Energy Risk Management

Wholesale Market Review and Impacts of Changing Landscape

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Wholesale Market Review and Impacts of Changing Landscape

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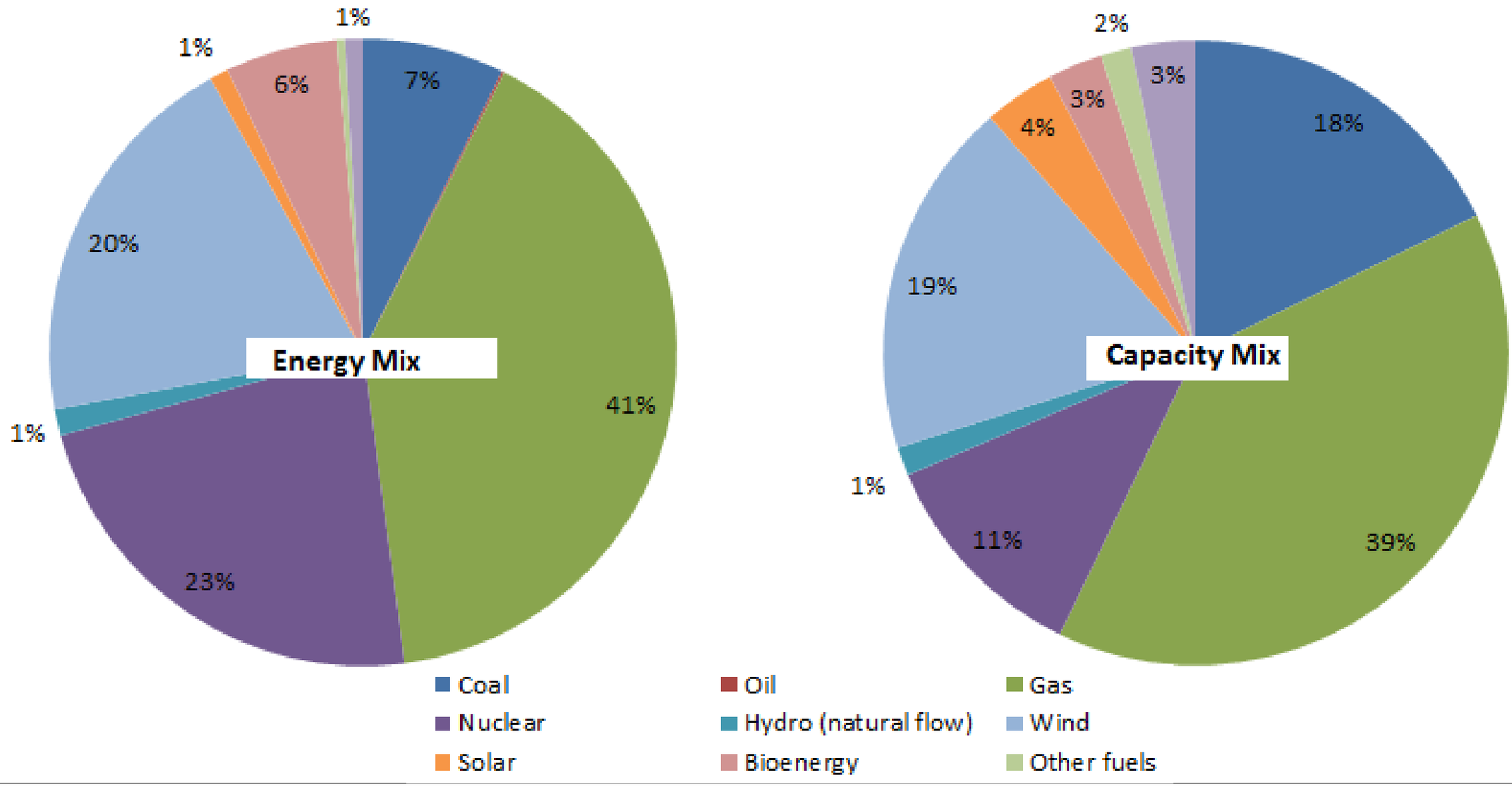
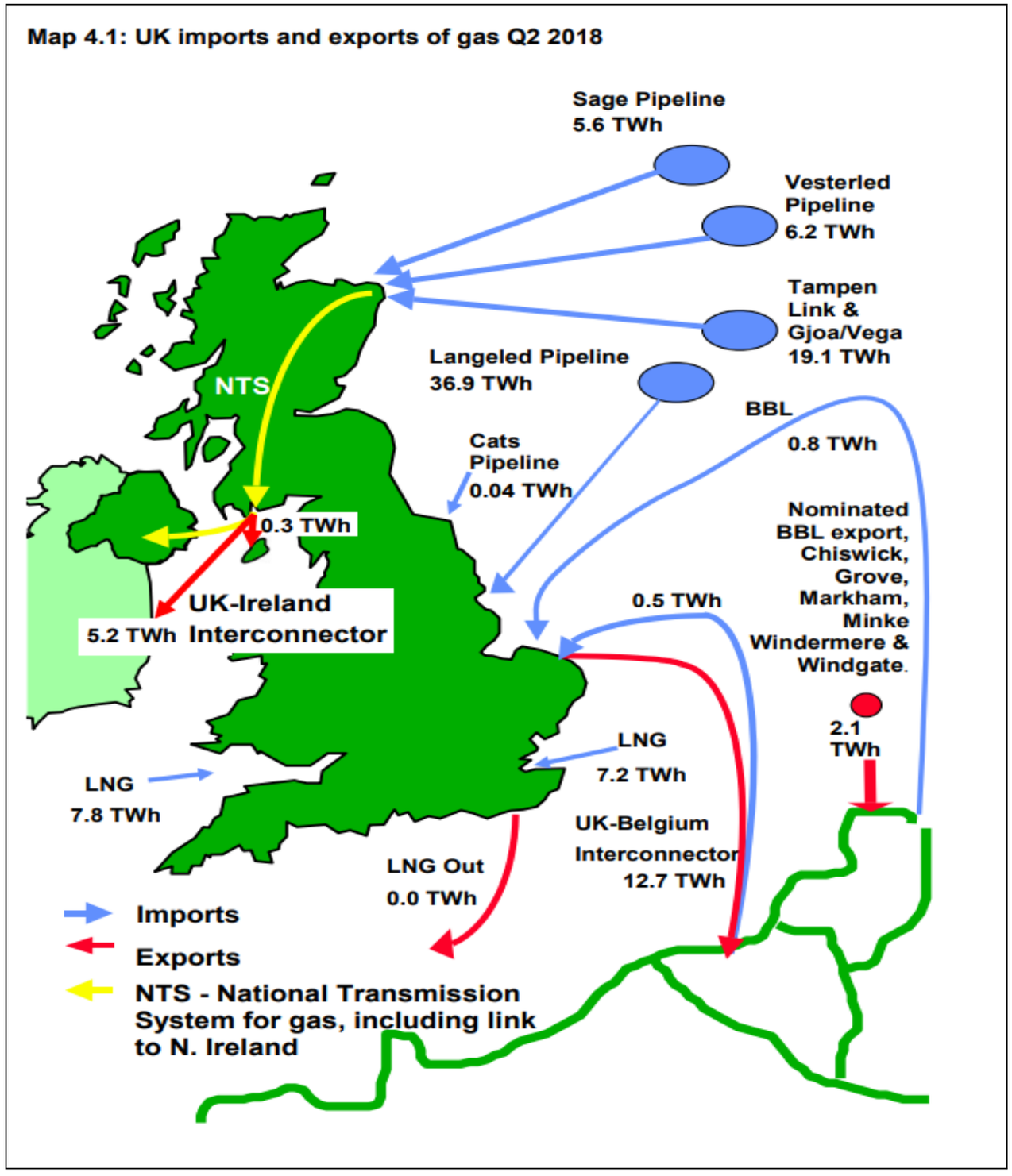
UK Market Overview

