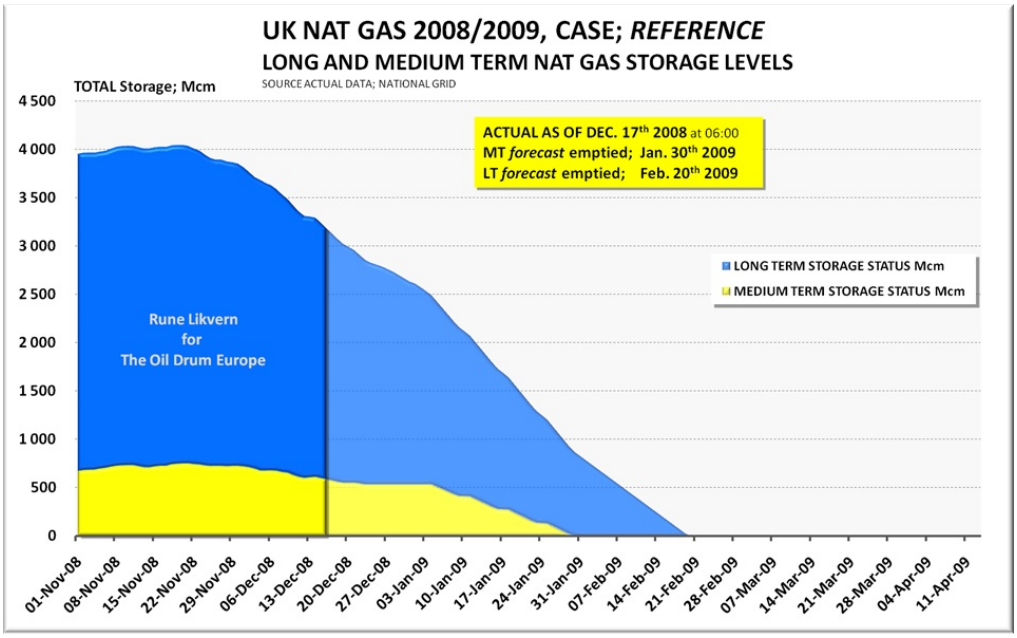
The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Will the UK Face a Natural Gas Crisis this Winter? (Part 2 of 2)

Posted by Rune Likvern on December 19, 2008 - 12:46am in The Oil Drum: Europe
Topic: Demand/Consumption
Tags: interconnector, langeled, lng supplies, national grid, original, uk natural gas imports, uk natural gas storage, uk natural gas supplies [list all tags]

This is the second part of a two part series about U.K. natural gas. In the **first part** of this series, I presented a historical look at natural gas supplies in Europe, with a focus on the United Kingdom's (U.K.) sources of natural gas supplies.

In this second part, I present the results of simulations of the U.K. natural gas supply and demand situation for the remainder of this heating season. The results of these simulations are quite alarming: it appears that there is a significant chance that the U. K. will run short of natural gas in storage before the end of winter.



If the U. K should run short of natural gas in storage, the U. K. will need to get along with only its on-going sources of natural gas. These are gas pumped from the U. K. continental shelf, pipeline imports, and imported liquefied natural gas (LNG). Recently, these sources have totaled about 300 million cubic meters a day (Mcm/d). Cutting back to this level of consumption may be difficult, since the shortfall is likely to exceed interruptible supplies, especially during cold weather when demand may exceed 450 Mcm/d according to National Grid. There is still considerable uncertainty in precise amounts because demand may vary due to economic conditions and the weather, and supply may vary because of changes in production amounts or imports.

The primary reason for the likely shortfall in natural gas is the continued decline in production from the UK continental shelf. Production has declined in each of the last four years, and is expected to continue to decline in the future. Because of declining U. K. production, increased imports are needed each year. There is no clear path for obtaining increased imports, however.

Pipeline imports are expected to remain flat or decline slightly, primarily because Norway's exports this winter seems to be at the maximum level. Liquefied natural gas (LNG) imports to date have been quite small, averaging less than 10 Mcm per day. LNG imports could theoretically ramp up with higher price or long-term contracts, but at this point show no sign of increase.

INTRODUCTION

NOTE: All diagrams are clickable and open in a larger version.

In this post, I present the results from what I now consider the most likely of several simulated scenarios. My previous experience with making predictions about U. K. natural gas (nat gas) supply and demand have taught me that there is a great deal of variability in predicted results because it is not possible to forecast weather conditions for the next several months accurately, and temperature has a significant impact on the amount of natural gas consumed. Economic conditions can also be expected to cause results to vary.

In some ways, making prediction of this type is comparable to standing on the bow of a small ship in a heavy storm taking aim for clay pigeon shooting while the ship is yawing, rolling, heaving, pitching and the gusts from everywhere tries to throw you off. I have chosen what I presently consider the most representative scenario. Actual results may be quite different. I plan to update this analysis in the second half of January 2009.

