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Energy Corridor Optimisation for the European Markets of Gas, Electricity and Hydrogen

Natural gas corridors among the EU and its main suppliers: Simulation results with the dynamic GASTALE model

Wietze LİSE[a], Benjamin F. HOBBS[b] and Frits van OOSTVOORN[a]

[a] Energy Markets and International Environmental Policy group, ECN Policy Studies, Energy research Centre of the Netherlands, Amsterdam, the Netherlands

[b] Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, MD 21218, USA

Funded by European Commission – DG TREN

Contract no. SSP6-CT2004-006588

ECN

Overview

Scope of the analysis:

- Convergence towards liberalized market with few players in the long run,
- Prices established via demand/supply equilibrium,
- Seasonal flexibility and sectoral demand,
- Production capacity is exogenous,
- Investment in transport corridors (pipelines, LNG, storage) is endogenous.

Main conclusion:

- Substantial investments needed in corridors towards EU,
- Especially the East–West route influence future gas prices.

Outline:

1. GASTALE model presentation,
2. Results.

The GASTALE model version 4.4

GASTALE distinguishes between:

Producers with market power: decide on production, transport to country border, earning a border price.

Transmission system operators (TSO): regulates transport through pipeline network & LNG shipping.

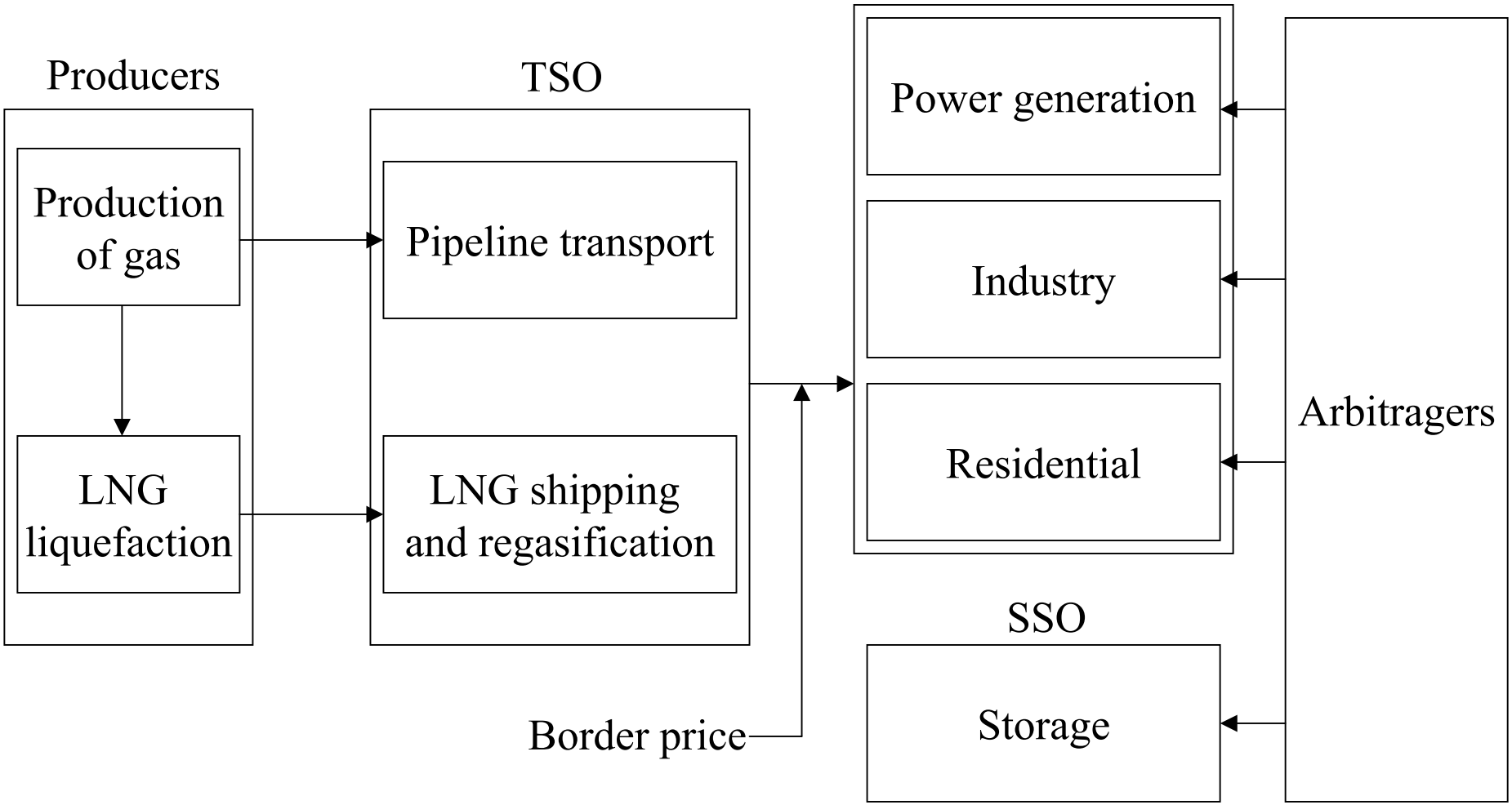
Arbitragers without market power: trade gas among power generation, industries, residents & storage.

