RSE Submission Electrical Supply- Constraints and Direction

Background Circumstance

The dilemma of energy provision has been the victim of populist pressure over global warming, induced by an uninformed media in a vortex of institutional hubris. Energy provision is not the only casualty, scientific integrity has been undermined and tolerance of differing opinion rejected. Its worst manifestation has been the widening gulf between rich and poor where the mechanism contrived by politicians to pay for mitigation of the problem was concealed within consumer purchase instead of through general taxation. In future years historians will compare such folly to medieval flagellation and renaissance witchburning. The essential failure has been one of perspective where mitigation was sought instead of adaptation.

Throughout history commercial interest has always underpinned these contentious social bandwagons creating a momentum of its own. The rigidity of institutions, especially when international, sustain this herd mentality until tts inherent contradictions are seen to become destabilising. Already reality of global warming has not been squared with forecast, heavily reliant on computer prediction that in itself has been discredited with financial instruments. The obsession with levels of carbon dioxide pale in comparison to water vapour, represented by cloud cover as a mechanism for retaining heat on the planet. Furthermore the contribution of man-made carbon emissions represent a twentieth of that produced by natural processes, not withstanding the significant level of plant growth stimulated by such minute increases. Given this perspective it beggers belief that political direction has allowed the enormous cost of supporting subsidy to continue its destructive process, subverting efficient wealth creation thereby undermniing social cohesion. The Trump phenonema and Brexit are an inevitable outcome.

Subversion of Wealth Creation

Electrical supply provides a revealing example of how this process has subverted wealth creation. EU targets for carbon emission reduction by 2020 place 54% of this burden upon the industry(1). When energy costs are the bedrock of living standards there can be no surprise these have fallen over the past decade for the greater majority of its citizens. Any serious attempt to meet such arbitary targets would surely have to include a reduction of air transport movements that at over 100,000 a day worldwide contaminate the fragile troposphere. The absence of restrictions with the transport of unseasonal foods and international tourism are no doubt seen to be politically unacceptable. The greatest concern over such targets lie with unintended consquences, especially as scientific and technical issues become subordinated within the political process of EU decision making. The concealed penalties for non-compliance of targets by 2020 raise further concern. These subsidies and rigid constraints imposed across Europe have profound economic implications becoming hostage to fortune. This is the threat from EU bureaucracy.

Already these strains are apparent with rising fuel bills, power disconnections and reduced security of supply. The leading nation of Europe, Germany with the highest level of renewable transition is not only prominent with these consequences but has increasing carbon emissions(2). In the Western world this dubious distinction is led by Australia having a minimal carbon contribution worldwide that has conspicuously failed to prioritise power security over renewable investment(3). This at a time when investment in coal generating capacity across Asia (the main emitter of carbon) is at record levels(4). What bureaucrats cannot grasp is changes in technology provide options that make void the original direction of support.

Technology Change and Competition Constraints

The technology of hydraulic fracturing has transformed the entire energy sector whereas misplaced confidence with energy storage techniques and certain renewable marine developments have shown little promise. Supercritical technology has raised efficiency of coal use. Institutional structures compound the benefit of technology change where subsidies in a system of private enterprise stimulate investment at the expense of viable options..Within the UK the separation of generation and transmission has encouraged transmission investment projects such as Beauly to Denny, Caithness to Moray, Hunterson to Wirral and cross border upgrading, all around a billion pounds apiece. In addition the intermittence of renewable sources and the obligation to accept their output introduce many operational inefficiences, raising costs above that for subsidy, ultimately reaching the captive consumer. Grid System costs are not subject to open competition and with generation supply represent half of the bill passed to the consumer from a distribution provider. These suppliers have considerable capital and human resource at stake in producing an essential uniform unchanging product giving a circumstance not conducive to compete in an open market. The change of subsidy mechanism from Renewables Obligation to Contracts for Difference place the utility into the status of contractor, an unsustainable position where civil servants determine the future generation mix.

The only real competitive pressure comes from costs of generation that reflect capital decisions made over past decades. The distorted market has prevented fossil-fired generation investment as future load factor is so uncertain with renewable priority in operation and investment subject to varying fuel charges. A grid system cannot operate without dispatchable generation and interconnection raises many issues of security. Since privatisation almost all new generation investment has been short term, initially with CCGT gas turbines followed by wind resource having operational lives of twenty-five and twenty years (studies have indicated the latter to have an economic life of fifteen years(5)). Currently half of installed generation capacity on the GB Grid system is derived from nationalised investment from over twenty-seven years ago, revealing the scale of new dispatchable investment needed especially with the imminent retiral of the coal portfolio, bedrock of past electrical supply.

Capacity Margins and Security of Supply

Plant margins have been tight for several years, cushioned by mild winters and reduced demand. A repeat of the harsh winters earlier this decade when on five occasions with 60GW of system demand, performance of grid connected wind farms provided between 2.5% and 5.5% of their installed capacity(6). Together with the scale of ageing plant subject to breakdown and recent inclusion of interconnection as firm capacity, a precarious circumstance of supply exists over winter peaks. This situation is not helped by an optimistic assessment of plant availability and assumed demand. Already there have been two fire incidents with biomass removing 1GW of coal capacity. (Biomass is a euphemism for wood burning and is expected to provide around a third of the UK power supply target. Wood fuel having a ninth the heat content of coal, is processed and shipped from the US). Over the present decade the intensity of generation dispatch for balancing is expected to treble with rising intermittence. There is further concern with composition of a future generation mix and short term pressure for more interconnection.

