GB Energy and market restructuring can deliver energy security

Threats and opportunities

One of the key challenges facing the new government is energy. There is already a risk that as we become increasingly dependent on electricity and as supply becomes less easy to vary, power cuts may occur and the lights might have to be turned off. This already happens regularly in emerging markets and we should not assume that it cannot happen here.

But energy also presents opportunities. UK has amongst the widest range of renewable energy resources in the world, with wind, solar, marine and biomass options. Technology means that the relative cost of energy is likely to become increasingly important in determining an economy's competitiveness[1].

The new government's proposed new publicly owned Great British Energy (GB Energy) company together with a proposed radical restructuring of the energy market can allow us to minimise the risks of energy shortages and could make the economy more competitive.

The future electricity system is complex

In the past it was relatively easy to build and operate an electricity system. The demand pattern was predictable, and thermal generators could be ramped up and down to balance supply with demand. In UK the 'dash for gas' of the 1990s ensured a large surplus of capacity, and our nuclear programme supplied a secure base load. The laissez faire decentralised approach to energy provision suited the technologies of the 1990s.

But for the 2030s a different approach will be needed.

In future much of the generation will depend on the weather and the seasons. Each generation of technology has its own characteristics, and the location of the resources will impose their own requirements on the grid. By their nature, generators are unlikely to be built close to demand centres, and a huge expansion of the transmission grid will therefore be required.

An optimal power system will mix variable renewables (wind, solar and wave) with predictables (tidal range, tidal current) and always on base-load (nuclear) supported by dispatchable biomass. Batteries, pumped storage and energy exchange with continental Europe can time-shift supply to match demand. Security can come from gas-fired plant as backup – initially fuelled by natural gas but transitioning to green hydrogen.

Planning and operating this system requires a precise mix of technologies, not just to match power supply and demand, but also to ensure "ancillary services" are available: inertia to prevent system disturbances from cascading; frequency response to keep the grid frequency within acceptable limits; fast ramping especially in the evening, to make up for declining solar output when demand is rising; spinning reserve to provide back-up when a generator or transmission line fails; voltage regulation is needed in the right place, especially as distributed generation loads and unloads the system; if it all goes wrong, blackstart capability is needed to restore power to the grid.

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[1] According to the OBR, in 2019 in the UK, the energy share of production costs was 3.3% compared with a labour share of 71.5%. But new technology is likely to change this dramatically and make labour much less important and energy intensive information processing much more important. https://obr.uk/box/energy-prices-and-potential-output-a-production-function-approach/

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The laissez faire development of the power system of the last 30 years cannot work in this new environment without huge inefficiencies. Careful planning will be needed, with each plant carefully selected, located and configured to provide the precise services that the grid needs.

The elasticities of the fossil fuel market will no-longer exist

The UK's electricity market based on the auction system for electrical energy has worked reasonably well since the 1990s. The generation on the system had a wide range of marginal supply costs due to different fuels and different efficiencies of conversion, providing price elasticity that enabled the auction system to bring down electricity prices. Security was maintained by the large capacity margin resulting from the dash-for-gas, when it became cheaper to produce electricity from new, highly-efficient gas-fired combined cycle plant than old coal-fired steam plant.

But as the excess capacity has disappeared, the effects of the auction system have changed and as a result it now ensures we pay the most we possibly can for electricity. Despite only 32% of our electricity coming from gas (2023 – National Grid) the wholesale price of electricity is typically set by high-priced gas generation. Although the cost of gas, and therefore gas-fired generation, has fallen from its peak in the early days of the war in Ukraine, the current price is still two to three times its pre-war and pre-Covid level. According to a House of Commons Report, in the second half of 2023 UK's electricity prices were higher than any other country in Europe.

In future virtually all of the generation in UK will have zero or negative (in the case of nuclear) marginal cost of energy. Paying more for electricity will not make the wind blow or the sun shine more: the price elasticity that used to bring more power onto the grid as prices rise will no-longer exist. Although demand over the longer term is price sensitive, this elasticity is very low in the short term. A new market model is needed.

The system operator needs full control of deployment and operation

The requirements for the new market are fairly simple - it must:

- enable each facility (generators, transmission or distribution elements, storage facilities, grid support components) to be planned, configured and built in the optimum manner to meet the objectives of clean, secure and affordable electricity;
- allow the system and each component to be operated for the optimum benefit of the grid and the consumers;
- facilitate use of commercial capital for development of the new electricity system;
- avoid lock-in to long-term PFI style O&M contracts;
- allow equitable sharing of risk between consumers and the private sector;
- create a market that will ensure rapid construction of the required facilities.