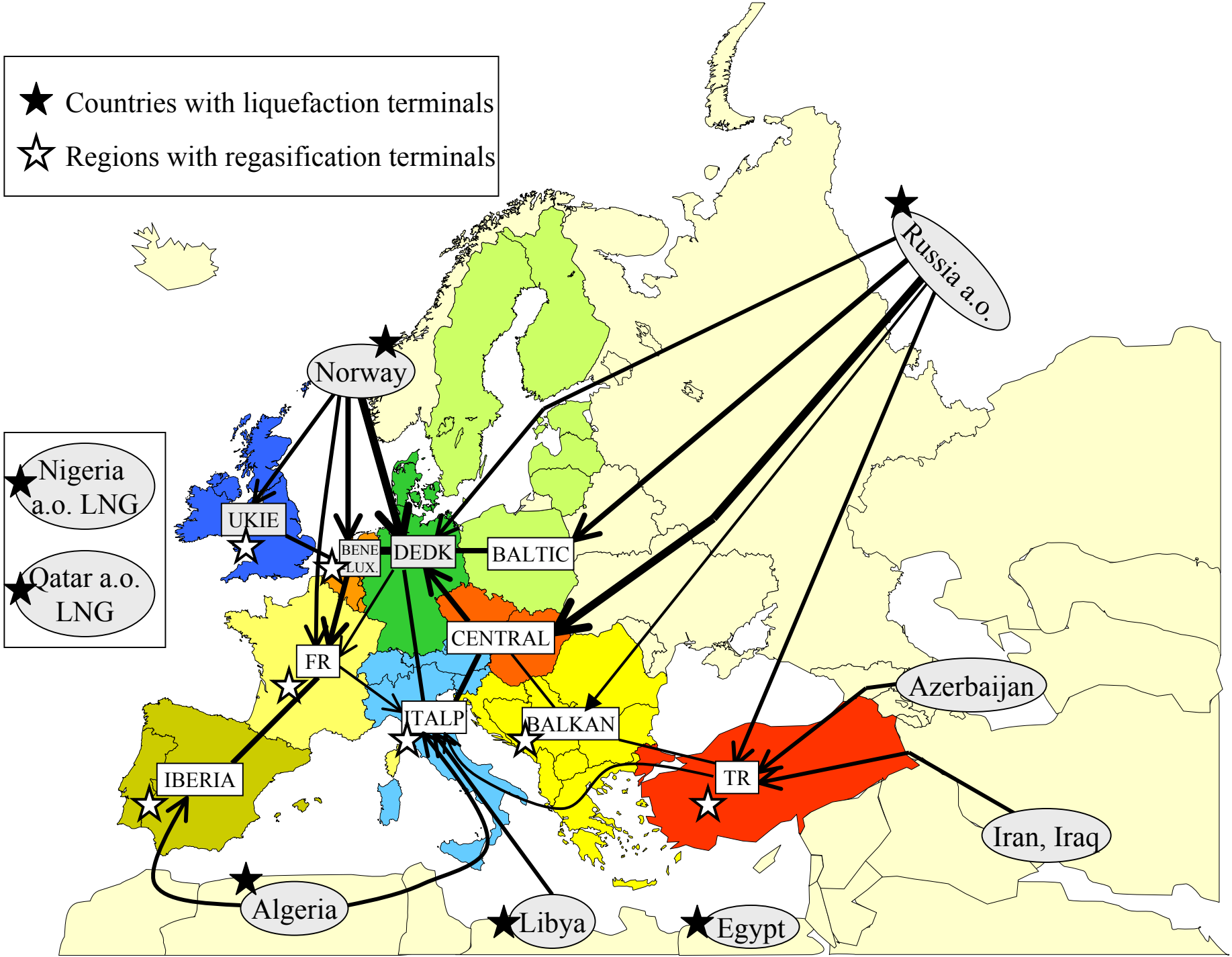
Storage system operators (SSO): regulates injection during the warm season and extraction from storage facilities during the cold season.

Consumer prices clear the market.

