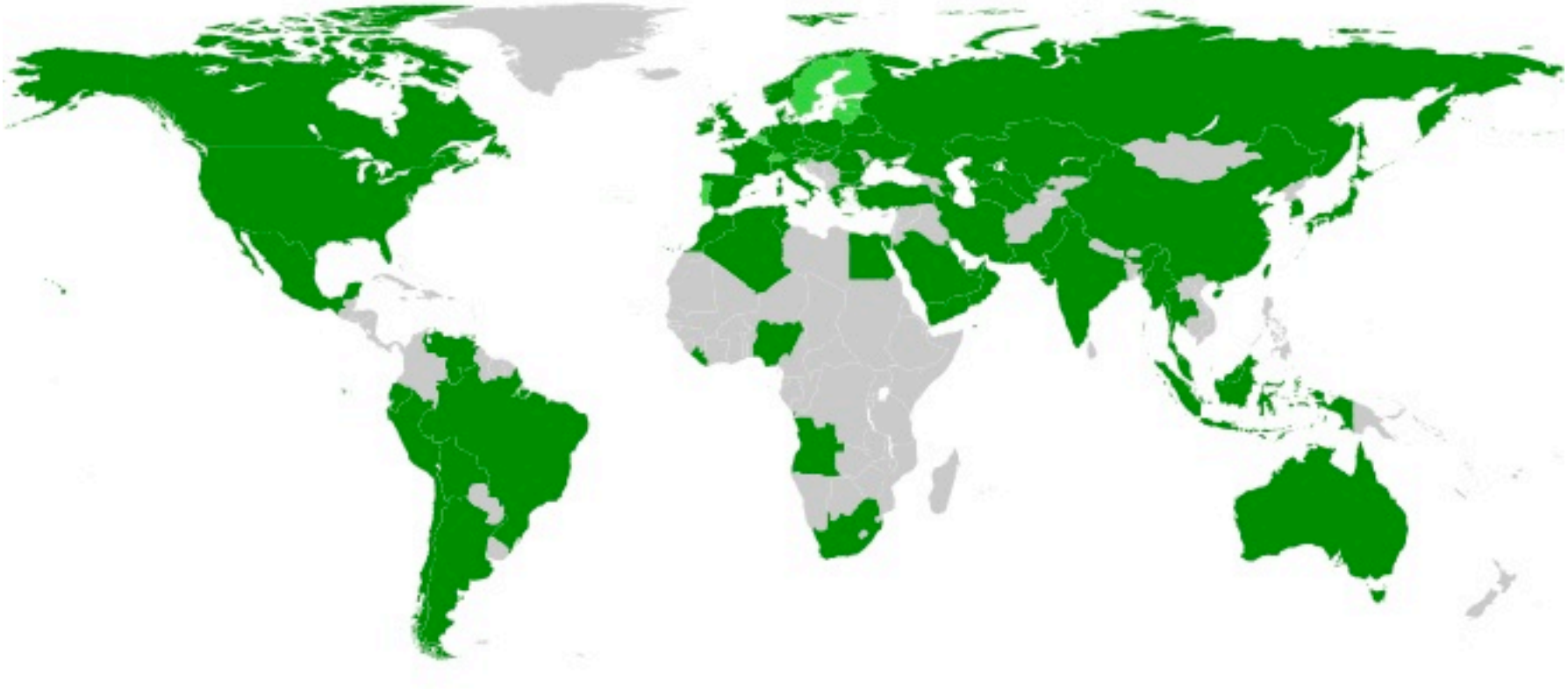
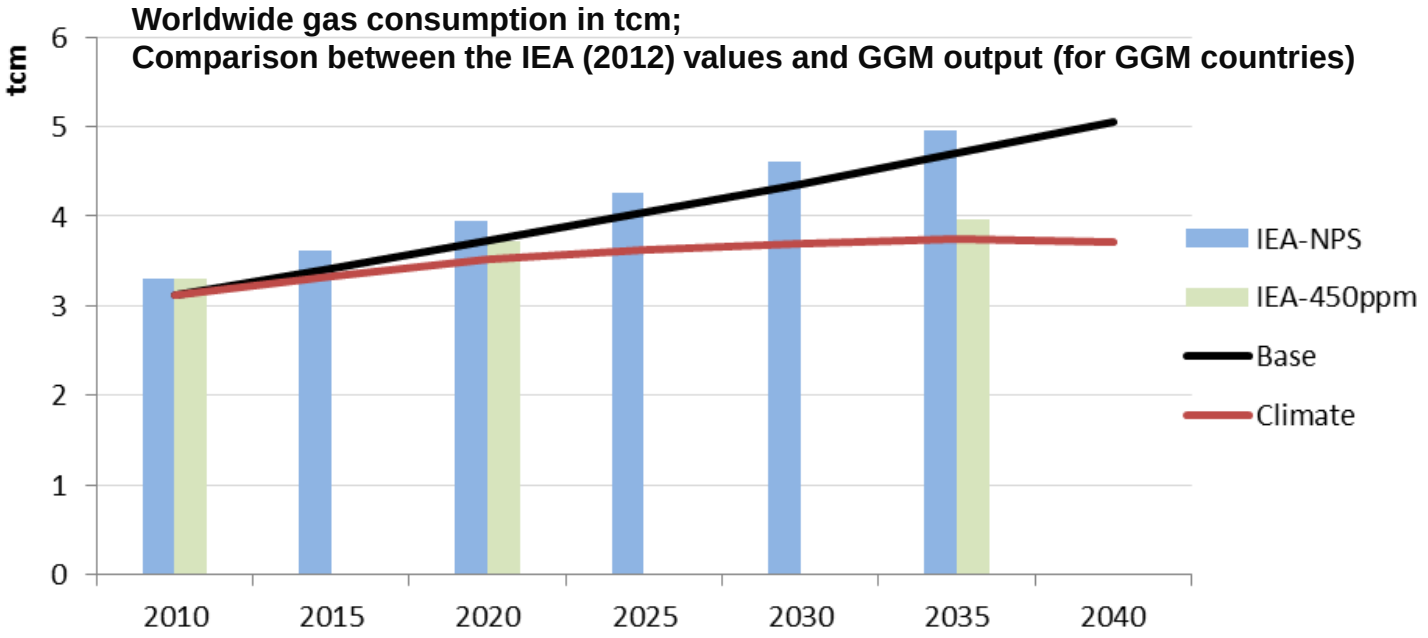


