A FIRST PRINCIPLES APPROACH TO ELECTRICITY CODE REFORM

Some preliminary observations and thoughts

This is a short conceptual document intended very much as a first attempt to outline the logic of a first-principles approach to code reform. It is intended in the spirit of taking forward the conversation, testing assumptions and shared understanding, not as a fully-developed and illustrated argument for a particular approach at this stage.

What is the problem being addressed?

The fundamental problem we are trying to solve is how to deliver safe, secure, clean energy (in this case electricity) to the economy and society of the UK at a competitive cost.

Energy is fundamental to our economy and society, so the energy system cannot and must not be optimised in isolation from wider social and economic developments.

Put another way, energy needs also to be delivered (optimally) at an intensity, via vectors and at locations matched to the needs of changing contemporary and future economic and social activities – we need to support an evolving industry and society: electric vehicles and social media (and their successors) not horse-drawn carriages and printing presses.

We need this problem to be solved continuously in real time, so any approach must also ensure an optimised on-going programme of infrastructure investment such that we can continue to solve this problem competitively, taking account of demographic changes and unpredictable technical changes on both the supply and demand sides of the market.

This is a complex control problem, with many actors and relationships and significant and unavoidable uncertainty.

Many of the 'control signals' are also executed by human decision-makers, and it's important these people are embedded in institutional and legal structures which are sensibly aligned to the consequences of the decisions made. These consequences vary depending on the nature of the decision, for example:

- A decision to switch an appliance on or off has largely immediate consequences affecting a small number of people and can typically be made sensibly by an individual customer, taking account of price signals and other immediate local consequences, such as disturbing neighbours.
- A decision to invest in nuclear power plants has intergenerational-consequences at national and international levels and thus requires substantial political debate and reference to global standards and treaties
- A decision to make local electricity infrastructure more or less accommodating to distributed generation and demand-side technologies, and decisions as to how infrastructure costs are shared across geographies and sectors has medium- and long-term impacts on industrial competitiveness, the costs of energy, resilience of the system (etc). These kind of decisions require some degree of strategic risk taking by bodies accountable for economic performance and structural energy costs to end customers.

The existing UK energy system is broadly market based and recognises different potential decision-makers:

- ***Consumers***. These are conceptual beings who largely focus on short-term price and security of supply and are passive. They are good at driving costs down and very bad at seeing or driving change. The more advanced notion of '***customer***' is better at judging quality and may be wiling to participate in demand-side activities as a market participant, but is still very short-term in their contribution to decision-making. Neither consumers nor customers can be expected to understand how the energy system works, so they are not generally helpful at taking strategic infrastructure investment decisions or judging technical or strategic risk.

- ***Markets***. These are composed of lots of consumers or customers, but structured and controlled by the regulator. They are good at driving down prices but poor at judging quality, which depends on customers or consumers (see above)

- ***The Regulator***. A complex entity which includes and is dominated by Ofgem but should probably be more broadly defined to include all the industry forums and groups established by or to support Ofgem and manage the codes etc. The regulator determines market structures (i.e., decides who qualifies to be suppliers and customers/consumers and what the traded units are (kWh, capacity, DNO 5/8 year plans etc))

- ***Industry.*** Market supply participants, taking investment decisions based on the rules set down by the Regulator. Generally quite rational and predictable.

- *Government.* Supervises the Regulator and sets policy, thereby taking major national strategic infrastructure investment decisions such as the generation mix.

A large part of the problem is that none of these decision-makers is effectively equipped to take the kind of decisions required to optimise a diverse and distributed energy system. This is by definition sub-national.

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How do electricity codes relate to this problem?

The electricity codes detail governance arrangements for electricity market management in the UK.

They are a key element of the control system designed to solve the problem set out above, but their ability to deliver optimal outcomes is constrained by:

1. how energy markets are structured (what entities are assumed to exist for the codes to govern – e.g., system operators, DNOs, generators);
2. the information flows (inputs and output signals) these entities are able to accommodate, and
3. the degree to which the control system as a whole is aligned to the realities of the physical and economic system it is controlling. (A traditional light switch is fine for controlling a single ceiling light; somewhat less efficient when optimising lighting across an office complex).

