

NORTH AMERICAN LNG EXPORTS

IMPACT ON THE WORLD GAS MARKET

Prepared For
United States Energy Association



13th May 2014

1. Nexant's World Gas Model

2. Case Studies

- North American LNG Exports – Impact on World Markets
- EU Embargo on Russian Gas Exports



World Gas Model

A Scenario Tool for the Natural Gas Market

World Gas Model

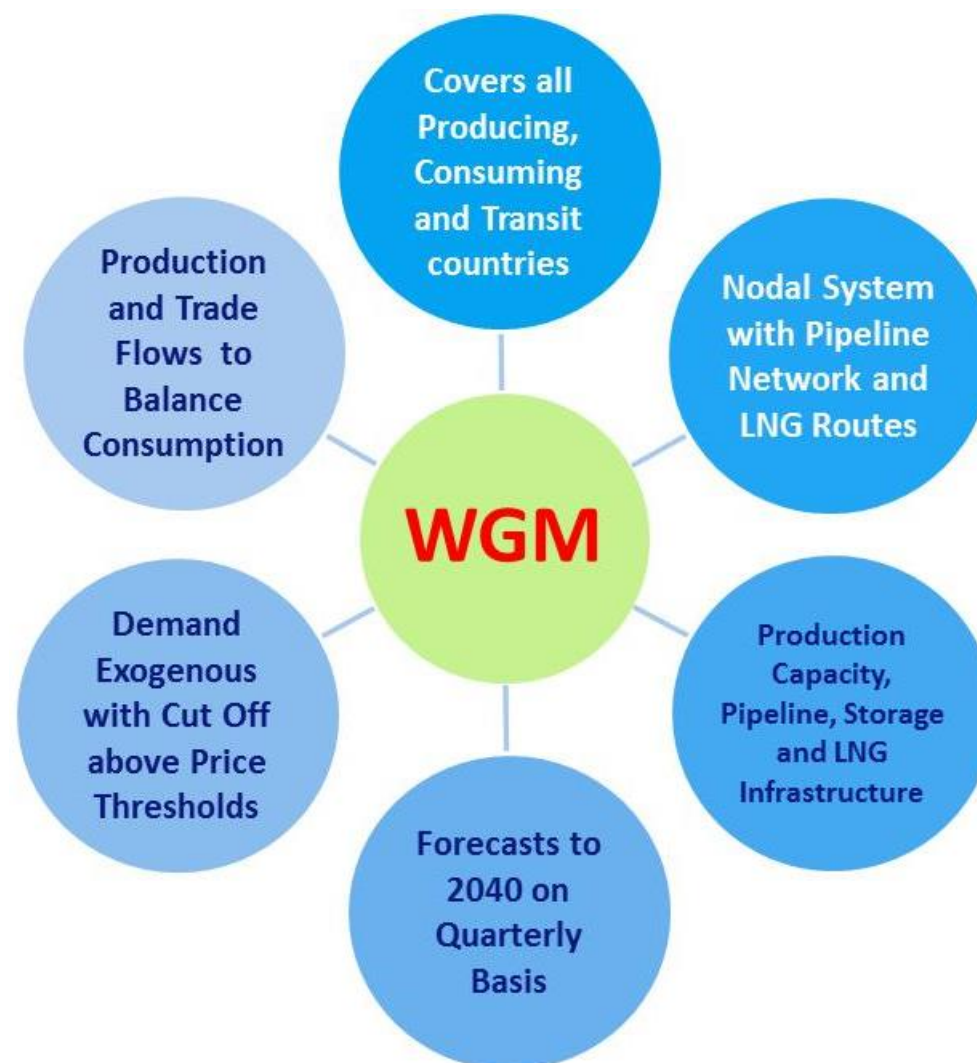
Scenarios for an Uncertain World Gas market

Companies can license WGM and construct their own scenarios OR

Commission Nexant to assist with scenario definition and run the model on clients' behalf. Then report back and/or hold workshops to discuss results.

WGM is also used by Nexant to support multi-client reports.

System Overview



World Gas Model Key Features



Software

All data and the model itself use Excel to allow easy interface with inputs and outputs. Optimisation uses a powerful add-in to Excel. WGM is open and transparent – users can see all constraints and formulas as well as data

Data

Nexant provides a comprehensive database with all data and assumptions needed to run WGM.

Users can add to or replace any and all of the Nexant assumptions in line with their own outlook

Using the Model

Licensees have the model installed on their own computer with no need to access information via the internet.

A powerful laptop or desktop with 64-bit software is all that is needed to run WGM.

Output

A vast amount of information is output from the model in Excel format.

Summary reports are also produced by the Model and users create different reports depending on their needs by accessing the detailed output.

All Data and Assumptions are in an Excel Database File



DATABASE CONTENTS

Data Set	Maximum	Rows Used	Last Row Used
Nodes	200	157	157
Production	600	522	522
Pipelines	450	358	360
Liquefaction Plant	240	213	213
Regas Plant	350	310	310
LNG Contracts	450	401	402
Pipeline Contracts	300	271	271
Transportation Contracts	300	199	271
LNG Routes	2500	2236	2236
Storage Facilities	500	335	335
Historical Data	Spot Price Assumptions		
Energy Prices	Misc Assumptions		
Demand by Sector	LNG Check		
Demand Side Response	Node Check		

- ❖ Data collected over a very long period of involvement in the industry.
- ❖ Mainly public sources complemented with private sources where confidentiality allows
- ❖ WGM users include policy institutes in Russia, Far East and Australia who are more free to share information than our private sector clients.
- ❖ Feedback from private clients is also useful.
- ❖ Nexant also has good contacts with major data reporting agencies like IEA and EIA.
- ❖ Continuous process of updating by Nexant – clients receive updates quarterly
- ❖ Database is in Excel, so open and transparent and users can modify data and assumptions easily to reflect their own scenarios.

StartPage / Hist Data / MCP / Energy Prices / Prod Data / Dem Data / LNG Data / Resp Data / Conf(L) Data / Conf(D) Data / Conf(T) Data / LNG

Key Assumptions – Gas Supply

Capacity

- **Over 500 Fields and Basins**
- **Conventional and Unconventional Production**
- **Capacity Profiles out to 2040**

Costs

- **LRMC of Production**
- **Specific Calculation for Large Fields**
- **Generic Calculations for Onshore and Offshore etc.**
- **Export Taxes and Royalties Added to Costs**

Production Volumes

- **The model schedules supply to meet demand and minimise costs. Volumes are set by model within capacity constraints**