U.K. NATURAL GAS DEMAND

In the U. K., nat gas demand is high in the winter, when it is used for heating, and low in the summer, when it is used primarily for electricity production and industrial uses. Figure 01 shows a graph of U. K. nat gas consumption, split between electrical production and other uses.

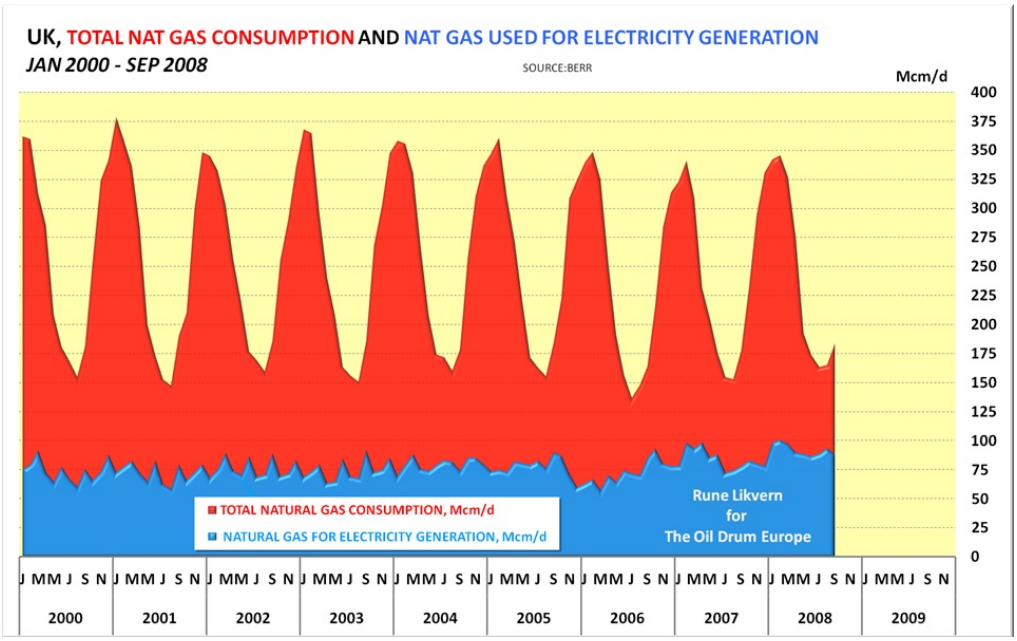


FIGURE 01 *Total U. K. nat gas consumption, split between electricity generation (blue area) and other uses, based on BERR data. The portion used for electricity generation has recently been growing.*

Figure 01 shows how U. K. nat gas consumption has varied in recent years. In the past year, U.K.

nat gas consumption has been increasing, primarily because of an increase in nat gas use for electrical generation. For the months January through September 2008, total U.K. nat gas consumption increased **by 3,9 %** compared to the same period of 2007. Last year, National Grid forecast nat gas demand (SND) to be 97,3 Bcm (Gcm) for contract year 2007 (01. October 2007 to 30. September 2008). Actual data shows demand grew to 102,5 Bcm (Gcm), which is **5,3 % higher than forecast**.

A major reason for the increase in natural gas demand is lower output of nuclear generated electricity. Nat gas consumption for electricity generation increased by close to 9 % during the first 3 quarters of 2008, compared to the same period of 2007. In the same time-period, total electricity consumption dropped by close to 4 %, most likely because of the economic slow down. 40 to 45 % of U.K. electricity is presently generated by nat gas.