- Deregulated since 1996
- 84,988MW generation fleet is a mix of most fuel types
- Natural gas tends to be the price setting fuel
- Coal generation capacity still makes up over 10% of the mix, expected to retire by 2025



Imports/Exports Overview

- The U.K. is a net importer of electricity from the Netherlands and France—approximately 22.9GW
- Rough storage facility closure results in the nation relying more on LNG imports during the winter
- The terminals have a combined send-out capacity of ~50 Bcm/y
- U.K. exports roughly 2.4GW to Ireland, transferring 5.2 TWh in Q2 2018
- U.K. is a net exporter of natural gas to Belgium through the Interconnector (IUK), a bi-directional natural gas pipeline
- 494 GWh/d BBL natural gas interconnector between the U.K. and the Netherlands will start bidirectional flow in autumn 2019

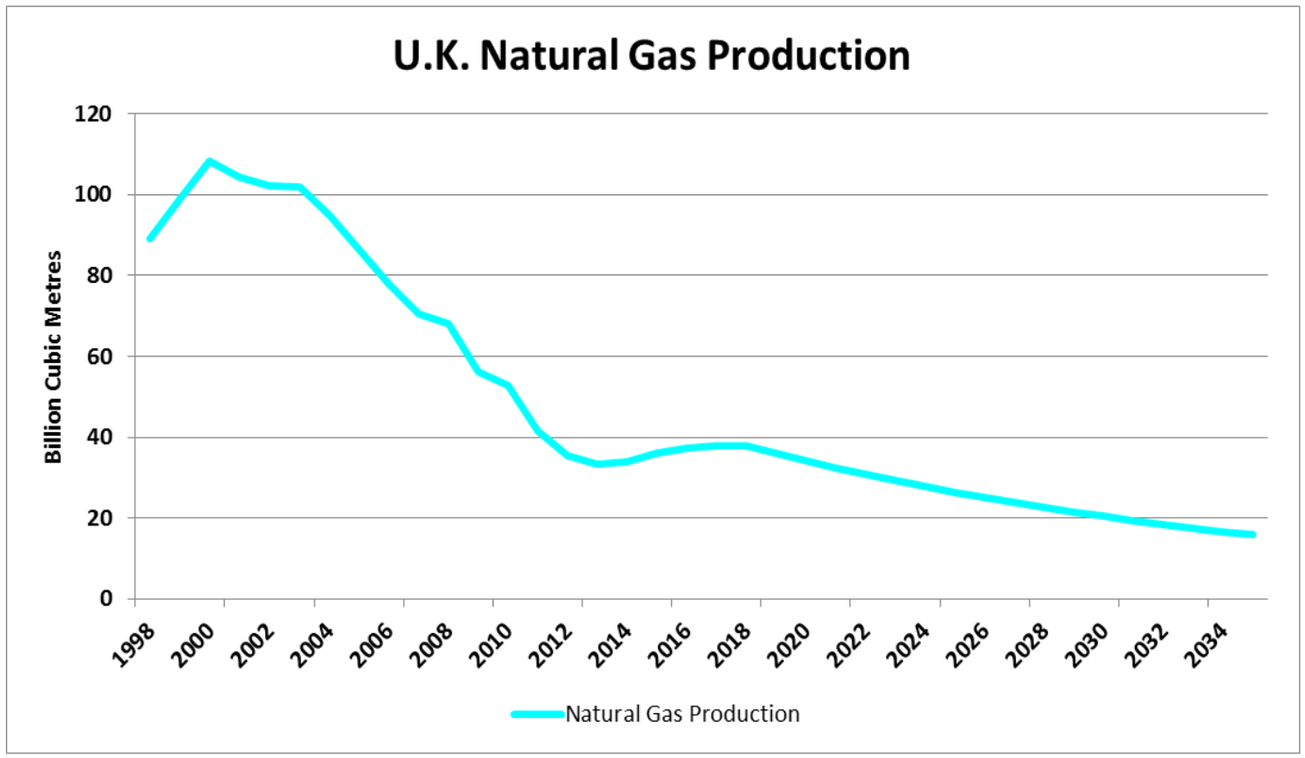


Key Supply Risk-Rough Storage

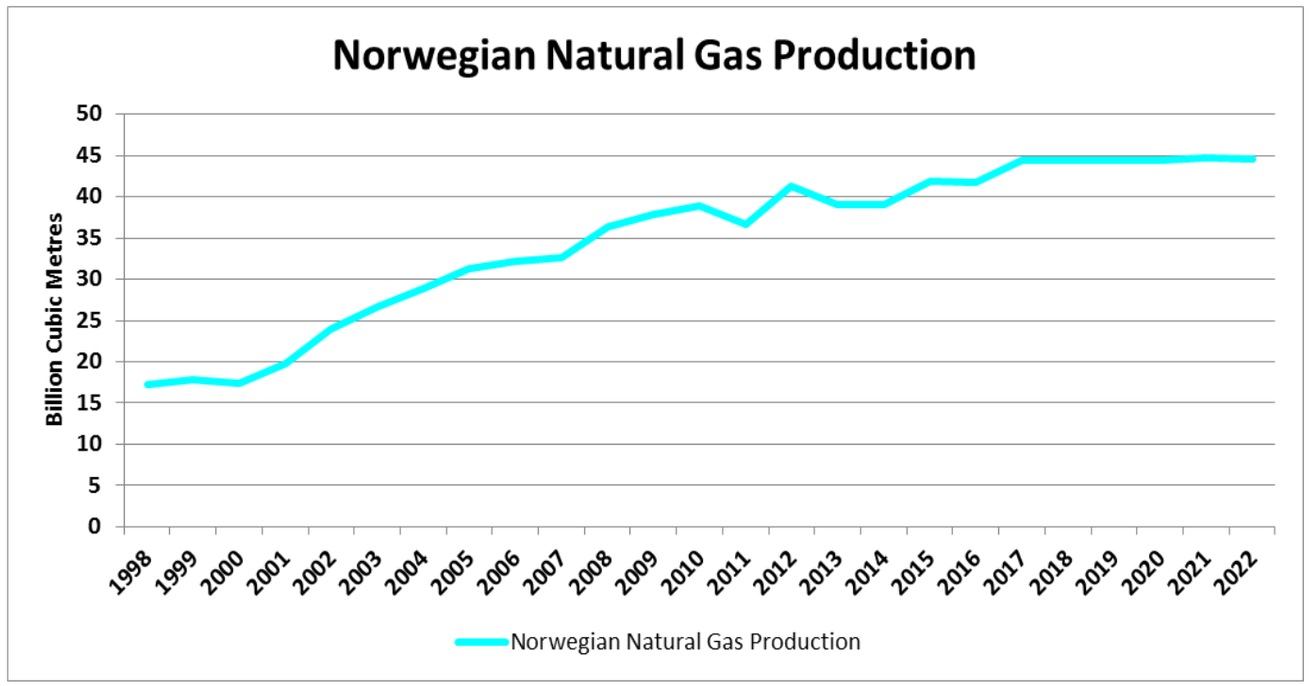
- A winter risk premium has driven energy prices in the U.K.
  - ~50% higher after a cold 2017/2018 winter and supply disruptions in the North Sea revealed the potential volatility in NBP and baseload electricity prices
  - The facility, which represented ~70% of natural gas storage capacity, was shuttered in early 2018.
  - With 3.4 Bcm of lost storage capacity the U.K. loses the ability to meet 10% of winter peaking demand
  - We now rely more heavily on imported natural gas and electricity to meet peak demand

Supply Outlook-Natural Gas

- A lack of new investment in natural gas exploration and production has reduced forward projections
- Natural gas production is expected to decrease by ~5% annually from 2019-2035
- Current wells will be depleted and without new investments, they will not be replaced