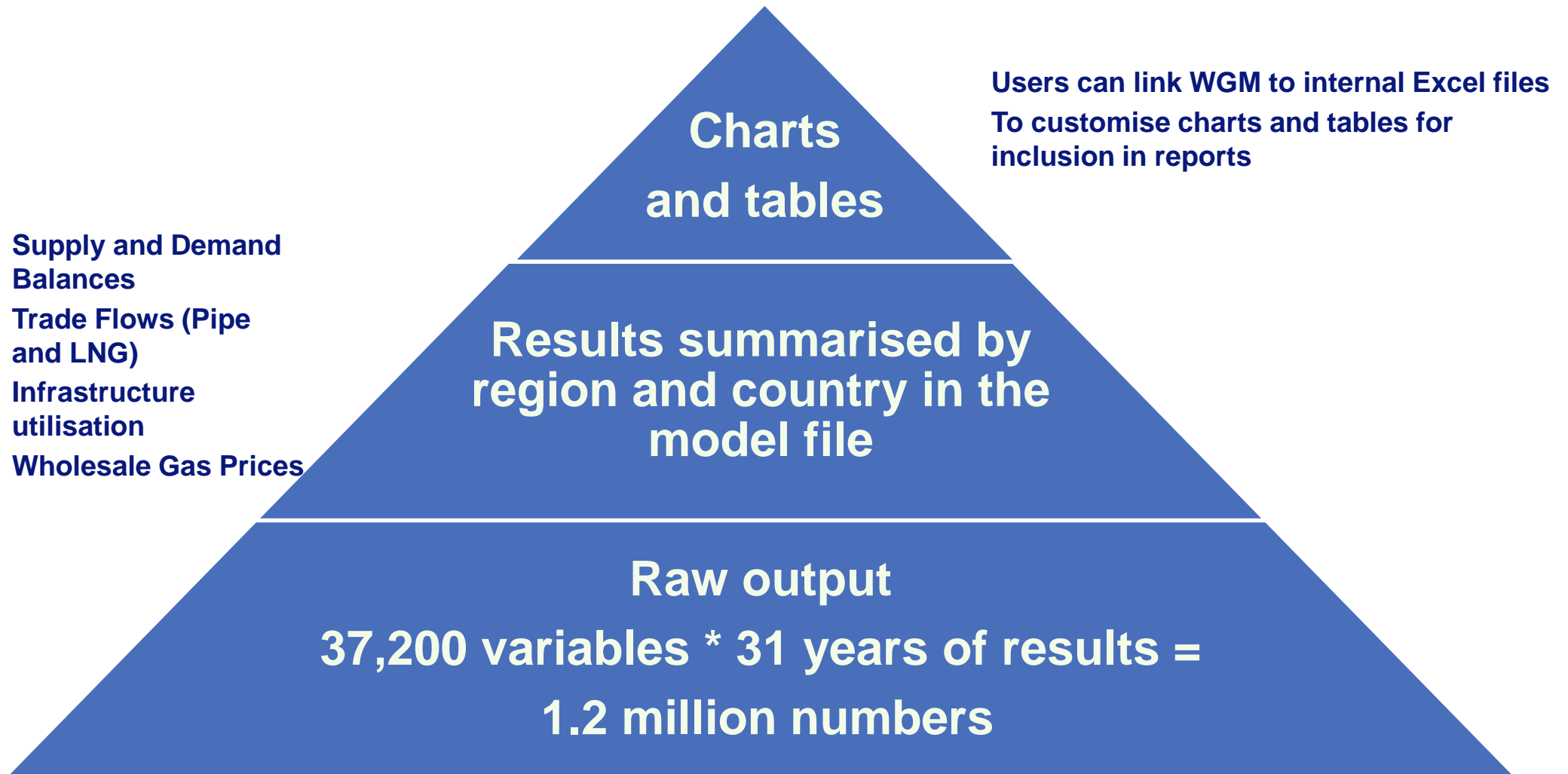
Key Assumptions – Infrastructure

WGM Database

- DB includes all existing, planned and proposed projects
- Pipelines, LNG plants and storage
- Capacities and LRMCs

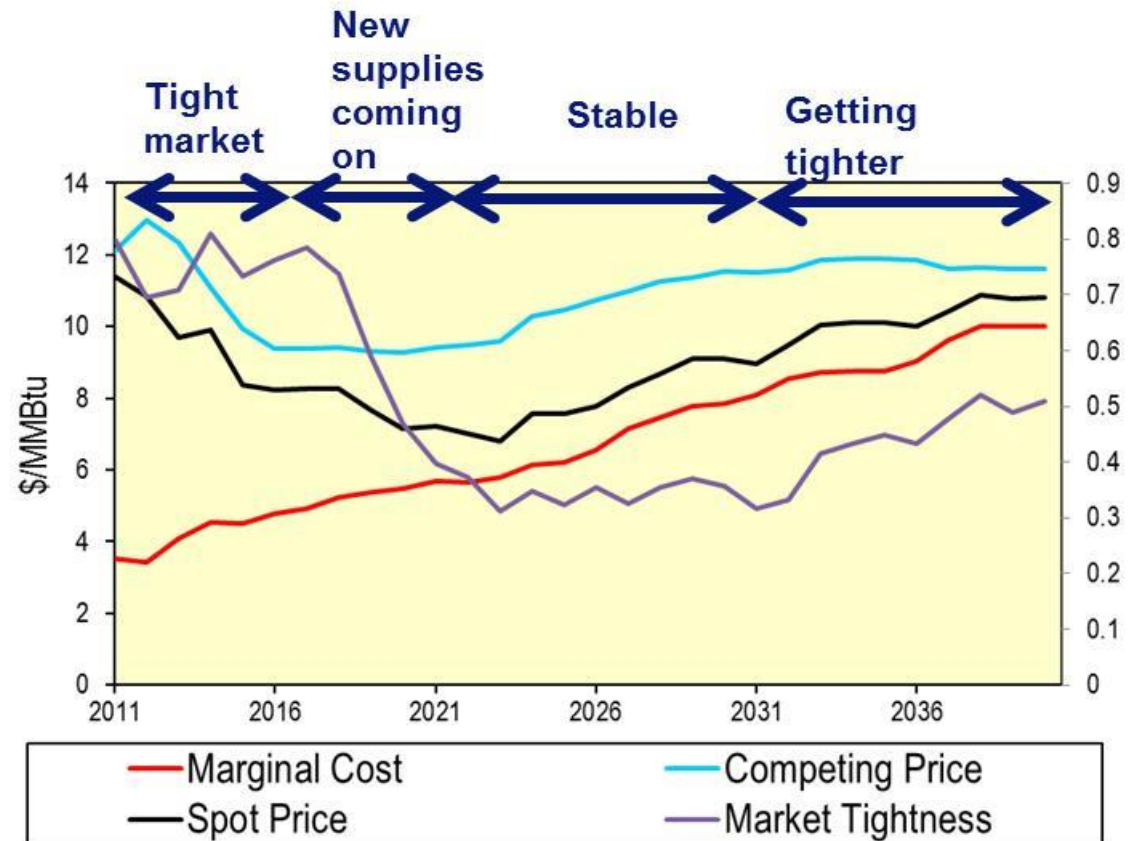
Investment Decisions

- User decides start dates of projects which can vary from scenario to scenario
- Model does not “build” capacity



Methodology for Forecasting Spot Prices

- Spot prices, either at hubs or for spot LNG cargoes, are considered to be a function of three factors:
 - The marginal cost of supply;
 - Prices of competing fuels; and
 - The tightness of the market which includes local production capacity as well as the availability of pipeline and LNG supply.
- The level of market tightness for the particular market determines whether the forecast spot price is closer to the marginal cost of supply or to the competing price.



The tighter is the market then the closer the spot price is to the competing price. In a less tight market the spot price might be expected to be closer to the marginal cost of supply.

The three components are explained in more detail on the following slides.