Security of supply is a critical feature of electrical supply as production has to be almost instantaneous with demand. This issue is what distinguishes the engineer from the accountant and politician. There is strong economic pressure for gas turbine investment but in the absence of any coal portfolio becomes entirely reliant upon gas supplies shared with inflexible domestic heating and scale limited industrial demand. The use of gas for electrical supply dissipates half its heat content on conversion. Imported LNG supplies are seaborne and vulnerable with North Sea supply on a declining trend coupled to limited storage capacity of around 5% of annual demand. This constraint is absent from coal technology as supplies in excess of a year can be stored at site. There is further need for coal, not just as an alternative long term dispatchable source to compete with gas but for system security with inertia and voltage support, a much neglected and critical issue not understood outside of the industry. The electricity grid is a dynamic entity, inherently unstable, increasingly affected by what had been the static distribution sector, becoming overwhelmed by embedded generation sources of wind and sun. The emphasis on dispatchable sources for new generation capacity is compounded by the need for additional standby capacity for the expanding wind portfolio and a higher single event loss requirement with prospective nuclear committment. National Grid have estimated that by 2020, up to 12GW of flexible operating reserve will be needed. As stated in a House of Lords report, wind resource.is 'additional to', not 'replacement for' conventional capacity.

Likewise interconnection is beset with security issues. Undersea cable links are vulnerable to both accident and sabotage with long delays for repair, especially under winter marine conditions, needing highly specialised equipment and personnel. Supply is subject to separate jurisdictions by mutual consent. With the requirement of AC to DC conversion and reversal these projects are extremely expensive in excess of a billion pounds. Their essential purpose is for trading, demanding dispatchable capacity as back up. What should be abundantly clear is the urgency to provide dispatchable plant on a significant scale over a prolonged period. This issue is a UK national problem distracted by unproductive transmission investment where an estimated £9 billion of transmission expenditure to 2020 is expected (considered an underestimate) with 70% earmarked for Scottish requirements (7). Only recently has a £10 billion scheme for a tunnel connection across Morecambe Bay been put on hold. New transmission when approved for wind resource has load factors of a quarter. This utilisation is not efficient, neither are exacting GBSQSS standards for an intermittent source of generation, particularly when the prospect of renewable wave exploitation is unlikely to be fulfilled. When national electricity demand is concentrated towards the south-east the exploitation of Scottish offshore wind has a significant footprint with transmission infrastructure quite apart from the hazard to prolific sealife. Stranded assets with transmission or at least unfulfilled expectation are bound to become a problem in the circumstance of forced EU targets.

Investment in Scotland

With around 8% of UK population Scotland has installed half the national total for onshore wind. The system of subsidy in place is based upon energy produced lasting for a twenty year period. This circumstance places emphasis on the degree of interdependence for electrical supply across the UK,.with Scotland firmly embedded in the GB Grid system. Investment therfore has to be seen from a UK national

perspective and not distracted by a wish for an independent capablity. However EU proposals across Europe for transmission investment have been of concern for the scale of power flows they imply prompted by a renewable agenda. Not only are power losses an issue, security requires more localised generation, especially from an island perspective. Scotland should have a major dispatchable source of generation within the central belt given the demise of nuclear capacity over the next decade. Deep water access suggests imported coal although LNG supplies are also available with the prospect of indigenous supply when political constraints are removed..

Considerations from Brexit

The timing of Brexit has not come before time. A delay of a decade would have seen the UK so enmeshed into EU energy dependency as to frustrate the prospect of national independence. Even so the parlous state of UK power supply faces considerable challenges that will take decades to resolve. However the constraints imposed from EU direction can in due course be removed to promote our national interest. The targets and regulation imposed on electricity supply over this past decade has been a disaster from which its consequences will take many years to overcome. There is some consolation in knowing that the electrical supply industry in Germany has been even worse affected, relying on coal for dispatchable capacity.

With a legacy of so much intermittent capacity to absorb and nuclear provision facing even further delay there are developments that hold much promise for the future. Hydraulic fracturing has the potential to extract gas from sources across the UK(8). Tidal lagoons if intoduced on sufficient scale in a coherent manner could provide consistent and flexible power over the solar day, absorbing renewable power at times of excess supply, a far more cost effective solution than for pumped storage with its siting restrictions (9). These power sources can be located within existing transmission infrastructure in proximity to consumer demand, savings that have been ignored with renewable exploitation. These technologies provide much needed inertia to the Grid system as well as voltage support. In the case of tidal lagoons, operations can last for a century providing long term security from an indigenous resource, a major consideration given the state of the existing generation mix, soon to become dominated from short term power resources.

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The author is a retired grid control engineer of twenty years experience having chartered status from a decade spent on installation and commissioning at five power station locations across the UK, mainly nuclear. Further operational experience was gained on coal-fired generation and hydro-electric control under nationalisation.

References

1.UK consumption of energy diagram IET Journal February 2012 page 29

2. http://www.thegwpf.com/new-study-germanys-energiewende-threatens-to-become-economic-disaster/
https://www.thegwpf.org/content/uploads/2017/02/Vahrenholt-20171.pdf

3. https://www.thegwpf.com/the-disastrous-electricity-situation-in-australia/

4. https://www.thegwpf.com/southeast-asian-nations-plan-huge-expansion-of-fossil-fuel-economy/

5. http://www.ref.org.uk/publications/280-analysis-of-wind-farm-performance-in-uk-and-denmark

6. Analysis of UK Wind Power Generation – March 2011. Appendix C . John Muir Trust

7.https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48274/4263-ensgFull.pdf
.

8. https://www.thegwpf.com/content/uploads/2017/07/Shaleupdate.pdf

9.http://www.publications.parliament.uk/pa/cm201314/cmselect/cmenergy/194/194vw05.htm
https://www.gov.uk/government/news/independent-review-into-the-strategic-role-of-tidal-lagoons-in-the-uk-published