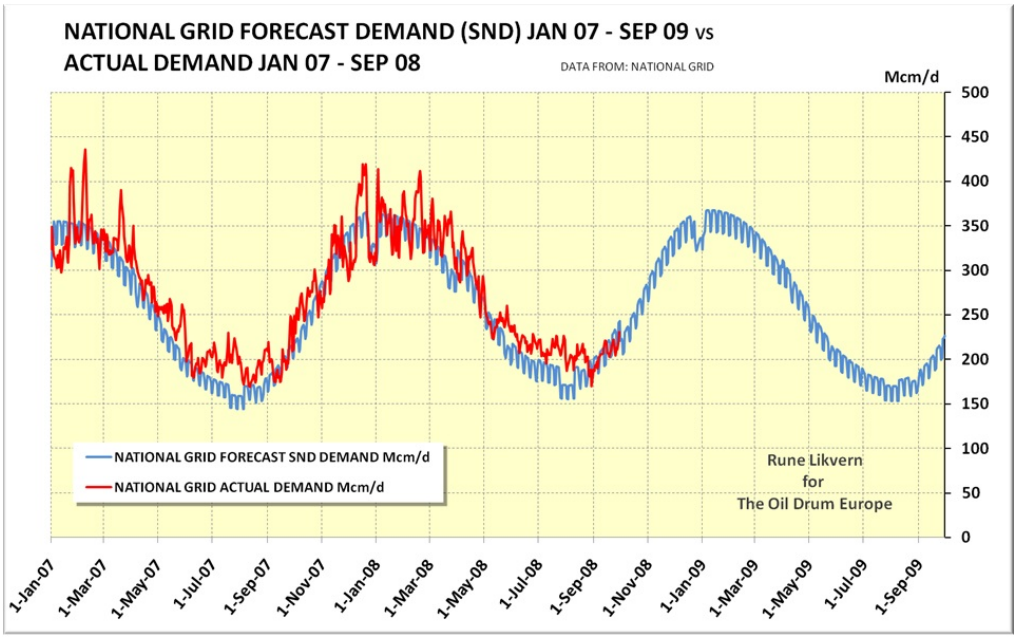


FIGURE 02 *The diagram above shows the National Grid SND forecast demand (blue line), for the period January 2007 through September 2009 and actual demand (red line) from January 2007 through September 2008.*

The SND forecast from National Grid for contract year 2008 (October 1, 2008 to September 30, 2009) shows a demand that is 1,2 % lower than the SND forecast for contract year 2007.

U.K. NATURAL GAS STORAGE FACILITIES

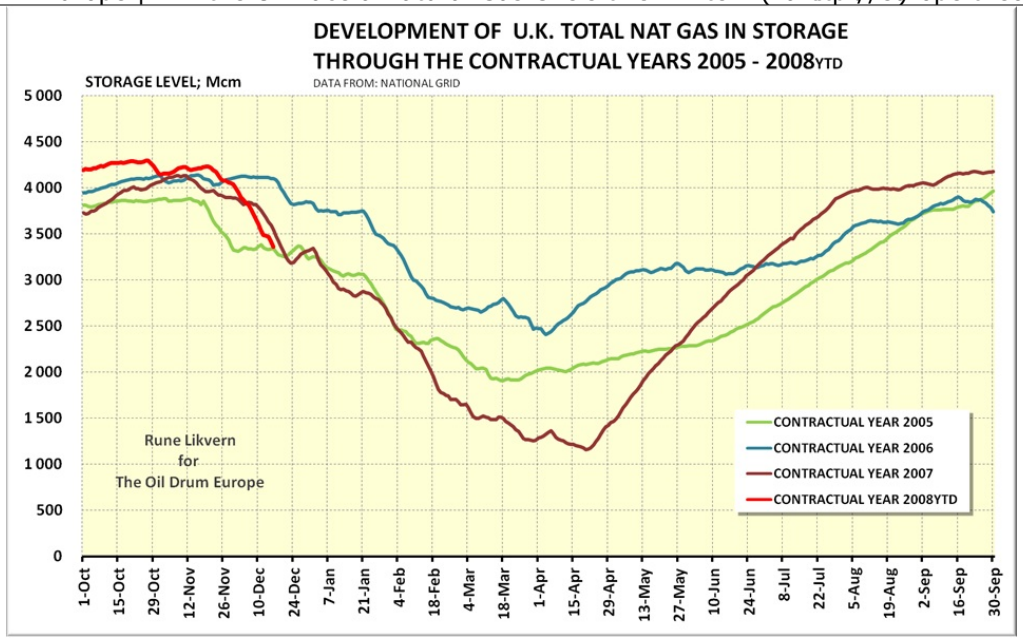


FIGURE 03 *U.K. nat gas storage levels for all facilities combined, expressed in Mcm for contract years 2005 through 2008 YTD (Year to Date). The red line in the diagram is for this contract year 2008 (01. October 2008 to 30. September 2009). From* ***National Grid****.*

Figure 03 shows that the amount of nat gas in storage for the 2008 contract year has been dropping relatively quickly (data is through 17.12.2008). While the amount in storage started above that for the prior three years, it is now on a path to drop below the other years.

U. K. has three types of storage facilities:

- Long Term (Rough, capacity of 3 340 Mcm and max flow rate of 42 Mcm/d),
- Medium Term (Hornsea, Hole House Farm, Hatfield Moor, Humbly Grove; total capacity of 767 - 837 Mcm and max total flow rate of 37 Mcm/d), and
- Short Term (Avonmouth, Dynevor Arms, Glenmavis, Partington; total capacity of 260 Mcm and max total flow rate of 48 Mcm/d).

The total storage capacity of these facilities at the end of May 2008 was 4 367 - 4 437 Mcm, according to data from BERR. This amount corresponds to about 4% to 5% of annual consumption.

Withdrawal of nat gas from storage is meant to complement locally produced and imported supplies when demand surges as during cold periods, or be a source of substitute supplies during unplanned shutdown(s) in the supply chain.

Normally for withdrawals of up to 42 Mcm/d, the long term storage facility is used. As demand dictates higher withdrawals, the medium and short term facilities are operated in tandem with the long term facilities. With all storage facilities operating in tandem, around 125 Mcm/d may be sustained for approximately 4 days. The long and medium term storage facilities can deliver approximately 80 Mcm/d when operated in tandem.

