Operating the electricity networks in 2020

Flexitricity response to National Grid's initial consultation

Underlying assumption: generation mix

Table 1: "Gone Green" scenario includes a large amount of fossil fuel capacity, and expects it to flex, presumably more than it does at present. Efficiency declines when thermal generators operate at part load. Has this been considered in calculating the generation mix that achieves the desired 2020 CO_2 reduction? If not, the nuclear and wind components of capacity required to meet the 2020 targets are understated.

Underlying assumption: "residual" balancer

Throughout, National Grid (NG) assumes its role is "residual" balancer without questioning what constitutes "residue". Ignoring system effects, residue is the net error in the aggregate of wholesale trades. The Licensed Generator component of residue (or imbalance) is effectively captured in National Grid's statistical plant availability factors, and the problem is largely one of determining the appropriate values for these factors.

However, the (large) Licensed Supplier component of imbalance is assumed to be in some way a continuation of what has gone before. This is artificial, because Suppliers are just as capable as NG of improving their forecasts of demand and of embedded generation up to gate closure. They are also capable of installing communications and control equipment to manage their positions within gate and to provide balancing services within gate.

A large contributor to Supplier imbalance at gate closure is the asymmetry in the incentive to balance. NG operates to a 1:365 security standard, and exceeds it by an order of magnitude, presumably because reputational and other impacts of major system failures are severe. Suppliers, on the other hand, face only financial penalties. These are weighed up against the cost of prediction and control systems, and of changing business practices.

A fundamental question for National Grid, which is not raised in this consultation, is whether it is appropriate to attempt to reduce the "residue" which falls to National Grid by improving the pre-gate performance of Suppliers. Additionally, it should be asked whether Suppliers' consumption accounts should become active in the Balancing Mechanism, with bids and offers being posted at non-sleeper prices and accepted by National Grid within gate.

These changes would require that Suppliers invest in control and prediction capability, in partnership with their customers (especially industrial and commercial, but also domestic and SME through smart metering systems).

We do not believe that the danger of "sterilising" capacity suggested by paragraph 4.24 is real, because wholesale market participants have historically lagged behind National Grid. The reverse proposition is more valid: if reduced wholesale imbalance is desirable, Suppliers should be encouraged, incentivised or required to raise their game.

This will naturally reduce National Grid's need to purchase balancing services, and will also allow each opportunity for improved demand-side balancing to find the route to market which is most appropriate to the technology concerned.

General comment: role of Distribution Network Operators

DNOs do not operate their networks for National Grid's benefit. Most have historically resisted embedded generators, and some continue to do so. The 27/05/2008 incident may have revealed some conflict between G59 and G75 standards (which protect local networks) and National Grid's need for stable generation (keeping generators on in a frequency disturbance). We believe that National Grid's perspective on embedded generation and demand-side balancing services should be communicated to DNOs and considered in preparation of any distribution network related standards.

DNOs have stress points in their distribution networks, and it is recognised that such stress points could be relieved through embedded generation and short term demand reduction, in an identical manner to the ancillary services procured by National Grid. This may create competition between National Grid and a DNO in purchasing the flexibility of a particular demand-side provider. However, there is a correlation between National Grid's needs and those of DNOs. While competition in purchase is a good thing, it may not be efficient to disallow overlap between transmission and distribution purchases.

Responses to specific questions

Q3: The flexibility in supercritical coal is not uniform. Two-shifting could be highly damaging to designs with the highest base-load efficiency, whereas dynamic frequency response is probably within the capabilities of most designs (albeit at reduced efficiency).

Q4: The economics of nuclear generation are dominated by capital repayment, and require that gross MWh generation be maximised. Whatever their technical capability, nuclear generators will seek base load operation wherever possible.

Q8: Cooling demand is rapidly increasing, driven partly by the Moore's Law growth in datacentre capacity. The economics of datacentres are characterised by a need to maximise the percentage of floorspace which is productive, therefore space for infrastructure is constrained. Consequently, virtually none of the new cooling load is associated with thermal storage. This is a substantial missed opportunity.

In general terms, National Grid should address this by educating industry on the value of deferrable energy consumption. This requires more intensive marketing efforts by National Grid and aggregators, and may also require greater flexibility in contract forms.

Q10: We agree that demand-side services will grow substantially. Flexitricity is the only open-market aggregator (as opposed to "agent") presently active in the GB market. We foresee very substantial growth in aggregation of demand-side services, both by ourselves and by others attempting to emulate our model.