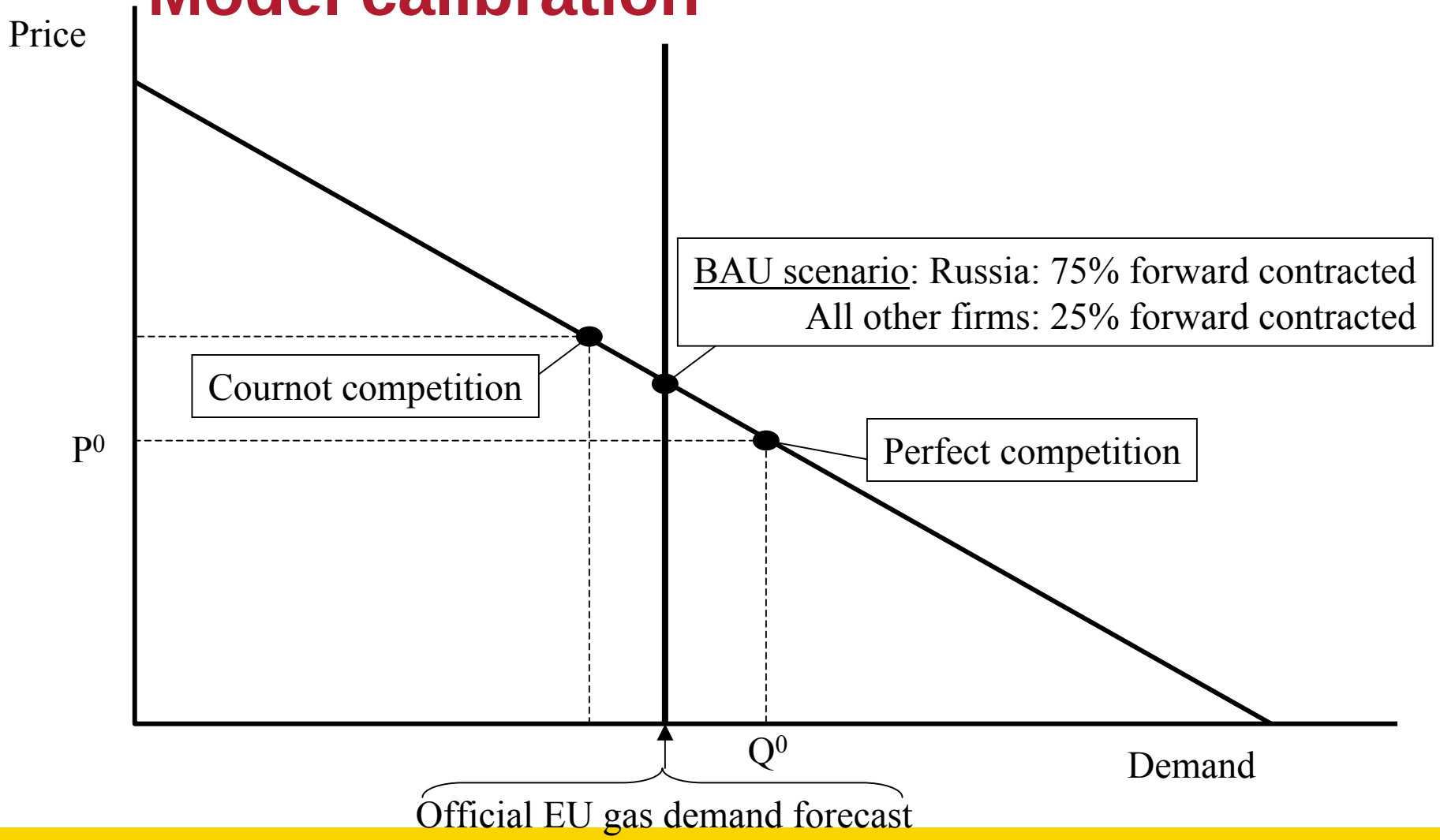
Investments in storage, pipeline, liquefaction and regasification, capacities.

