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Gas & LNG in the UK (& Europe)



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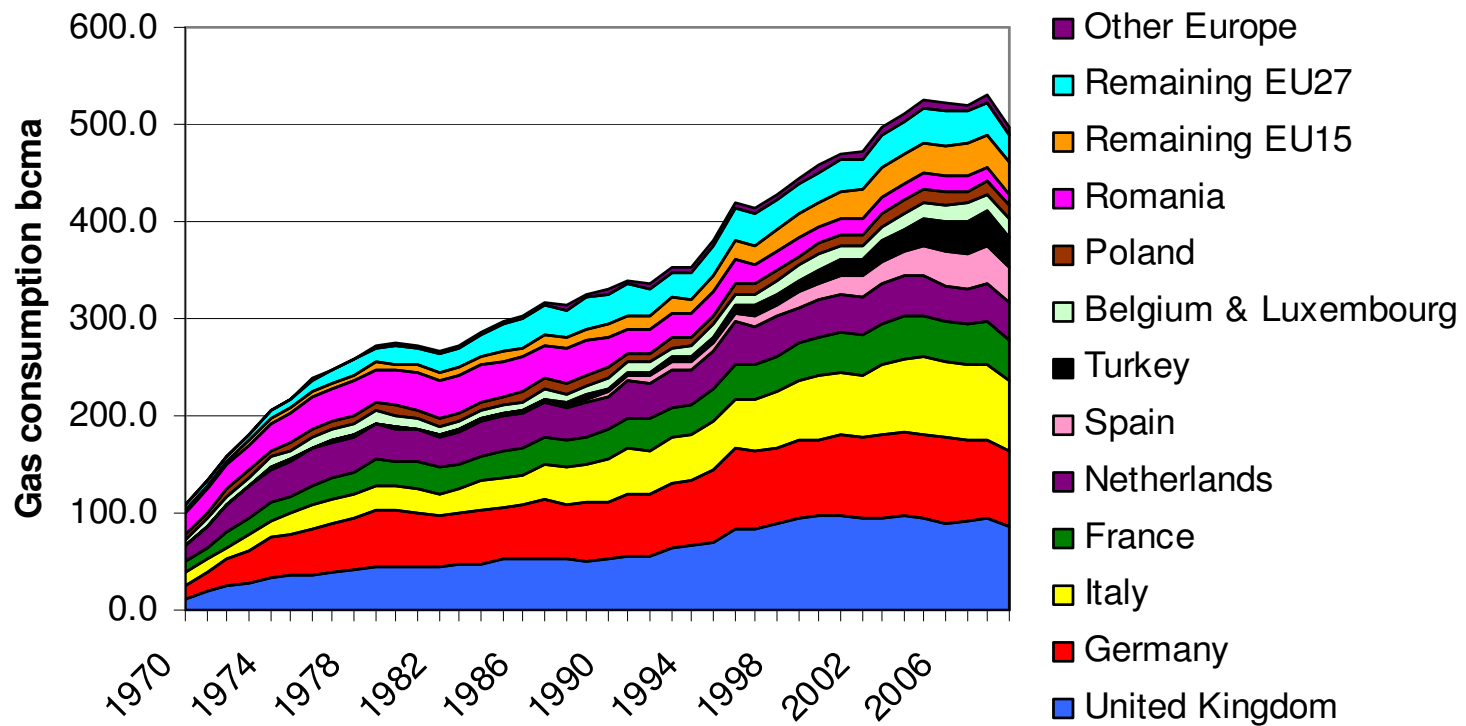
Gas Demand



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Gas demand in Europe

Historically gas demand in Europe has been increasing



Source BP Statistical Review of World Energy

Will gas demand continue to increase?

EU Environmental policies

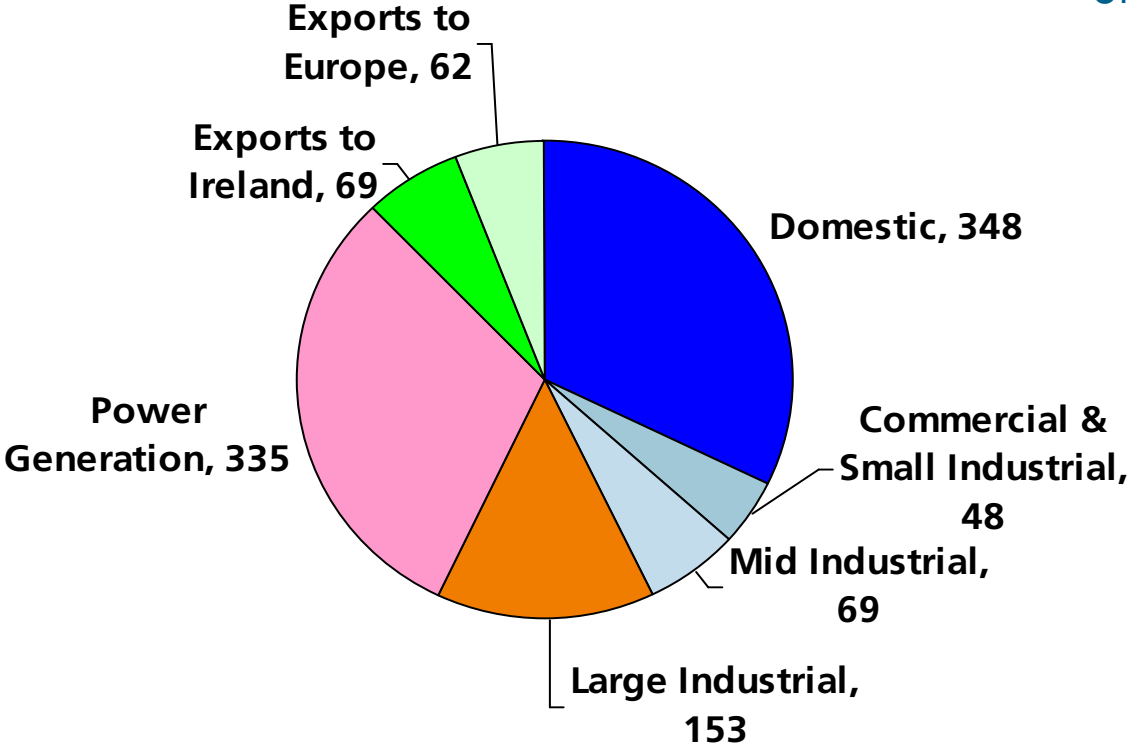
1. Integrated energy/climate control proposal
 - 20% of European energy (including electricity, heat & transport) to come from renewable sources by 2020