We do not foresee rapid progress in demand-side aggregation done directly by Suppliers, as they lack sufficient imperative to participate in system balancing from their consumption accounts (as discussed above).

Several DNOs are considering development of balancing services analogous to those purchased by National Grid for their own network needs, and some are considering the potential overlap or correlation between transmission and distribution needs. However, it is not yet clear at what speed the DNOs will emerge as contributors to National Grid's balancing requirement.

The potential contribution from small demand-side elements such as electric vehicles (EVs) and smart appliances is very large, but none will emerge without both standardisation (to give manufacturers and purchasers confidence, and avoid a VHS/Betamax conflict) and open protocols (to allow post-deployment enhancements by innovative third parties). Over-simplification of smart metering or EV requirements will turn a roll-out into a lock-out.

Q12: It is not valid to *assume* that EV charging will be co-ordinated or react to price signals. On the contrary, National Grid must *insist* that it be so, and strenuously object to any proposed roll-outs which do not facilitate such co-ordination. It would be informative to see a version of the 2020 scenarios in which EV charging peaks just after the evening rush hour.

Q13: It is not apparent that National Grid has considered the flexibility inherent in CHP, especially district heating and absorption chilling (CCHP/trigeneration) systems. The driving commodity in such installations is heat (coolth) which can be cheaply stored if storage is designed in. Such storage decouples heat (coolth) production from electricity production over operational timescales. Flexitricity has already demonstrated the potential for such systems to contribute to National Grid's balancing needs.

Q16: We refer to our earlier comments on Supplier imbalance.

Q17: Low wind events clearly must be considered in evaluating operating margins. More generally, National Grid has taken a reasoned position based on technical arguments. Public discussion of wind energy is enhanced by National Grid's approach.

Q18: We question the availability factor ascribed to new nuclear build. It seems highly unlikely that new nuclear designs will exceed the availability factor of established coal generators by ten points.

Q19: Flexitricity is not a wind farm generator and therefore does not directly manage periods of low wind generation. However, our role as a reserve provider and "virtual power station" operator is to contribute to the reserve generation and demand reduction which manages these periods. We believe that periods of low wind generation should be managed using demand-side measures, including:

- Increasing electricity generation at embedded CHP and CCHP stations and storing any heat or "coolth" for later consumption;

- Aggregated despatch of deferrable loads for short periods while other generators are warmed, relying on on-site storage of the commodity produced by the electricity load concerned to ensure that such deferment is non-disruptive;
- Operation of existing standby generators.

Q20: Any use of interconnectors to satisfy a reserve need in GB immediately creates an equivalent reserve requirement at the other end of the interconnector concerned. Conversely, heavy interconnection over a wide geographical area substantially reduces the effect of variation in renewable generation. Engagement with other EU system operators is vital.

Q21: National Grid has made very little mention of energy efficiency in the consultation. In general, National Grid treats total GB TWh demand as an input number which it cannot influence. We believe that this is an omission, and that National Grid should become more involved in the promotion of energy efficiency as an essential part of system security.

Q22: Please see our response to question 41.

Q25: Greater access to "active" bid prices for wind generators would be obtained with active participation in the BM by Suppliers, as discussed above. Currently only around one third of wind generation is transmission connected. However, please see our response to question 26, which we believe is more important.

Q26: Rather than assuming that wind can be bid down in preference to nuclear at minimum demand, National Grid should be more pro-active.

Bidding down wind causes an environmental opportunity cost: a chance to generate electricity at zero marginal carbon has been lost. Nuclear fuel considerations mean that marginal nuclear electricity is not zero carbon. However, nuclear stations must maintain base load running for many reasons.

Minimum demand conditions should therefore be seen as an imperative for the deployment of electricity storage systems. Rather than volunteering wind curtailment as a solution to the problem, National Grid should use its 2020 scenario to quantify the required storage volume.

Q27: We make the following observations:

- We believe that market participants' imbalance will not improve without significant changes to the imperatives on Suppliers to balance or actively trade their consumption accounts.
- The volume of flexible embedded generation and demand modulation available for exploitation is of a similar order to the anticipated increase in Short Term Operating Reserve Requirement. Most of this could become available to National Grid without major changes in the manner in which National Grid purchases balancing services. In particular, it is not necessary, in the main, to reduce real-time reporting standards to allow demand-side participation.
- We question the validity of the assumptions concerning wind imbalance at gate closure. These figures will only be achieved if market mechanisms make imbalance sufficiently expensive.
- As has been noted, NIV is an artificial figure; a product of market rules rather than technical capability.