Figure: Countries included in GGM (light green: consumption only)

Worldwide Natural Gas Consumption Scenarios (from Holz et al. 2015)



Base Case:

- Follows *"IEA WEO 2012 New Policies Scenario" (NPS)*
- Moderate climate policies, concentrated in Europe and OECD
- Global CO_2 emissions 20% higher in 2035 relative to 2010
- 50% higher NG consumption; 20% higher coal consumption

Climate Scenario:

- Follows *"IEA WEO 2012 450ppm"*
- Global climate policies implemented in line with 2 degree target
- Global CO_2 emissions 27% lower in 2035 relative to 2010
- 20% higher NG consumption; 30% lower coal consumption

(Regional) Gas Exit Strategies ?

- Parallel to coal exit efforts
-

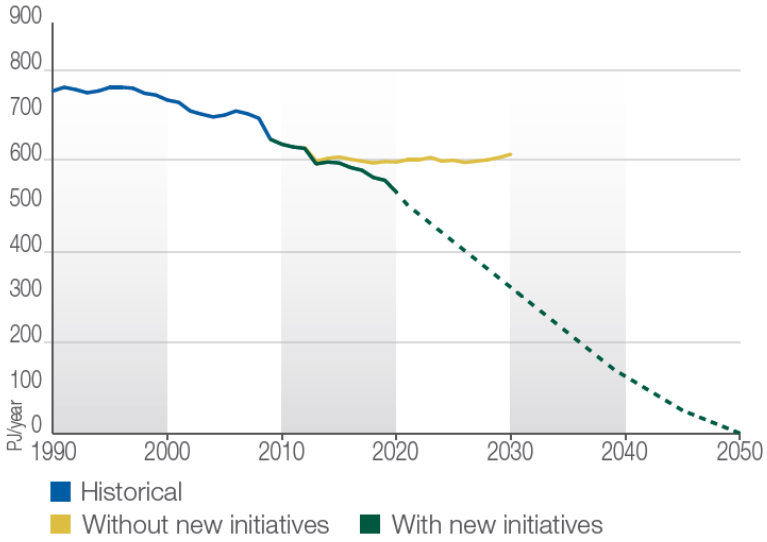


Figure 0.3 Consumption of coal, oil and natural gas 1990-2050. Source: Danish Energy Agency

Danish *Energy Strategy 2050* (2011): 100% renewables in the energy mix by 2050

- Focused on the energy sector
- Perspectives of natural gas utilization in other sectors (industry, transportation) ?

„Niche use“? : Small-scale LNG

- Small barges (river and coastal)
- Trucks (long-distance and local use)

Advantage:
lower emissions

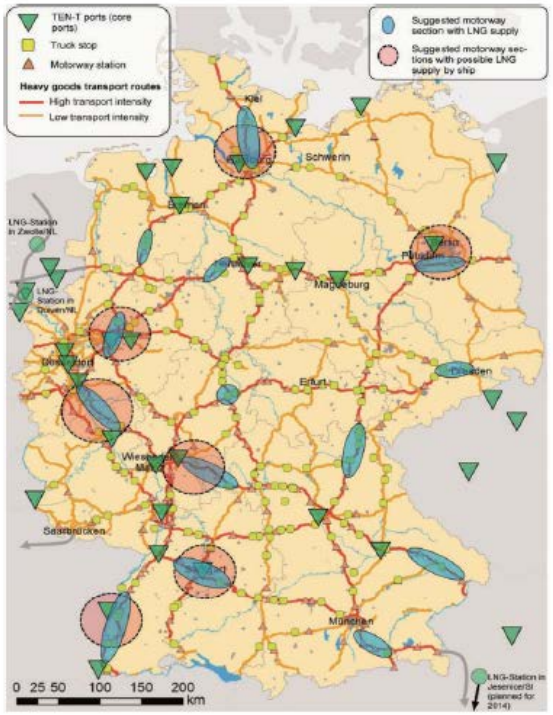


Figure 4: Plan for initial LNG filling station network with 14 stations in the blue areas