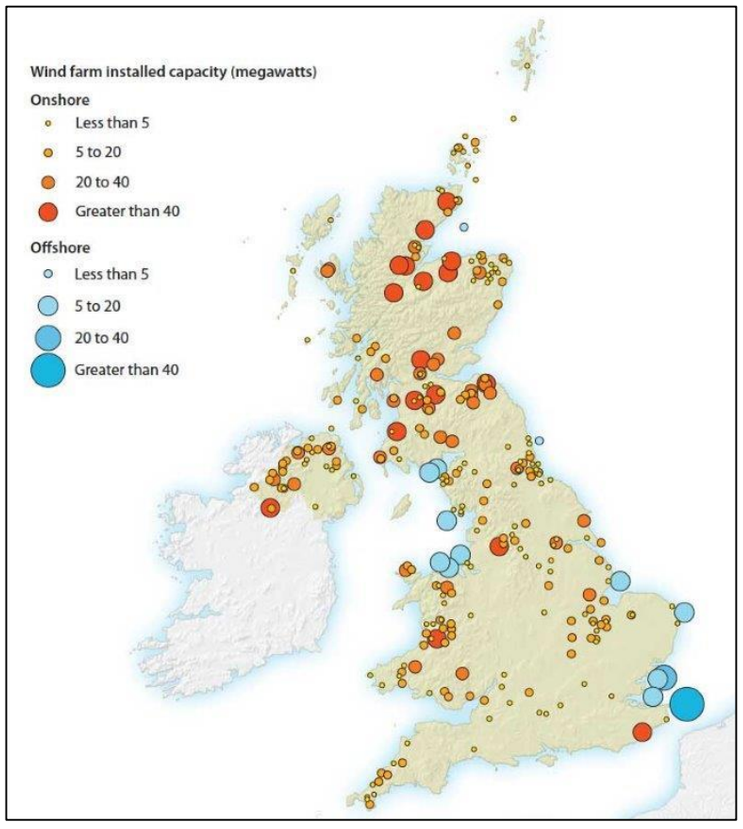


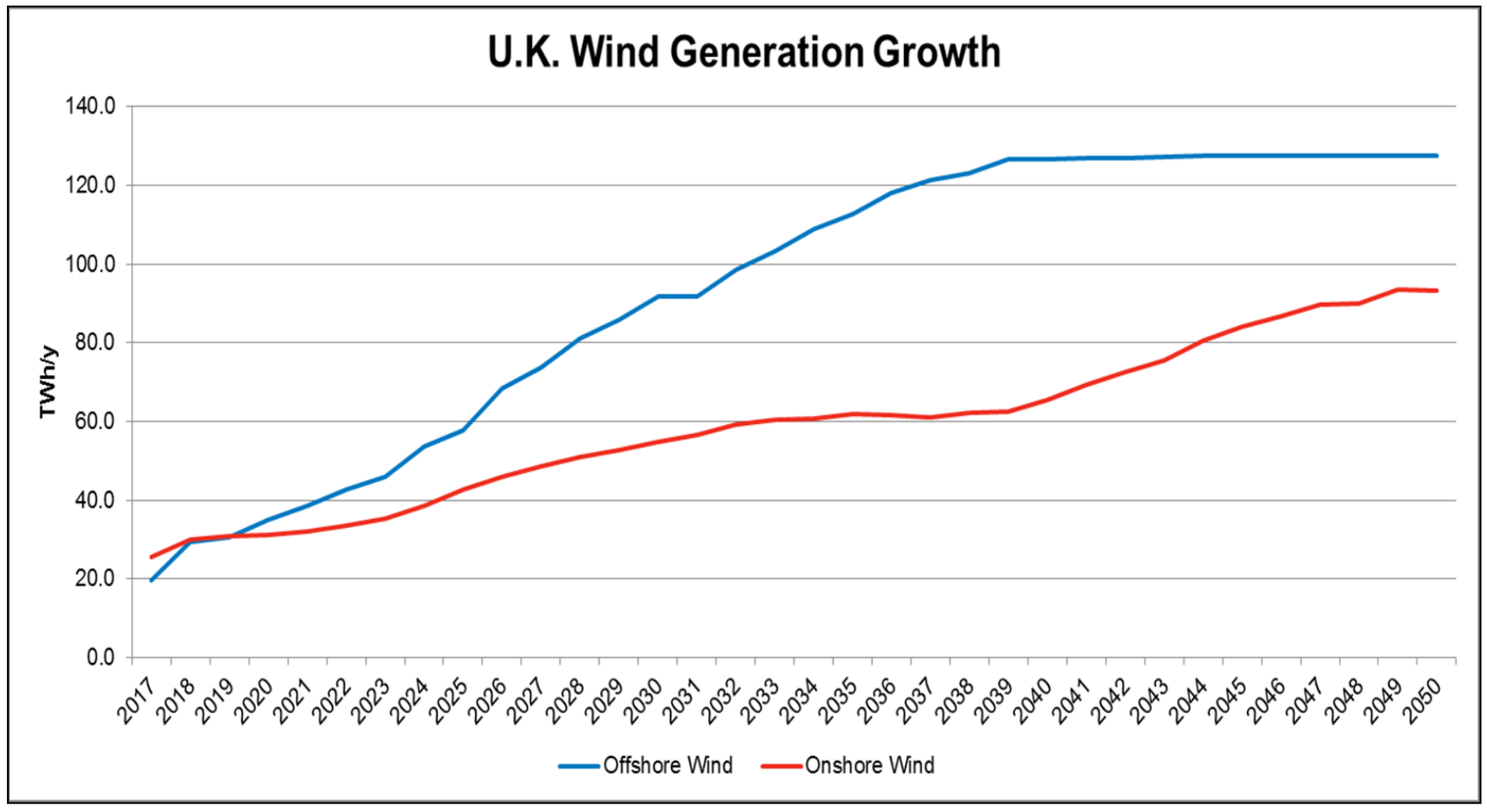
- Norwegian natural gas production has been increasing slowly over the past few years but is expected to plateau near 45 Bcm going forward
- Lower natural gas production will force the U.K. to depend on other imports such as LNG to meet demand, especially in the winter



