Grid-scale electricity storage
enabling renewables to power the world
affordably, reliably and resiliently

Ofgem Consultation on Early Competition In Onshore Electricity Transmission Networks

This document is only a summary of Storelectric's consultation response, which includes all the documents to which this is linked.

Excessive Costs of the Current System
National Grid's (NG's) Network Options Analysis 2021 proposed ~£16bn grid reinforcement to accommodate ~17GW new offshore wind by 2025, almost £1bn/GW. This ignored that NG would also have to source balancing and stability services elsewhere, and connect those services, and manage the complexities and the disturbances between the source of the problem (the wind farms' grid connections) and the solution (the balancing and stability service providers' grid connections); Storelectric guesstimates the total cost to be of the order of £1.25m/GW capital costs alone. Based on previous reports, annual maintenance costs are ~5% of that, and management costs are also ~5%, so (even before considering the costs of the balancing and stability contracts) annual costs are of the order of ~£125k/GW.

Non-grid solutions to this have potential to provide enormous savings (well over 50%) on this, saving the majority of the grid costs of the energy transition. BEIS, Ofgem and National Grid are right to investigate ways of achieving this, and the Early Competition Plan shows great promise. Its main shortfalls are short-term thinking and a lack of joined-up whole-system approach.

Loss of Focus
The basis for managing and operating the electricity system should be best value-for-money for all consumers, long-, medium- and short-term, with a more-than-adequately reliable and resilient grid. This basis is mostly lost by the mantras developed supposedly to deliver it.

The mantras for BEIS, Ofgem and National Grid include:

1. Lowest-cost wholesale electricity, regardless of total system cost, which is why total consumer bills are such a political hot potato now and why Ofgem is involved in setting price caps for consumers.
2. Lowest cost now, sacrificing tomorrow's consumers on the altar of today's, explained in more detail below.
3. Ever shorter-term contracts, preventing large-scale long-term investment without special financial instruments, discussed in more detail below.
4. Not "picking winners", which has been derailed into the mistaken interpretation that no assistance should be given to any developer/technology, instead of offering the same opportunities for assistance to all.
5. Competition everywhere (derived from not picking winners) to the point at which developers are greatly discouraged from developing and putting forward imaginative proposals. A level playing-field would be achieved equally by allowing all developers equal access to bilateral negotiations, and agreeing contracts that reflect the modelled capabilities of each plant and adjusted for actual capabilities.

Which Consumers?
BEIS, National Grid and Ofgem continually (including in this consultation) focus on "value for money for consumers" but never define which; in particular, when. Over the last 30 years there has always been a short term focus as opposed to the medium and long terms, sacrificing the consumers of tomorrow on the altar of today.

As an example, the cheapest way to procure energy over a 2-year period is with a 2-year contract. The cheapest way to deliver it is with a fully amortised plant. At the end of the contract, it's won again in the same way, only the plant is older, more clapped-out, less reliable and more expensive to run. Over a 20-year period, prices rise gradually to be more expensive overall than having let a 20-year contract to start with. And the cheapest way to deliver a 20-year contract is to build a new and better plant, so the longer-duration contract provides for the ongoing renewal and resilience of the electricity system at cheaper overall cost. And the situation is getting worse, with moves towards real-time half-hourly contracts which are, of course, supported by incumbents because they know that it excludes major capital investment and hence new market entrants / competition.

This is why nearly all the major investment since privatisation (other than what was already in the pipeline at that time) has been against special financial instruments such as ROCs, OFTOs, CFDs, CATOs, T-4 Capacity Market etc. But each such instruments has rules and is therefore a market distortion.

