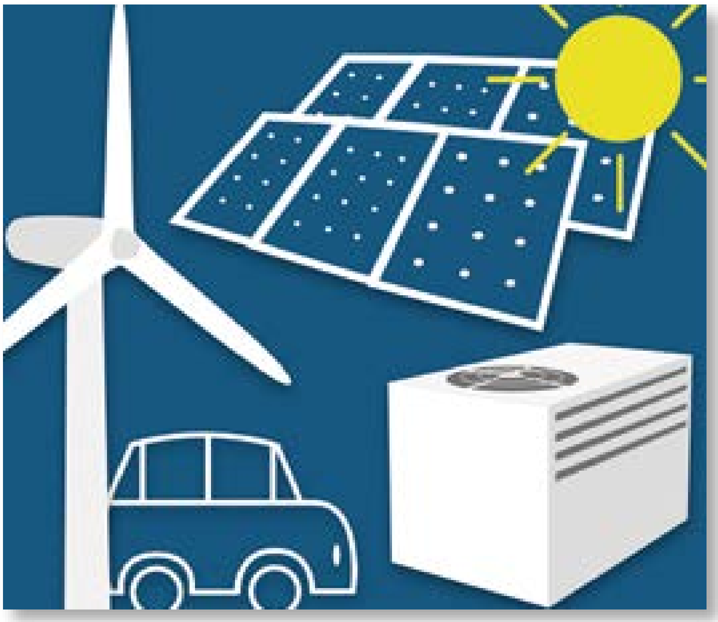
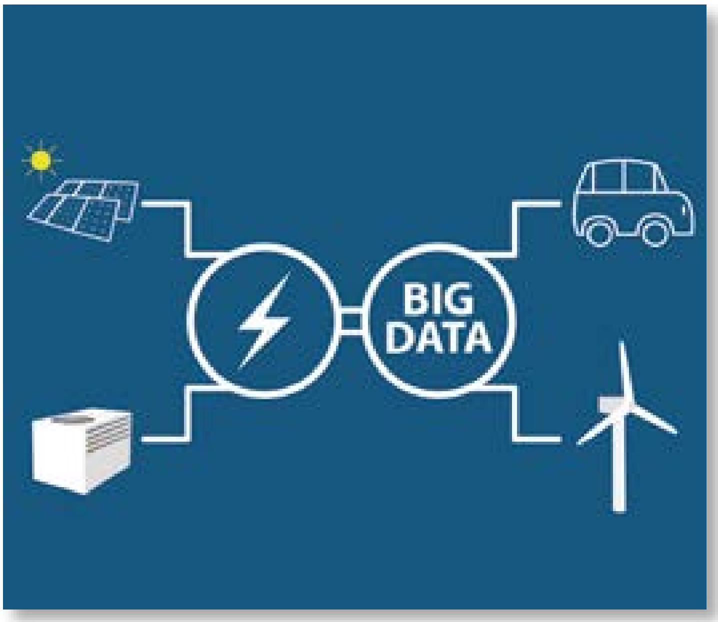
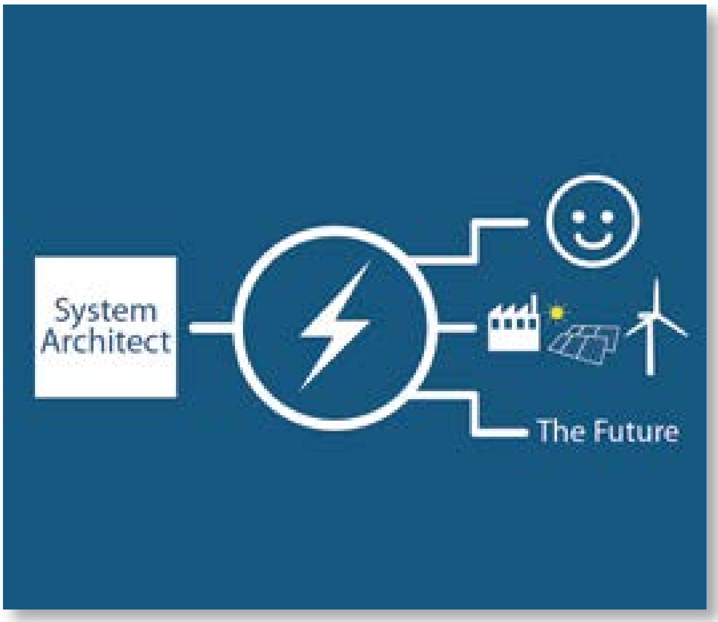
The Institution of Engineering and Technology