Overview of actors in GASTALE 4.4

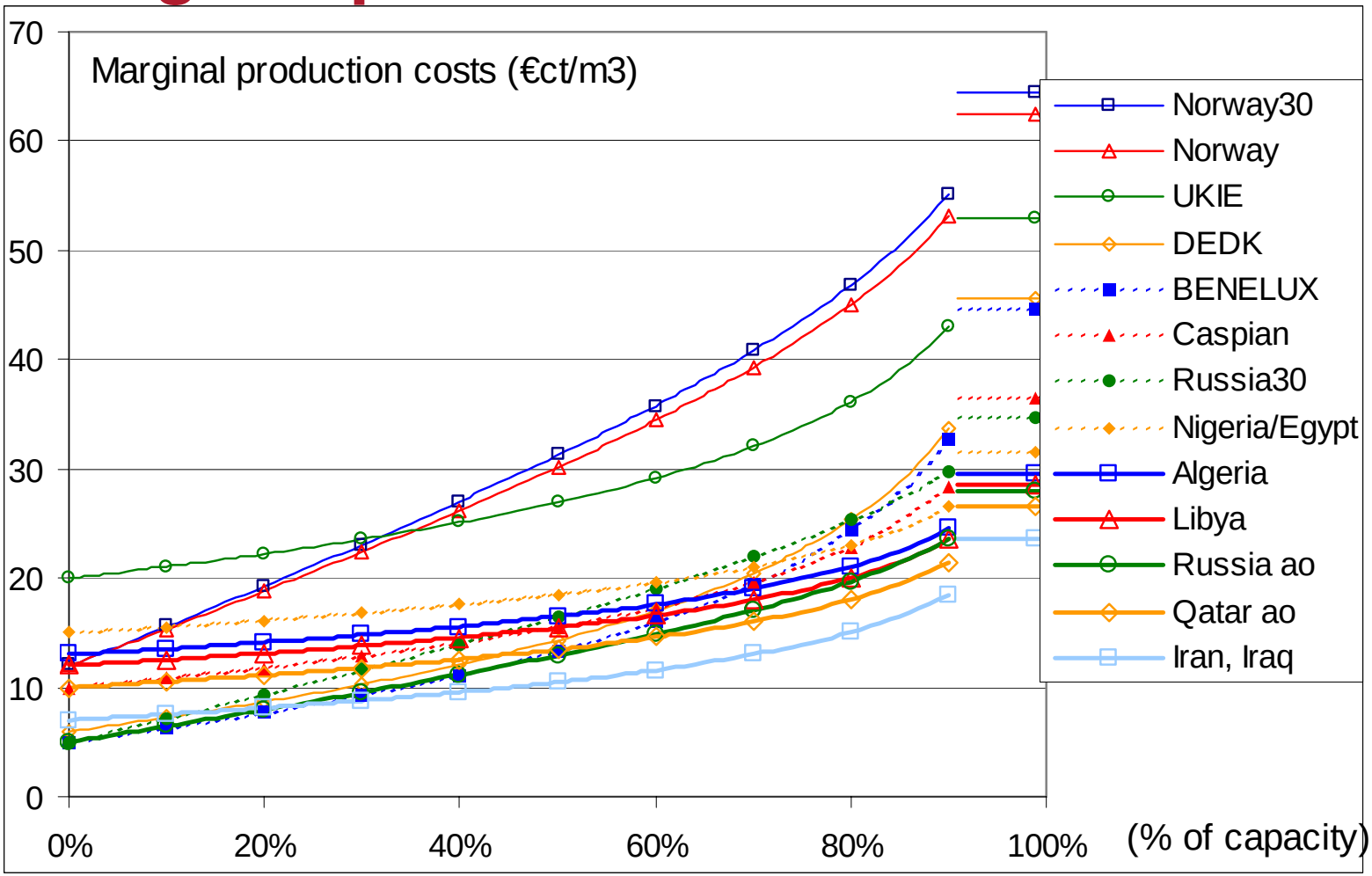



Countries with liquefaction terminals
Regions with regasification terminals
Nigeria a.o. LNG
Qatar a.o. LNG
Russia a.o.
Norway
UKIE
BENE LUX.
DEDK
BALTIC
CENTRAL
FR
ITALP
BALKAN
Azerbaijan
IBERIA
TR
Iran, Iraq
Algeria
Libya
Egypt

Model calibration



Marginal production costs



Four policy scenarios

BAU case:

driven by official EU gas demand/supply/prices forecasts,

Forward contracts: Russia 75%, other countries 25%

Low demand case:

driven by high oil prices etc.,

demand more elastic +20%, World LNG export –20%

High demand case:

driven by low oil prices etc.,

demand less elastic –20%, World LNG export +20%

Deferral case:

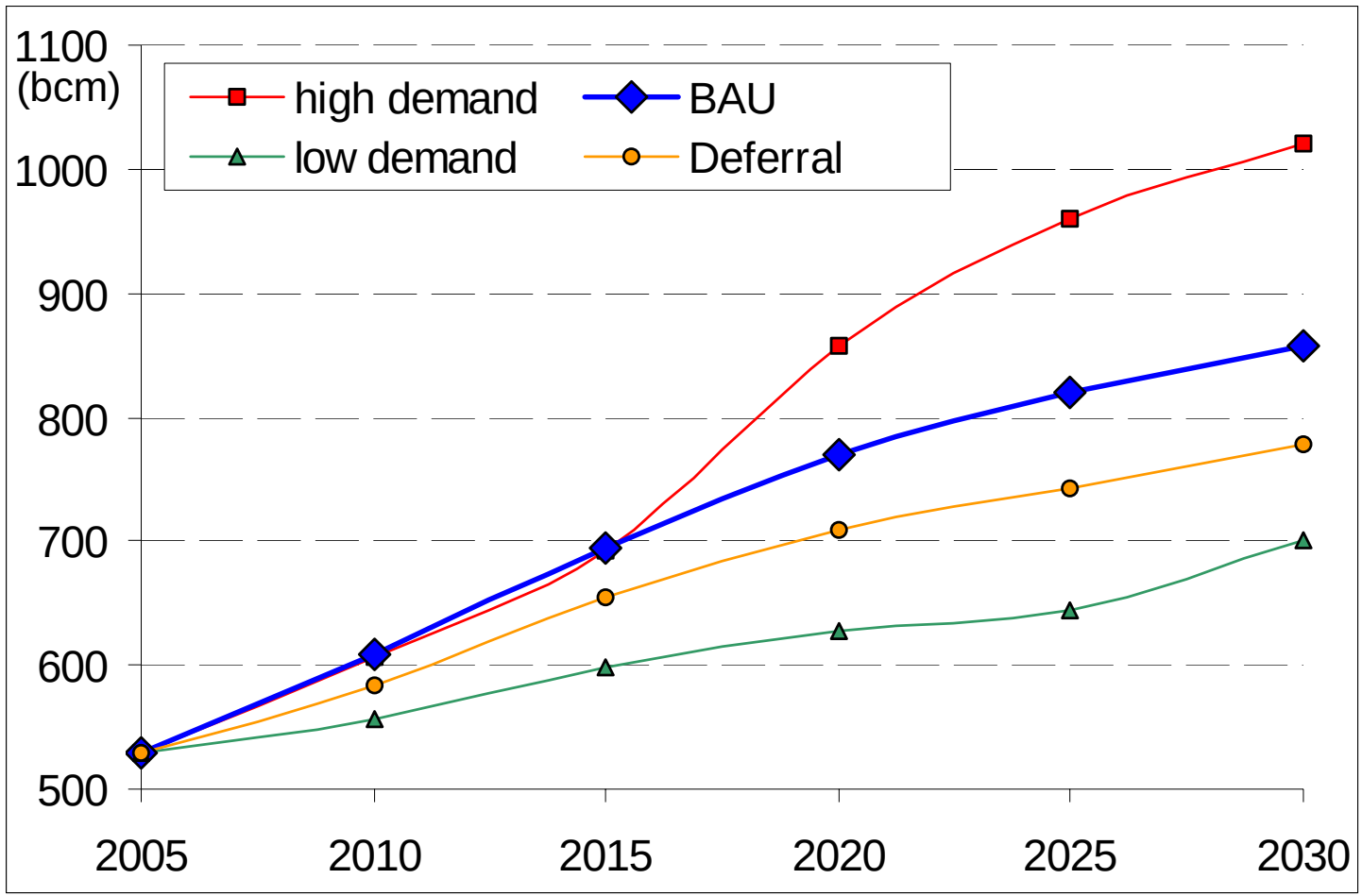
driven by increased market risks for banks etc.,

resulting in 30% additional investment costs

Expected European demand in 4 cases:

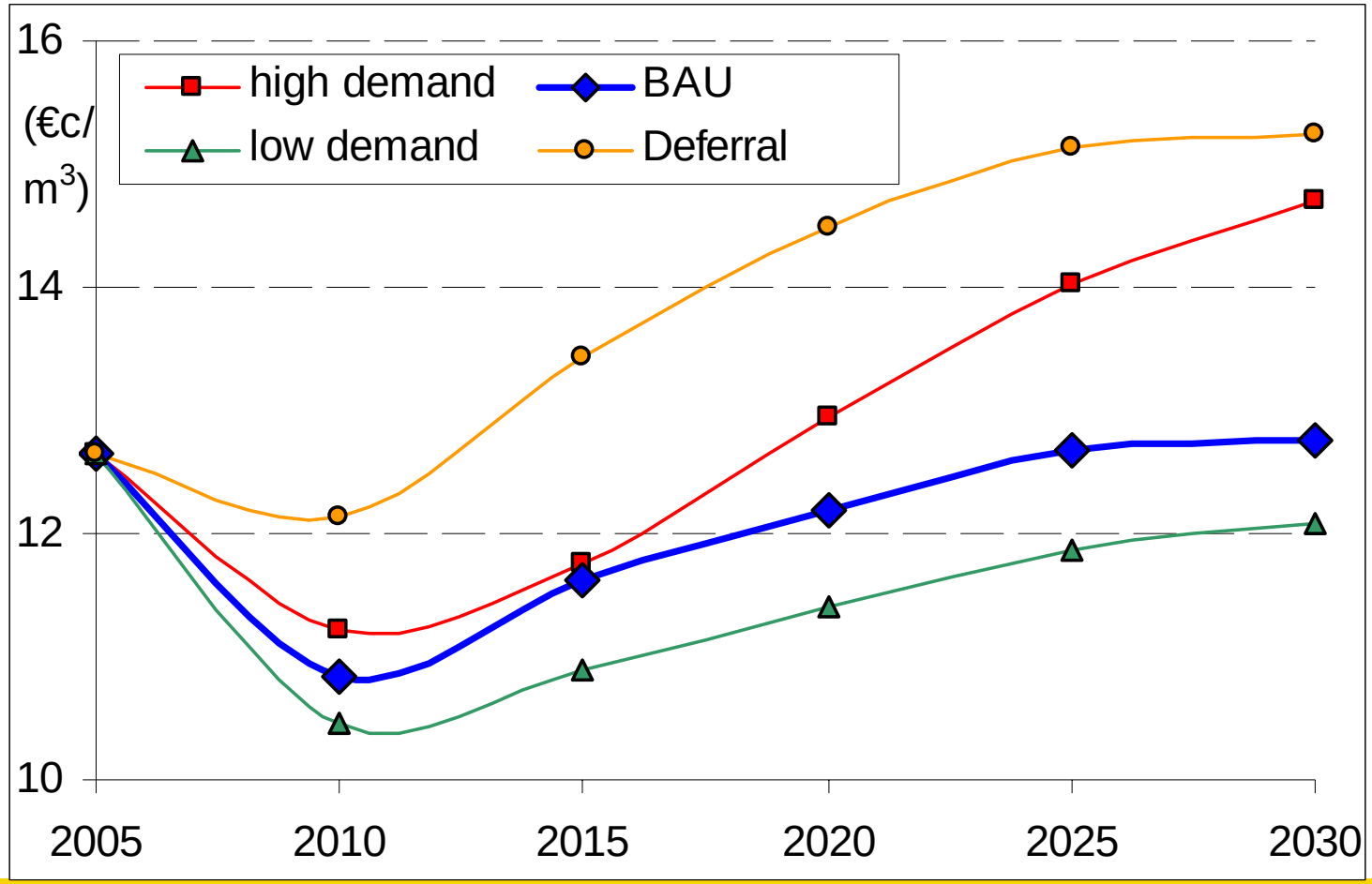
Relatively low demand in the deferral case:

Slower investments →higher prices →lower demand.



Projected gas prices at EU border in 4 cases:

- Prices drop from 2005 to 2010 in all cases and rise afterwards.
- High demand prices higher than BAU prices in 2010/2015, due to assumed lower elasticity.



Optimal corridors according to model's economic principles

Some connection would not be built:

- The Baltic line between Russia and Germany

This connection is exogenous in analysis

Some connections would be expanded beyond reality:

- Norway – UK, would by-pass other Norway-EU connections
- Algeria – Spain
- Algeria – Italy
- Libya – Italy

These connections are restricted → Algeria/Libya use second best option, LNG.