Proactive Grid Development
It is worth recalling that the grid was only built because of whole-system, long-term thinking. For that reason, it was developed and extended based on forecast rather than current needs. This has been caricatured politically as "gold-plating the grid", with a focus over the last decades on increasing utilisation. But in reality,

- Building the grid in a measured and rational programme ahead of need is as much as two-thirds cheaper than building it reactively against need, as discovered in Australia; the Electricity Networks Association can cite excellent examples from South Australia and elsewhere, to support this statement.
- Even if such demand did not materialise at the expected time, it has materialised since, so the benefits of investing in such more rational and measured ways greatly outweigh the small number of years for which a given part of the grid was under-utilised.
- And the current method means that now there are large and unknowable numbers of projects that are just not being proposed because of the cost of reinforcing the grid to accommodate them, slowing down the energy transition and reducing the quality of the entire system.

What is Cheaper?
This focus on cheaper electricity costs and short-term asset sweating (known euphemistically as increasing asset utilisation, or investing according to actual rather than forecast need) leads to cheaper wholesale electricity prices. It also leads to letting narrow (salami-sliced) contracts to address individual challenges. However, to ensure that the grid remains adequately supplied, reliable and resilient (and greening), levies and

charges have increased inexorably because these matters are not embedded into the market mechanisms. This means that levies and charges are now a greater proportion of the electricity price than are wholesale electricity prices, and this trend/distortion is growing inexorably.

This salami-slicing also favours the narrowly-capable, smaller plants over broadly-capable, larger ones. If a plant can deliver a dozen services, it cannot bank on winning all twelve contracts every time they are built. Therefore it needs to recover its costs on an expectation of the number of contracts it will win (say, eight). This will increase its cost recovery rate by 50%, putting up the prices to consumers; and if the plant wins all 12, it would over-recover by 50% and so earn excess profits which the regulator cannot prevent as it's the cost of the commercial risk created by the salami sliced system.

This in turn means that the higher-value-added services (such as dynamic containment and frequency/voltage control) are let separately from the harder-to-let contracts (such as longer-duration ones), yet the plants that can deliver the latter need the former in their revenue stacks also; not having the former in their revenue stacks means that they have to recover their costs over only the latter, meaning that the whole-system cost is increased by the value of the former services that the more-flexible plants can also deliver cost-effectively. In other words, the system will be paying for excess higher-value services, and the means for such excess payment will be in the raising of the prices for harder-to-let contracts, so the problem will be mis-identified as high prices for the latter rather than the sourcing of too much of the former from narrowly-capable plants.

Short-Duration Contracts

National Grid has expressed bewilderment that, although market signals have shown over £100m p.a. costs incurred from constraints in the England/Scotland boundary regions, and shown such levels for almost a decade, no plants have been put forward to deal with them. In fact, this should be no surprise: it is due to the short-duration nature of contracts. If a developer were to spend millions on a plant based on the expectation of such revenue streams, there is no guarantee that the next year NG won't build some assets that remove or reduce them. For major capital investment, the market needs not only market signals but contract durations sufficient to recover costs. And the longer the contract duration, the longer the amortisation period and the lower the contract price – assuming that the asset has sufficient plant life.

Therefore short-duration contracts prevent major capital investment; and disincentivise long-lived plants more than short-lived ones. Hence, for example, the major build-out of 8-year-life batteries when 4-year contracts were offered, and no 40-to-60-year-life inertial storage plant was proposed for such contracts.

Less Reliable

It also means that the country now relies on imports through interconnectors during "times of system stress" (high demand and/or low renewable generation), and will continue to do so for decades to come, according to National Grid's Future Energy Scenarios and other such analyses from most analysts. This ignores two facts: (a) we can't rely on imports for our electricity needs, and (b) Brexit. We can't rely on imports because the

energy transition plans of all Western European countries except Iceland, Norway and Switzerland rely by 2040 on imports during such times, which are often concurrent in neighbouring countries: if all are importing, who is exporting. And Brexit means that we can no longer rely on contracts: we have moved from being legally a "domestic" customer to an export market, and it is not conceivable that any grid operator would tell their government that a black-out in a major city was because they could earn a few million euros exporting the energy that that system needed, whatever the contractual constraints. We were forecasting eventual black-outs for these reasons from 2015; the first occurred in 2019 (though primarily due to reliance on synthetic instead of real inertia, and there have been many near-misses both before and since.