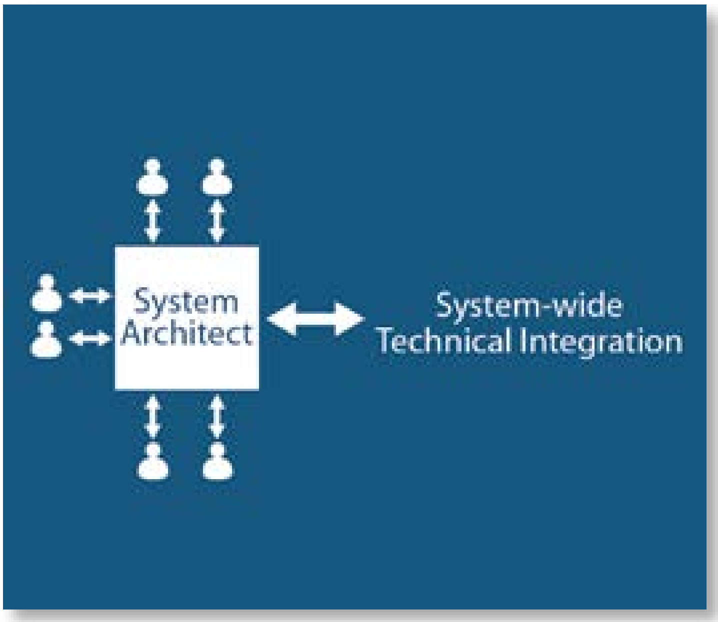
Britain's **Power System**
The case for a System Architect

A briefing paper









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Energy

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Briefing Paper Britain's power system: the case for a System Architect

8th December 2014 v 1.5

Britain's Power System: the case for a System Architect

Overview

What's the concern?

- There are fundamental changes now taking place that will have increasing and significant impact on Britain's electrical power system.
- The power grid is starting to migrate from traditional centrally managed and largely passive operation, to a highly distributed and more complex architecture.
- Today's technical governance arrangements are too fragmented to manage the seamless integration of numerous smart systems, under differing ownerships.

What's driving the changes?

- These changes are being driven by government policies for clean, low-carbon and efficient energy, resulting in new technologies, services and behaviours.
- Examples are smart meters, smarter grids, home energy displays, demand management, community energy, new renewables, electric vehicles and more international interconnections.
- The power system is already experiencing change and it is essential to maintain supply security while ensuring that innovations deliver real benefits to consumers.

What needs to be done?

- The IET's expert group has examined best practices in other sectors and has concluded we must address the mechanisms for whole-system integration.
- Standard practice elsewhere is to ensure end to end thinking by having a System Architect function to ensure effective design interfaces across multiple parties.
- This is about creating a mechanism for integrating complex systems in a liberalised sector; it is not a proposition for a power sector 'Chief Engineer'.

1 What are the objectives of the power system?

The objectives are to meet future demands for electricity services in a cost-effective and publicly acceptable way, while complying with environmental obligations and maintaining security and quality. Development of a 'smarter power system' is seen by many commentators to be key to achieving these objectives, which may at times be in conflict with each other.

Electricity services are the services consumers actually want that are provided by use of electrical energy, for example: illumination; transport; space and water heating or cooling; cooking; electrical energy to allow operation of electronic goods and instruments; and as input to industrial processes.

Environmental obligations include ambitious decarbonisation objectives; air quality targets that will close most coal-fired generation within 10 years; statutory objectives for renewable generation; tough controls on nuclear safety and waste management risks; and the protection of biodiversity and landscapes.

Security means more than just having sufficient supply to meet demand. The system must be stable and resilient under stress and function well in the face of changing demands. It must be resistant to malicious disruption. It must be adaptable enough to allow integration of the new technologies and techniques that will drive cost-effective decarbonisation, and not create avoidable constraints on the policy choices open to ministers.

Quality means maintaining voltages within acceptable upper and lower bands, avoiding dips and surges that could damage consumer equipment or cause irritating flickering of lights, minimising power losses, staying within necessarily tight requirements for power system characteristics such as frequency, and maintaining a satisfactory sinusoidal waveform for alternating electric current.

Public acceptability requires that energy delivery is affordable for households and competitive for businesses. The consumer experience must be acceptable and new technologies should not be excessively intrusive or burdensome. Privacy must be respected and data kept secure. Disadvantaged, at-risk or disengaged consumers should be well treated and protected. Extensive infrastructure developments such as major wind farms, barrages, or grid enhancements may also challenge public acceptability and must be balanced against societal desire actively to address climate change and to ensure grid adequacy.

2 What are the challenges in meeting the objectives?

The key challenges include ensuring the continuing fitness of the power networks to meet the fundamental changes now taking place and that are anticipated to accelerate over the coming decades; many of these changes are disruptive in that they are not a continuum of the present system, which challenges industry processes and standards, and introduces the requirement to accommodate new third party players.

The electricity system has evolved over 100 years to provide reliable, stable and continuous electricity supplies on which normal life in the developed world depends. However, there are fundamental changes underway. These arise from the objectives of harnessing cleaner energy and the ever-growing interdependencies with communications, data and automation, while maintaining affordability and security with quality. More specifically the challenges arise from:

- Greater variability in large scale generation, for example from offshore wind farms and PV arrays;
- Locally connected and often intermittent generation that is not dispatched centrally, for example, community energy programmes, large PV solar arrays or CHP systems serving large buildings or localities;
- More active consumers changing their pattern of demand through demand side response, smart metering and automatic controls will help to manage the system efficiently, but could also result in unpredictable herding behaviours and feedback effects that become problematic;
- Substantial and novel demands arising from electrification of transport and space heating – these may have high sustained power demands and may be unevenly distributed and subject to herding behaviours;
- Reducing system inertia that creates a 'lighter' power system, needing new measures for frequency control;
- Increased opportunity for greater use of distributed storage, potentially including electric vehicles;
- Integration of information technologies into energy supply and the evolution towards a 'smart grid'; and
- The emergence of cyber attacks on energy infrastructure as a Tier One threat to national security.