Source: Peters-von Rosenstiel 2014, p.22

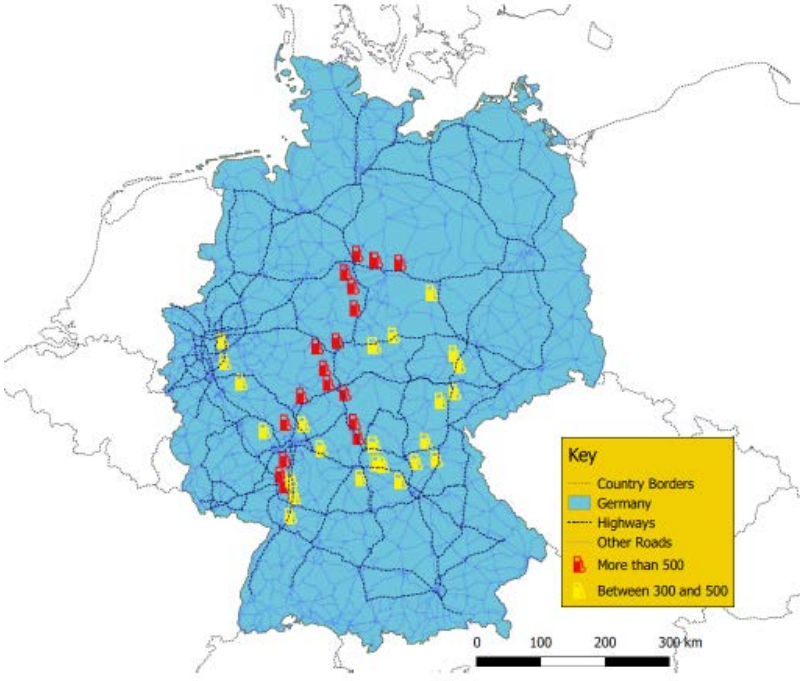


Figure 14: Location of most frequented filling stations

Source: K.B. Hainsch (2016) „A complementarity approach of analyzing the impact of simultaneous routing and refueling in a congested network”. TU Berlin.

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Gas infrastructure

- Future needs
- Future use

Cross-Border Gas PCIs

(Projects of Common Interest)

SET-Nav
Strategic Energy Roadmap

Little additional need

- Given the existing dense pipeline network in Europe
- Given that some major extensions recently were decided (*in black*: Nord Stream 2, TAP and TANAP, but also IBS and IGB, DE-CH, AT-IT, IT-CH, AT-DE)

Investments are economically and financially viable in

- Shannon LNG
- Baltic cluster
- ITB
- PL-LIT(with EU support)
- SI-HU (with EU support)

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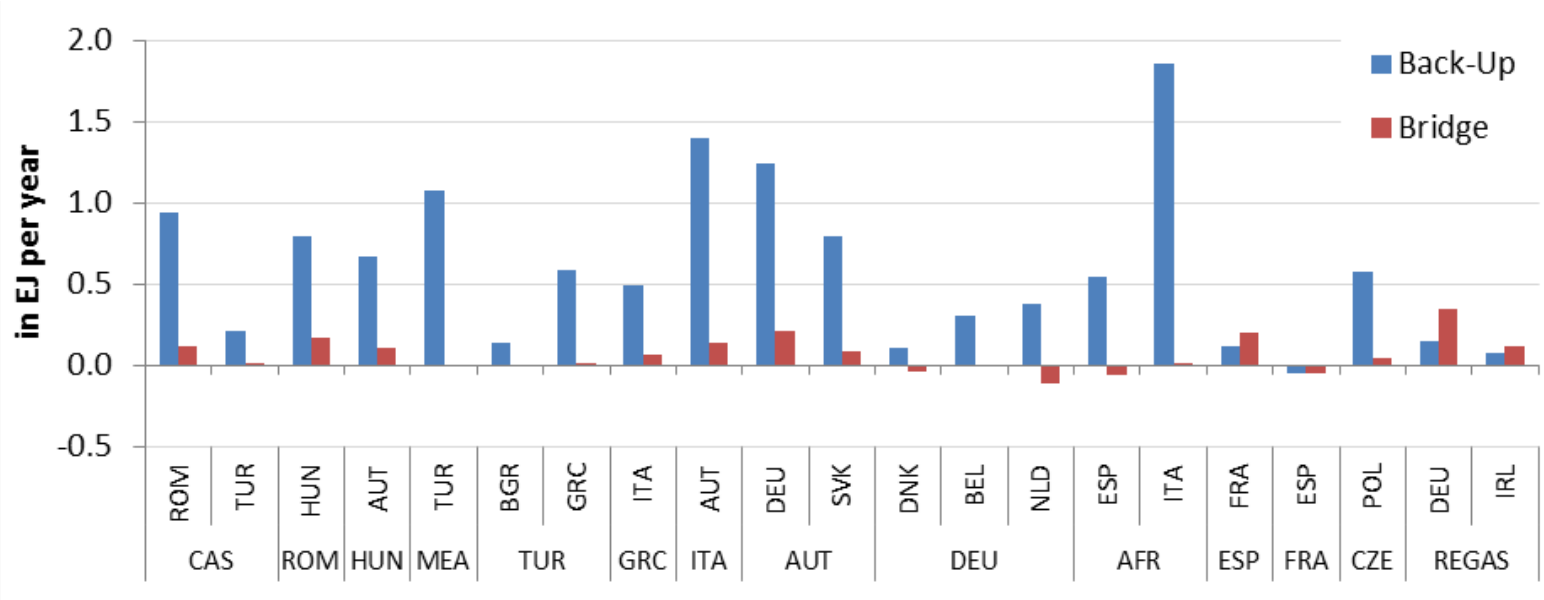
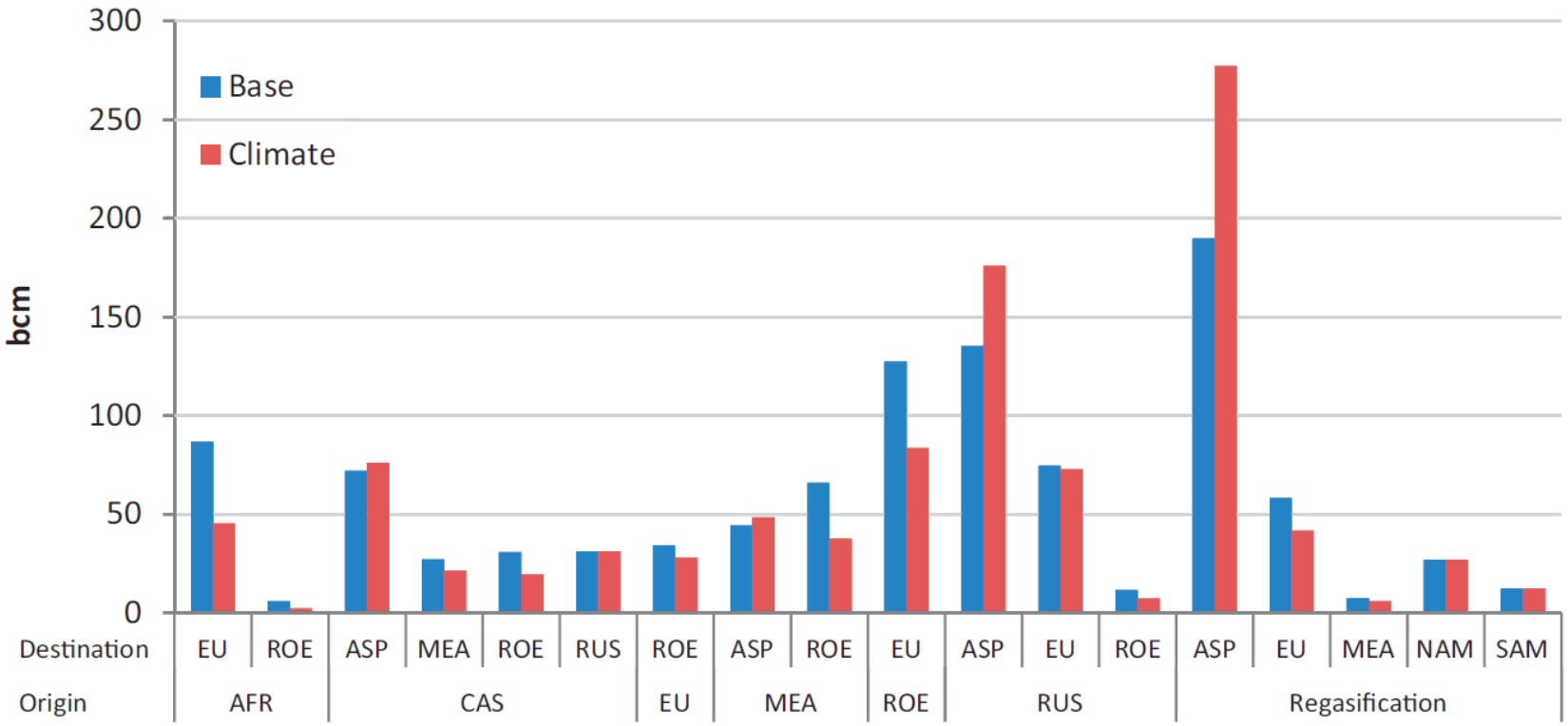
Considerable difference of infrastructure expansions in various demand scenarios (from Holz, Richter, Egging, 2016)