The following is a comparison of some vital natural gas statistics between Germany, UK and USA for 2007:

- Germany nat gas was 24 % of primary energy consumption, 83 % was imports, and storage capacities were 22 % of annual consumption.
- U.K. nat gas was 38 % of primary energy consumption, 21 % was imports, and storage capacities were just above 4 % of annual consumption.

- USA nat gas was 25 % of primary energy consumption, 16 % was imports, and storage capacities were just above 15 % of annual consumption.

The comparison above, showing the nat gas portion of U.K. primary energy consumption and forecast future growth in imports, suggests that total U.K. nat gas storage facilities need to expand by a factor of 4 to 5 to provide the same flexibility and security of supplies as some of the countries it is natural to compare the U.K. with.

In the USA and Germany, there is a wide consensus that the draw down of storage facilities should not go lower than 20 % of their working capacities as the heating season ends. This assures available spare capacity for potential spring cold snaps and/or supplemental supplies for unplanned losses from any supply source.

Nat gas storage facilities are expensive and take years to construct, so it is unlikely that the U. K. will be able to overcome its relative shortfall in storage capacity quickly. In the days when U. K.'s production was higher and was a net exporter, it could more easily meet surging winter demand and thus had less need for storage. Now that its nat gas production is rapidly declining, it needs more storage, but the storage is not available.

SUPPLY ASSUMPTIONS

The U. K.'s single largest source of supply is its own indigenous supply from the U. K. Continental Shelf. Production has been declining for four years, and is expected to continue to decline.

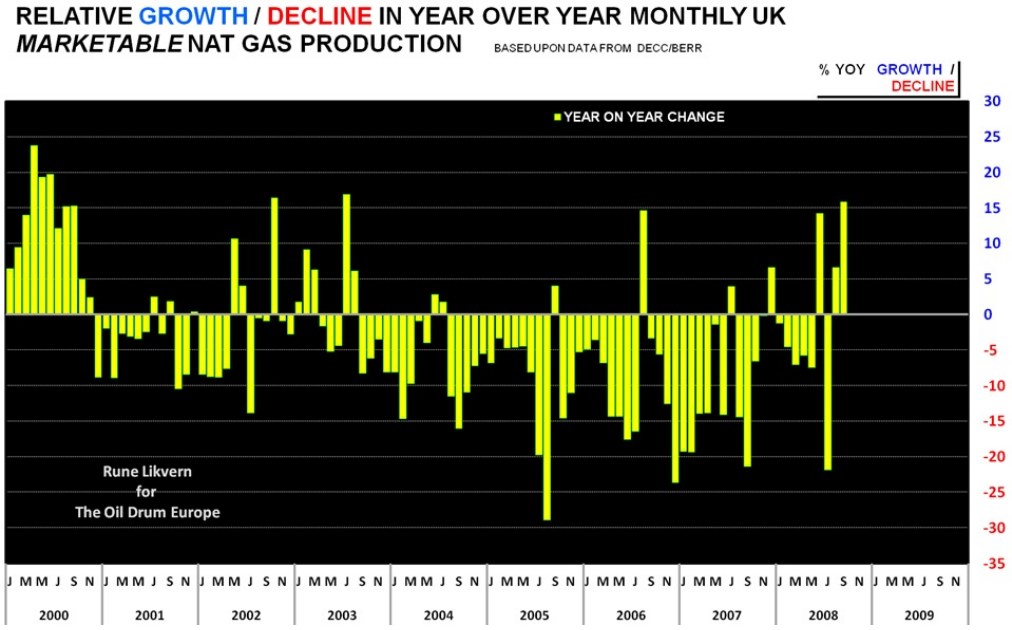


FIGURE 04 *The diagram above shows year over year monthly decline rates for U.K. marketable nat gas supplies for the period January 2000 through September 2008.*

Figure 04 shows the decline in natural gas production is something that goes on continuously and is hard to forecast. As natural gas fields deplete, their decline rates can increase dramatically. Natural gas decline rates are truly **"The elephant in the room"**. The figure illustrates why it is difficult to forecast changes in nat gas production which more becomes an art than science.

The simulation which is presented below uses National Grid forecasts of U.K. nat gas supplies for the rest of the winter as most recently documented by **Operational Monthly Updates** published by National Grid. Over the modeled period, production averages 190 Mcm/d. This corresponds to approximately a 10% decrease over the corresponding period a year ago. This

assumption may prove to be optimistic, because the most recent National Grid update seems to indicate nat gas production during November below this level.

Net nat gas imports as modeled average 108 Mcm/d during the forecast period. This corresponds to a very slight (< 1%) increase in imports over a similar period a year ago. The modeled amount includes both pipeline and LNG imports.

In the summary at the beginning of this post, I noted that exports from Norway presently are maxed out. This is the case because nearly all of the production available for export is subject to long term contracts.