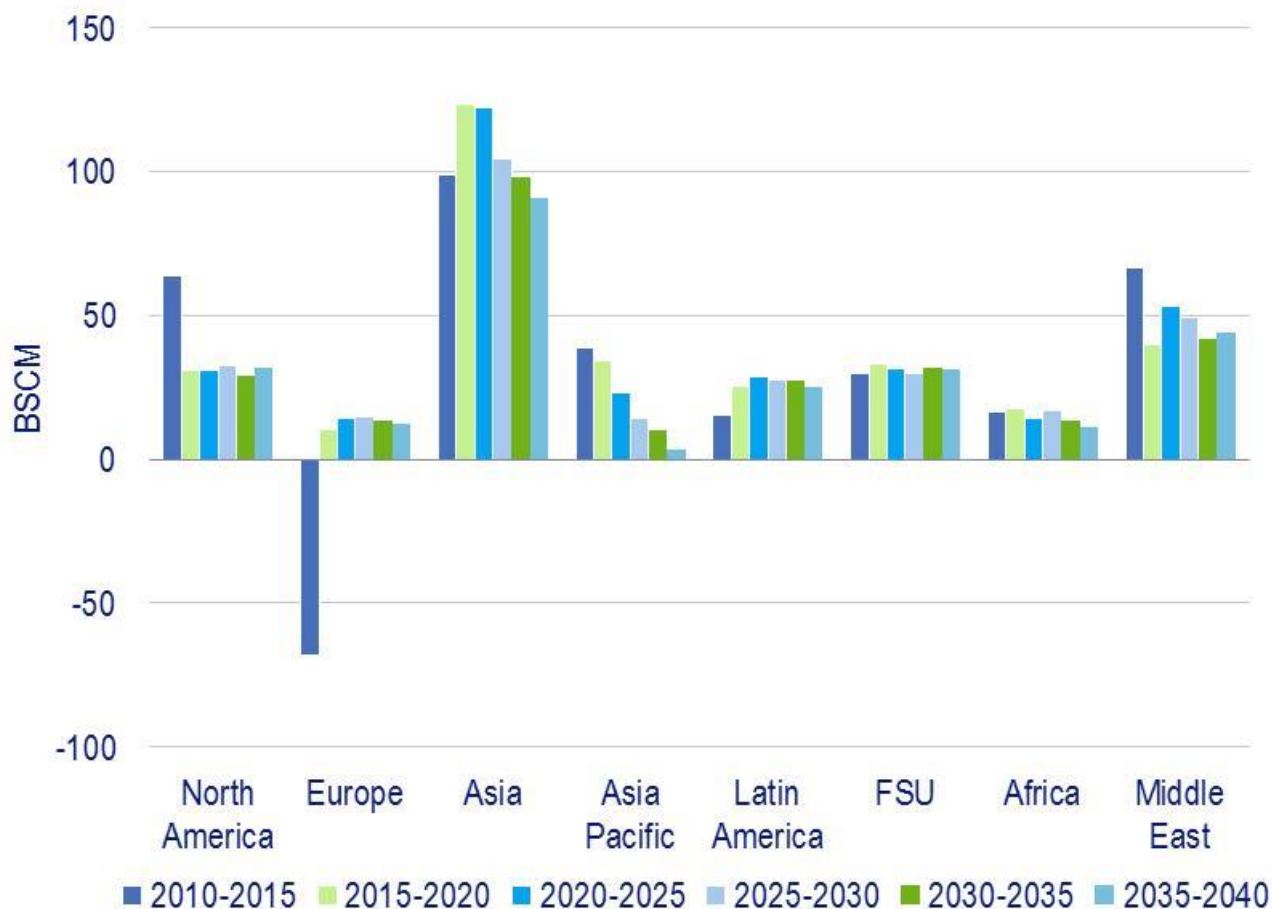
World Gas Model

Case Studies

- 1. North American LNG Exports – Impact on World Markets**
- 2. EU Embargo on Russian Gas Exports**

- **Prospects for Demand**
- **Prospects for Supply**
- **North American LNG exports**
- **How tight will the market be?**
- **Impact on prices**

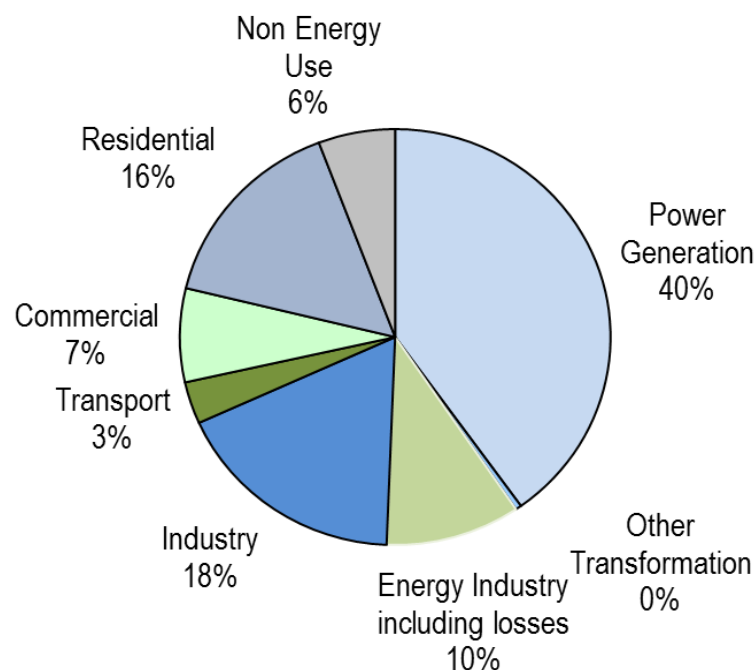
Consumption Growth



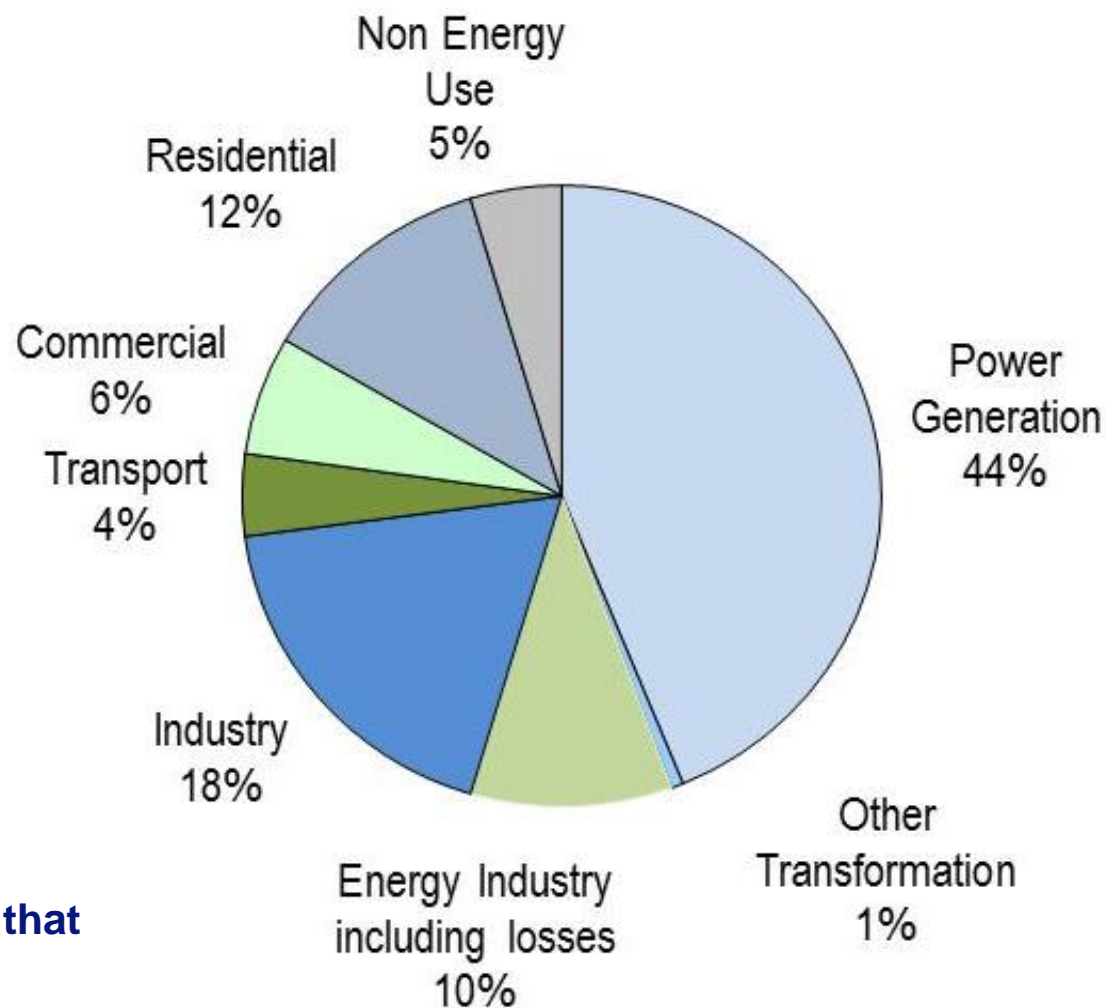
- **Asia drives growth – China in particular**
- **Only Europe shows weak demand**
- **Total consumption increases from 3.3 tscm (93 tscf) in 2010 to 5.1 tscm (143 tscf) in 2040**
- **Nexant base case demand forecast is slightly lower than IEA New Policies and EIA Base Case (about 3 percent in 2040)**