Less Resilient
This approach has also led to the loss of resilience, including plants that can regulate the voltage, frequency, reactive power and recovery (including black start) of the grid. True, batteries can provide most of these, but dedicated batteries are needed; a large-scale long-duration inertial storage plant can deliver them concurrently with all the other requirements (balancing, ancillary services, stability services etc.).

And, by National Grid's own analysis, batteries cannot provide black start. Yet millions are still being spent on chasing this mirage, not only wasting those millions but also distracting the grid and regulatory experts from solutions that will actually work.

Lack of Whole-System Thinking
As the energy transition has progressed, one issue at a time has been identified (lack of new build, inertia, phase-locked loops, black start, voltage/frequency regulation, reactive power/load, wholesale price volatility etc.). These have been addressed one at a time, bringing in narrow contracts that are let separately, with the express aim of bringing new assets into roles supporting the grid. This is great, but such assets are small and of narrow capabilities, delivering only the capability sought and little else. Which in turn makes large and flexible assets impossible to build as their commercial risks are too great, even if they're exactly what the grid needs and what would deliver best overall value for money for consumers – see the salami-slicing link above.

This siloed thinking misses the fact that the entire suite if challenges has just two causes: short-termism (see above) and the replacement of inertial, dispatchable power stations with asynchronous, intermittent generation. And that the most efficient way to deal with the majority (not all – each technology has its place) of the issues raised is solvable most economically, reliably and resiliently using large, flexible assets, especially large-scale, long-duration, inertial storage which has (to date) not been built owing to all these adverse market and regulatory issues, as well as the regulatory mis-definition of storage. Thankfully, the need for longer-duration inertial storage is starting to be accepted, with the latest Future Energy Scenarios, some other analyses and BEIS' competition for longer-duration storage; some current consultations are also showing a measure of realisation.

Replacing this siloed, short-termist, blinkered thinking with long-term, whole-system thinking, evaluation and contracts will deliver a system that will address today's needs,

develop proactively for tomorrow's, and be cheaper for consumers in the medium and long terms; potentially also for short-term consumers.

Short-Term Thinking

The entire process of planning and regulating the grid is exceedingly short-term. The longest vision, NG's Network Options Assessment, focuses on a 10-year timescale; with such thinking, the grid would never have been built in the first place, leaving the entire economy struggling and held back. An example of such short-termism was the much-touted (though, thankfully, not achieved) "second dash for gas" to achieve 2025 emissions targets even though 2030 emissions targets would have turned most such power stations into stranded assets. The only way to avoid such waste is to prioritise 30- and 50-year timeframes – which will ensure a cheaper, more reliable and more resilient grid in those timescales without increasing greatly the cost to today's system/consumer.

As most grid-connected assets that are developed today will still be operational in 2050, all new developments must be one of:

- 2050 compliant (i.e. emissions-free);
- Convertible to 2050 compliant; or
- Short-life assets that will be replaced before emissions targets exclude them from markets.

If short-life assets, emissions relating to disposal and replacement should be taken into account, as should global resource availability in comparison with forecast global demand, e.g. lithium, cobalt and rare-earth metals.

Excessive Costs for Consumers

The result of all this is that system costs are rising so fast that a pro-market government has instructed a market regulator to intervene in the free operation of markets by imposing a cap on consumer electricity prices.

The poor design of market mechanisms means that all manner of levies and charges are added to electricity bills. A couple of decades ago, these totalled under 25% of consumers' bills, paying for grid upkeep, and balancing and ancillary services. Now they account for over 50% and still rising inexorably. This in turn means that plants are deriving a majority of their revenues from activities other than providing energy and the services necessary to maintain the grid, distorting market price signals; the price cap distorts them further.

An Alternative Approach

There is a very simple alternative approach to the regulation and contracting a 21st-century electricity system, which can be implemented step-by-step rather than as a "big bang". Not only will it deliver the major capital investment required by the system, and the total systems cost reductions, but also new technologies, innovation and "cleanness" (lack of emissions and other pollutants, and could include other considerations such as resource scarcity) can be incentivised without a penny of subsidy.