These challenges are manageable, and well managed at present, but they are already emerging and may be subject to tipping points. If we are to succeed in decarbonising the economy, between now and mid 2030s they will become highly significant features of the electricity system. Taken together they amount to a fundamental challenge to the long established 'architecture' of the British electricity system. Architecture can be defined as follows[1]

The fundamental organisation of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution.

A new architecture will be needed to meet the challenges, but changing the existing architecture while maintaining service and meeting the challenges above will be technically challenging, potentially risky and require purposeful direction. Architecture in this context refers here not only to the 'visible infrastructure' but also the codes, standards and processes that enable seamless movement of information and operational instructions. In addition, this must be achieved in compliance with new and planned European requirements whilst addressing the specific characteristics of the GB system.

[1] The term 'architecture' in this context has its origins in software engineering. This definition is from IEEE standard 1471-2000 - IEEE Recommended Practice for Architectural Description for Software-Intensive Systems.

3 What are the risks arising from these challenges?

The future is seen to be a far more complex, multi-party world that requires a whole-system approach: without significant re-engineering into a flexible 'smarter grid', the electricity system is at risk of being unable to support the innovations necessary to deliver efficient and secure decarbonisation. Furthermore, we will lose the wider benefits of a more intelligent power system that can interact with consumers.

The established organisation of the existing electricity network is essentially hierarchical: large-scale power stations are dispatched through the wholesale market by a handful of large players, their output is delivered via a national high-voltage transmission grid. This meets the aggregated and relatively predictable demands of domestic, commercial and light industrial consumers through local distribution networks. Whether as the local companies of 100 years ago, a state-run monopoly, or as today's market based mechanism, an electricity system has always required its centralised controlling function to balance supply and demand and to ensure that the electricity supplied remains within tight operating limits for voltage and frequency. Though sophisticated in implementation, this is currently a relatively simple architecture in which: most generation is predictable and deliberately dispatched; demand is well understood, predictable and passive; and there is little complication arising from active demand management, distributed storage or real time information flows.

3.1 Managing the new challenges

This is expected to change significantly as we approach 2020 and as we progress through the decades beyond. The challenges listed in 2 above have the effect of making demand more unpredictable and 'peaky', susceptible to herding effects (analogous to soldiers marching in step on a bridge) and novel in several other respects. The supply side also becomes less predictable and much of it beyond central control. The task of balancing supply and demand in real time without imposing constraints on development of low-carbon technologies and while maintaining standards of power quality will become far more demanding. The complexity arising from introduction of more data, software and communications will have risks as well as benefits. In Appendix A, we identify six examples of whole system risks that arise from these changes – this is not an exhaustive list.

Addressing the different challenges will require effective mechanisms to ensure interaction between many more parties, some of whom will be traditional players, but in the future there will be parties who are new to the power sector including non-UK providers. They may, for example, come from local communities or from the data/ICT sector, offering energy and other new consumer services.

3.2 Realising new opportunities

Ultimately these challenges are likely to be addressed by the development of a sophisticated smart grid that is an integral part of smart communities, smart cities and the Internet of Things, where sensors and systems interact across all aspects of society to enhance efficiency and create new services for all. Low carbon home heating and low carbon transportation are early policy drivers here. Appendix B illustrates the evolving 'reference architecture' model for the smart grids of the future. Effective leadership will be essential to enable the practical development of a smart grid, taking a system-wide view and building on the work and experience within the Smart Grid Forum, and resolving or referring any conflicts that arise in its development. Alignment with new European Codes will be a key requirement and addressing cyber security in a comprehensive way will require an 'end-to-end' approach.

4 Can the challenges be met with existing institutional arrangements?

The nature of the challenges and risks is resulting in serious issues that in many cases interact across the whole system; however today's institutional landscape has evolved into a multi-party structure where there is no actor with responsibility for seamless technical functioning of the whole system across its many players and technologies. The current arrangements will need significant enhancement as distributed generation, demand side management, smart communities and smart metering become more pervasive. The timing of this is uncertain: changes to system characteristics are already becoming observable but tipping points will likely arise from around 2020 depending on carbon reduction trajectories.

At present the system is well managed as components in a supply chain: generation, grid, distribution and supply. There is no entity that takes responsibility for the correct functioning of the architecture of the whole system. Ad hoc arrangements for whole system challenges have worked so far; however, as whole system effects become significant, a more robust response is clearly required.