SIMULATION RESULTS

In the simplest form, the results of my simulations show how quickly the storage facilities are likely to deplete, given the estimates the National Grid has made with respect to demand and with respect to supply from U. K. production, and estimates I have made with respect to imports. These indications can be summarized in the graph I showed at the top of the post, and show again as Figure 05:

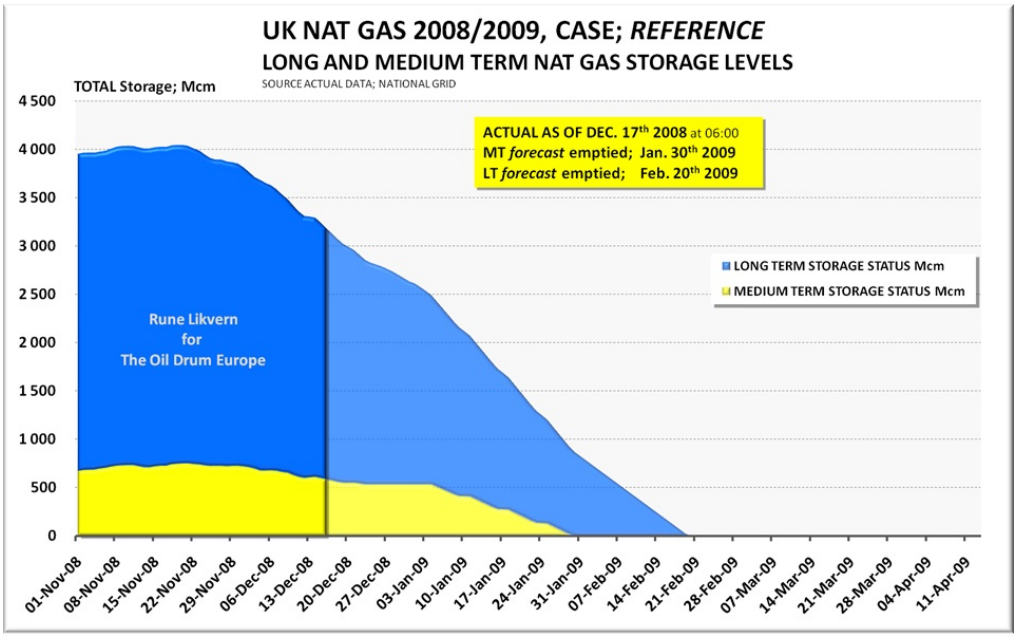


FIGURE 05 *Expected depletion of U.K. long term (blue area) stacked on medium term (yellow area) nat gas storage levels based on simulation analysis.*

Figure 05 indicates that based on my simulations, **medium term storage (yellow) is forecast to be emptied by late January, and that long-term storage (blue) is forecast to be emptied by mid February.** The amounts shown on Figure 05 are a combination of actual and forecast amounts. The darker shades represent development to date; the lighter shades represent the forecast period.

Figure 05 is only a summary exhibit. To understand better what is happening, it is helpful to view how the parts of the model work together, as illustrated in Figure 06. I start with the demand forecast by the National Grid, and fill in the portion underneath it with expected supply from various sources. During time-periods when the sum of production plus imports is expected to be less than what is required to meet supply, I draw down nat gas from storage. If there are periods with excess supply, I use the excess to refill storage. In this way, I simulate how the storage facilities are expected to deplete, and can estimate the extent of the shortfall.

It should be noted that even if Figure 06 shows a gap between demand and supplies, this should not be taken to mean that homeowners or electric power plants will see a nat gas shortfall. The operator of the grid uses models that identify potential shortfalls, and can minimise the effects by **reducing flows to or cutting off low priority customers on interruptible contracts**. If this is not enough to balance the system, additional customers can be cut off according to priority and/or criticality.

