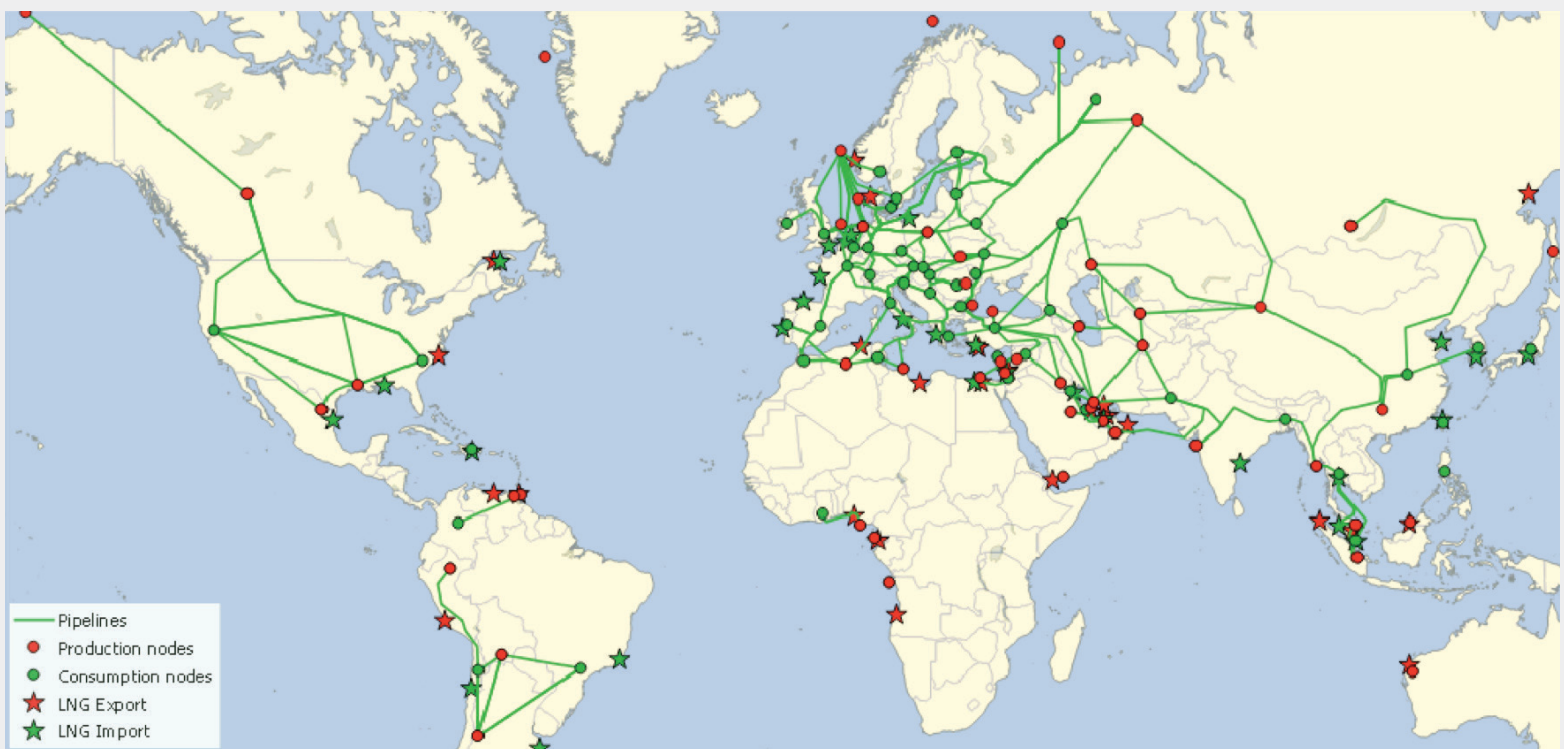


## COLUMBUS

### The model

COLUMBUS is a long-term simulation model for the global natural gas market. Taking into account worldwide interdependencies, the model predicts possible developments up to the year 2040. In addition to simulations on the annual level, it is also possible to perform calculations on the semi-annual, quarterly or monthly timescale. In doing so, the seasonal fluctuating demand profiles are able to be taken into account. In addition, the model extends the option to display the strategic behavior of some natural gas market participants.

The model takes into account all key natural gas producing countries and their specific characteristics (e.g., production costs, infrastructure connections, unconventional natural gas reserves). Furthermore, all relevant demand countries are included (approx. 99 percent of global demand). All required data for the model is continuously updated in the ewi ER&S database.



**Market coverage of the COLUMBUS model:  
Production and demand regions, pipeline connections and LNG terminals**

#### Characteristics of the supply side:

- Production costs and production capacities,
- pipeline routes as well as LNG import and export terminals,
- consideration of oil- and hub-based long-term contracts

#### Characteristics of the demand side:

- Country-wise demand,
- seasonality,
- price elasticity of the demand function

COLUMBUS is designed as a dynamic, spatial and intertemporal model. It is based on a mixed complementary programming approach (MCP). The model includes all key natural gas market fundamentals and characteristics, facilitating a comprehensive quantitative analysis of future market developments.

## COLUMBUS—A global gas market model

### Possible applications

#### Trade flow projections

COLUMBUS simulates current and future global natural gas and LNG trade flows.

#### Infrastructure utilization

COLUMBUS determines capacity utilization of natural gas infrastructure such as storage, production facilities, pipelines and LNG terminals (export and import).

#### Demand for investment

COLUMBUS shows the amount and the geographical location of demand for investment in production fields, transport and storage infrastructure.

#### Price developments

COLUMBUS predicts medium- and long-term price developments (with or without strategic behavior of the different natural gas market participants).

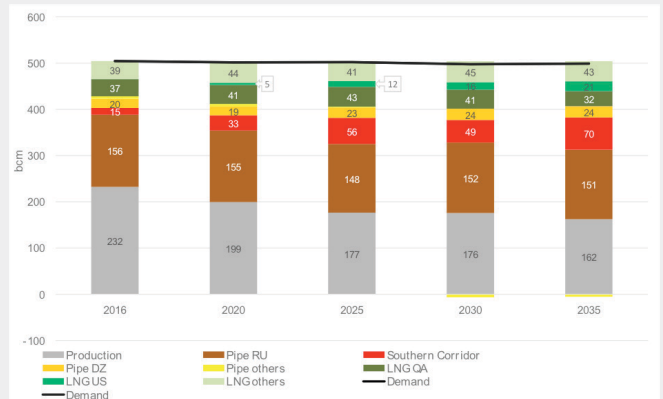


Figure 1: European natural gas balance (2016-2035)



Figure 2: Demand for investment in Southeast Europe up to 2030 (assumption: transit stop of Russian gas through the Ukraine and the expansion of the South Stream project)

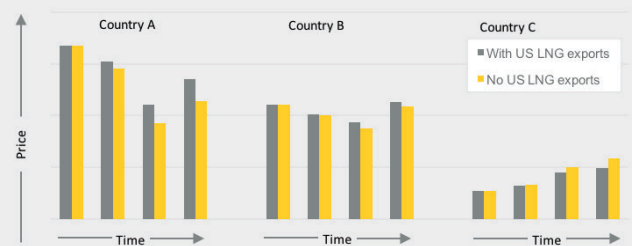


Figure 3: The impact of US LNG exports on the natural gas price (wholesale price) in different countries