World Consumption Growth Sectors

2010 3.3 tscm



2040 5.1 tscm

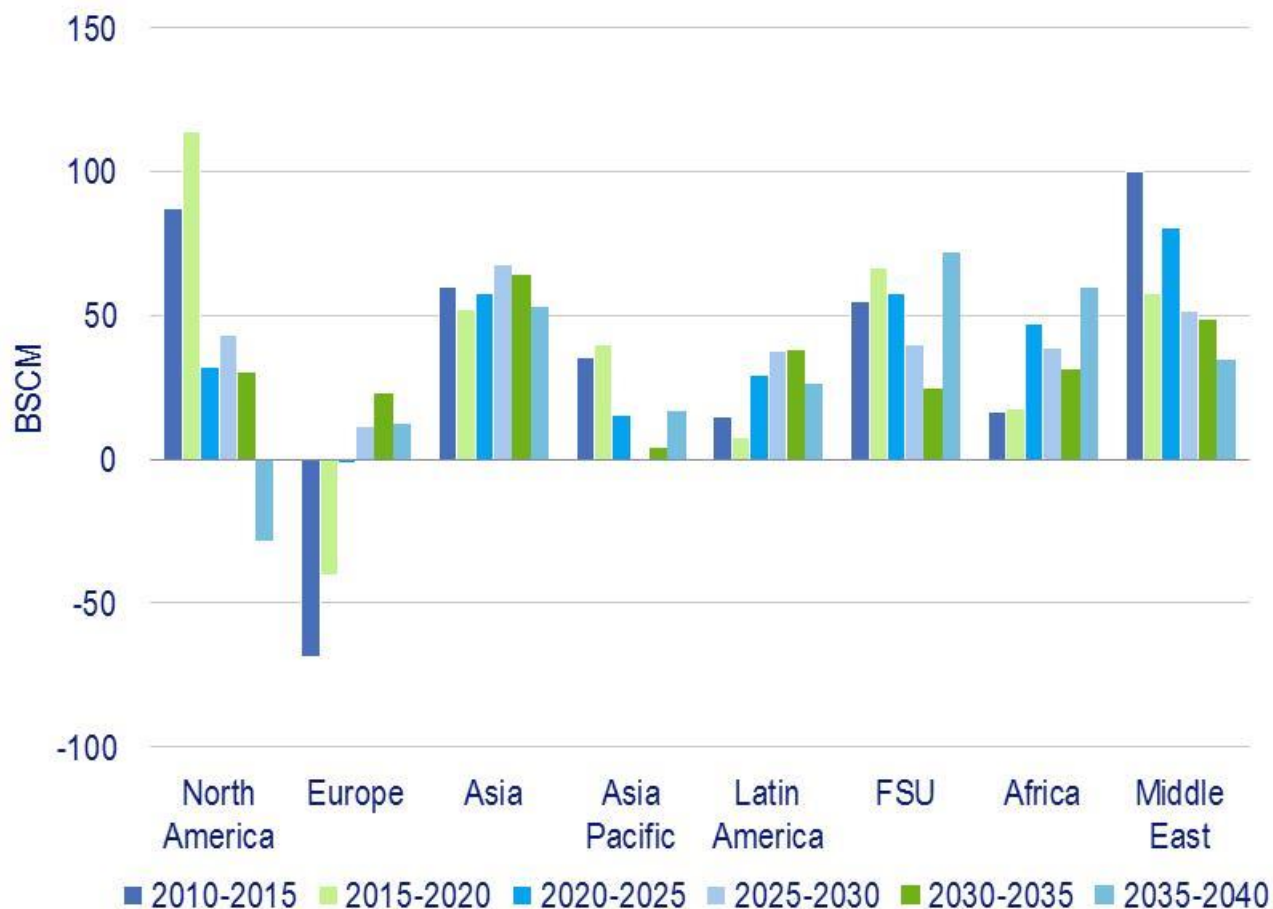


Power generation is the largest and fastest growing sector

Final Energy sectors grow but less quickly than power

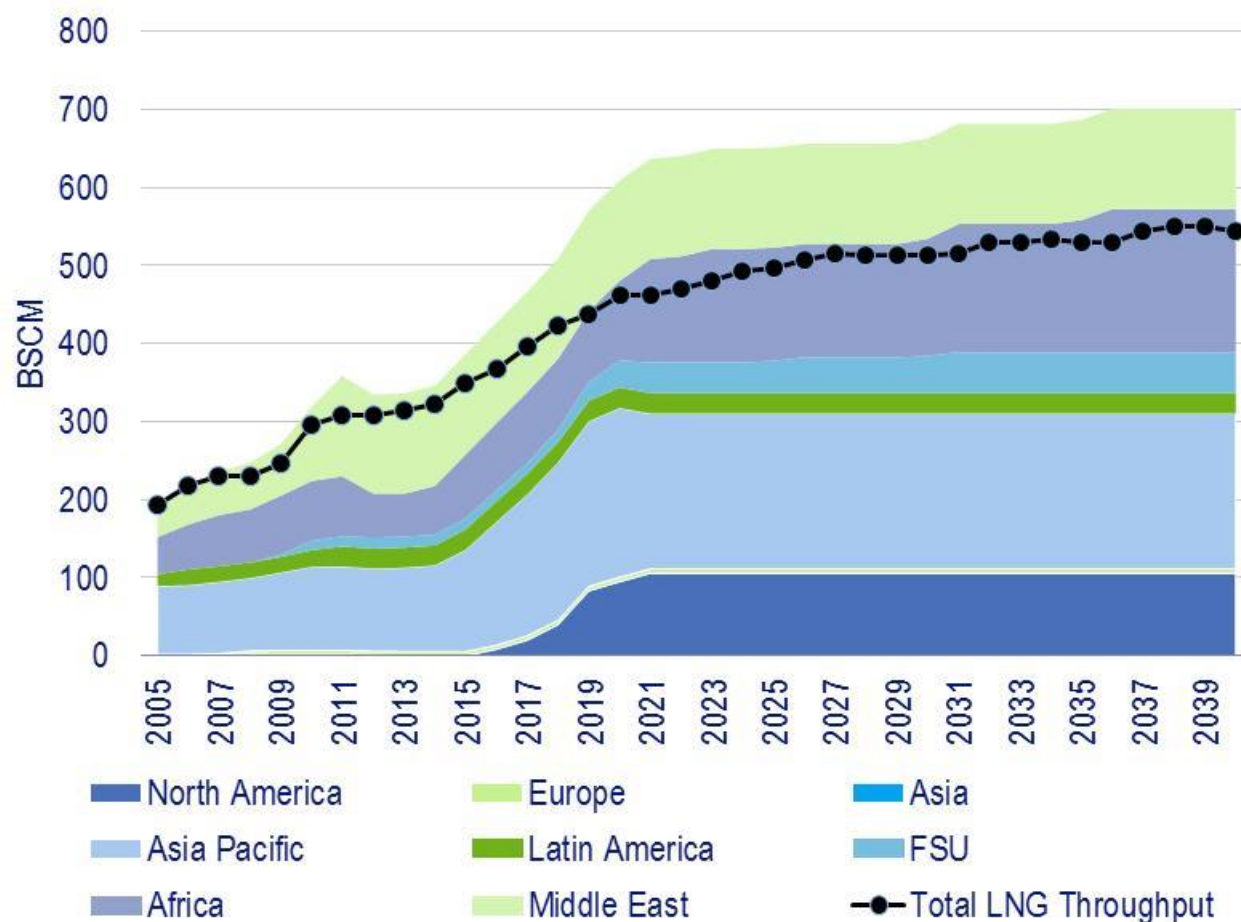
Non Energy use is gas as a chemical feedstock

Production Growth



- **Strong growth in NA, especially to 2020 driven by Marcellus shale**
- **Russia and Turkmenistan also continue growth**
- **Middle East growth in Qatar, Saudi Arabia and Iran**