2. EU 20/20/20 vision for 2020
 - 20% reduction in green house emissionsby
 - 20% renewable energy (15% for UK) +
 - 20% improvement in energy efficiencyLeading to a 80% reduction of green house gases by 2050 (from 1990 levels)

Price

Gas demand in the UK - 2010

Units TWh



Source National Grid 10 Year Statement

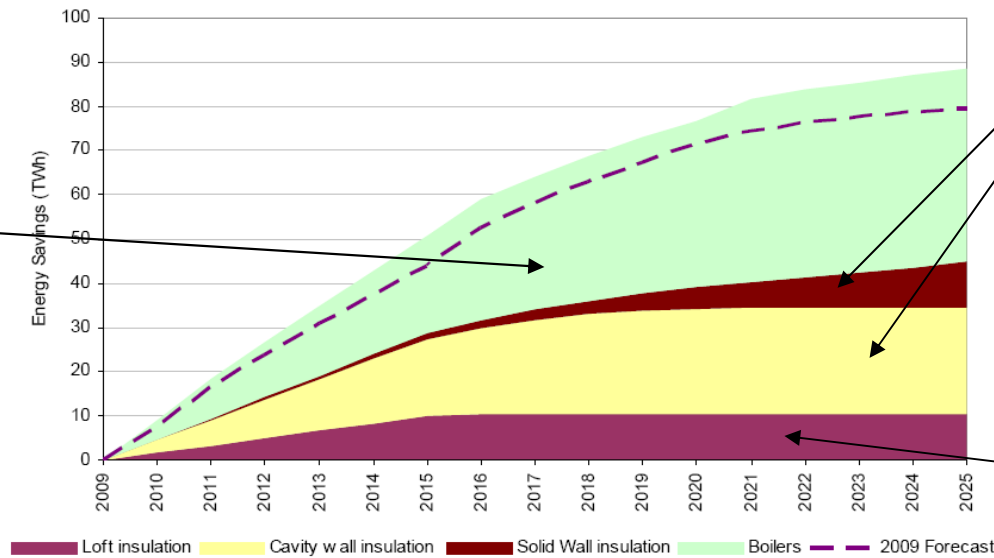
Domestic demand

UK demand - static or falling

- Price – consumers using less
- Energy efficiency – less demand



High efficiency boilers



Cavity wall insulation



Loft insulation

Power generation – UK 2009

Gas largest power producer
Significant coal based power plant
Small renewables generation

Need to increase renewables and move away from fossil fuels

Nuclear
21.7%



Coal
34%



Gas
40%



Renewables
2.3%



Option 1: Slow Progress (SP) ^{NOW}



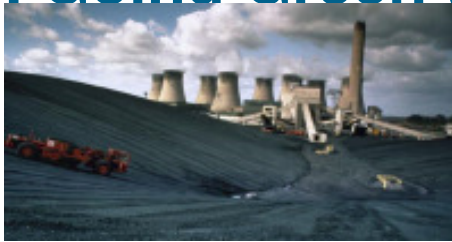
Transition



2020 Scenario 1 – Slow progress



Option 2: Going Green (GG) ^{NOW}

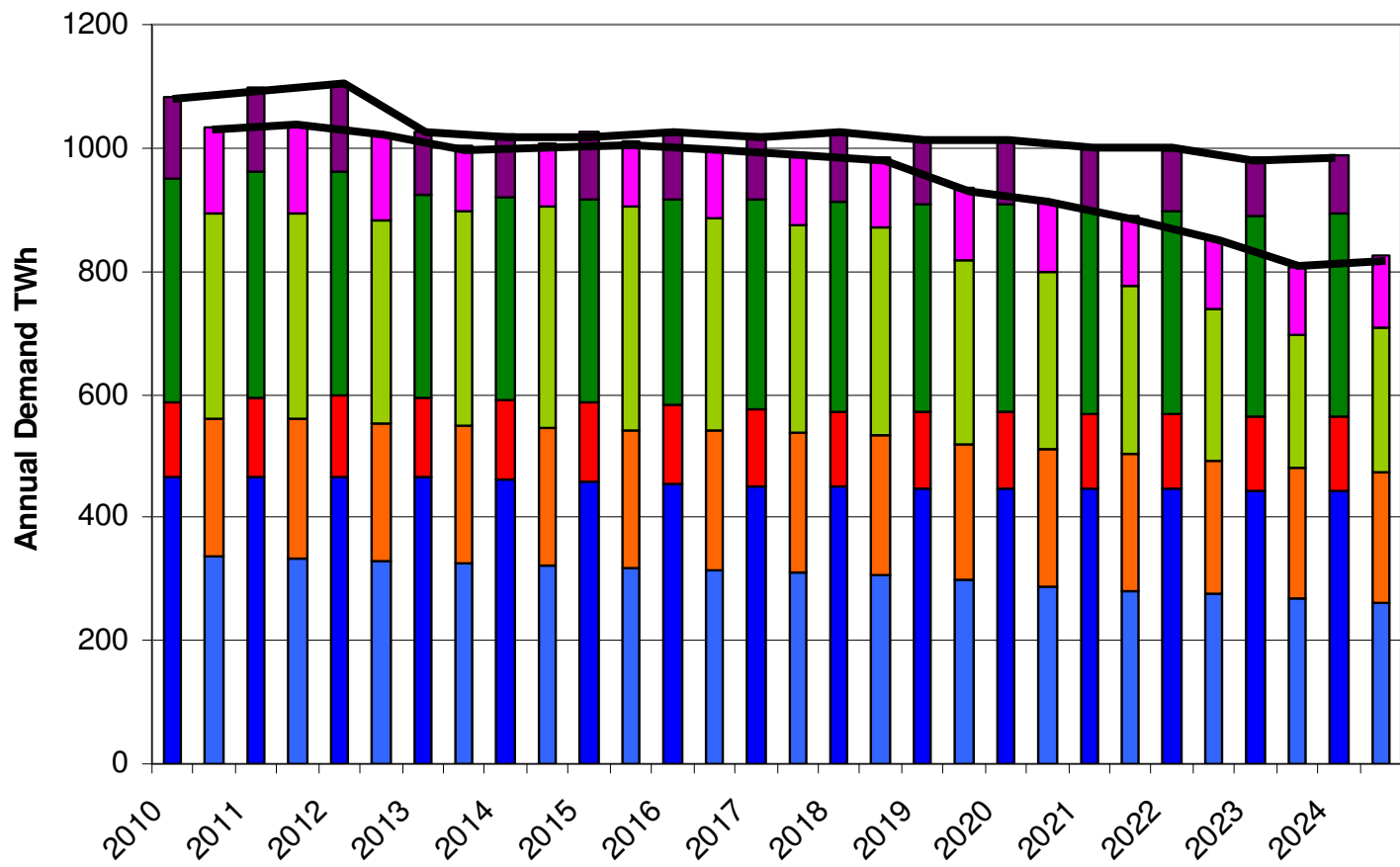


Transition



2020 Scenario 2 → Gone Green





■ Domestic/Commercial - Slow progression/Gone Green
 ■ Power/Industrial - Slow progression/Gone Green
■ Domestic/Commercial - Slow progression/Gone Green
 ■ Export - Slow progression/Gone Green