Two key existing entities are the Grid Code and Distribution Code Panels. They have narrowly defined remits limited to subsets of the system as defined in their respective codes. Their focus is limited to technical and operational matters, rather than integration of technical, operational and commercial aspects across the whole system. The panels are not well constituted to address structural, system wide and long-term challenges. They are inherited mechanisms that operate within their structural constraints, but have no ability to restructure themselves. Also at the time they were constituted there was not the technical interaction between homes and networks that is now emerging, for example with distributed generation and demand management. National Grid plays a key role as the National Electricity Transmission System Operator. However, its focus is primarily on the high voltage transmission network: many of the challenges ahead span the whole system – generation, transmission, distribution and the consumer, and related information flows. Ofgem takes a system-wide view, but is focussed at the commercial and economic level, rather than ensuring the integrity of the underlying systems engineering. The Energy Networks Association and its member companies support the work of the Panels

Overall there is a highly fragmented institutional landscape that maintains and develops codes governing the operation of different aspects of the system, but none that explicitly takes a whole system view. In particular, the 'Grid Code' and 'Distribution Code' panels are a segmented arrangement and a range of ad hoc arrangements have been adopted for managing the smart meters programme, the evolution of a smart grid, the introduction of demand-side response and the emergence of electric vehicles and residential heat pumps. The integration of information technology and data management presents further challenges. Though there is no criticism of these arrangements at present and they rely on considerable good will and commitment of the stakeholders and expertise of the individuals involved, the whole landscape lacks any legal personality or party that is accountable for ensuring the functionality of the increasingly complex system. The current institutional landscape is shown at Appendix C in diagrammatic form. If the system architecture must change in response to challenges over the coming decades, then it is right to ask: 'who or what is the system architect?' It is unlikely that the existing arrangements will be adequate, so a new function, the System Architect, is necessary.

5 What would a System Architect be accountable for?

The System Architect would take a whole system and long-term responsibility for developing and agreeing the framework of architectures, standards, protocols and guidelines needed to ensure seamless technical integration of the sub-systems of the many market players and parties, enabling a seamless response to the challenges arising from policy imperatives as they emerge over the coming decades. The System Architect will be a single clearly defined entity responsible for management of the complexity of the evolving power system architecture in the public interest on behalf of the government.

Solutions for system integration challenges would be developed in consultation with industry, replicating best practice from existing governance arrangements where these are effective, and considering whole-system cost-benefit across the supply chain.

5.1 Function and scope

The System Architect would be responsible on an arm's length basis to ministers. It would be accountable for the adequacy of the evolving power systems architecture, with the long-term aim of supporting and driving development of a 'smart grid' capable of meeting the challenges of the coming 20-30 years. It would also have an advisory role: providing assurance that the whole system can meet the policy-driven technical challenges of the next two decades. The role would involve developing functional specifications (not product designs), interfaces and best practices, and oversee system integration: the system architect would in effect be responsible for ensuring adequate technical specification of an 'intelligent network' or 'smart grid', interpreting the direction established by policy makers to enable the organisations responsible for implementation and operation to do so in an effective and coherent way. These will be traditional industry players and, most likely, new third parties. In addition there should be a role as adviser and risk manager, providing warning of emerging risks to system stability and advising on the feasibility and timescales for policy implementation. The System Architect would be appointed by and accountable ultimately to ministers, and measures involving material costs would be subject to tests of efficiency and consumer interest by Ofgem.

The scope of the role of the System Architect could take a number of forms, two of which are:

(1) The System Architect could operate on a 'subsidiarity' model and only consider whole-system issues, leaving other issues to be addressed by existing Code Panels and other machinery.

(2) The System Architect could operate on an 'integration' model that combines many of the existing segmented functions into a single organisation with overall responsibility and ultimate accountability to ministers. It could also evolve from one to the other over time and the existing Panel arrangements might be varied to a greater or lesser extent, depending on detailed analysis and consultation.

Implementation of a System Architect role is envisaged to be best undertaken as a staged process rather than a single step. An iterative approach would not only enable greater consultation with stakeholders, but could also provide opportunities to form linkages with any wider sector developments.

5.2 A national power system framework

To supplement the Grid and Distribution Codes, an option for consideration would be to develop a 'Power System Framework' to address whole-system issues that cannot be contained exclusively within any existing code. Furthermore, the Framework would encompass the interests of new third parties as well as the traditional industry players represented on the today's Code panels. The System Architect would own the development of this Framework for the GB power system, its alignment with new European requirements, and be responsible for ensuring its consistent adoption and relevance.

5.3 Institutional form for a System Architect

The functionality of System Architect could be delivered as a standalone body or by incorporating it into the responsibilities of an existing body – it is too soon to be prescriptive. Its formation presents an opportunity to bring greater coherence to the existing multi-party institutional landscape. Participation would be a matter for consultation, but would likely include transmission companies, distribution companies, large energy suppliers and other key stakeholders such as smart communities, vendors and new entrants.

Some participants might be subject to industry governance, as with the present panels, while others might be involved less formally. Addressing whole-system issues on a 'best endeavours' voluntary basis would be an inadequate response in view of the issues and risks that can be foreseen. Initial high level thinking for the form of the system architect is illustrated in Appendix D. This appendix also references a comparative study undertaken by The IET into system architect practices in other sectors – helpful lessons can be drawn from this.