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What are the realities of the physical and economic system being controlled?

Energy infrastructure options (including both generation and demand side assets: including 'technologies' such as buildings and batteries) are becoming significantly more diverse.

The costs and (instantaneous) economic value of generation and demand assets are becoming more variable and sensitive to context as many more (location-sensitive) renewables and (flexible, multi-use) demand-side assets become available.

Context includes (local) customer behaviour and attitudes – both of these can affect the costs and value of energy assets significantly.

Almost all the cost of most renewables and demand-side technologies is capital/infrastructure.

Electricity storage is becoming significantly cheaper.

Data processing and communication (ICT) costs are becoming extremely cheap.

The wider economy is becoming more diverse: there is a drive to develop local industrial strategies which recognise and build on the strengths of local geographies; substantial encouragement (and need) for greater innovation and commercialisation of innovation; and a desire and need for greater public engagement in economic and political developments.

In principle, higher diversity, greater engagement and faster innovation should lead to a stronger, more competitive and more successful economy.

Most customers have no interest or expertise in energy or energy markets but a high degree of interest in energy services. The quality of their local industry, housing and environment matters to them – all of which depend on an efficient and optimised energy system - and they relate to these at least as strongly as to many national issues.

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What does this mean for the electricity system?

An implicit assumption in current electricity market and code design is that the industry and society the sector serves changes only slowly, if at all, and the only efficient way to control the system is through a single national market structure.

The current control (governance) system only accommodates and responds to limited and simple signals from customers and supports limited variety in infrastructure assets. Much of the potential diversity and variety in the system potentially available for local and national optimisation (e.g., real-time price and demand signals at very local level) is not recognised at all. (This used to make complete sense, because previously higher costs of ICT and storage made collecting and dealing with such diverse information flows prohibitively expensive).

However, this approach is poorly aligned to the realities of the emerging physical and economic system described above, which means it is increasingly unlikely that we are getting optimal economic outcomes as a country.

While this situation is increasingly recognised by stakeholders, it isn't clear that we have an agreed national model for changing the system (hence questions like 'evolution or revolution?').

This creates a double 'whammy': not only do we potentially have the wrong system (so we need to design a new system architecture etc - lots of people seem to agree about this) we also potentially have an inappropriate model for changing the system. This means there is a high risk that the costs of getting from 'as is' to 'to be' are going to be a lot higher than necessary, plus 'to be' is probably not a static outcome anyway – there will be further and different 'to be's beyond this, so this cost and risk could get worse.

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Comparing models for change.

There is not just one way to change things in the sector. We should consider some alternative models.

Three are summarised below.

Model 1 – Incrementalist - the current default

Change is typically accommodated within the current structure by adding to the codes, which have consequently become complex to the point of impenetrability, particularly to the uninitiated (e.g., customers, innovators). This model of change broadly assumes continued presence and roles of all incumbent parties, and it gets harder and harder to sustain as the system struggles to accommodate new entities in the diminishing gaps between them…

In this model, scope for evolution is limited and revolution is disastrous, uncontrollable and very destructive. The struggle to resist revolution and evolve instead thus tends to delay change and handicaps wider economic and social development (because our energy infrastructure becomes out of step with economic needs and international competitors.)

This model of change is appropriate for governance of a system likely to change only very slowly, with fixed stakeholder groups who are not likely to change at all.

Model 2 – Managed revolutionary centralist

An alternative model is to take a small group of well-informed and expert people off into a (conceptual) room with a very large conceptual blank sheet of paper and redesign the governance system from scratch, taking as much data on board about market realities as possible.