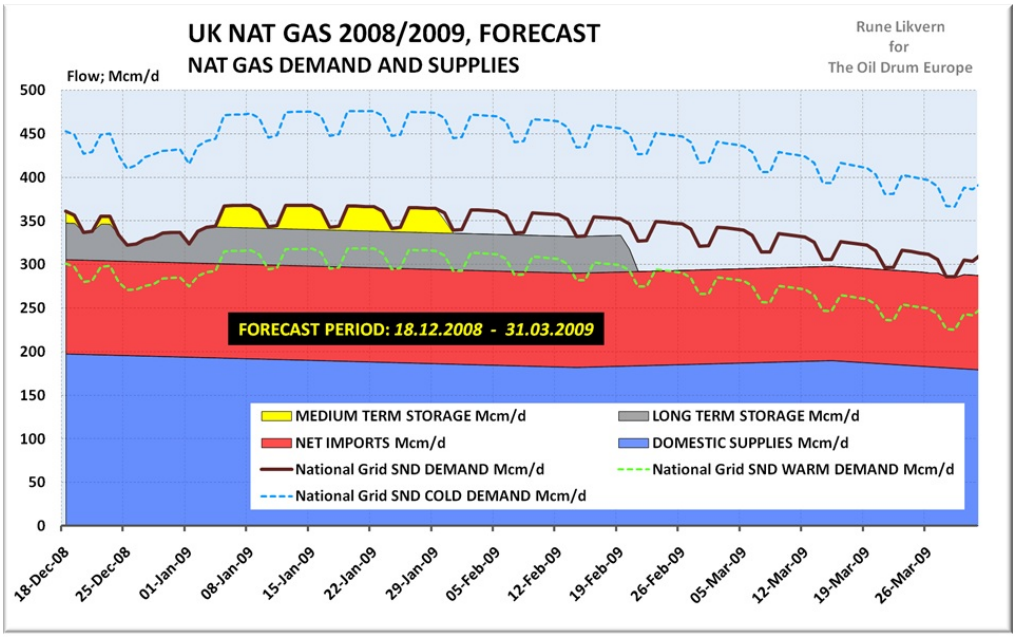


FIGURE 06 *How demand can be expected to be filled, based on simulation results.*

In Figure 06, the thick dark wavy line shows the forecast average demand (SND) by National Grid, and the amount filled in under this line represents the way this demand is expected to be filled from various sources (indigenous production, imports--pipelines or LNG, or storage withdrawals). The blue area represents UK's own production; the red area represents net imports (pipeline and LNG combined); the grey area represents withdrawals from long-term storage; and the yellow area withdrawals from medium term storage.

The dotted blue line (maximum demand) and the light green line (minimum demand) give an estimate of expected day to day variability in demand, reflecting changing weather conditions, based on National Grid forecasts. If total supply on any day runs higher than demand, the surplus will enter storage.

In making these forecasts, the simulation uses expected U. K. natural gas production, as most recently forecast by **National Grid**.

In the middle of February, demand is forecast to vary from as much as + 460 Mcm/d (See also Figure 07 below.) as suggested by the blue dotted line to as low as 300 Mcm/d, as suggested by the dotted light green line in the diagram, depending primarily on the weather. On days when demand is at the low end of this range, it may be possible to meet demand with virtually no draw-down from storage, since indigenous supplies plus imports are expected to be close to 300 Mcm/d.

The results from the simulation shows that there could be periods with a gap between supply and demand of + 60 Mcm/d. During cold spells, the gap could be even larger. Figure 06 also illustrates that less total natural gas is needed with the approach of spring and warmer weather.

In Germany and USA, there seems to be an understanding that storage facilities should not be completely depleted of working gas at the end of the heating season. Instead, storage is kept

approximately 20 % filled with working gas, to handle late spring cold spells or outages of other types. For the U.K., 20 % would translate to 800 Mcm, which corresponds to approximately 4 - 5 full days demand during spring/summer (from storage only). In the USA, this corresponds to roughly 12 days of demand.

The simulation forecasts a need for additional supplies of approximately 2 300 Mcm between late January till the end of the heating season, assuming that 800 Mcm of natural gas is held in storage for late spring cold spells or other emergencies. For the simulated period of 18th December 2008 and 31st March 2009, National Grid forecasts a growth in U.K. nat gas demand of 1,8 % relative to the same period of last winter, when 2008 is adjusted for being a leap year. (This is the same demand I use in my forecast.)

Figure A. 21 – Cold spell analysis for 2008/9, for average conditions

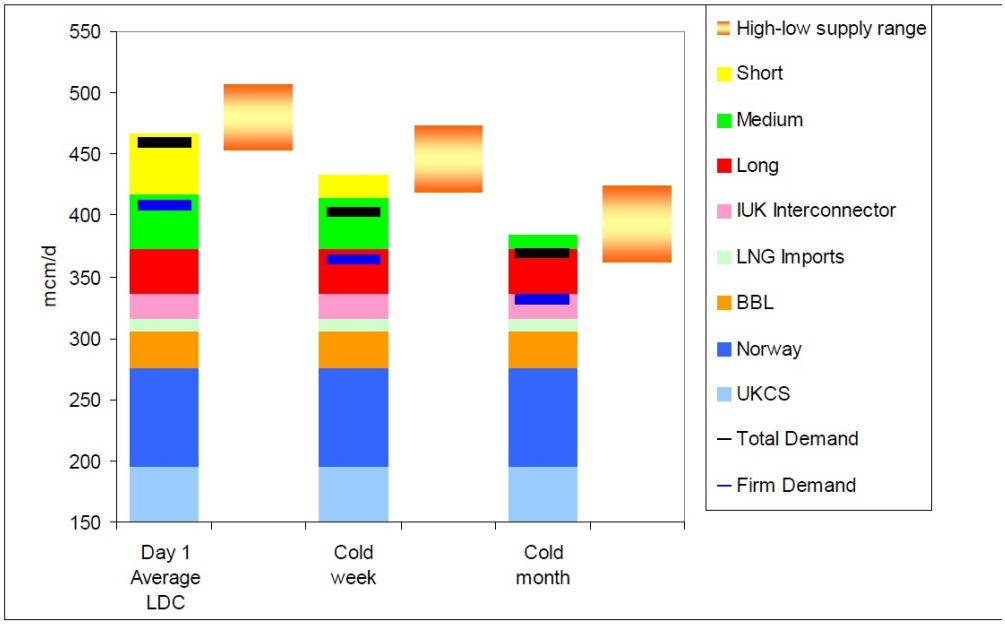


FIGURE 07 *Figure A.21 from National Grid's "Winter Outlook Report 2008/2009", 2nd October 2008.*