- **Europe decline slowed and later reverses by shale in UK and Poland**

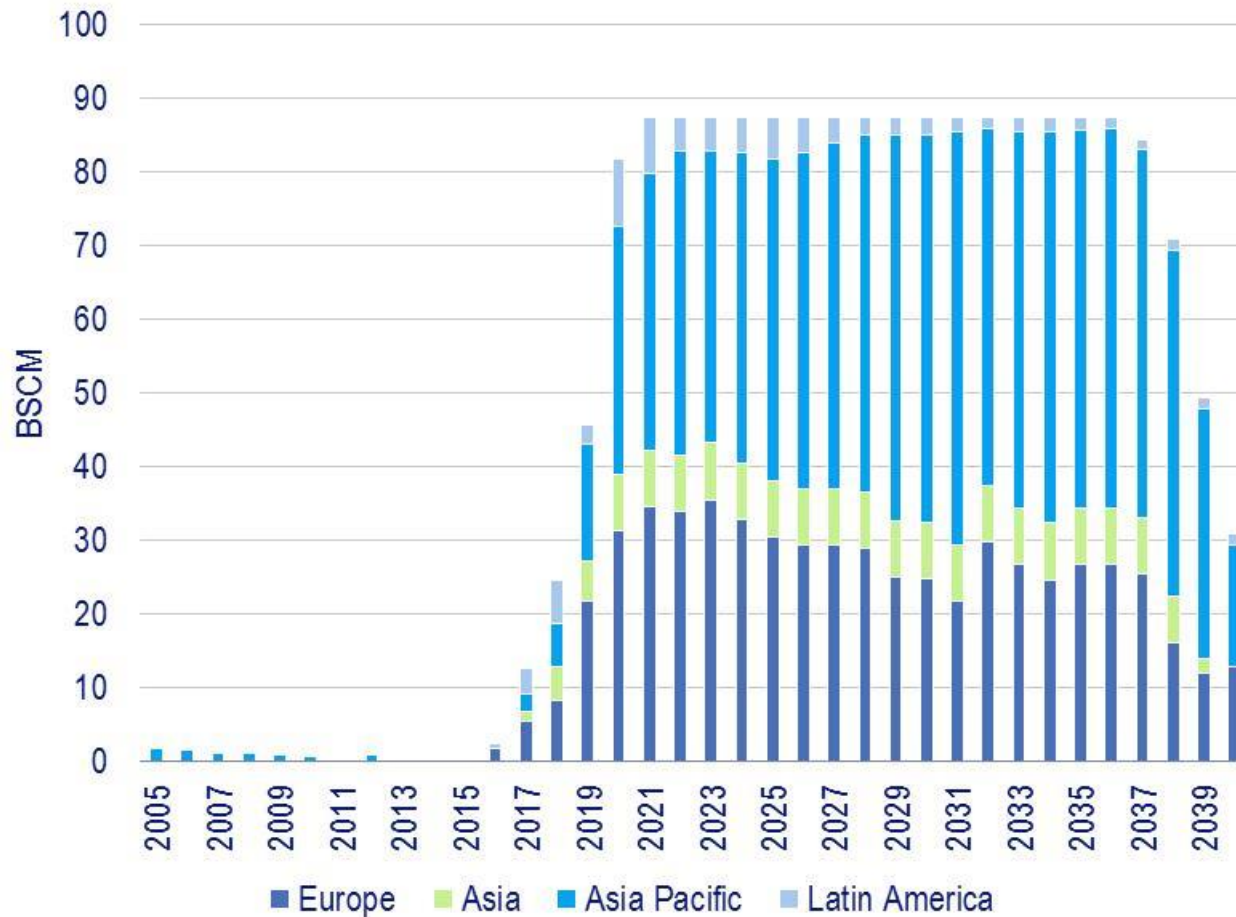
Liquefaction Capacity



- **Tight liquefaction capacity through to 2015**
- **2015 new capacity is mainly Asia Pacific – Australia and PNG**
- **Joined in 2016 by North America**
- **Russia (Yamal and Vladivostok) 2018 onwards**
- **Africa (including Mozambique and Tanzania) post 2020**
- **Utilisation drops to 73 percent in 2021 and recovers back to 78 percent longer term**