Long-term planning is relatively easy. It used to be standard, and still is current practice in many countries, to produce a long-term power system development plan with a 20-to-30-year horizon, updated annually. It has become more complicated since the traditional planning tools balance power and energy over ½ hour or 1 hour time slots, and do not take account of the ancillary services that are needed. However new planning tools are being developed that address this.

Operating for the optimal benefit of the system requires the system operator to have full control of when generation is deployed. This may mean retaining energy in storage to insure against future shortfalls, even when short-term demand might encourage generation.

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The costs are huge, but most has to be spent anyway

The capital requirements to achieve net zero are huge: we estimate £900 bn at today's prices for generation; BEIS (now DESNZ) estimates £330 bn is required for the transmission and distribution system; we estimate around £200 bn is needed for storage to time-shift generation and provide ancillary services; add £6 bn pa to 2050 for research, efficiency incentives and to encourage decarbonisation of heating, transport, industry and agriculture, and the bill comes to around £1600 bn in today's money. It's a big number, representing some 2.5% of GDP to 2050. However most of it needs to be spent anyway, irrespective of net zero targets. None of today's generation apart from hydropower will be operating in 2050 – it all will need to be replaced. Similarly 70% of the spend on transmission is needed irrespective of green ambitions. Our estimates are consistent with McKinsey's estimate that most advanced economies will have to invest 2.5% of GDP in energy infrastructure to 2050 regardless of their net zero ambitions[2].

Cutting the cost of electricity not only requires an optimised electricity system – we need to revise the risk allocation strategy. Much of the cost of energy is payment for risk, and this is particularly true for capital intensive renewable energy. Allocating risks to the private sector crystalises the cost of the risk – the consumer pays a risk premium whether the risk materialises or not. Socialising risks among electricity consumers means risks are valued at their true cost rather than incorporating an inflated risk premium from the implicit insurance market and financial markets (some of which involves risks associated with impacts of government policy!)

Procure facilities, not energy

We propose one option for the new market, the public sector plans the electricity system, specifies and configures the facilities and invites bids from the private sector to finance and construct them. On completion the private owner leases the facility to a public entity which then takes full control of operation. At the end of the lease term ownership is transferred to the public entity, giving rent-free ownership for the residual life of the facility. This concept is known as FELT (Finance, Engineer, Lease and Transfer); a similar arrangement known as EPC-F (Engineering, Procurement, Construction and Finance) is favoured by the Chinese, and provides similar control of specification and operation, but ownership vests with the public sector from the start, which can complicate financial structuring.

In order to reduce costs further, construction finance may be provided to the private developer on concessionary terms from a revolving fund, reducing interest during construction and minimising the level of lease required to achieve commercial debt service cover ratios. The construction loan is refinanced after the start of operation, replenishing the revolving fund. This model is known as BELT (Borrow, Engineer, Lease and Transfer).

The role for GB Energy

The proposed model requires a publicly owned entity to undertake project preparation, act as asset owner/lessee and be responsible for (although not necessarily undertake) operation and maintenance. The proposed GB Energy seems ideally suited to this role. While seed money is required for project preparation, capital expenditure is financed by private funds, and GB Energy can facilitate huge investment from the private sector with leverage ratios of up to 50 times. The entire £1600 bn capital investment required could be mobilised by £40 to 50 bn of public money.

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[2] https://www.mckinsey.com/capabilities/operations/our-insights/global-infrastructure-initiative/voices/infrastructure-for-a-net-zero-economy-transformation-ahead

Under the proposed mechanism GB Energy could award short-term (5 to 10 year) contracts for operation and maintenance, ensuring value-for-money with break clauses and penalties for non-performance. Unlike PFI and most IPP arrangements, with ownership de-linked from O&M, change of O&M contractor does not impact the ownership or lease arrangement.

A change in policy is needed

The historic electricity market that served us well during the days of fossil fuel is not suited for our future Net Zero system. A model based on procurement of facilities rather than energy is needed to ensure the required infrastructure can be built on time; risks should be socialised among consumers to minimise costs, and ownership should be de-linked from operation and maintenance to increase the attraction to private investors such as pension funds. GB Energy can play the critical role in making this happen.

There is an opportunity to provide cleaner and relatively cheap energy that can boost economic growth with limited fiscal exposure in a way that is consistent with the government's policy intentions. We should take it.

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