Q29: We agree that National Grid's System Operator role must be facilitated with highly capable technical infrastructure, and that the proposed investment is justified. We strongly believe that interfaces with demand-side participants should be improved together with core systems.

Q30: Factors which could restrict the emergence of the flexibility required by National Grid include:

- For multiple, very small sources such as EVs and smart appliances, a failure to standardise, over-simplification of technical requirements, and closed protocols;
- For industrial and commercial scale systems, continuing use of out-dated and unreliable despatch systems;
- For all sources of demand-side flexibility, failure by National Grid to commercially support and make operational use of viable and compliant demand-side opportunities;
- Any concessions on the standards required by National Grid which lead to poor performance by demand-side flexibility, thus lessening the willingness of Grid's operational engineers to make use of it.

Q31: We believe that existing communications infrastructure already provides far more bandwidth than is required to meet all of National Grid's current and future balancing needs from demand-side participants. However, the security and resilience of these networks (and the particular ways in which they are used) must be monitored and subjected to continual improvement.

Q32: Real-time interfaces between National Grid and embedded generators providing balancing services are available using technology already developed and deployed in the market. Information-only communication between National Grid and other embedded generators could be implemented quickly using this same technology. Central processing and aggregation of this information could provide a forward view of large tranches of embedded generation in tractable form.

If this type of service would be valuable to National Grid, it could procure it relatively cheaply without any requirement for major modifications to codes or the imposition of costly reporting requirements (which embedded generators would resist). Voluntary participation at no cost to embedded generators may be an attractive starting point.

It is not necessary or reasonable to place embedded generators into the BM or under Grid Code. Nor is it necessary given current technology to accept over-simplified, and therefore uninformative, reporting from embedded generators.

Q33: Distribution network considerations currently prevent embedded generators from providing black start or reactive services. Should the provision of these services become restricted, National Grid should enter into dialogue with DNOs on this subject.

Q35: The potential for EVs to provide balancing and other services has not been overstated in the consulation. However, very little of this will be delivered unless National Grid insists on it through the application of standards. This will require engagement with manufacturers, aggregators and government.

Q36 and Q37: Deferrable load is not a constant, but is subject to two variables: the degree of disruption associated with deferment, and the degree of firmness in its availability. These two are related in a non-linear fashion: if a load is working to keep a process parameter within a critical limit, the load cannot be deferred without disruption.

Flexitricity's research has confirmed that non-disruptive load deferment could be practiced by well in excess of 1GW of electricity demand (in addition to that already responding to triads). The firmness of this load is highly variable, which means that it cannot contribute to operating margins without the application of continuous predictive methods.

This means that National Grid's current procurement methods (which require week-ahead commitment) may be poorly matched to a gigawatt-scale tranche of potential demand reduction. National Grid is encouraged to develop more flexible procurement mechanisms, which pay in accordance with the contribution made by a particular tranche of deferrable demand to the operational planning cycle. That is, load which provides firmness sufficiently far ahead that a BM Startup instruction is not issued should be paid in accordance with that contribution. Load which provides firmness only within gate should be paid less.

Q38: Please see our response to question 13. District heating and combined cooling, heat and power installations can effectively store electricity by proxy, using technologies which are much simpler, cheaper and more commercially viable than chemical or kinetic storage. Thermal stores (hot water, phase change materials, thermal mass) allow electricity generation to be deferred or advanced in accordance with National Grid's needs.

Q39: The large installed base of standby diesel generators (estimated at between 14GW and 20GW) removes the need, business case and environmental arguments for new OCGT in anything other than a black start role.

Q40: Table 14 considers very small demand-side participation, and large industrial sites, which are effectively transmission-connected. The vast majority of UK industry falls between these two extremes, and is capable of providing frequency response, fast reserve, fast start, STOR and energy balancing services at multi-GW scale.

Q41: Consultations, forecasts and outlook reports provided by National Grid inform discourse and assist in business planning. We look forward to regular updates of the 2020 outlook, with comparisons to forecasts, and to the 2025 consultation.

Q43: Please see our response to questions 36 and 37.

Q44: We believe that this question has been posed in reverse. We do not believe that National Grid is in danger of reducing the performance of wholesale markets. National Grid's procurement of balancing services can force improvements to the efficiency of wholesale markets, or partially compensate for their inefficiency.