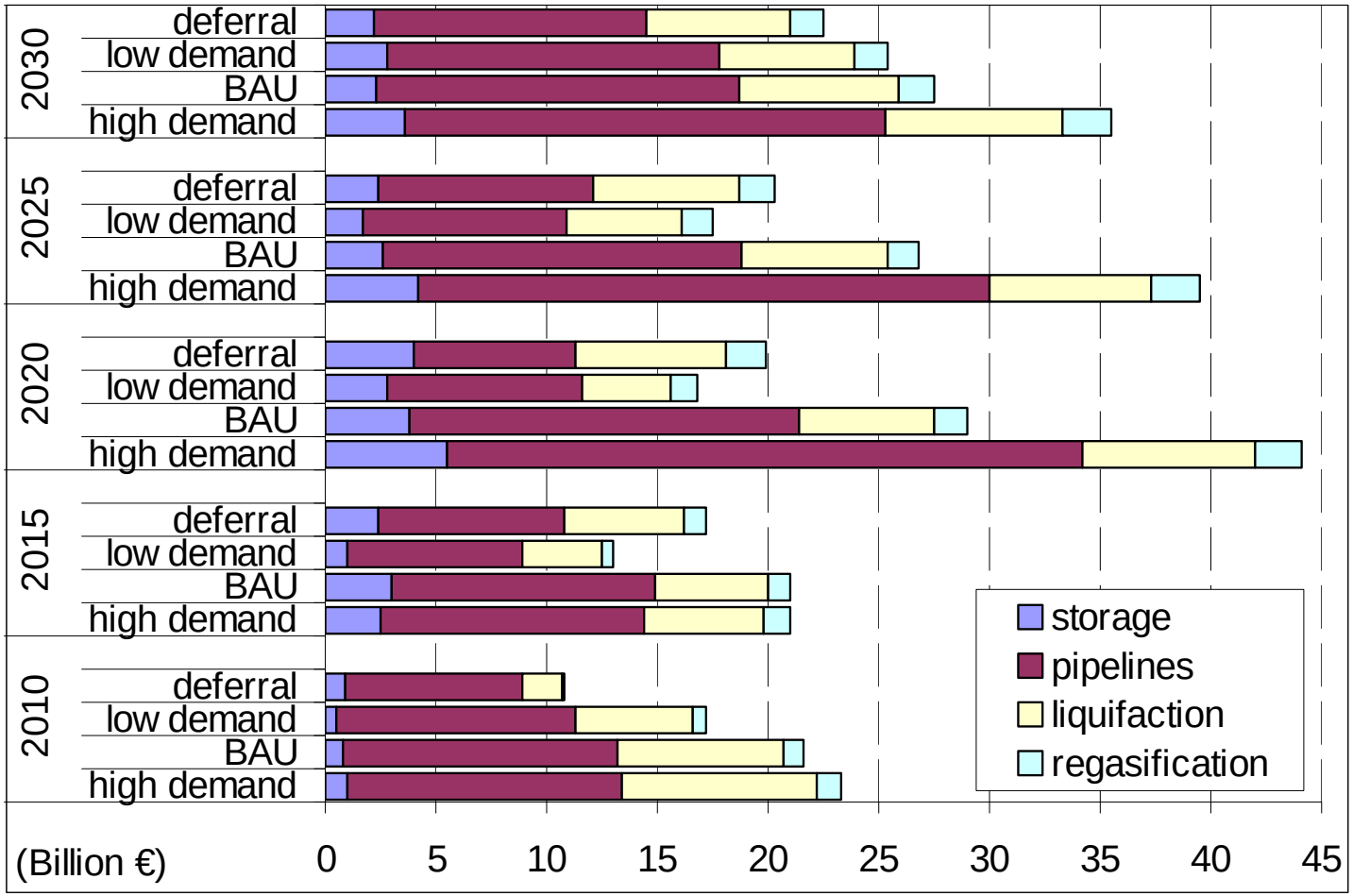
LNG to Europe from Russia is attractive option; binding restriction in analysis.

Total yearly investment costs in 4 cases:

Highest for pipeline connections,

High pipeline costs from 2020 onwards in high demand case,

Low costs in 2010 deferral case, low costs in 2015 low demand case

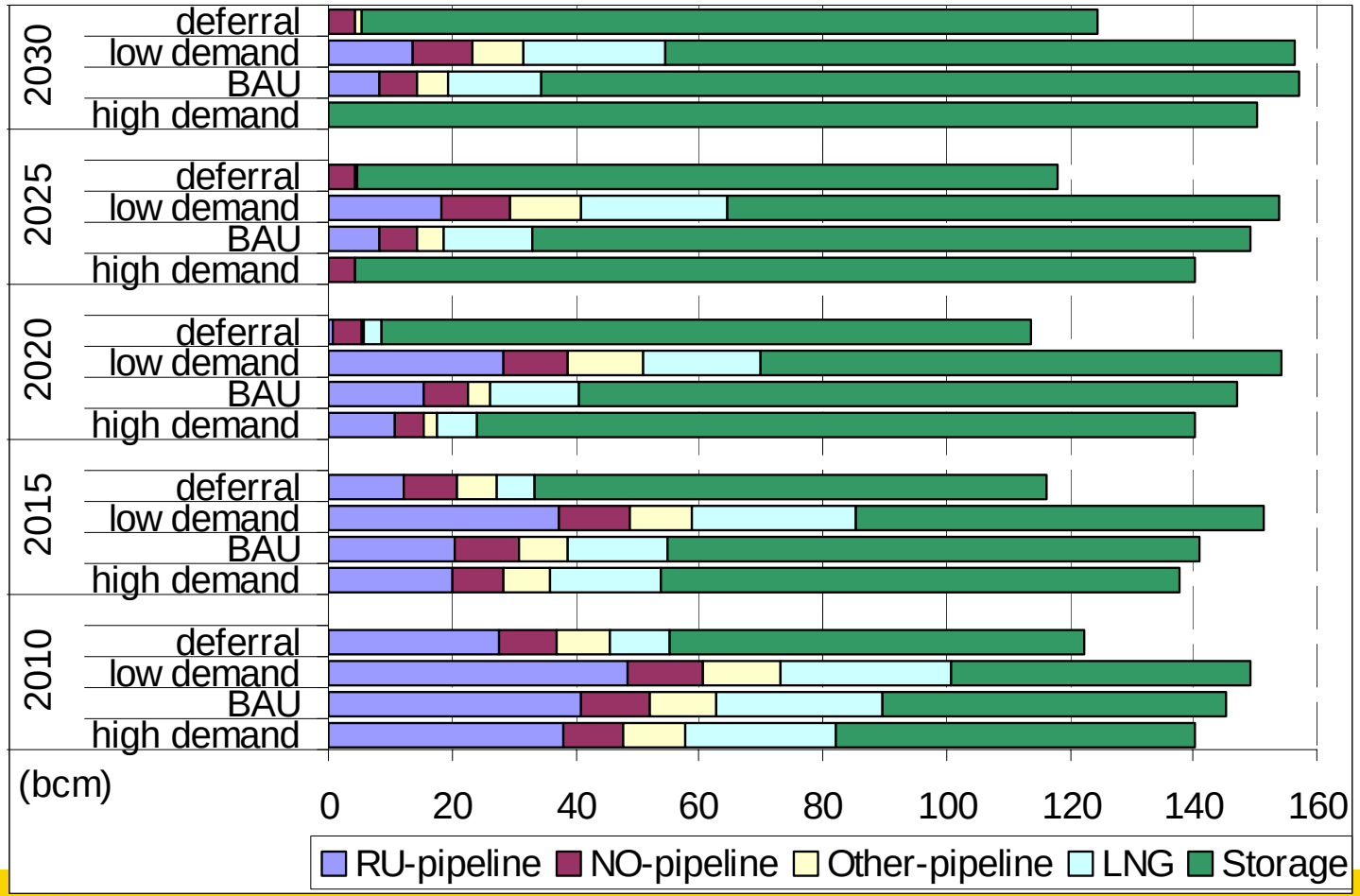


Total yearly difference between cold and warm season:

Storage gains importance in time, 100% in high demand case by 2030,

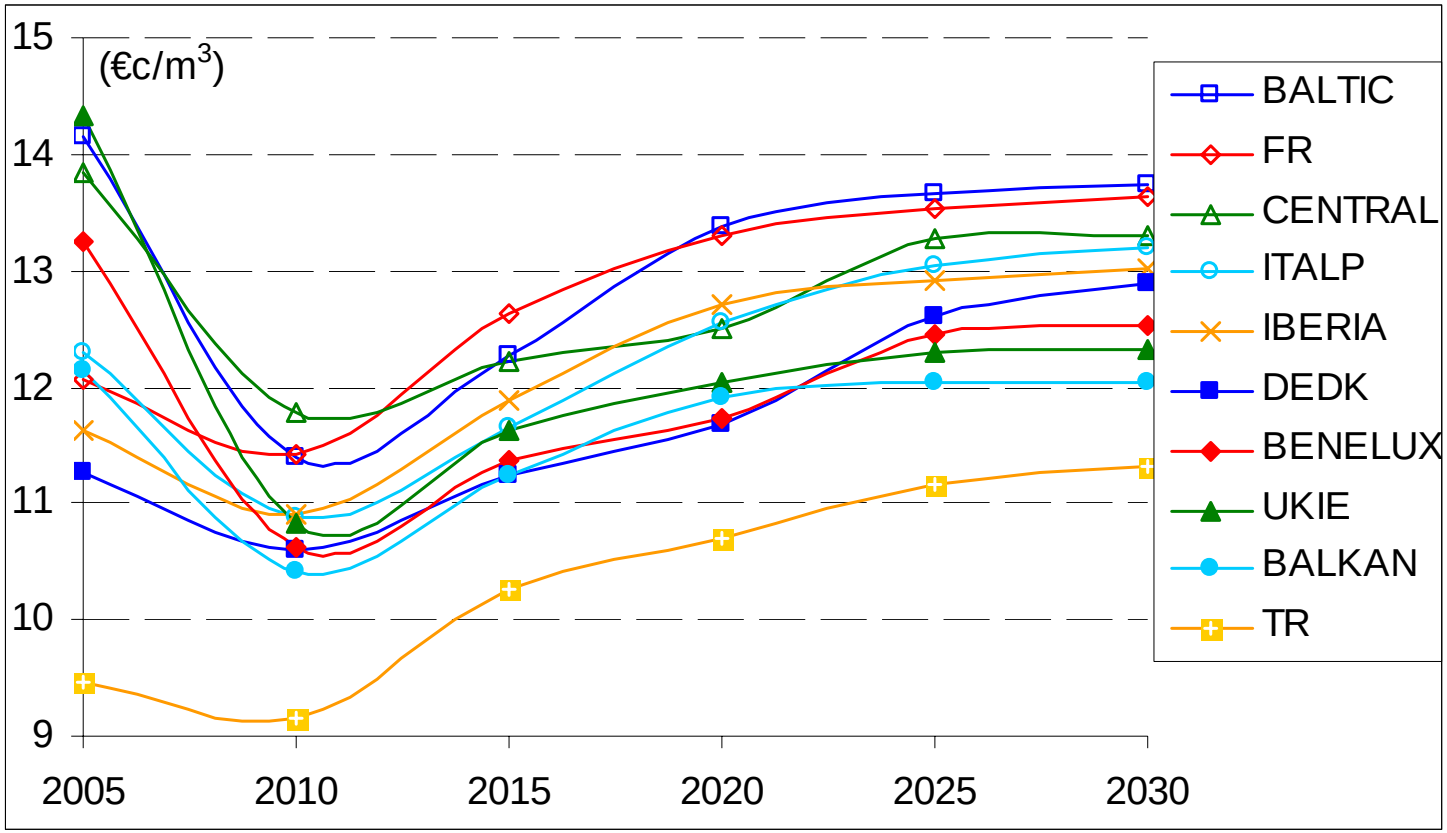
Flexibility from Russian pipelines decreases in time,

Flexibility through LNG remains important in time in low demand/BAU case.