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Gas Supply

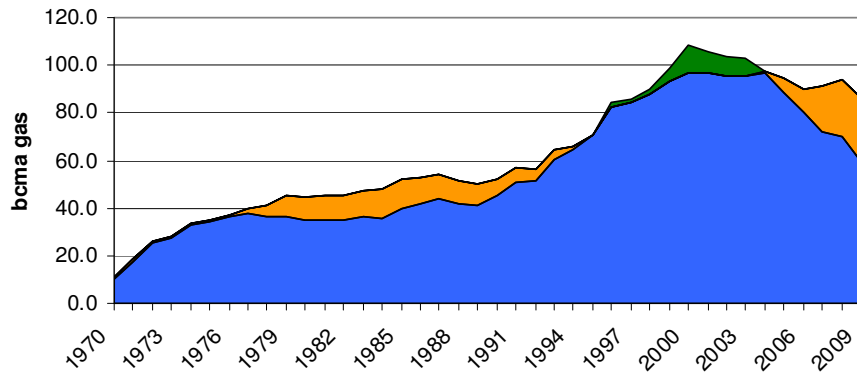


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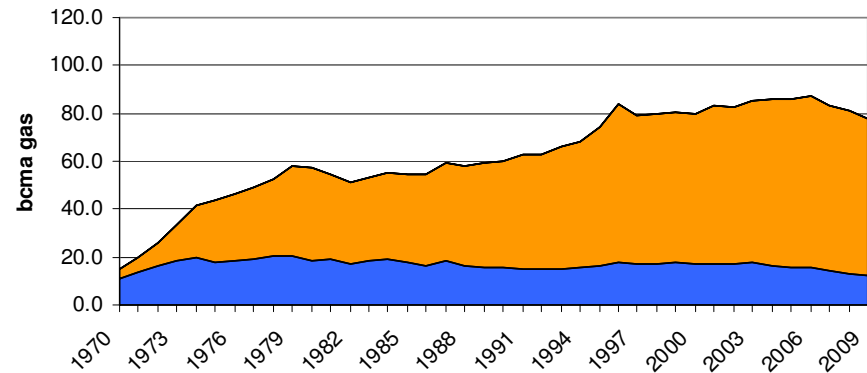
Gas Supply