Supply Outlook-Wind

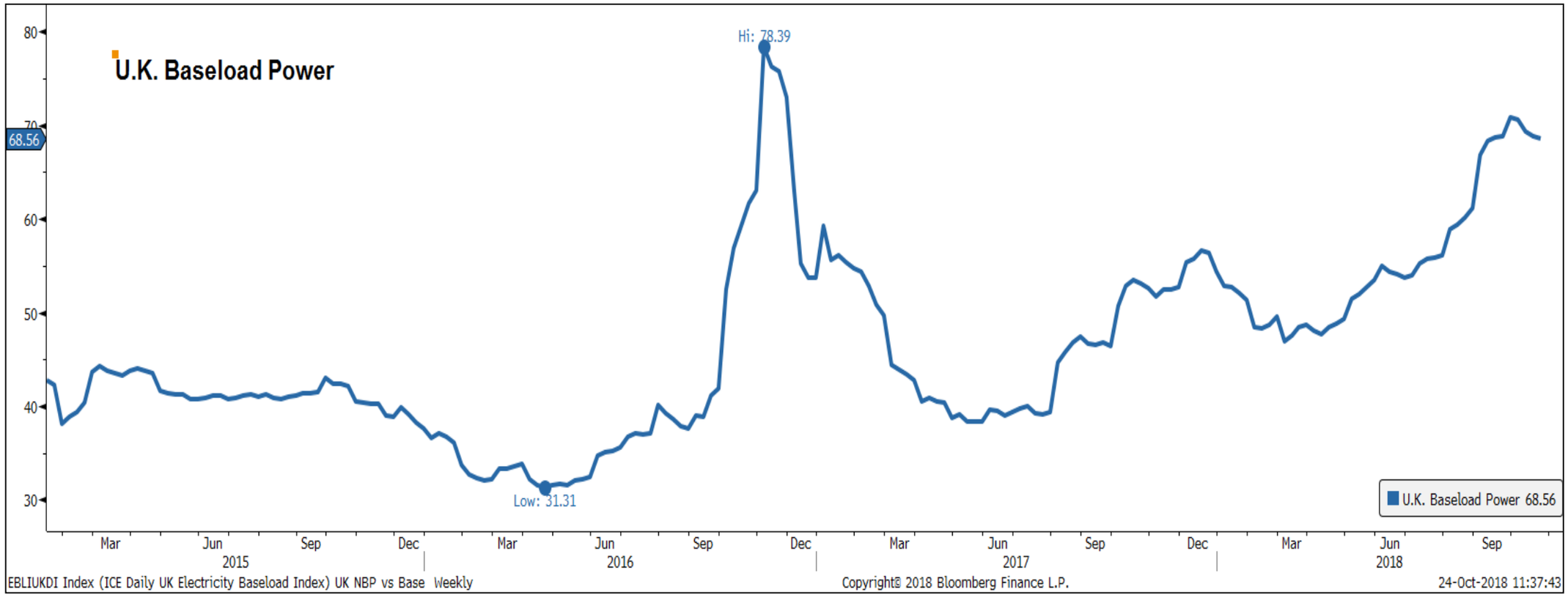
- Increased levels of wind generation will boost price volatility/risk in electricity markets
- In 2017, the U.K. had ~20 GW of on and offshore wind capacity installed, up 10GW, more than double 2012 levels with generation levels at 50 GWh, more than 150% of 2012 levels
- In National Grid's 2018 Future Energy Scenario report, onshore and offshore wind generation is expected to increase by ~70 and ~175 percent respectively over the next 10 years
- Annual generation would reach 51 TWh from onshore wind farms and 81 TWh from offshore wind farms by 2028





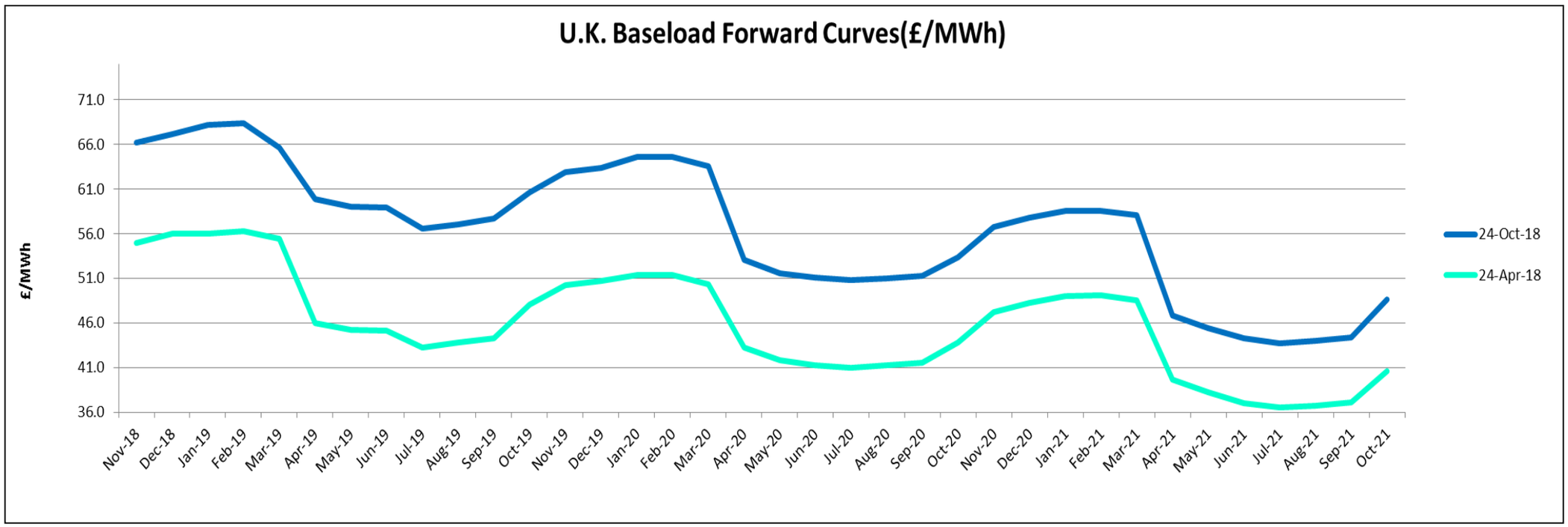
Key Price Drivers

- The wholesale market trades forward two-to-four years into the future on a pair of bilateral exchanges where the Suppliers and other market participants hedge forward volume and price risk
- Baseload power prices peaked at ~ £80/MWh in late 2016 due to shutdowns of French nuclear power plants which limited electricity imports
- Baseload power prices have surged in 2018 alongside stronger fuel prices (natural gas, oil) and carbon prices and with winter risks due to Rough storage facility shut down