Assuming the right experts are assembled this approach may generate an outcome better matched to significantly changed market realities faster than Model 1. Its drawbacks are:

- it's difficult to assemble the 'right' group before you know who the key actors in the future system will be
- it may be impossible to get a conceptual room or sheet of paper big enough to get a sensible handle on all the data and complexity that the actual energy system is now capable of handling at very low cost – in other words we end up constraining the ability of the new control system to govern and optimise the system because of the inevitably limited capacity of the designers
- it generates a subsidiary problem of how you get from 'as is' to 'to be' including getting buy in from stakeholders etc: this can be an expensive process, especially if we try to proceed by consensus (similar to Model 1)
- as soon as you've got to the 'to be' outcome – which may take some time - you risk being out of date and have to start again.

This model of change is appropriate to relatively simple systems, and can be particularly appropriate and efficient when they are exposed to significant change. However, the more complex the system and the more stakeholders who are involved, the more expensive and challenging and less efficient it becomes.

'Triage' is (possibly?) an adapted form of this, seeking to address the challenges of scope and complexity and speed by focusing only on the most critical issues, hence simplifying the problem (at the risk of constraining the degree of change and potential efficiency and effectiveness of the outcome).

Model 3 – Managed evolution

A third model is to break the system down into the smallest possible viable units and then encourage these to reform and re-negotiate relationships between each other within a (looser) national framework.

This is a more organic and adaptive approach to change, mimicking the way evolution works (nature's answer to the question of what is the most economically-efficient model for managing complex change with multiple stakeholders and actors).

'Triage' in this context might be used to identify what governance needs to happen at a national level and what can be left for evolutionary development within and between 'units'. In addition, once you get to unit scale, complexity may be sufficiently reduced (e.g., by the pragmatic realities and priorities within the unit, that a model 2 approach becomes viable – the local system is simpler and more accessible to an expert approach than the national).

The challenge in this model is agreeing what the ‘smallest possible viable unit’ is. It also assumes (or requires) a level of capacity, competence and responsibility at this level which may not exist or be aligned with evolutionary needs (species cannot evolve if they have lost key attributes necessary to engage with their environment).

In this model it may be helpful, when incumbent economic and political structures are particularly strong and entrenched, to create new units altogether (at an appropriate scale and with appropriate scope). These should cut across existing system boundaries and thus minimise the biases created by existing institutional and organisational structures defending their interests[1].

However, the model 3 approach is particularly appropriate when it is the system boundaries and system environment themselves which are changing, and new actors and agents are becoming important. It creates an opportunity to start from evolutionary ‘units’ which reflect these new agents and boundaries without adding either an impossible degree of additional complexity to an already complex problem (the risk in model 2) or bringing in powerful new actors to an already intractable political context (model 1). Again, the Chinese example (see footnote) is illustrative.

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Concluding thoughts

Devolved regions (i.e., 6-10 new democratic entities across the UK) are probably about the smallest possible viable units for a model 3 approach to change. They balance the need to support sufficient expertise, resources and risk with retaining local accountability, and they are the lowest political level where there exist distinctive and coherent strategic perspectives and oversight over critical determinants (arguably active elements) of the future energy system such as spatial plans, waste, transport infrastructure and local industrial strategy which still retain sensitivity to local and community context.

With reference to the analysis of decision-makers on pp1-2, introducing an additional substantive decision-maker into the UK energy market at this scale (i.e., an informed regional strategic customer) would also equip the country better at an institutional level to secure optimal outcomes from the electricity and energy system (i.e., systematically take properly-informed decisions through regulated markets).

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[1] An example of this approach was the use of Special Economic Zones (SEZs) in China in the early 1980s to introduce capitalism to the country. The granting of SEZ status to a (large) regional geography was a privilege earned by demonstrating appropriate competences to the national government. However, once attained it gave powers for the zone and the economy within it to evolve in wholly new ways (within the Chinese context). 40 years later, the Communist Party still controls China quite effectively from the centre, but the economy has been transformed, and there has been no revolution (nor upheaval similar to that which occurred in Russia, for example).