6 What would a System Architect not do?

The System Architect has a vital function, but one that is limited largely to technocratic issues – it is not an alternative source of policy-making or centralised management of the GB power industry. Ministers and officials have a duty to assess feasibility and value for money of policies, and the System Architect should play a role as a trusted adviser, but not decision maker, in this respect.

The System Architect role is about making the GB power system function effectively to meet policy objectives determined by governments and to accommodate the behaviour of markets. It is not intended to make decisions or recommendations on broader aspects of energy and environmental policy. Its role in this regard is as a 'policy taker' – defining the system architecture choices necessary to deliver the government's energy policy objectives, and to create the resilience and flexibility to incorporate policy and technology innovation. There will be occasions where effective technical integration requires attention to commercial and regulatory frameworks, and the System Architect would be expected to identify these and work with government and other parties to address them.

7 What should happen next?

7.1 Development of stakeholder consensus

Until May 2015, the stakeholders involved should develop the case and options for a system architect, achieving a consensus where possible, and set out options and their respective pros and cons where there are legitimate alternative views.

7.2 Political commitment in principle – the 2015 general election

Prior to the 2015 election, we urge political parties to consider a manifesto commitment to examine the System Architect function, or at least to ensure that the GB power networks are supported by institutional arrangements to meet the challenges of the coming decades. This will galvanise stakeholders and officials to work together to develop credible options for an incoming government.

7.3 Policy development

After May 2015, if the case for a system architect is recognised in principle by the incoming government, then the next stage would be for ministers to authorise further work and for DECC to undertake or commission a more detailed options appraisal, with consultation. This would build on work conducted by stakeholders before the May 2015 general election, and would be likely to include assessment of:

- The merits of alternative implementation models
- Draft terms of reference for the scope and limits of the role, powers, duties and advisory responsibilities
- Accountabilities and assurance mechanisms
- Examine control roles and influencing roles
- Corporate and legal form, scope of existing legislation and any need for new legislation or regulations
- Membership and participation of industry bodies, organisations and third parties
- Estimated scale, costing and cost recovery options
- Possible conflicts of interest arising in any of the options
- Ensuring that the System Architect would have a practical and deliverable remit
- Alignment with the Electricity Market Reform and climate change objectives and policy
- European requirements and opportunities
- The opportunity to build economic growth via innovation

Appendix A: Six examples of the need for a whole system approach

A.1 Changing nature and location of generation: distributed and variable sources

At present, generation connected to the distribution networks or individual properties looks much like 'negative demand' to the power system. It currently creates limited impacts that are within normal demand fluctuations. However, as these distributed sources increase in scale, at some point they will start to cause significant reversal of flows across the distribution networks and into the national transmission system, potentially beyond the design capability of the system and resulting in operational constraints. To add to the challenges, these may exhibit weather related fluctuations and create local network imbalances, for example when clouds cause shadows to pass across high penetrations of large solar PV installations.

A.2 Changing customer engagement: Smart Meters, DSM and energy efficiency

It is anticipated that consumers will participate more actively in the optimisation of the electricity system, through DSM (Demand Side Management), smart metering and software based energy management systems. Their aggregated behaviour is likely to become significant at the whole system level – and it may exhibit herding, clustering or other effects that amplify operational impacts and constraints. Developments in tariffs, so-called 'smart tariffs', will support efficient use and balancing of the system, but they may also create rapid fluctuations in demand if the response to tariff incentives is automated and aggregated over many suppliers.

A.3 Changing customer demands: Electric Vehicles, Heat Pumps and Storage

New and large unconventional loads are expected to be connected by customers at an increasing pace (for example 7kW of EV charging for six hours, compared with today's 1.5kW average household loading). The impact on the power networks will be exacerbated by spatial and temporal clustering as EVs move between home and workplace and have more or less charge in their batteries throughout a daily cycle. These challenges are likely to be compounded by the connection of electric heat pumps (being promoted for decarbonisation of home heating) as well as distributed electricity storage, including storage in the form of EV batteries which is mobile and only available for discharge under certain conditions.

A.4 Big data: its utilisation and security

Developments in smart grids, building management systems, and smart metering will all contribute to a significant increase in sensors and available data. This will bring many new opportunities (being explored for example in Smart City projects and the Internet of Things). However, it will also require effective overall management to ensure best use of data generally, maintaining privacy, and minimising malicious interventions such as cyber attack. Basic measures such as common standards for data formats and protocols will be key to data sharing, aggregation and the creation of reliable added value services to customers.

A.5 Maintaining power quality: customers require more than simply 'continuity'

The network companies not only ensure the reliability of supply to homes and businesses, but also its quality in terms of voltage variations, dips and spikes, and the smooth shape of the sinusoidal AC waveform. Voltage dips and surges can result in flickering lights, and waveform distortions can interfere with industrial process controls and the more sophisticated devices now appearing in homes. The sources of voltage and waveform distortion are set to increase significantly and include variable generation and storage devices, and the DC/AC power invertors associated with PV panels, battery storage devices and EV charging. These impacts are modest and localised at current penetrations but will require a whole-system approach to retain quality, especially when the tipping points of these new devices are reached and consumer take-up accelerates.