Indigenous gas production declining

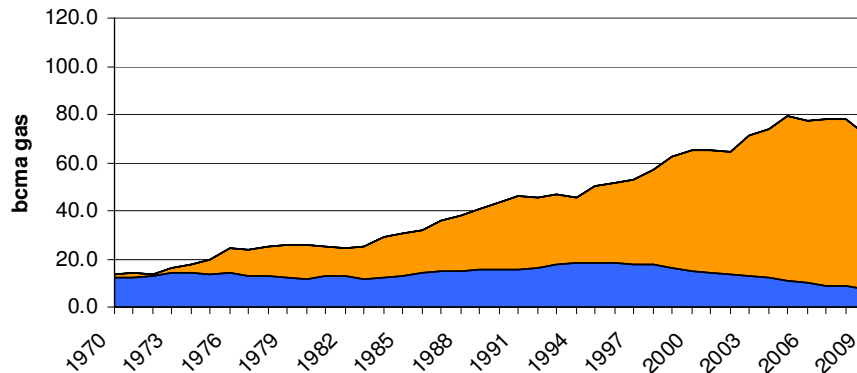
United Kingdom



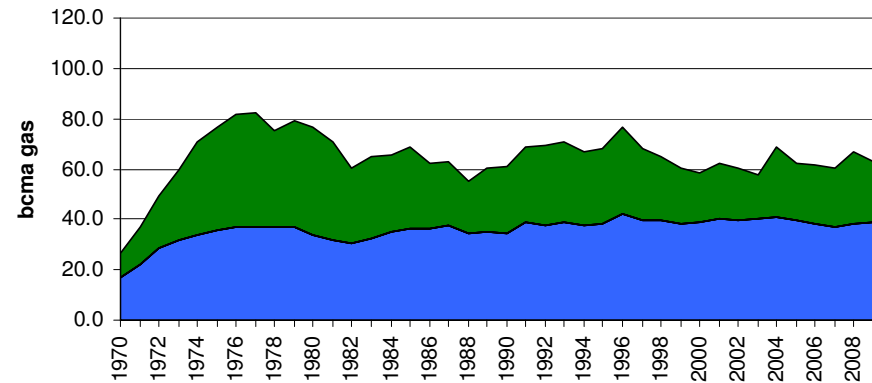
Germany



Italy

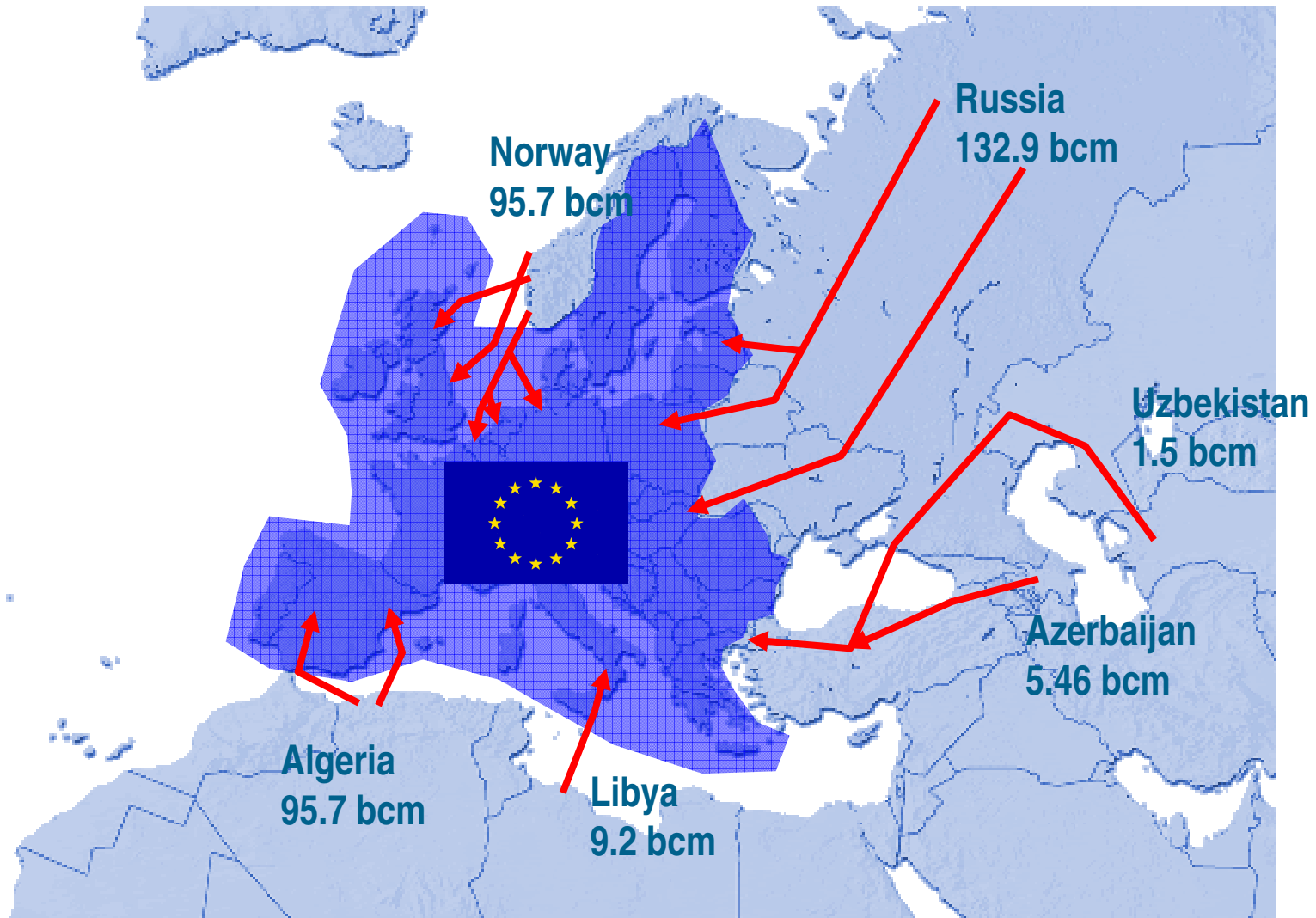


Netherlands



Source BP Statistical Review of World Energy

Pipeline deliveries to the EU



Source BP Statistical Review of World Energy

Security of supply

Russia supplies 22% of EU27 gas supply

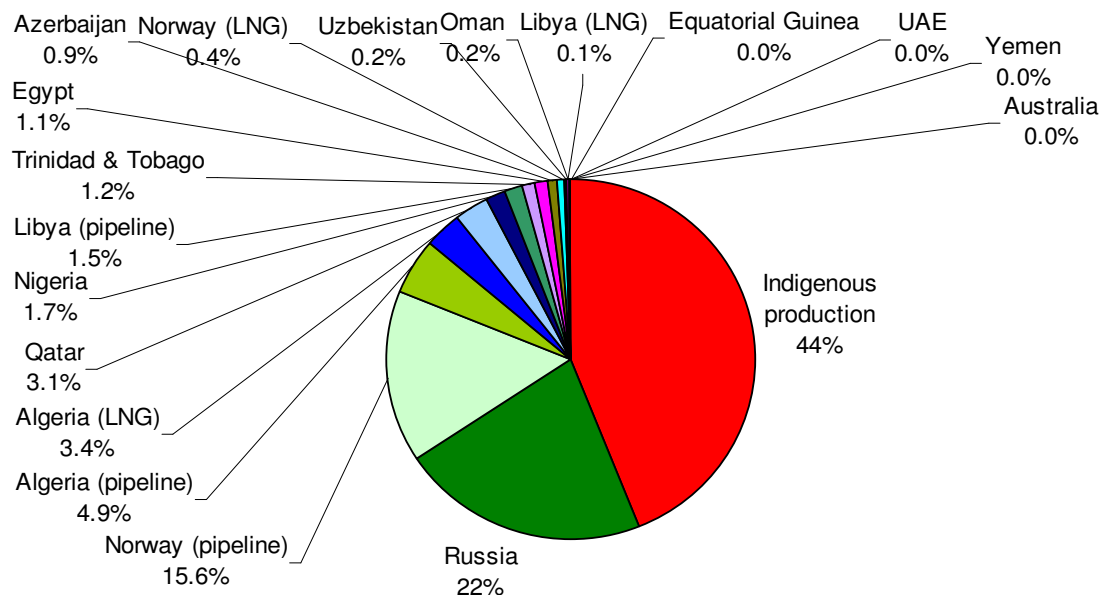
- (39% if indigenous production excluded)
- 3 countries supply 46% of EU gas (Russia, Norway & Algeria)
- (82% if indigenous production is excluded)

Russia has never missed a gas delivery to the EU27

- EU became embroiled with Russia's disputes with Ukraine & Belarus

Economist Intelligence Unit Risk Ratings

- EU15 11 (Sweden) to 40 (Greece)
- EU27 11 (Sweden) to 42 (Romania)
- Russia 54
- Norway 14
- Algeria 65