Figure 07 above from National Grid suggests daily peak demand during this heating season is projected to reach + 460 Mcm/d, and could be even higher during extreme weather conditions. The highest recorded so far is approximately 450 Mcm/d.

DEALING WITH A POTENTIAL SHORTFALL

There are several ways a potential shortfall might be met.

First, the evaluations in this post assumes that the end of the heating season allow the U.K. storage facilities to end at a comfortable level of 20 % of present total working gas capacities or around 800 Mcm. It would be possible to reduce or eliminate this margin.

A second option might be to increase LNG imports. This is the option assumed in National Grid forecasts, and underlying recent and planned additions to LNG infrastructure.

According to my calculations, if LNG alone were used to offset the shortfall, and additional LNG imports could begin the 20th of December, about 23 Mcm/d would be needed to bring supplies to fulfill modeled demand, and leave 800 Mcm in storage at the end of March. If imports do not begin until approximately the 20th of January, an additional 33 Mcm/d of LNG would be needed. The current amount of LNG imported is somewhat less than 10 Mcm/d. Increasing imports by

this amount would amount to roughly tripling or quadrupling the amount of imported LNG, from its current level. An additional 33 Mcm/d of imports would equate to approximately 7% of world demand.

The Isle of Grain has recently expanded its LNG import facilities, so that imports of this level are theoretically possible. News reports indicate that additional supplies are being procured from Qatar, but it is not yet clear how much these new supplies will amount to and when they will start to arrive. Published reports do not yet show a significant increase in imported LNG.

A third option, if inadequate LNG is available, might be to do some fuel switching with respect to electrical supply. Natural gas used in electrical supply is expected to reach 100 Mcm/d (about 28% of total natural gas consumption) during early 2009. If another fuel could be substituted for portion of this 100 Mcm/d, this would reduce the storage draw-down.

The recent distribution of fuel used for electrical supply is as shown in Figure 08.

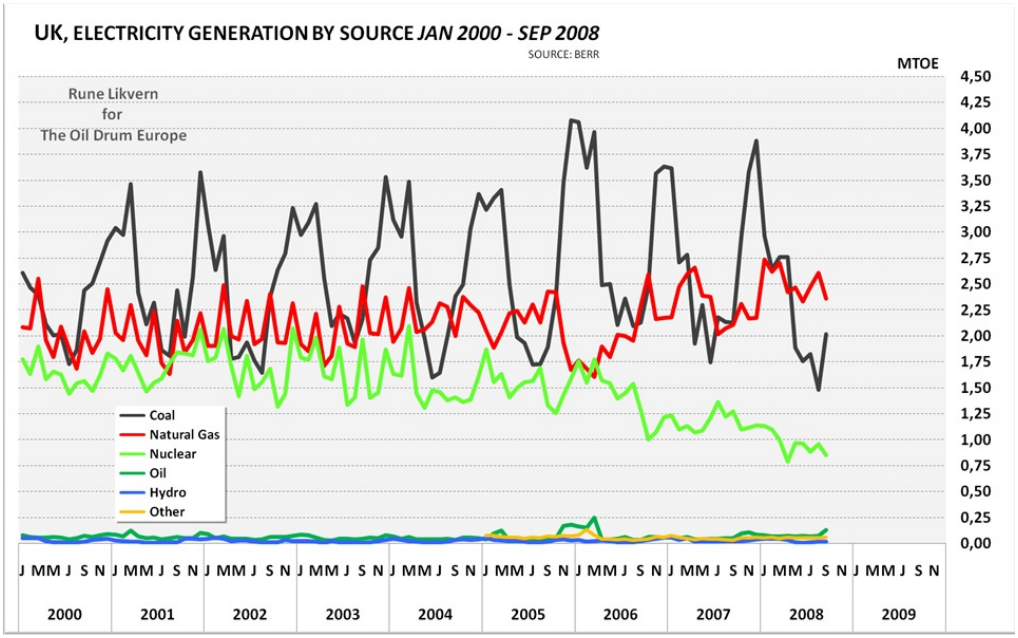


FIGURE 08 *U.K. electricity generation by fuel source.*

In the winter, coal is the single largest source of electrical power. Nuclear power has been declining due to plant closures. Natural gas consumption used for electrical power has been trending up. Natural gas consumption for U.K. electricity generation grew by 20 % between Q3 2007 and Q3 2008.