A.6 Recovery from power outages: new 'cold start' challenges

Electricity supplies in Britain generally meet a high standard of reliability (number and duration of interruptions), which compares well with international benchmarks. However, interruptions do arise from time to time as a result of a local equipment failure or wide area impacts such as a severe storm. There is also the (remote) possibility of a whole system shutdown as can be observed internationally from time to time. The power industry has well-developed contingency plans for these eventualities – but the changes ahead will create new risks to be addressed. Notably there is a 'cold start' problem where in the future, when an area of network is re-energised after a period of shutdown (particularly in cold weather), the simultaneous demand from large heat pump and EV charging loads could greatly exceed network capacity and result in an immediate re-tripping of supplies or threaten the national energy balance. Solutions to this could be through soft-start controllers, randomised start-up delays, and frequency-sensing devices. Such solutions, while not unduly costly or technically difficult, however require a whole-system co-ordinated approach and rigorous implementation.

The consequences of not addressing the issues raised above

As described in the paper, there are many changes ahead associated with new generation, new demand types, smart metering, and smart grid technologies. This is already starting to bring changes to the characteristics of the GB power system and there is a potential for tipping points in take-up rates. There is a shift towards not only more ‘cross-system’ interactions, but also a significant rise in data, communications, processing and overall systems complexity. Failure to integrate these developments effectively can be expected to result in consequences such as:

1. **Consumer frustration**, for example being unable to charge their electric vehicles at practical times, or operate electric heat pumps without major reinforcement to local power networks;

2. **Unnecessary investment** in infrastructure due to adoption of traditional rather than smart network solutions including demand side response;

3. **Policy delivery targets being missed** arising from grid inflexibility due to delays in making new connections, constraints in grid capacity and operational flexibility, and failure to achieve ‘joined up thinking’ between initiatives across sectors;

4. **Serious adverse interactions** between advanced automated systems, resulting in (at the least) unexpected consequences and failure of new systems to deliver customer services as expected, or (at the worst) causing serious instability and a ‘systems crash’ that shuts down part or all of the power system.