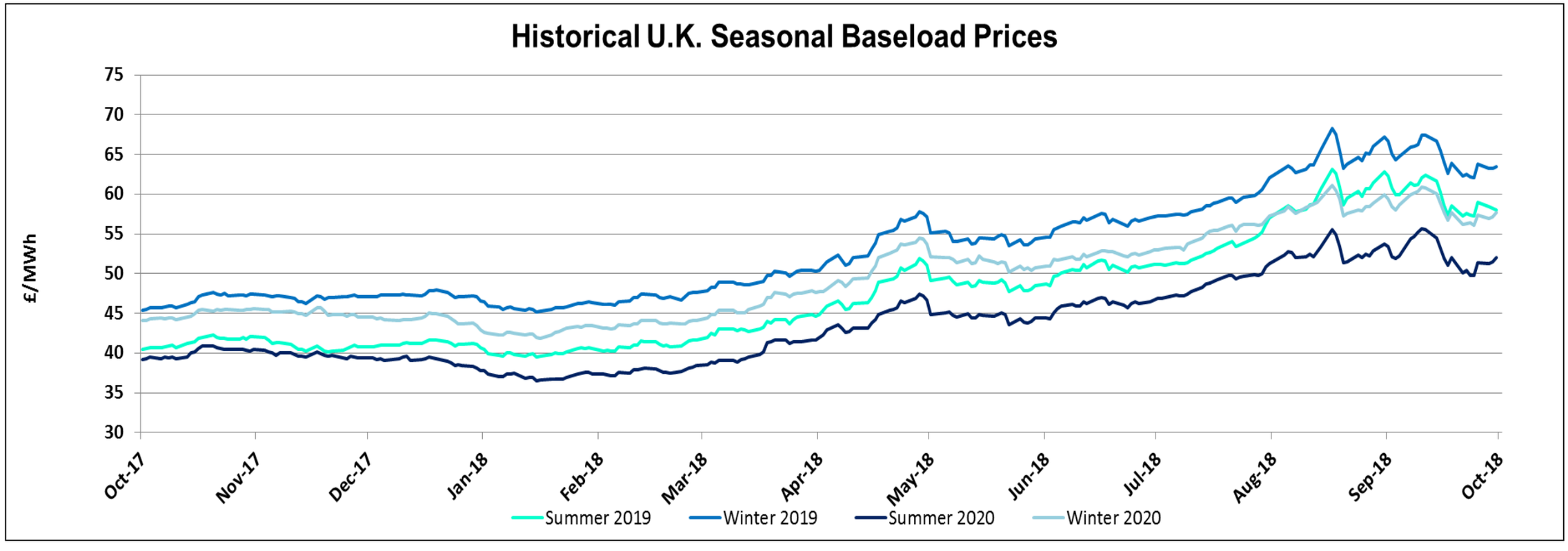
Key Price Drivers - Seasonal Volatility

- Increased seasonal volatility is expected in the coming years due to the growing reliance on both intermittent renewables (wind) and natural gas fired generation
- Additional volatility is expected as Rough storage is no longer in service and the nation will have to rely on imports from neighboring countries as well as LNG cargoes to meet demand during the peak winter months
- Uncertainty surrounding the interconnections with mainland Europe in the post Brexit era has the potential to place a risk premium in the market
- Higher oil prices and a stronger Euro/weak Pound could also provide additional risk of higher electricity prices