One fuel switching approach would be to replace some of the natural gas generation with oil. It takes around 0,1 million barrels per day (Mb/d) of distillates to substitute for 16 Mcm/d nat gas, so in theory, 0,625 mb/d of oil could substitute for 100 Mcm/d of natural gas, if all nat gas generating facilities are dual fuel and distillate is available.

It is doubtful this much oil generation capability exists, since Figure 08 shows little use of oil in the past several years. National Grid also seems to question the feasibility of much switching to oil. Point 24 on page 4 in National Grid's "Winter Outlook Report 2008/2009" says:

> We continue to believe that the switch to distillate would occur based on a gas price signal but there may be practical issues about how much switching would actually take place.

Another option, which would probably be considered unacceptable by most because of climate change issues, would be to import more coal, and use that to substitute for some of the natural gas used in electrical power generation. Coal fired generation is normally used only for a short period. If it were used for a little longer, it could permit more natural gas usage for other purposes. Based on Figure 08, this approach appears to have been used in early 2006.

If these options are insufficient, the only remaining option may be to cut off interruptible supplies, or to cut off other low priority supplies. From Figure 01 (above), it may be deduced that total U.K. industrial nat gas demand runs approximately at 60 - 80 Mcm/d. Most likely, this would be cut off, before electrical or residential production would be affected.

All of these approaches relate to total exhaustion of available working natural gas in storage over a several month period. There is also the issue of being able to meet natural gas demand on an individual cold day. The approach for an individual day would need to be similar. It is likely that some cut-off of interruptible power supplies would be needed on very cold days.

U.K. NAT GAS PRICES

The price of natural gas in U. K. is important, because it helps determine the amount of imported natural gas available, both as pipeline imports and as LNG imports. Presently U.K. nat gas is traded at around 60 p/therm (day ahead) at NBP.

At this price, it is unlikely that natural gas supplies can differentially be moved to the U. K. The necessary price to shift supply to the U. K. will change as prices for oil and natural gas change around the world. Based on prices as they are today, it seems to me that a price in excess of 100 p/therm will be needed to move additional supplies to the U. K. I talked about this in an earlier post.

In November 2008, Russian natural gas was trading in Germany at around 110 p/therm (US$ 16 - 17/Mcf) at present exchange rates. If this reflects nat gas prices at the margin from Continental Europe (plus transport and administrative costs etc.), this suggests that U.K nat gas day ahead prices need to exceed 120 p/therm this winter to attract any meaningful supplies from Continental Europe.

As I noted earlier, there is little possibility of increasing imports from Norway at any price, because nearly all of the production has been sold, and this winter there is little or none available for purchase.

The situation with LNG is less clear. Much of this is under long-term contract, and is not available on the spot market. With oil prices now relatively low, and most countries in recession, it is possible that there will be LNG available for a lower price than would otherwise be the case. A price higher than 60 p/therm would still seem to be necessary to obtain supplies, however.

One problem in planning for the future is that people assume that the future will be much like the past. If there was not a huge need for additional sources of natural gas supply in the past, the assumption is that there will also be little need in the future. One of the issues has to do with human nature and steep discount rates, which Nate Hagens has written much about, as in I am Human, I'm American and I'm Addicted to oil.

The article linked to above describes how we weight the present much more than the future when making decisions. In other words, if people experience cold during the winter, most will not care about the natural gas price at the time of the purchase, but when the bill arrives later in the spring then..... much may be changed.

BEYOND THIS WINTER

The results from the simulation of the remaining winter U.K. nat gas supply/demand show that there is a possibility that the U.K. storage facilities will become fully depleted by or before the end of this winter.

Next winter is likely to have similar, or even worse, problems. U.K. indigenous nat gas supplies are forecast to continue their decline. It is unlikely that any future increase in pipeline imports will fully compensate for these declines.

Two factors:

- increased need for refilling of the U.K. nat gas storage facilities and
- continued indigenous nat gas declines

are expected to further tighten European nat gas markets in the near future and thus support an upward pressure on U.K. nat gas (and electricity) prices. It is likely that this will also affect the nat gas markets in Continental Europe, inasmuch as less natural gas from the U.K. will become available for export to Continental Europe through the Interconnector.

As Continental Europe's production of natural gas declines, their export potential towards UK will steadily weaken. This will increase demand for supplies to Continental Europe from sources like Norway, Russia, North Africa and LNG to maintain present or growing consumption.

More posts on U.K. nat gas supplies:

Will UK face a nat gas crisis during this winter (Part 1 of 2)

Why UK Natural Gas Prices Will Move North of 100p/Therm This Winter

Daddy, will the lights be on at Christmas?

SOURCES:
[1] BERR; ENERGY DATA, tables E T 4.2, 4.3, 4.4, 5.3
[2] National Grid; Winter Outlook Report 2008/2009
[3] National Grid, data from their webpages
[4] National Grid "Gas Transportation Ten Year Statement 2008" December 2008