If the government then wishes to encourage the development of other technologies, any funding would be entirely separate and additional. This would reduce greatly the cost of

such public funding, as it would only have to cover a proportion (subject to match funding) of the difference between commercial and developmental costs.

Matched with this are other ways to incentivise R&D, first-of-a-kind plants and clean technologies, by the finance ministry and others. The more such measures are combined, the more affordable, reliable and resilient will be the energy transition and subsequent Net Zero energy system.

The Early Competition Plan

The basic ideas behind early competition are very sound, though some of the proposals, by failing to tackle some regulatory shibboleths, will prevent the best and most cost-effective solutions being brought forward, making the grid unnecessarily costly for consumers in the medium and longer terms, and rendering it less reliable and resilient.

For it to work in practice will need the following elements:

1. Anyone can propose projects for Early Competition.
2. Long lead times must be allowable: many technologies are prevented by the short lead times allowed for in contracts.
3. Many proposals cannot deliver grid benefits without also delivering contractual outputs; life-of-plant contracts should be granted for these.
    - For example, inertial storage cannot deliver constraint management or curtailment reduction without delivering inertia. It therefore needs to be remunerated for that inertia. See the salami slicing link above for further details as to the economic, contractual etc. consequences.
    - If the contracts were shorter than life-of-plant, then if the plant were to fail to win a follow-on contract, it cannot remove itself from the grid. In examples such as connecting more wind farms to grids because they're connected through storage, the storage cannot suddenly remove itself from the connection: firstly, very expensive work would need to be undertaken to by-pass it, and secondly, the grid would need reinforcing greatly to take the raw in-feed energy from the wind farm. Both aspects would cost the grid millions, possibly billions for the reinforcement. This would be an excellent illustration of the sayings "spoiling a ship for a ha'p'orth of tar" or "the battle was lost, all for the want of a horseshoe nail".

Going A Stage Further

For the network to be most cost-effective for consumers in the short, medium and especially longer terms, the following provisions are needed:

4. Any business should be able to propose any project that will benefit grid one-off and ongoing costs, regardless of whether constraints or other issues are highlighted in National Grid's (or the DNO's) reports.
    - Depending on the proposal, if it were to be tendered publicly, then all incentive for project developers to spend time, money and effort in identifying such projects would be unremunerated and discouraged from doing so, ultimately a huge opportunity cost for the grid and hence consumer.

5. Offers / enforceable letters of intent should be made pre-planning, and firmed up as projects develop through their stages; but should be quantitative at an early stage in order to attract private finance.
   - ♦ Such offers should be withdrawn if the project is deemed not to be progressing sufficiently.
   - ♦ Some changes in the financial values should be changeable:
     - ◊ Contract values in a letter of intent may be re-evaluated pre-construction, as the design evolves;
     - ◊ If the plant does not deliver all the capabilities, relevant reductions are made in the remuneration;
     - ◊ If taken out of service earlier, relevant refunds relating to NPVs of capital benefits;
     - ◊ If life-extended once in service, contracts (but not one-off benefits?) should be extended;
     - ◊ If upgraded, new contracts for the differential performance should be entered into.
6. The grid should remunerate any such proposal, without tendering to others, 50% of one-off and ongoing savings, and provide life-of-plant contracts for necessarily-integral services at 80% of market rates.
   - ♦ The 50% sharing ensures benefits for all.
   - ♦ The 80% of market rates reflects the reduction in commercial risk from (a) not tendering competitively and (b) life-of-plant contracts; it cannot be lower because the contracts are delivered by buying electricity in order to re-sell it again, and the cost of electricity is roughly 80% of a storage plant's operational costs. Indeed, the figure may have to be increased somewhat, if the plant is unable to trade sufficient other (commercially bid) contracts concurrently in order to make a profit.
   - ♦ Only "necessarily-integral" services are contracted in this way, as the benefits to the grid cannot be achieved without also delivering these services; other services provided by the plant are contracted commercially, in the normal way.
   - ♦ The consumer benefits by the savings (of which the grid operator may take a percentage to align its incentives too).
   - ♦ This does not offend against "competition everywhere" because all are able to make such proposals.
   - ♦ Nor does it "pick winners" because each project's remuneration would be against its own performance; better projects will receive more, and worse less.
   - ♦ This delivers Ofgem's fundamental purpose of delivering a reliable grid / energy supply for best value to consumers.