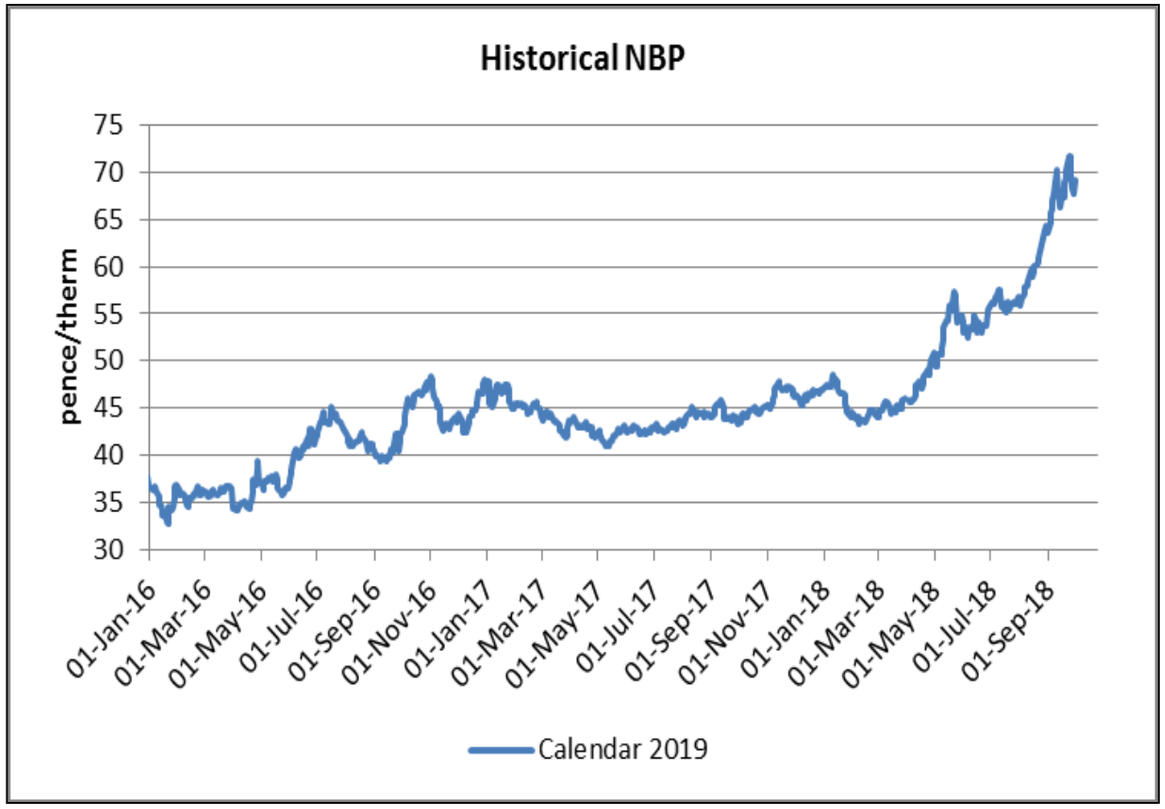
Key Price Drivers - Baseload

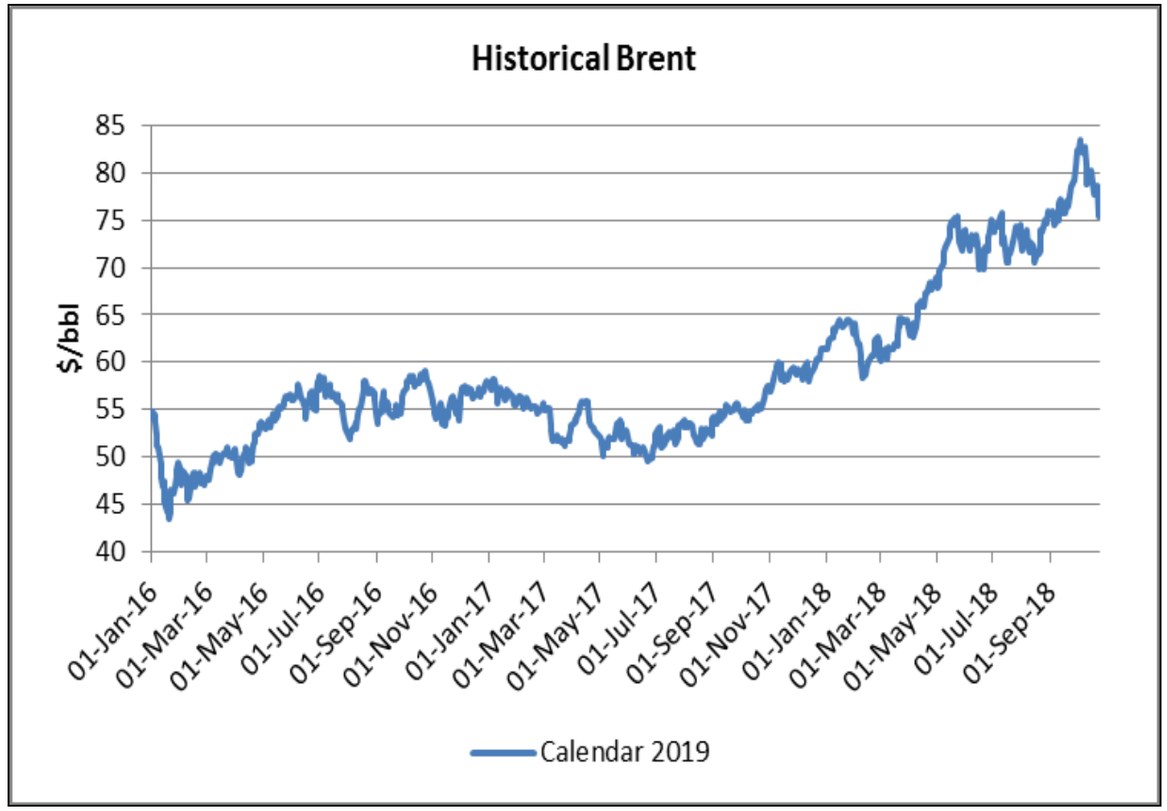
- Seasonal baseload electricity prices over the past year have gained 27-36% on the back of rising fuel (oil, natural gas, coal) and carbon prices
  - Calendar ’19 and ‘20 Brent crude prices have gained ~31-35%
  - NBP seasonal prices have gained ~30-42%
  - Calendar ‘19 and ‘20 ARA coal prices have gained ~25-31%
  - Calendar ‘19 and ‘20 carbon prices have gained **~157-169%**
- After reaching record highs in September, baseload electricity prices have pulled back ~10% following the same fuel and carbon prices lower