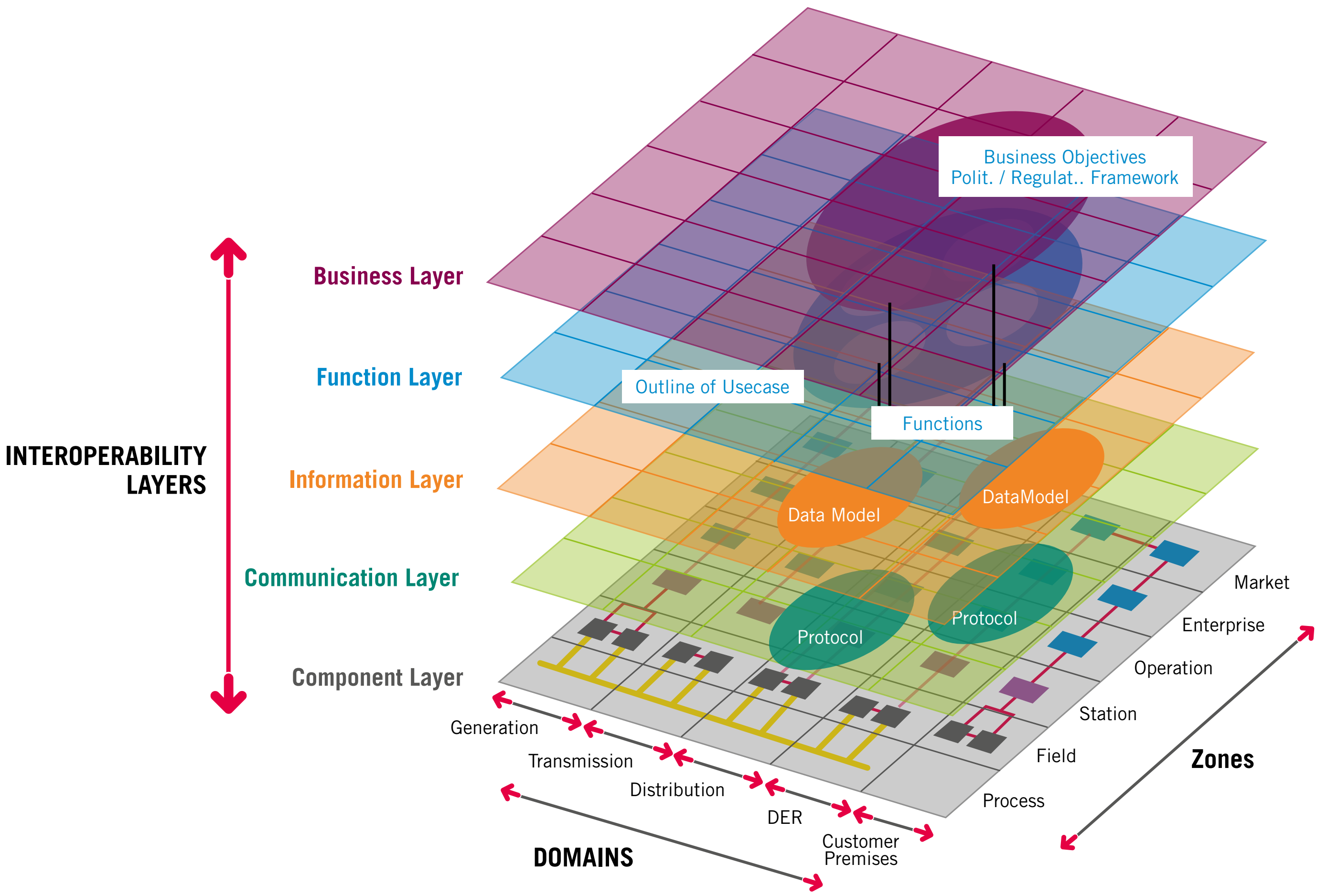
Appendix B: Smart Grid Architecture

The GB Smart Grid Forum is actively promoting the development and application of an emerging European standard tool for representing and assessing complex smart systems. Work is underway in the UK and at European Union level to design a ‘reference architecture’ for the smart grids of the future. One emerging design, the Smart Grid Architecture Model, is represented in the layered 3-dimensional schematic below – though the basis for European standardisation has yet to be finalised. The CEN/CENELEC/ETSI Joint Working Group report on standards for smart grids has defined the context for the development of the Smart Grids Reference Architecture:

It is reasonable to view [the Smart Grid] as an evolution of the current grid to take into account new requirements, to develop new applications and to integrate new state-of-the-art technologies, in particular Information and Communication Technologies (ICT). Integration of ICT into smart grids will provide extended applications management capabilities over an integrated secure, reliable and high-performance network.

This will result in a new architecture with multiple stakeholders, multiple applications, multiple networks that need to interoperate: this can only be achieved if those who will develop the smart grid (and in particular its standards) can rely on an agreed set of models allowing description and prescription: these models are referred to in this paragraph as Reference Architecture.

The Smart Grid Architecture Model (SGAM)