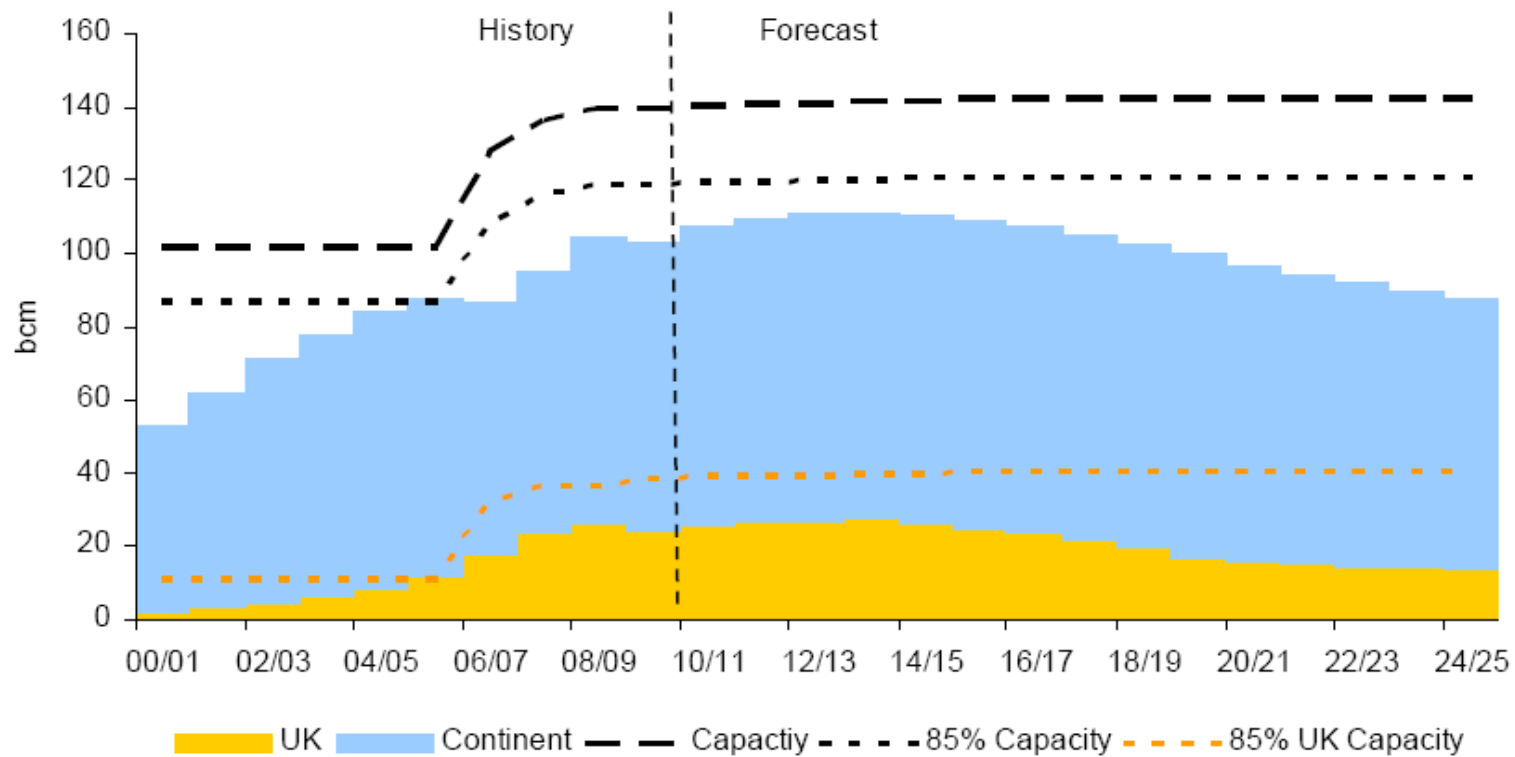
Source BP Statistical Review of World Energy

Norway – the great hope?

Norwegian production will plateau in 2015 then decline

Norwegian production has never met pipeline transport capacity

Source: NPD, National Grid



Pipeline options

Do new pipeline options improve security of supply?

More Russia (EIU 54)

More Algeria (EIU 65)

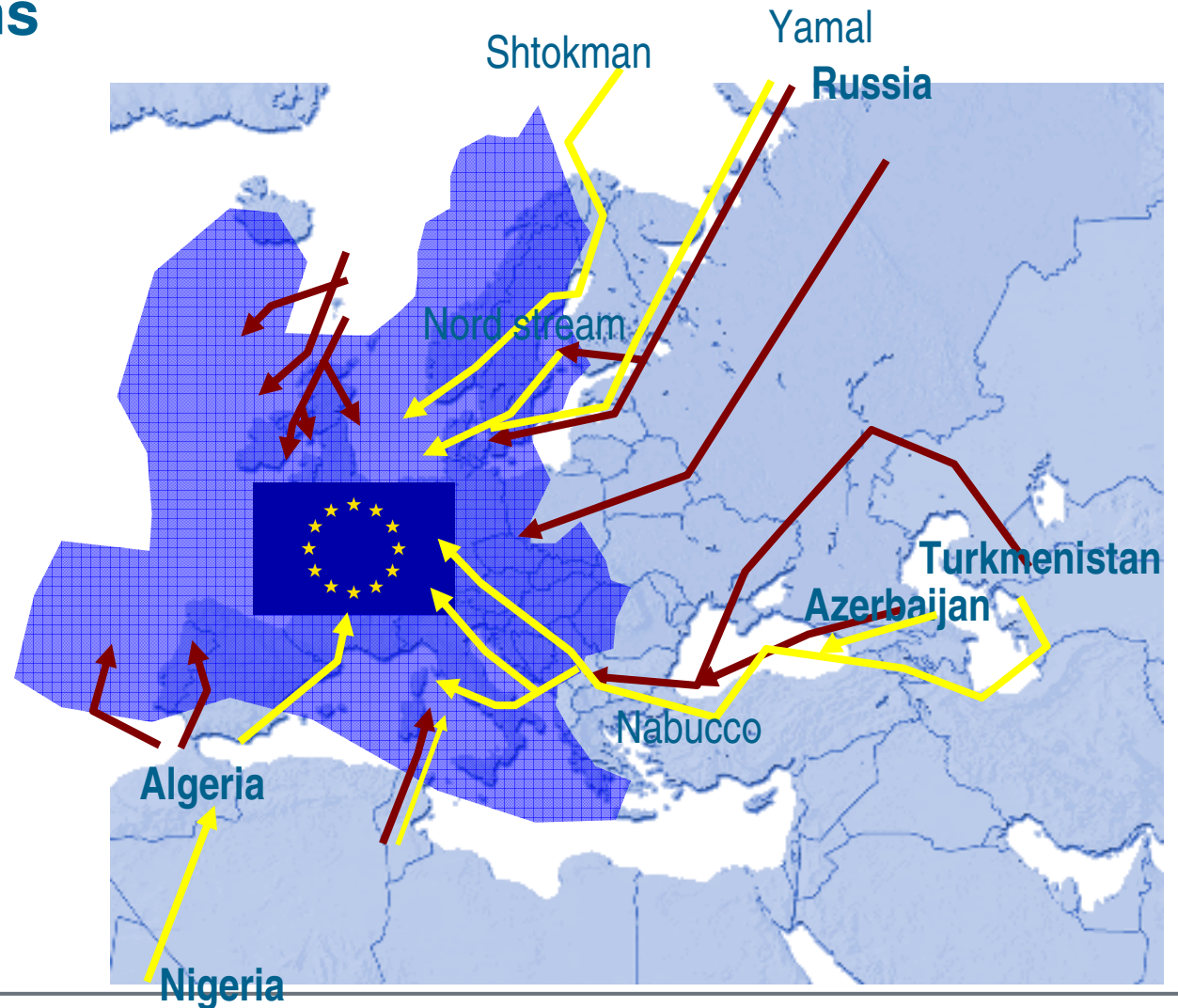
More Libya (EIU 54)

Nigeria (EIU 69)

Turkmenistan (EIU 77)

Azerbaijan (EIU 58)

Iran (EIU 65)



What about LNG?