- „Back-Up“:
  - Larger expansions than in REF plus some additional connections
  - Almost double the investment of REF (€ 43 bn. until 2050 vs. € 25 bn.)
- „Bridge“:
  - Much higher capacity utilization rates of flexible LNG import terminals
  - Almost same investment as in EU1



Deviations of “Back-Up” and “Bridge” scenario from the REF scenario of selected cumulative expansion until 2050 (in EJ/y)

Import capacity expansions for inter-regional trade: Less infrastructure expansion to Europe in Climate scenario



Worldwide inter-regional import capacity expansions (pipelines and regasification) until 2040 by origin (lower part of horizontal axis) and destination, in bcm

Source: F. Holz, P.M. Richter, R. Egging (2015): A Global Perspective on the Future of Natural Gas: Resources, Trade, and Climate Constraints. *Review of Environmental Economics and Policy*, Vol. 9 (1), pp. 85-106.

Natural gas and renewables: Hydrogen !?

- Main topics of the DIW research group „Transformation of the Energy Economy“:
  - Market and system integration of fluctuating renewables
  - Flexibility options
  - Sector coupling (power-heat-transport)
- Potential longer-term options:
  - Flexible hydrogen generation (renewable H_2)
  - Synthetic fuels (based on H_2, using sustainable carbon sources)
- Research interest:
  - Costs, flexibility and power system impacts of such options
  - Comparison with other options for flexibility and sector coupling

Hydrogen transport by pipeline ?

- DIW is part of the large-scale German „Kopernikus“ project *Power-to-X* (2016-2019)
- Evaluation and comparison of different electrolytic and catalytic processes in terms of costs and economic efficiency
- Specific focus on liquid organic hydrogen carriers
  - Potential for **remote H_2 generation and transportation** via LOHC, using existing tanker infrastructure

→ Potential alternative for H_2 distribution (compared to pipelines, compressed gas and cryogenic liquid)

Picture from www.hydrogenious.net

On the **supply security side,** many more topics will be important for Europe in the (near and medium-term) future.

For example, …

… earthquakes in the Netherlands (Holz et al., 2017)

Image: Royal Dutch Shell plc.