Roles and Responsibilities

Storelectric is less bothered about exact roles and responsibilities. In general, the TO or DNO should undertake such analyses and competitions, regulated actively by Ofgem.

Where contracts are involved, the ESO / DSO should also be involved, in providing a combined cost/benefit and in identifying the value of contracts to be let at 80% of market rates.

The Questions
S = Section (the first part of the paragraph number), Q = Question.

S3 Q1. Yes, it is good value for money for consumers to pursue this, but this value-for-money would be multiplied many-fold if the work were to include potential for other contracts, earlier legally enforceable letters of intent, and analysing/contracting proposals without (in some appropriate cases) competitive tender. If regulatory derogations and/or changes are needed, these should be considered positively.

S4 Q1. Stakeholders should be able to propose and explore (with the support of the grid operator and, where appropriate, the system operator and regulator) projects at any time, affecting any part of the grid. Maybe those identified by the grid operator are Early Competition, while those identified and proposed by others are Very Early Competition. These should be analysed to see if they should or should not be tendered competitively.

- Should: identified by the grid operator; stand-alone; identified by another party who has not invested a lot of effort and/or cash into the proposal.
- Should not: identified by another party who has invested a lot of effort and/or cash into the proposal; proposals for combined developments (e.g. renewable generation connecting to the grid through storage). As discussed above, this is not anti-competitive as all developers can make proposals and all technologies / projects are considered and remunerated on their own merits.

S4 Q2. Very early competition is likely to be proposed by a project developer. It should be evaluated on its own merits: the developer is offering to build a project that benefits the grid. The basis of evaluation should be to compare system costs (capital, ongoing [e.g. maintenance, management, control] and contractual [which would involve the System Operator]) with a view to sharing the capital and ongoing benefits 50-50 between grid/consumer and developer/operator, and a 20% discount on contract prices. The capital benefits sharing would defray some of the project's capital costs, and the revenues from benefits sharing of ongoing and contractual costs would provide a firm, long-term foundation to the revenue stack; all this would make many more projects commercially viable, and therefore undertaken and benefitting the consumer with lower overall system prices, and a more reliable and resilient grid.

Ref. 4.9, both early and very early competition should be followed: they complement each other and will deliver much more and broader-range projects than will early competition alone. This would not import uncertainty into the model (4.10), but instead would bring early sight of many projects to be able to plan the system more effectively with a longer advanced view of its development and needs.

S4 Q3. Ofgem proposes to favour Early Competition (whereby NG identifies potential projects for tendering via their annual Network Options Analysis) and seeks to drop the idea of Very Early Competition (whereby developers look at longer-term forecasts and propose their solutions for assessment).

Early Competition is good, but so is Very Early Competition: both should be done. Very Early Competition:

- Looks at longer-term needs;
- Enables all technologies to be proposed, not just those favoured by NG;
- Identifies more opportunities for system benefits than does Early Competition, because numerous developers with diverse solutions and approaches will consider more varied options.

For Early Competition (i.e. identified by the System/Grid Operator), there will need to be criteria of size/cost above which most developments should be opened up to early competition. But these criteria must be flexible: there will be many projects for which innovative grid planners can see major benefits although they fall below such criteria, and other situations above the thresholds in which new grid lines/substations will be required whatever else is invited.

For Very Early Competition, no threshold is appropriate for initial consideration. There should be a benefits threshold below which no contracts will be entered into by the system / grid operator, in order to avoid indefinite multiplication of tiny benefits, and developers "trying their luck" in adding some minor additional revenue sources. Such thresholds should be estimated during initial consideration and determine (challegeably) whether a proposal is given a detailed evaluation. There will need to be transparency on the costs and benefits, alternatives considered and reasoning for all such contracts, while minimising publication of any technically or commercially sensitive data; for example, the prices, costs and margins should be declared, but not the plant's cost breakdown.