18 countries currently produce LNG = 280 mtpa

- Trinidad, USA, Peru, Nigeria, Equatorial Guinea, Algeria, Libya, Egypt, Qatar, Oman, UAE, Yemen, Norway, Russia, Australia, Indonesia, Malaysia and Brunei

3 Countries building their first LNG plants = 40 mtpa

- Angola, Papua New Guinea & Iran

8 Countries have aspirations = 115 mtpa (200 mtpa)

- Venezuela, Mauritania, Cameroon, Mozambique, Tanzania, Canada, Georgia, Gabon

No security of supply issues!



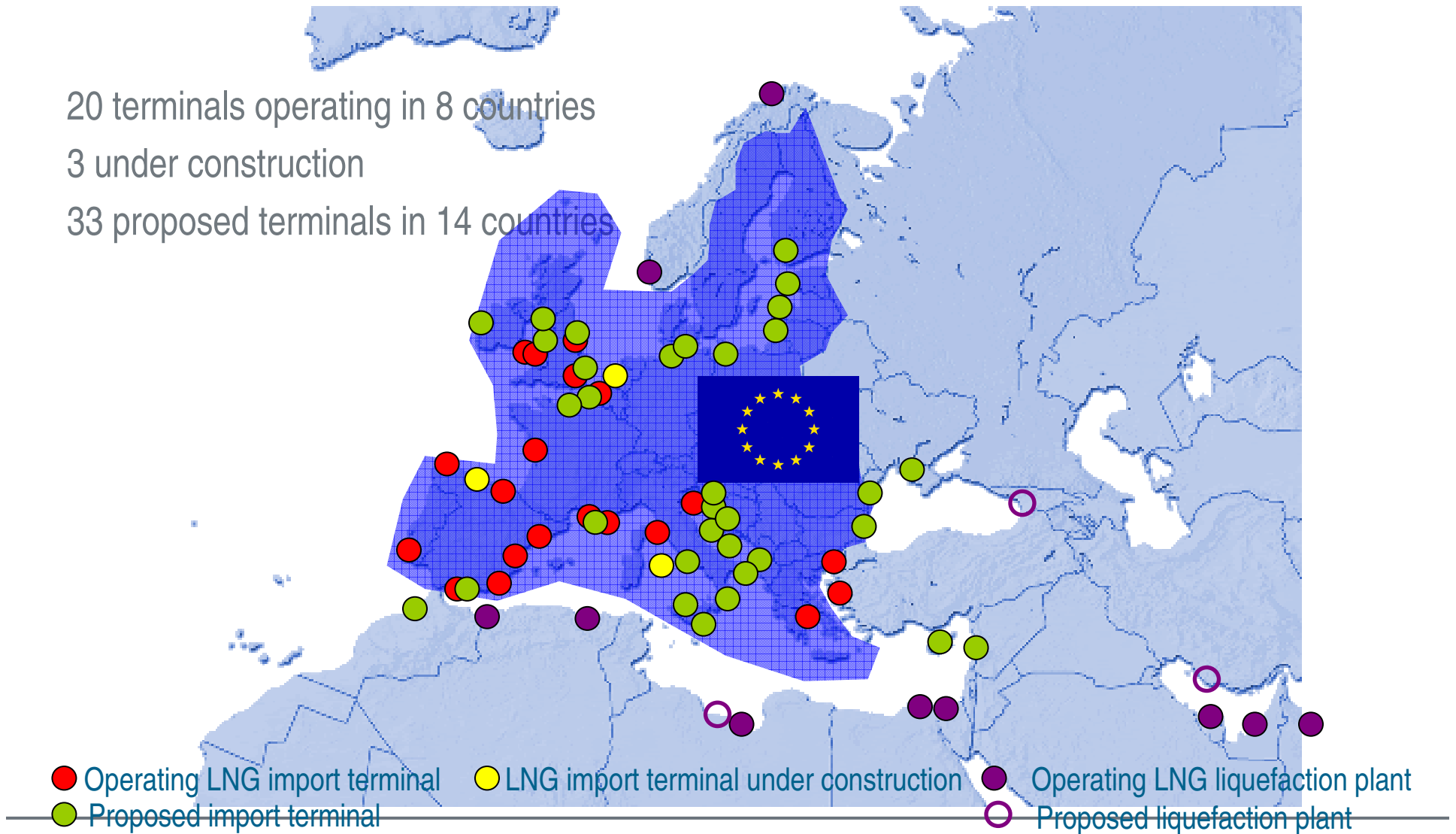
Source LNG Journal January 2011

LNG Import Infrastructure

20 terminals operating in 8 countries

3 under construction

33 proposed terminals in 14 countries

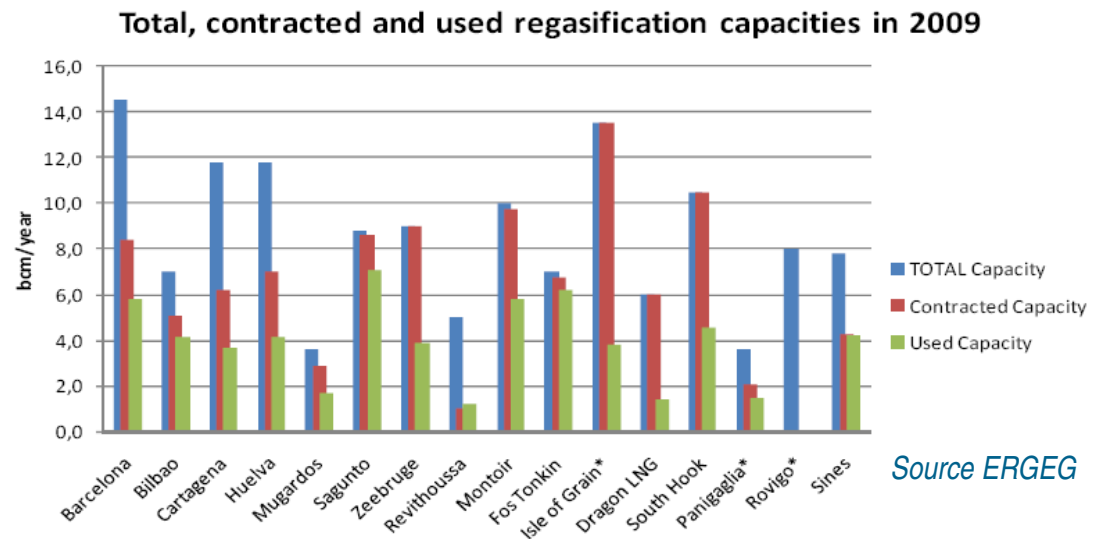


LNG supply

The LNG supply is there, the import infrastructure is there or planned, will LNG come to Europe?