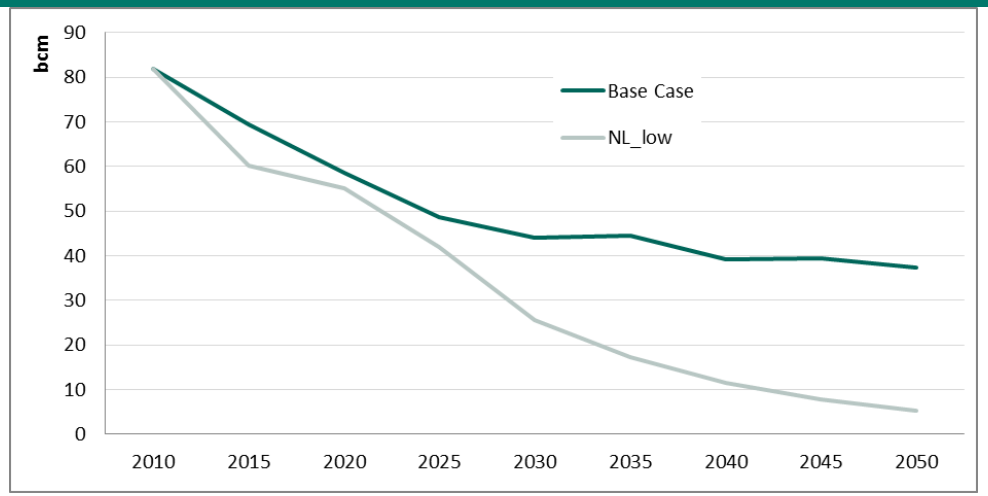


Figure: Dutch production capacities in Base Case and NL_low scenario (in bcm)

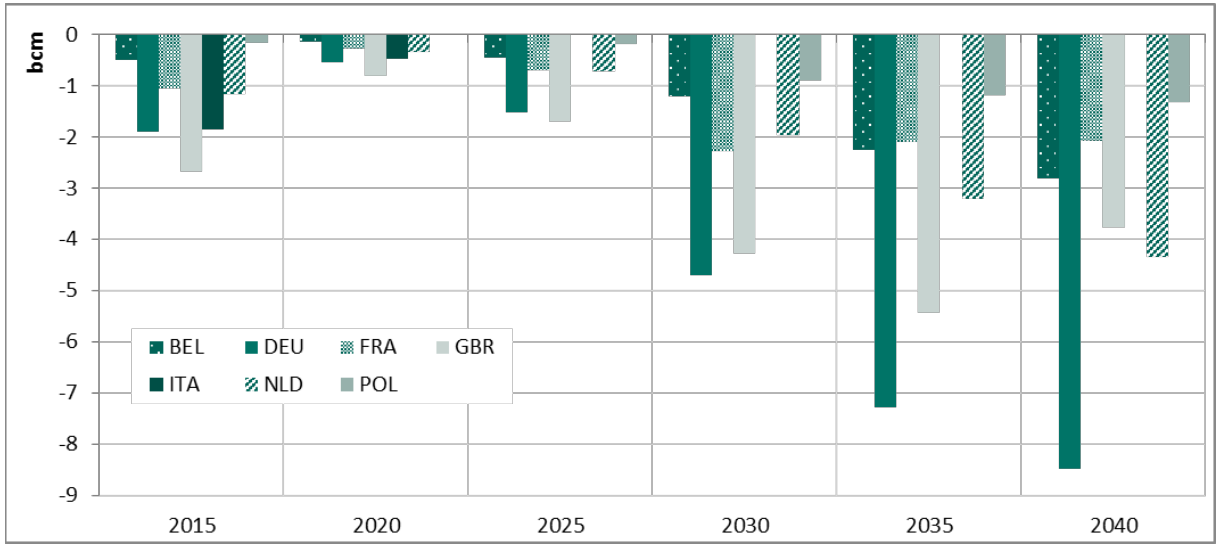


Figure: Change of Dutch gas supplies: RUS_NL_low vs. RUS_DISR (in bcm).