Price Drivers – Natural Gas

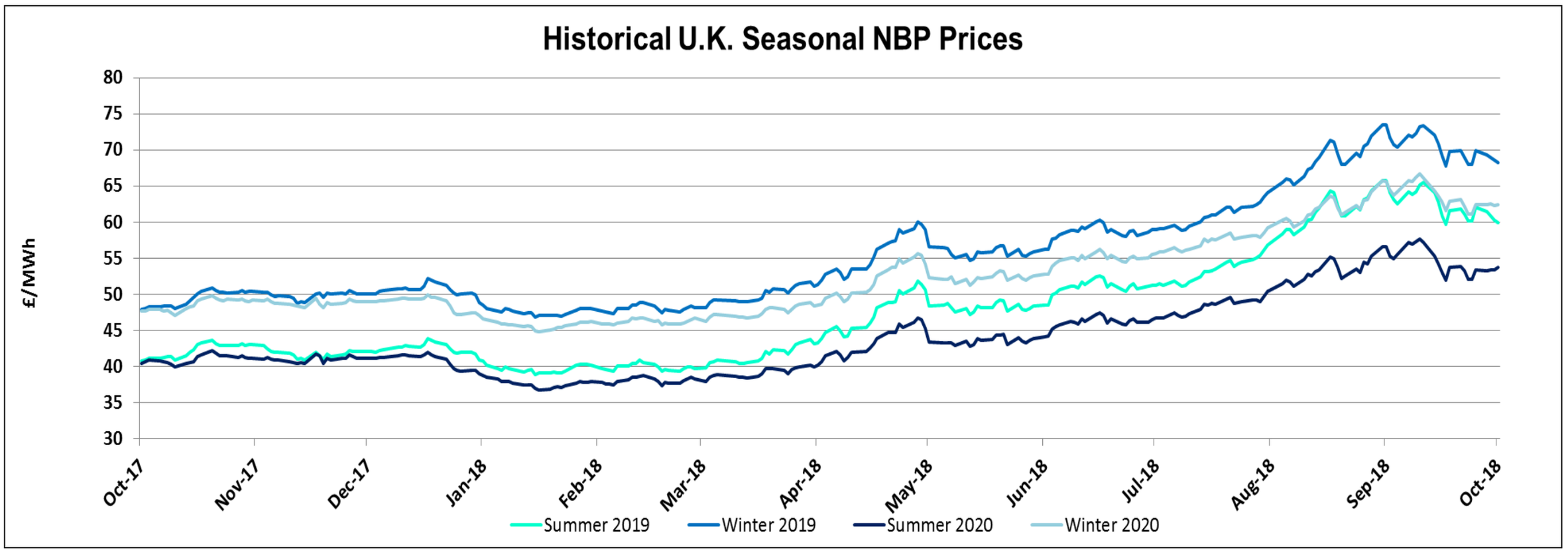
- The National Balancing Point (NBP) is the primary British natural gas index with which the majority of trades reference
- The lack of investment in new natural gas storage after the loss of the Rough natural gas storage facility may provide additional uplift to NBP prices during peak winter demand
- Advent of hydraulic fracturing (fracking) could provide stabilization in gas supply prices if they materially impact domestic production. However, only one well has been drilled so far, pushing the possibility of further onshore production out at least a couple of years.





Price Drivers NBP

- Seasonal NBP prices over the past year have gained 30-42% in sympathy with rising oil and Asian LNG prices, as well as supply concerns during peak winter demand periods due to the closure of the Rough storage facility and North Sea production disruptions.
  - Calendar ’19 and ‘20 Brent crude prices have gained ~31-35%
  - JKM LNG prices have gained ~18%
- After reaching record highs in September, NBP prices have pulled back ~10% alongside sliding oil and JKM prices



Forward Outlook

- Winter 2018 prices are expected to be both higher and more volatile than the more recent winter driven by the loss of the Rough natural gas storage facility increasing the reliance on natural gas imports and elevated LNG prices during periods of peak demand.
  - The increase in prices will also be driven by volatility due to the increasing influence of renewable resources coupled with elevated international crude oil prices.
- Summer 2019 electricity and natural gas prices will likely remain elevated compared to historical prices due to stagnant levels of domestic natural gas production and uncertainty of wind production levels.
  - The uncertainty regarding how electricity interconnections will function and be priced post-Brexit have added considerable risk to the current forward markets
- Winter 2019 will again see increased volatility as uncertainty regarding North Sea natural gas production levels, in both domestic and neighboring countries, is anticipated to add risk during peak heating season.
- Summer 2020 should see a firmer price environment as the BBL pipeline, which links the U.K. to a major natural gas price point in the Netherlands, begins to allow bi-directional flow.
  - This will allow the U.K. to become an exporter of natural gas during periods of low domestic demand as regional production grows.

UK Regulatory Overview

- There remains uncertainty over the future of U.K. natural gas production as fracking has hit regulatory speed bumps and opposition by local groups
- The build out in subsidized renewable generation (FiT, CFD) will boost supply and add volatility to electricity prices
- COP21 Paris Agreement on Climate Change
  - Coal production fell more than 25% in 2017 to an all-time low of 3 million tonnes. Consumption by electricity generators was down ~27% in 2017 to a new record low of 8.7 million tonnes
  - The U.K. continues to close coal power stations and plans to have exit coal-fueled generation altogether by 2025; unlike other European countries, however, the U.K. is considering natural gas and nuclear as a replacement
  - Binding target of at least 40% domestic reduction in greenhouse gas emissions by 2030 based upon 1990 levels

Non-Commodity Costs

- **Transmission network use of system (TNUoS) charges**
  - Recover the cost of installing and maintaining the transmission system. As more infrastructure is built to support renewable generation these costs will increase 3-5%/annum.
- **Balancing services use of system (BSUoS)**
  - Recover the cost of day-to-day operation of the transmission system. As the grid accommodates more and more intermittent resources these costs will increase 4-6%/Annum.
- **Electricity connection charges**
  - Recover the cost of installing and maintaining connection assets that are not normally used by any other party. These costs should remain fairly consistent over time with only minor adjustments.
- **Assistance for areas with high electricity distribution costs (AAHEDC)**
  - The North of Scotland is currently the only area specified to receive assistance. These costs are expected to remain flat to possibly decrease as better infrastructure is installed.
- **Feed in Tariffs (FiT) and Contract for Differences (CfD)**
  - Subsidies for renewable generation. These costs are expected to continue to increase as additional resources receive payments. Increases are expected to be 5-7%/annum.
- **Non-Commodity costs are expected to increase annually by 3-6%.**

Key Conclusions

- **Deceasing Gas Storage**
- **Increased seasonal volatility**
- **Fossil to renewable Long term Transition**
- **Assistance for areas with high electricity distribution costs (AAHEDC)**
- **Feed in Tariffs (FiT) and Contract for Differences (CfD)**
- **Non-Commodity costs are expected to increase annually by 3-6%.**
- **Questions welcomed**