S5 Q1.
I believe that the ESO should indeed be the Procurement Body, with full oversight by Ofgem. This may be enhanced by the proposed full separation of ESO from TO, though we don't have firm views on that.

S5 Q2. The proposed roles are fine; alternatives would also work – the key will be in the regulatory supervision.

S5 Q3. The ESO (and DSO) should plan their networks, tasked with undertaking 10-, 30- and 50-year planning. TOs (and DNOs) should be consulted extensively on it, as it pertains to their remit and expertise too. Ofgem should participate too, with one of their explicit remits being to avoid "capture" of the SO by the TO.

S5 Q4. Option 2 looks better: the SO's role is much more long-term whole-system than the TO's, and the TO is incentivised (by the RIIO cost-plus framework) to build ever more grid assets. TO should be banned from participating in Very Early Competition.

S5 Q5. The principal difference between the proposed counterfactual approach and TO bidding on the same basis as other bidders is principally in the timing: the bids would be after publication of need, and the counterfactual would be published with the publication of need. The counterfactual approach is better because it sets a baseline against which all bids are assessed, which will have additional beneficial results in (a) leading developers to avoid putting forward more-costly schemes and (b) giving an idea of the contract values that can be expected. Without (a), small developers are excluded

because they don't have the resources to put forward many bids; and even large developers would have to bid more to price in a greater probability of failure. Without (b), many developers would be discouraged from proposing bids due to revenue/margin uncertainty.

S6 Q1. Yes.

1. Contracts should be life-of-plant, or at least long-enough life to amortise it.
2. Contracts should be renewable solely against counterfactual, not commercially tendered, at cheaper rates to reflect the amortised state of the plant but allowing for any refurbishment/upgrade costs, so that they are treated just like any other grid asset – this would minimise long-term costs for system/consumers. Plants would not be compelled to renew, but could withdraw from the system (with sufficient notice [e.g. 3-5 years] to run a competition for any unmet needs and then to build the replacement asset) if they wish. If a replacement asset will take longer to build, then there should be potential for compulsory life extension (at constant profit prices minus the completed amortisation plus that of any refurbishment required) to allow solely for such lead time.
3. A small proportion of the savings (as compared with the counterfactual) should be paid to the TO so that they are not penalised for non-grid solutions, but are instead incentivised towards solutions that benefit the system as a whole.

S6 Q2. No. But it shouldn't apply to the Very Early Competition model, which is an evaluation of a single proposal – potentially against a counterfactual.

About Storelectric

Storelectric (www.storelectric.com) is developing transmission and distribution grid-scale energy storage to enable renewables to power grids reliably and cost-effectively: the world's most cost-effective and widely implementable large-scale energy storage technology, turning locally generated renewable energy into dispatchable electricity.

- Innovative adiabatic Compressed Air Energy Storage (Green CAES) will have zero / low emissions, operate at 68-70% round trip efficiency, levelised cost significantly below that of gas-fired peaking plants, and use existing, off-the-shelf equipment.
- Hydrogen CAES technology converts & gives new economic life to gas-fired power stations, reducing emissions and adding storage revenues; hydrogen compatible.

Both technologies will operate at scales of 20MW to multi-GW and durations from 4 hours to multi-day. With the potential to store the entire continent's energy requirements for over a week, global potential is greater still. In the future, Storelectric will further develop both these and hybrid technologies, and other geologies for CAES, all of which will greatly improve storage cost, duration, efficiency and global potential.

About the Author

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A graduate in Physics with Electronics, he has 12 years' management and innovation consultancy experience world-wide. In a rail multinational, Mark transformed processes and developed 3 profitable and successful businesses: in commercialising a non-destructive technology he had innovated, in logistics (innovating services) and in equipment overhaul. In electronics manufacturing, he developed and introduced to the markets 5 product ranges and helped 2 businesses expand into new markets.