… dependency from Russian supplies in (Central & East) Europe

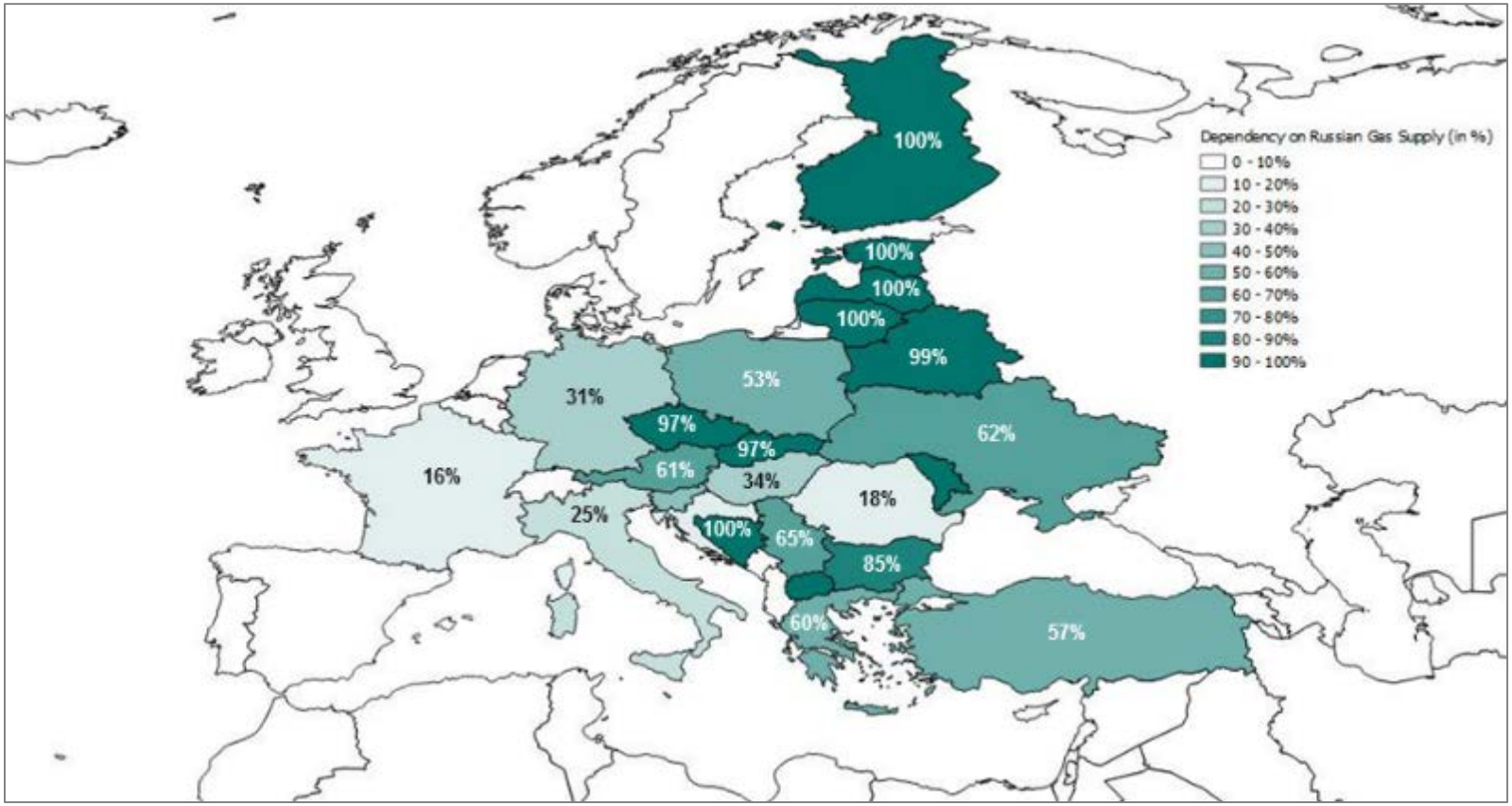
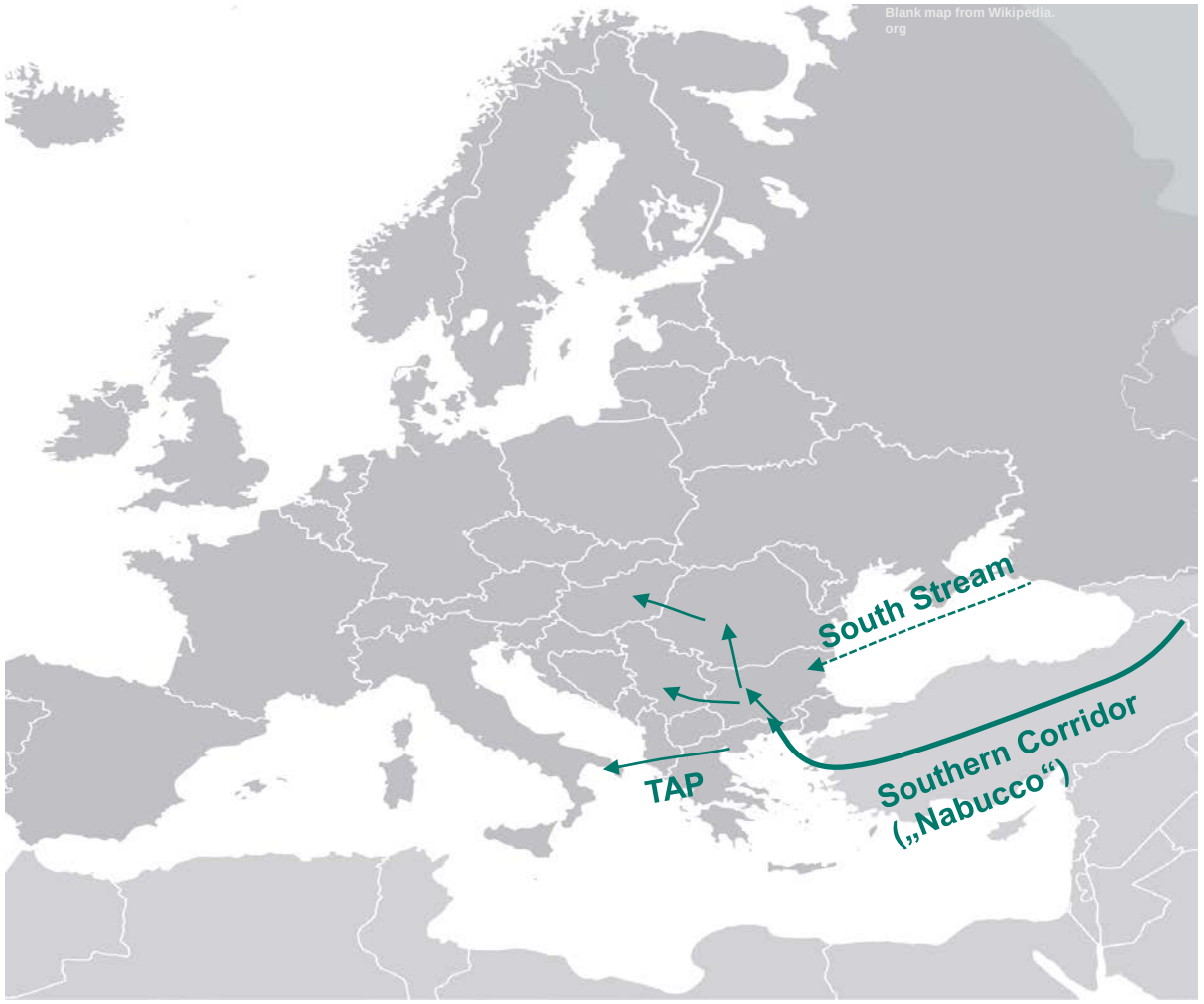


Figure: Dependency on Russian natural gas in 2012, calculated by the share of imports from Russia in total supply (domestic production and total imports), in percentages.

Dependency on Russian natural gas supply is geographically concentrated in the East of Europe → Effect of Nordstream 2?