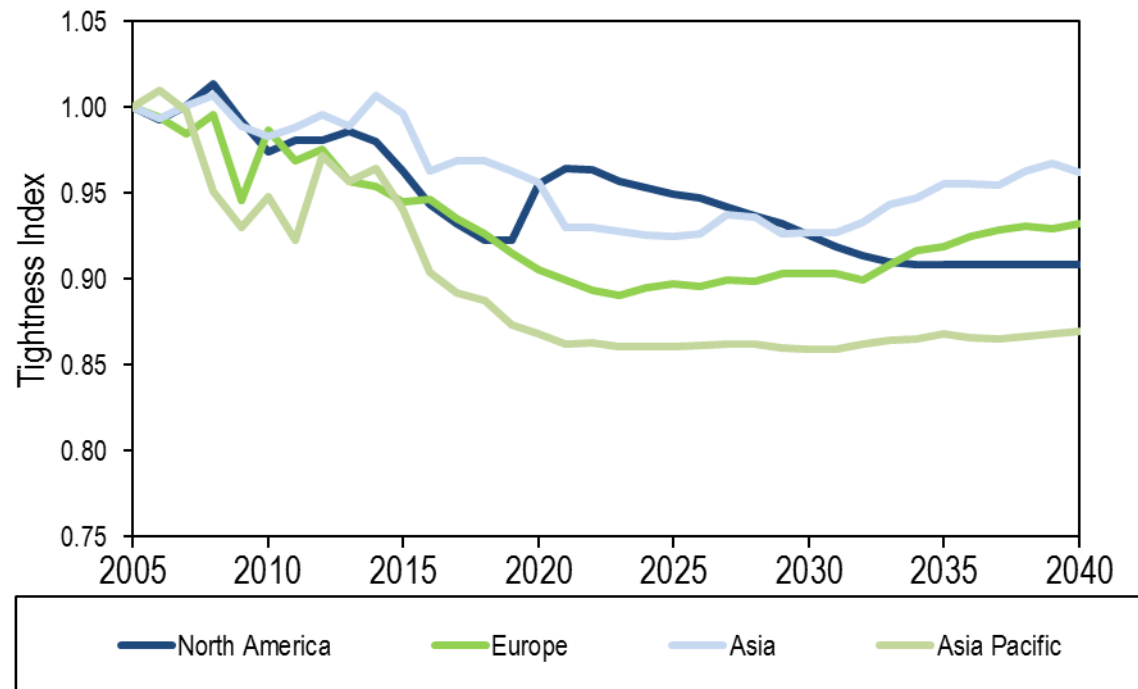
NB Based on announced projects only

North American LNG Exports



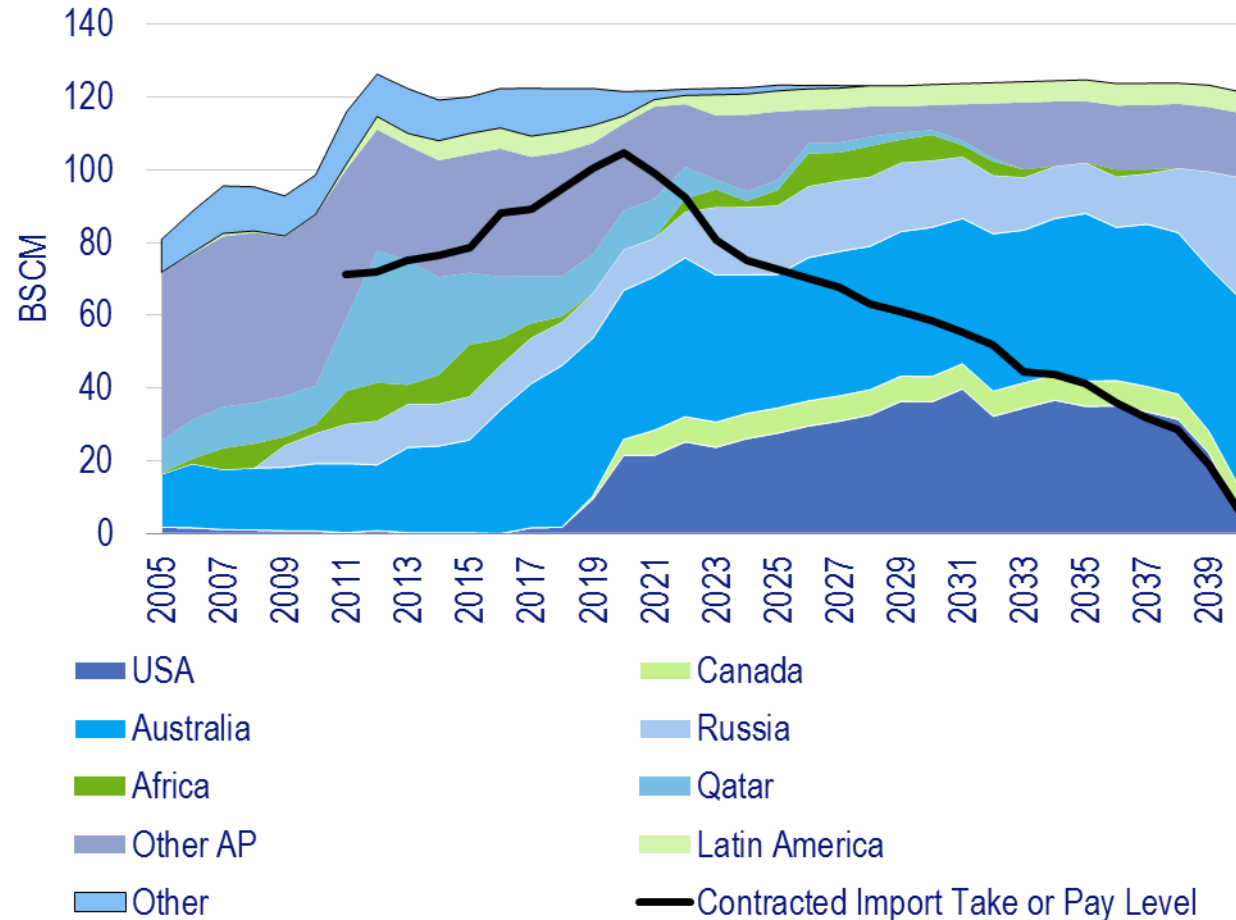
- **5 US terminals with non-FTA approval**
- **2 Canadian terminals**
- **Japan and Korea take bulk of exports**
- **Europe is the residual sink for cargoes (displacing pipeline imports)**
- **China and India markets remain dominated by Qatar and Australia so relatively little US exports go to these markets**
- **Decline in US exports post 2035 may not happen if contracts are extended**