Regional prices in the BAU case:

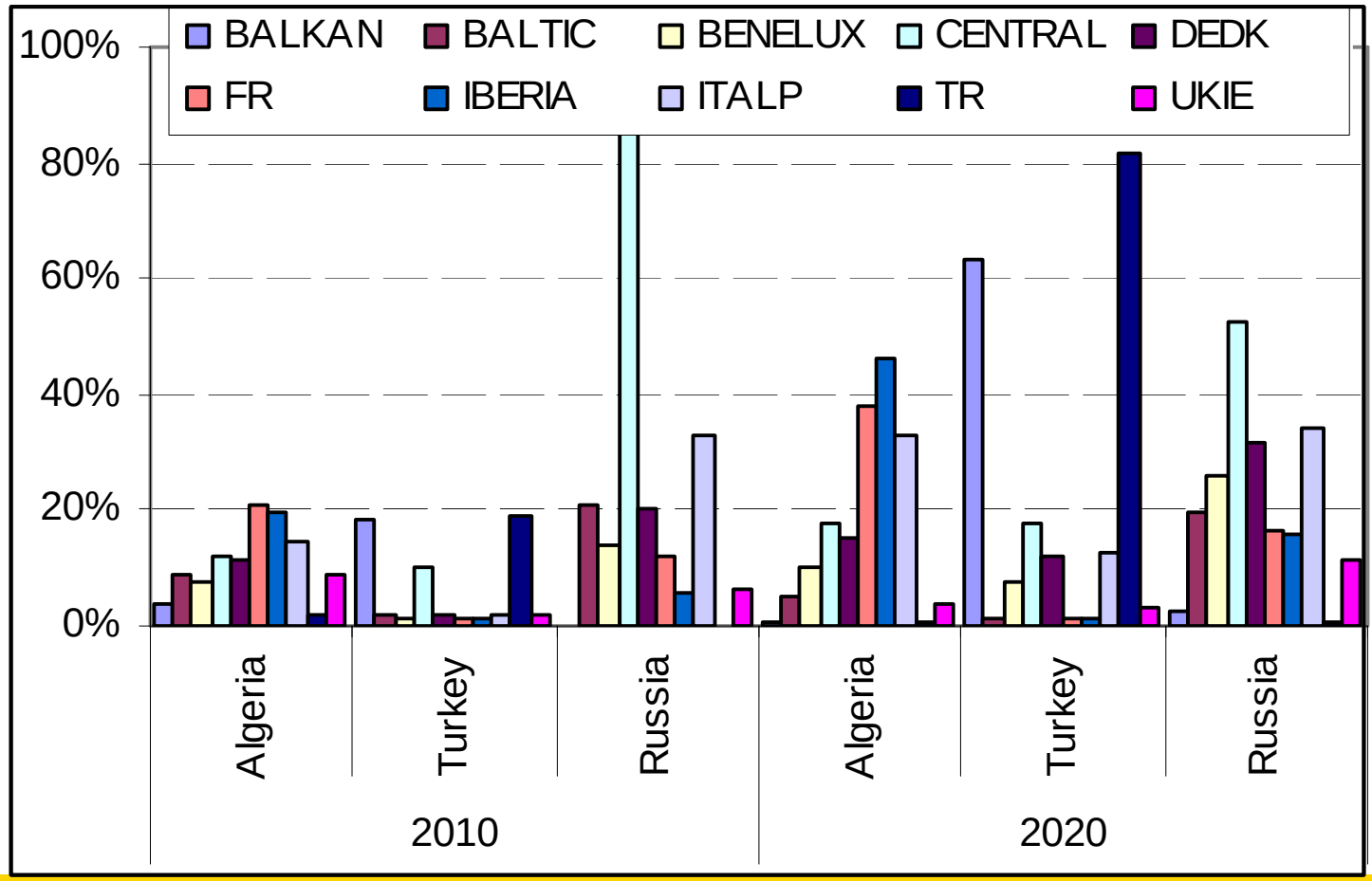
- Prices lowest in Turkey → potential transit artery to EU.
- Prices high in FR, BALTIC, CENTRAL → competition, accessibility.
- New investments reduce market power → prices ↓ from 2005 to 2010.



Price response in disruption cases:

Percent changes w.r.t. BAU prices of a full (100%) short-run (≈year) disruption of supply for 2010 and 2020 through: Algeria, Russia, Turkey.

No investment responses possible in such a short time-frame.



Conclusions

- **Price differences** due to: 1) distance from producer, 2) market power.
- **Pipelines dominant** in future: 83% (low demand), 81% (high demand & BAU) and 77% (deferral) in 2030.
- **Storage is cheapest option** for arbitrage between summer and winter demand. LNG is second best option.
- Decisions for new corridors **political**, shown by existence of expensive and absence of cheap options.
- **Disruption** leads to higher gas prices in neighboring countries. Price effect in 2020 higher for Algeria/Turkey due to higher demand Price effect in 2020 lower for Eastern Europe due to alternative supplies.
- **Substantial investments** needed in corridors towards EU, Especially the East–West route influence future gas prices.