… the role of LNG for Europe

- Southern Corridor
  - Constructed and expanded in all scenarios
  - Up to 27 bcm capacity
  - Supplied by Iraq and Caspian (Azerbaijan)
- TAP: in all scenarios (ca. 10 bcm)
- South Stream: 6 bcm investment to 2020
- **Only complementary role for LNG (insurance) because of global competition (Asia)**

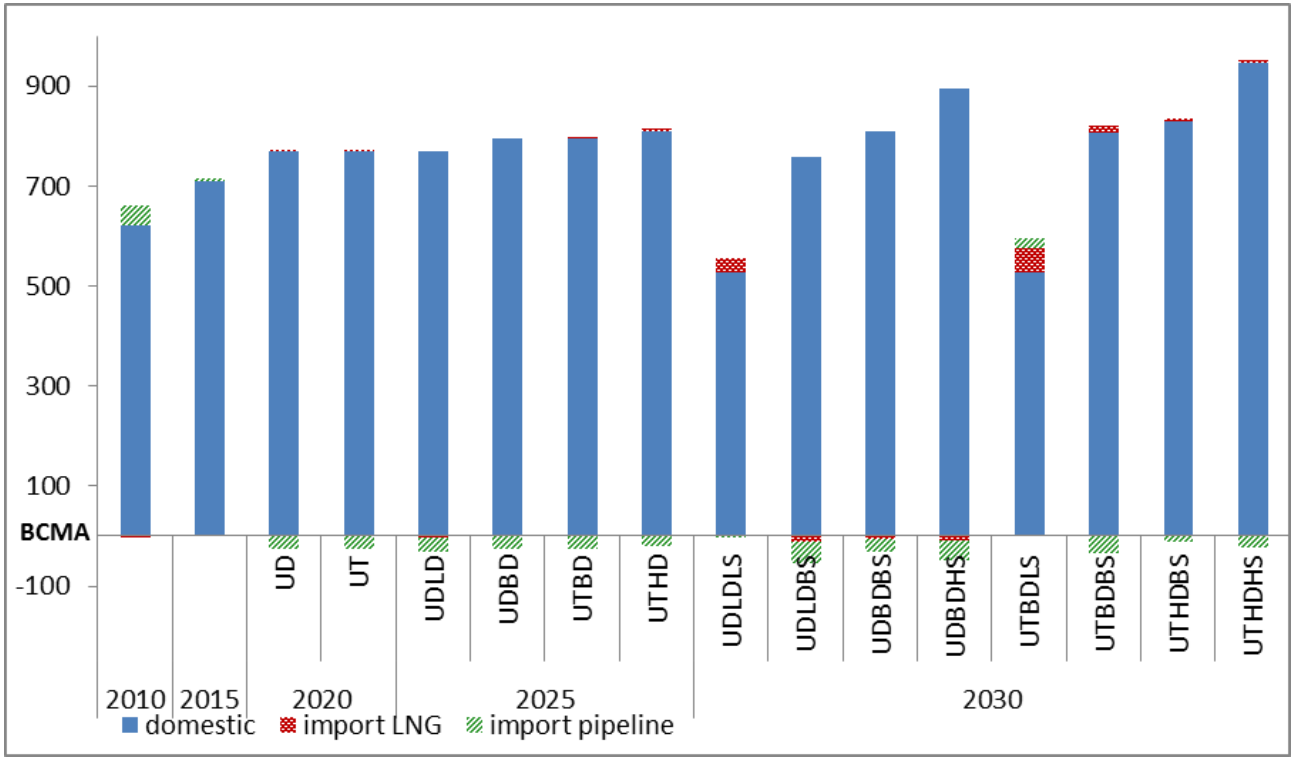


Source: Egging and Holz (2016)

… potential LNG exports from the US

The US: net LNG exporter or net LNG importer ?

→ Strong role of unconventional assumptions and of domestic gas demand assumptions



Source: Egging and Holz (2016)

Figure: US supply mix across scenarios and over time, in bcm/year

But really important is Asia

→ China

→ India

Chinese LNG Imports

- Enormous increase in demand and imports in the last 20 years
- Today, China is the 5th largest importer in the world
- LNG is flexible supply option, depending on scenario