Market Tightness



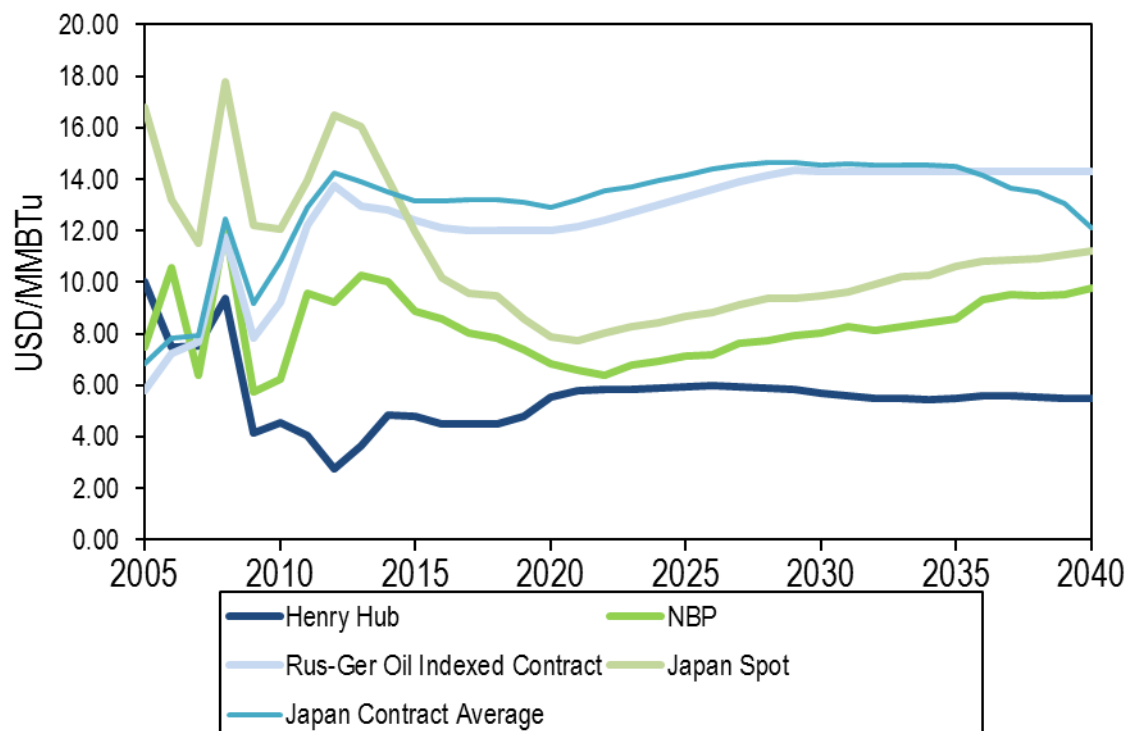
- **Compares supply capacity to actual supply by region**
- **Index where 2005 = 1**
- **2015 onwards tightness eases**
- **North America tightens in 2020 as LNG exports rise sharply**
- **Decline in tightness can be expected to put downward pressure on prices**

Japan LNG Imports



- Japan consumption expected to be flat around 120 -125 bscm
- Similar to IEA “New Policies” Scenario
- Contracted LNG is rising to 2020 – US and Australia in particular.
- Squeezing the spot requirements through 2020
- Post 2020 contracts start to expire and WGM Base Case does not assume renewals.

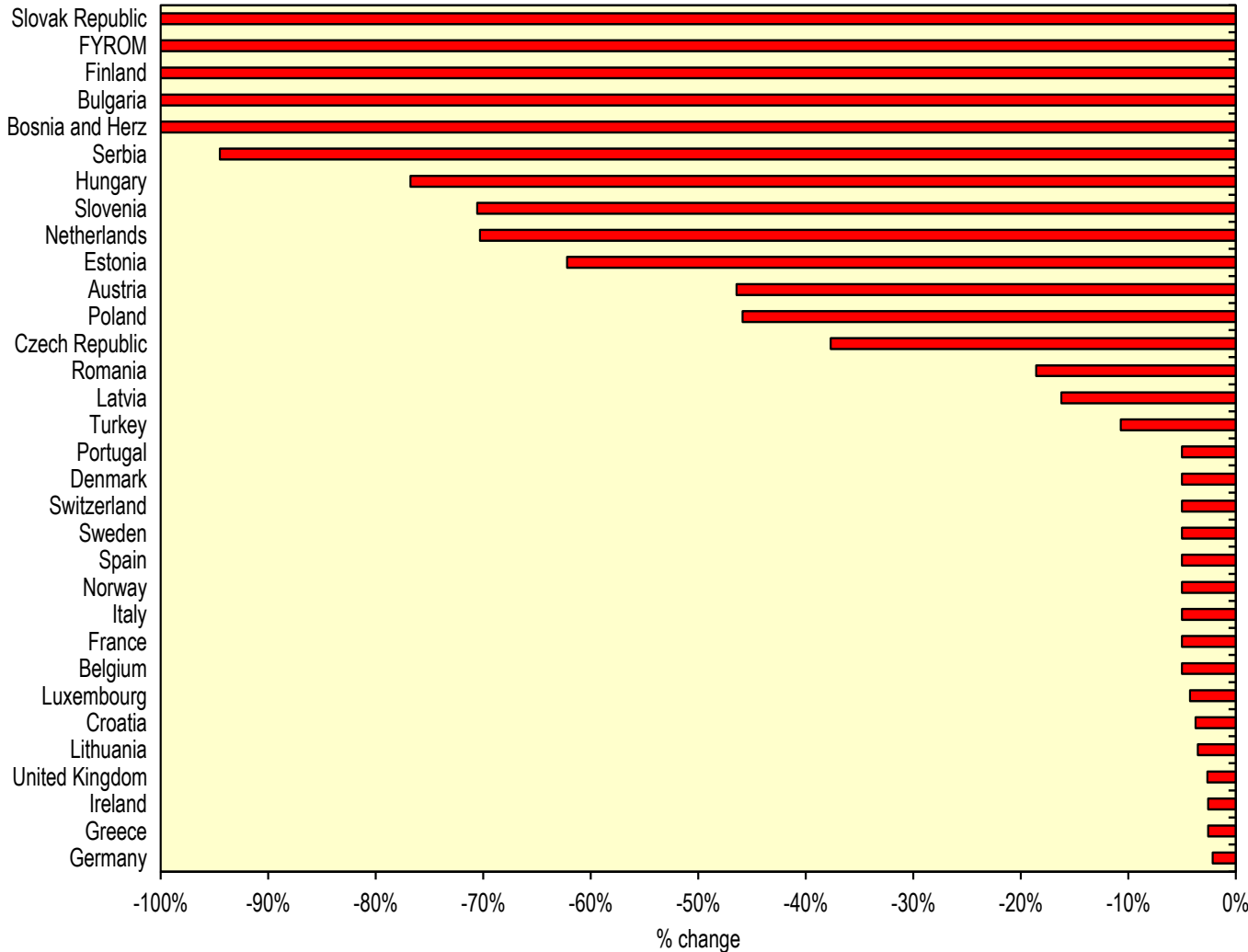
World Wholesale Prices



- **Contract prices will largely reflect oil price developments**
- **Brent down to \$100 by 2016 to 2020 before rising steadily - \$120 by 2028**
- **Outside North America spot prices weaken post 2015, especially Japan**
- **Henry Hub steady around \$4 until surge in demand 2020 on, pushing up to \$5 to \$6**
- **Narrowing differentials may not be sustainable – especially NBP to HH**