Since EU abolished destination clauses nothing is certain

- LNG goes to the highest price - typically Far East buyers
- Utilisation varies by country
- Typically about 30-40%



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Unconventional Gas Supplies



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Unconventional Gas

Mines Gas/Coal Bed Methane

- Mines gas used in the UK, Germany, Czech Republic and Poland
- Active coal bed methane exploration programmes
- UK recoverable reserves 5 tcf – 1 producing facility

Shale Gas

- Shale gas reserves vary by different shale geologies
- Much lower reserves expected than in US
- Much denser population densities in Europe makes exploitation more difficult
- No/limited rig availability = high cost
- Greater environmental awareness

Biomethane

Biomethane

Multiple sources

Potential UK Biomethane Production in 2020 (million m³ of gas)

| | |
|-----------------------|-------------|
| Sewage/waste water | 270 |
| Manure – dairy/cattle | 254 |
| Agricultural waste | 234 |
| Food waste | 729 |
| Biodegradable waste | |
| 1042 | |
| Wood waste | <u>1253</u> |
| TOTAL | <u>3780</u> |
| Energy crops | <u>1845</u> |
| TOTAL | <u>5625</u> |

5% of UK domestic gas demand

Multiple uses

The waste from four cows can produce enough energy to heat and light a house for a year

UK agricultural manure and food waste could meet 16% of UK transport fuel demand

Sewage works near Oxford supplies the gas requirements of 200 homes



Source The Potential for Renewable Gas in the UK, National Grid

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Mind the Gap



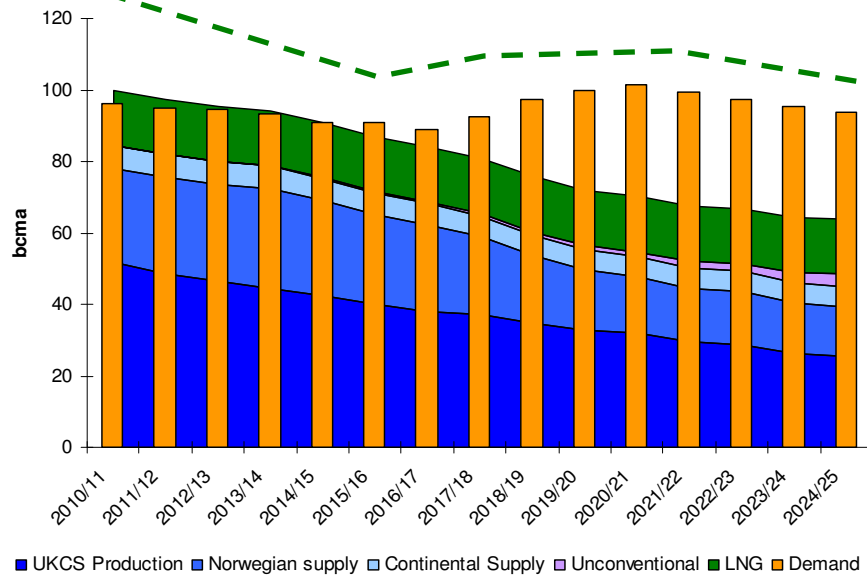
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More UK infrastructure needed

30% LNG terminal utilisation
(34% historically)

New infrastructure required in 2016/17

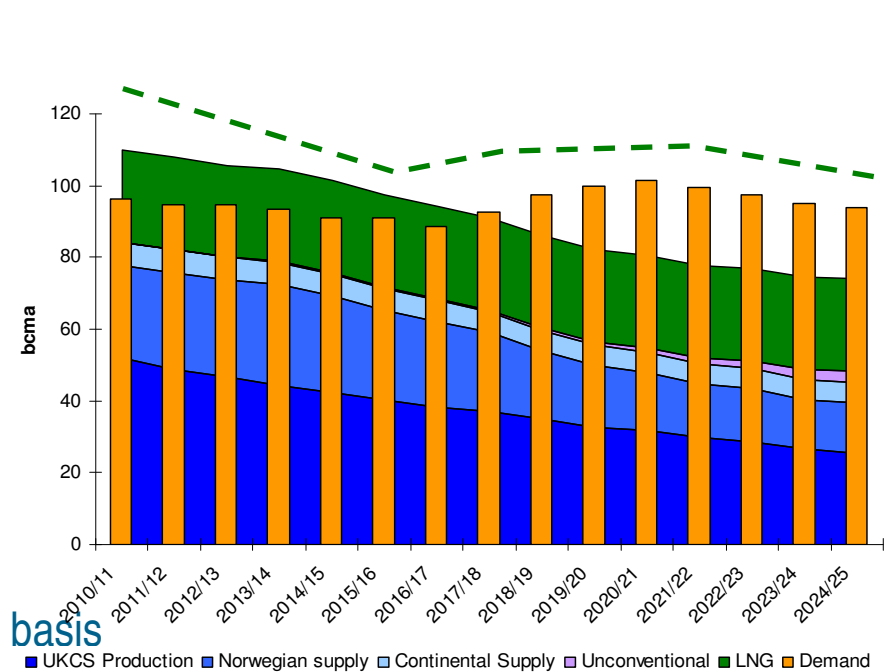
Potential 32 bcma deficit



50% LNG terminal utilisation
(43% recently – 2010/11)

New infrastructure required in 2018/19

Potential 22 bcma deficit



SLOW PROGRESS basis

What infrastructure does the UK need?