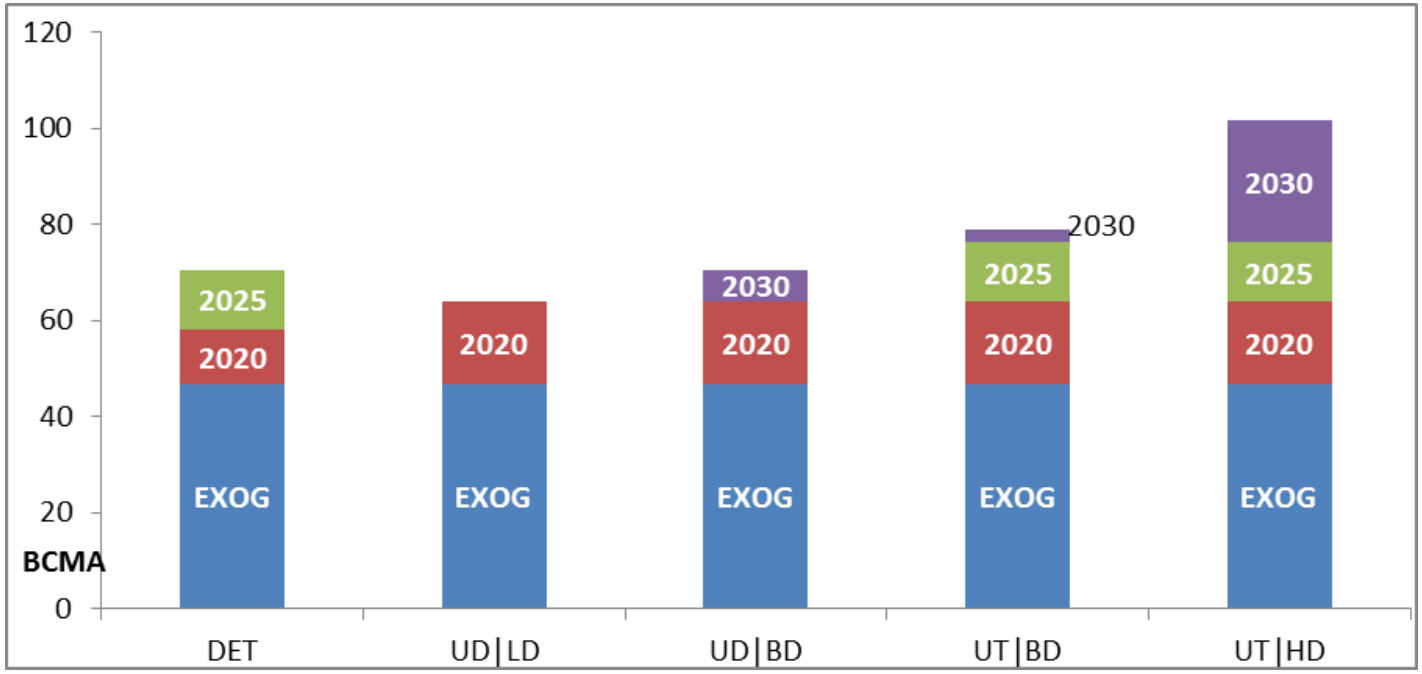


Figure: China regasification capacity development (by year available)

Source: R. Egging and F. Holz (2016): Risks in Global Natural Gas Markets: Investment, Hedging and Trade. *Energy Policy*, Vol. 94, pp. 468-479.

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Chinese Pipeline Imports

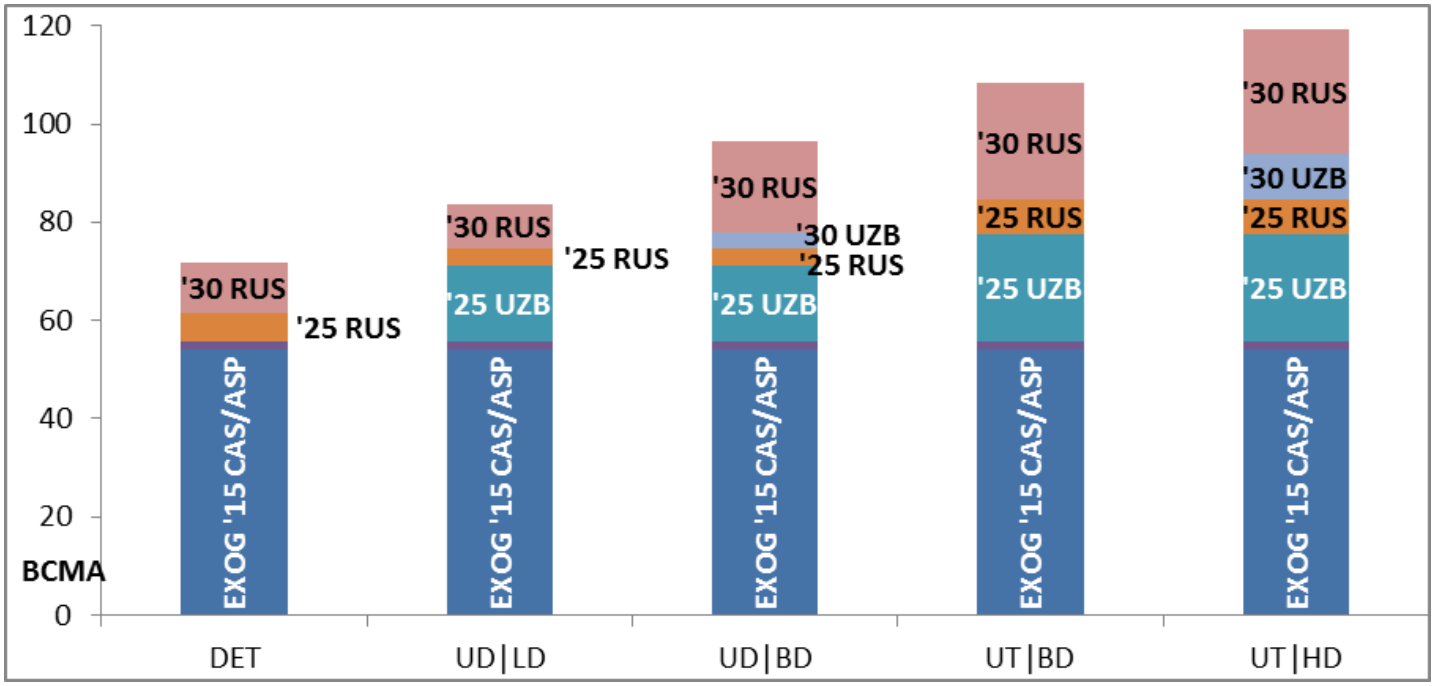

Figure: China import pipeline capacity development (by exporting country and year available)

Source: Egging and Holz (2016)

- Availability of local shale gas?
- Competition with coal?
- Role of gas in NDCs and further NDC amendments?

In lieu of conclusions: research challenges

Research on natural gas markets and related aspects

- Role of natural gas in Europe, in world regions, in various (climate policy) scenarios, in different economic sectors
- Perspectives of natural gas infrastructure
- Supply security in Europe
- …

Research on the methods

- Linking of sectoral natural gas models (e.g., with energy system models)
- Improving modeling of risk and uncertainty
- …

Thank you for your attention.

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