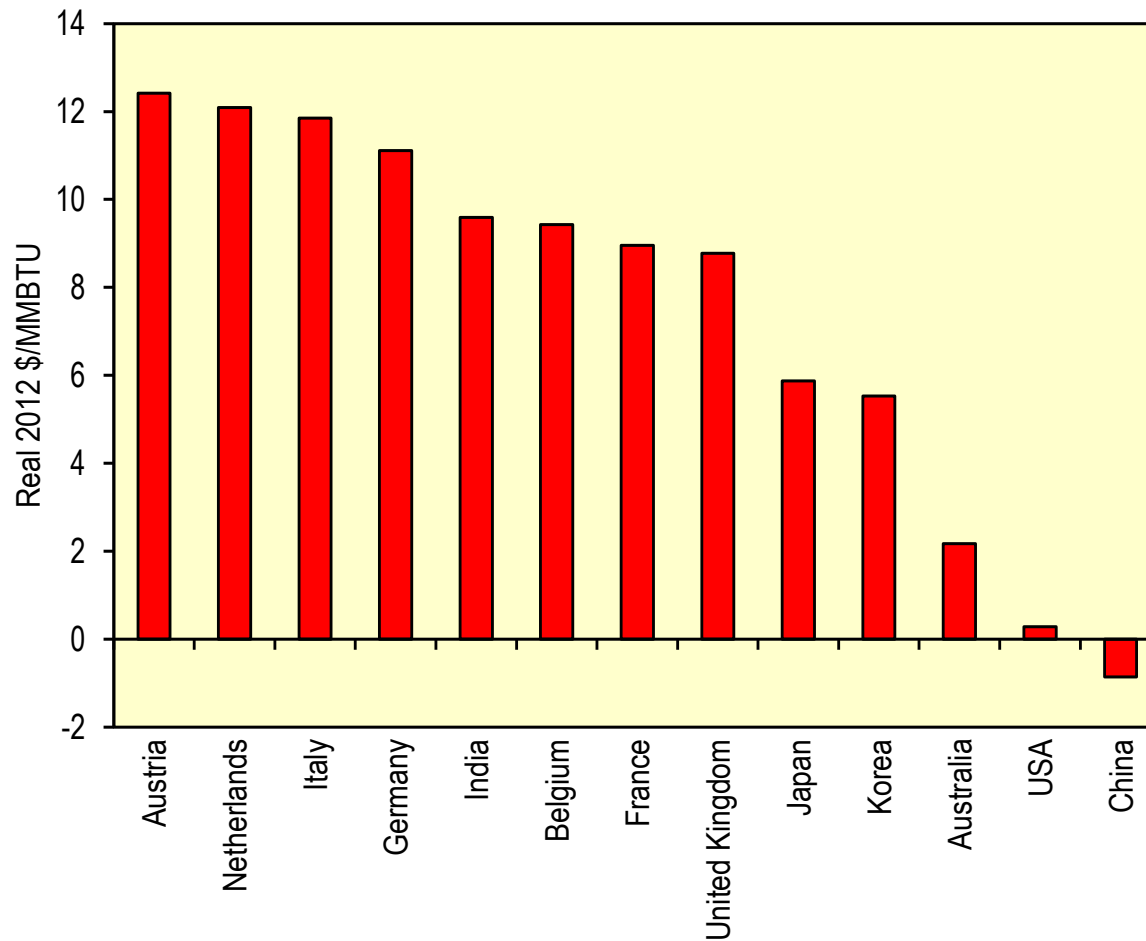
- **Assumed that all routes from Russia to Europe, apart from Blue Stream pipeline, are closed**
- **Sensitivity shows the first order effects i.e. no change is assumed to oil or coal prices, no new infrastructure built. In reality it might be expected there would be other responses which would be easy enough to model**
- **Impacts are shown for a full year – 2015 – for:**
 - Europe demand
 - Spot prices
 - LNG imports

Change in European Demand



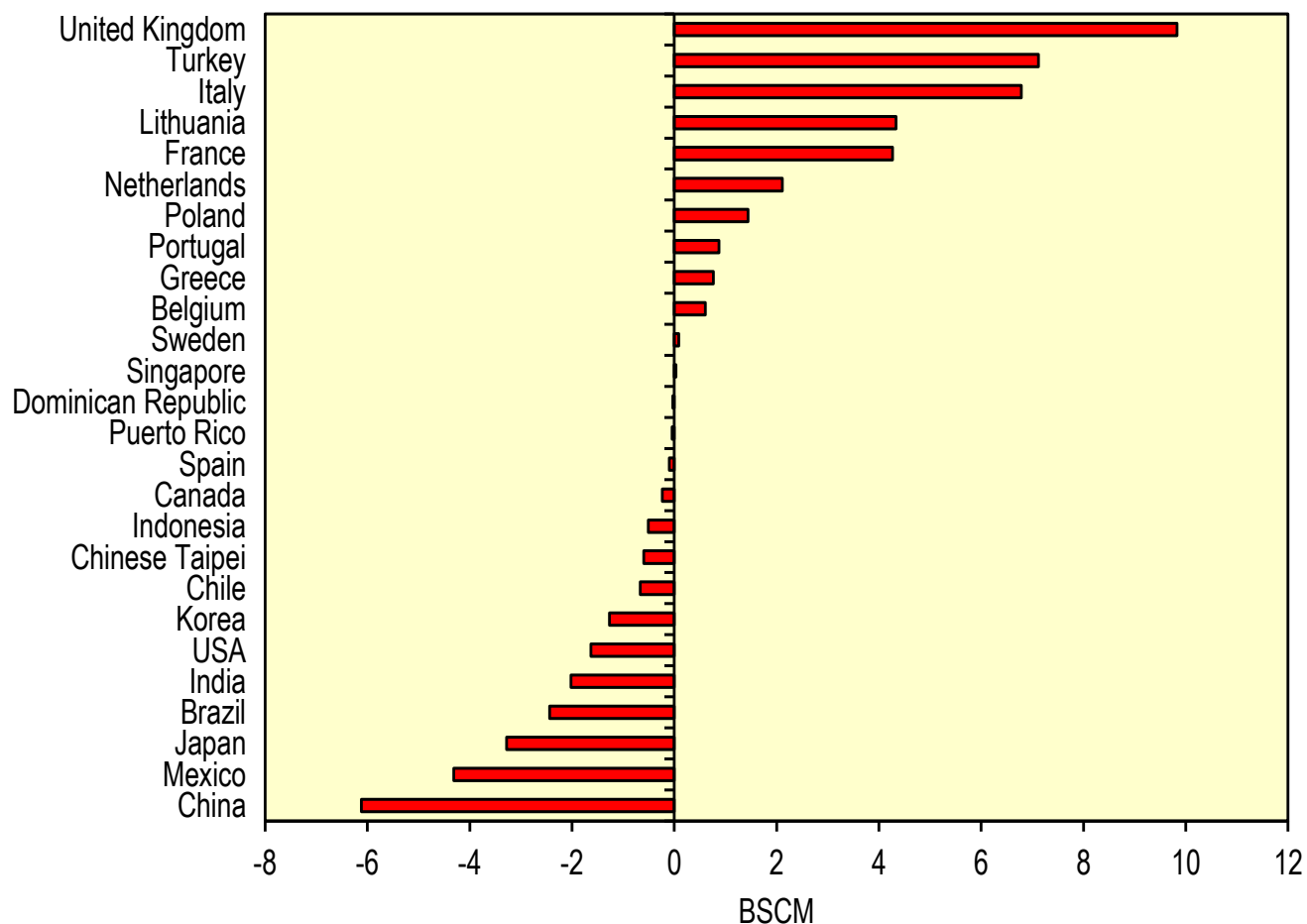
- **Total Europe consumption down by 100 bscm – 18% - in 2015**
- **Central and south east Europe worst affected, plus Finland**
- **LNG imports means Lithuania, Latvia less affected**
- **Netherlands reduction an anomaly, because of its interconnections, it continues to export**
- **Germany relatively unscathed**

Change in Spot Prices



- **European spot prices rise sharply as supply falls – Germany and NBP in \$18 to \$20 range**
- **Rising to competing fuels prices but driven by more costly supply**
- **Japan and Korea prices rise as LNG market gets tighter – around \$18 level**
- **China prices fall – reflects more available FSU supply as that can't go anywhere else and there is additional pipeline capacity in 2015**

Change in LNG Imports



- Imports into Europe increase – new terminals onstream in Lithuania and Poland
- UK used as landbridge to re-export
- Largest reduction in China as they have alternative sources of supply – pipeline gas from Kazakhstan, Turkmenistan and Myanmar

Thanks for Listening



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