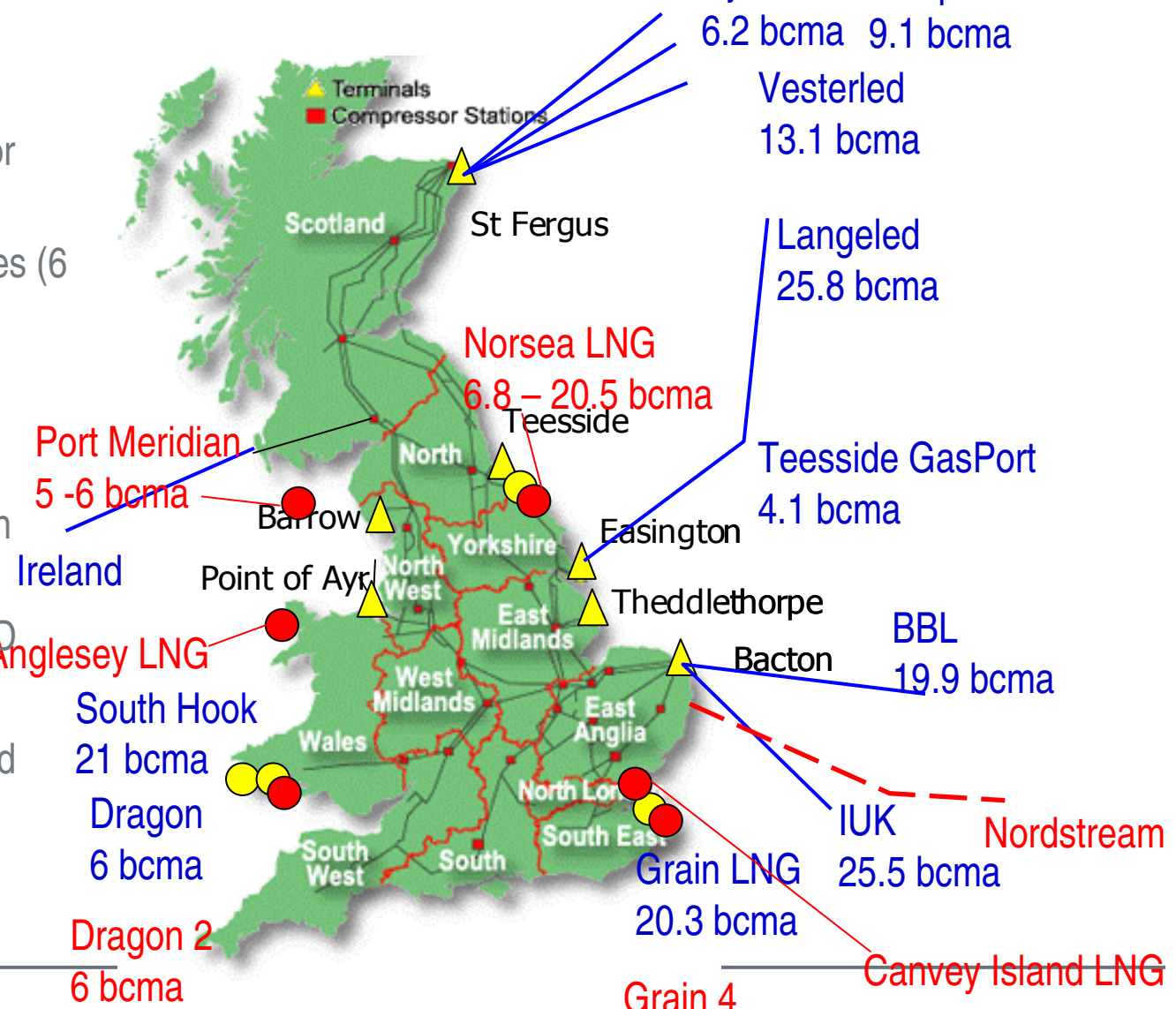
Gjoa 6.2 bcma
 Tampen 9.1 bcma
 Vesterled 13.1 bcma

Pipeline

- Link to Nordstream via BBL or IUK
- Spare capacity in existing lines (6 bcma projected use)

LNG

- Expansions at Grain & Dragon possible
- Port Meridian permitted no FID
- Norsesea LNG largely permitted
- Shannon LNG could back feed UK

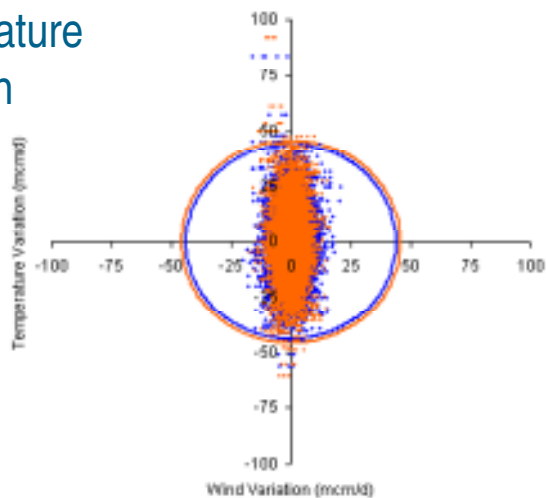
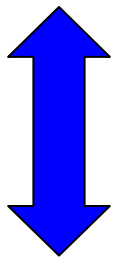


The problem with windmills

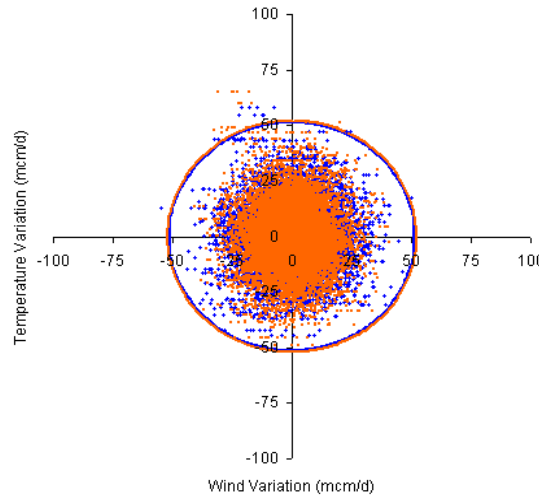
Gas infrastructure built for seasonal temperature variation
 Relatively slow load following

Wind energy more variable
 Need conventional plant to back up renewables
 Need CCGT for fast load following

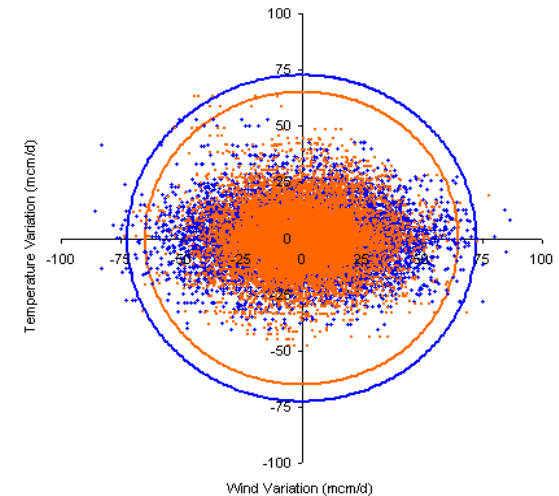
Temperature Variation



• Gone Green • Slow Progression — GG Range — BP Range



• Gone Green • Slow Progression — GG Range — BP Range



• Gone Green • Slow Progression — GG Range — BP Range



Wind speed variation

Pipeline or LNG?

Need a responsive gas network to load follow wind turbines

Gas pipelines + gas storage or LNG

Pipeline

- Capacity exists
- UK needs more gas storage

LNG

- Expansions relatively low cost
- LNG can act as short term gas storage
- Multiple projects required

Conclusions

The future depends on how green we wish to be

Gas demand will grow during the transition period between coal and renewables

Gas fired power will be fundamental in backing up wind generation

Responsive gas networks will be required

The storage element of LNG may be preferable to pipelines and gas storage



Thank you for your attention!

For further information visit www.gl-nobledenton.com

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