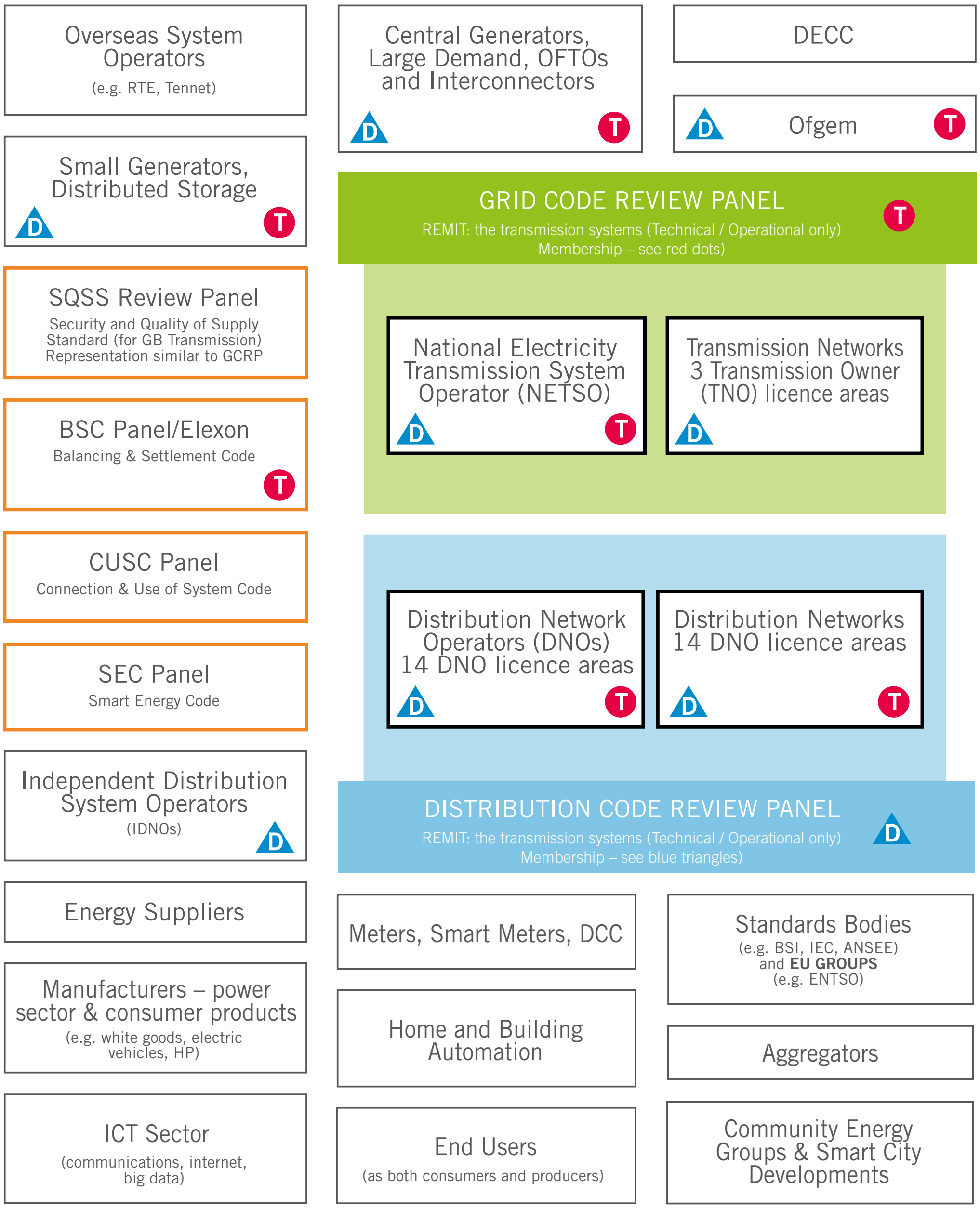


Derived from Source: CEN-CENELEC-ETSI Smart Grid Coordination Group, Smart Grid Reference Architecture, 2012.

Appendix C: The current institutional landscape illustrated

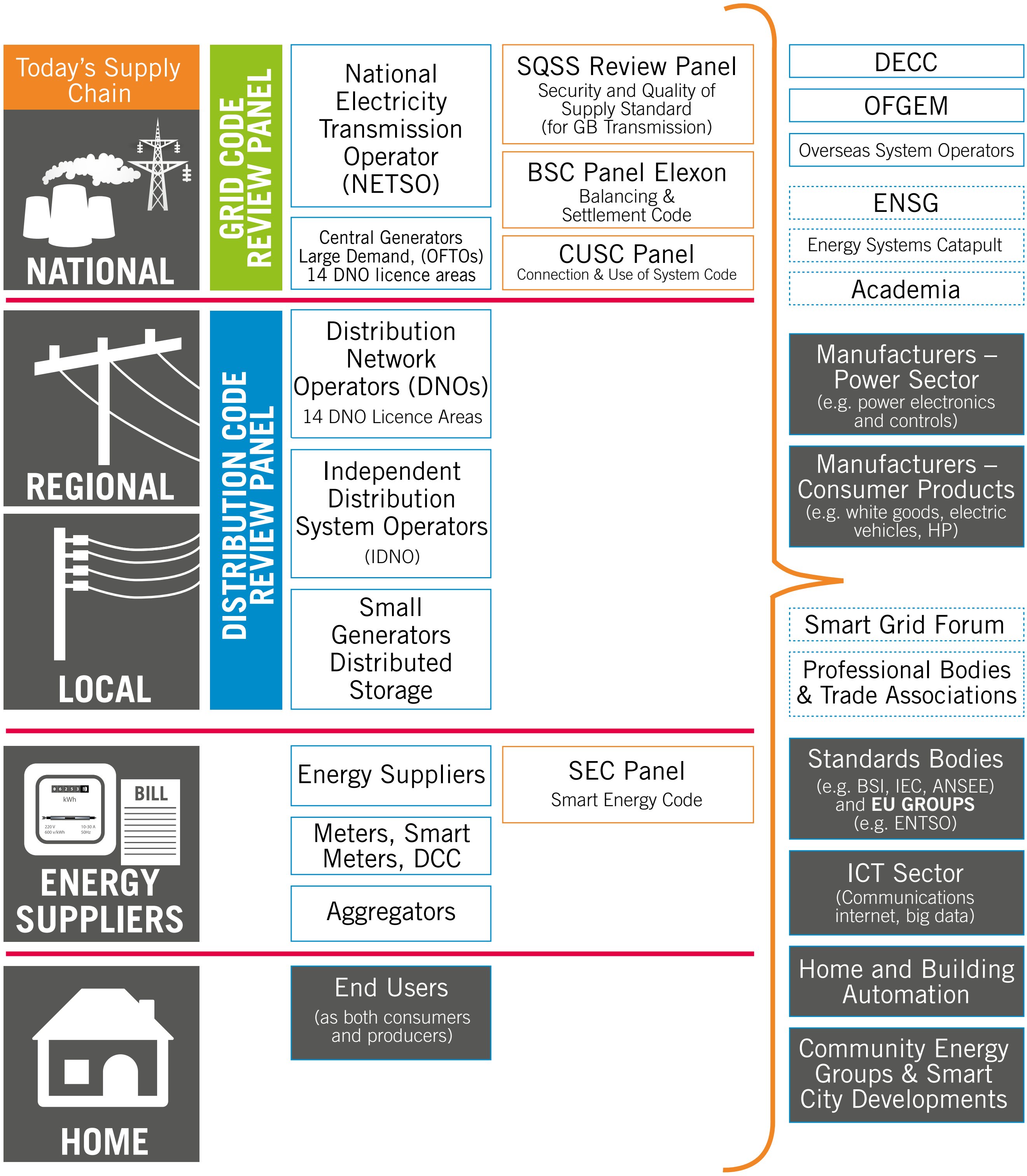
C.1 The current landscape

This diagram shows the main bodies concerned with operation of the whole system, highlighting significant fragmentation within the overall supply chain. Red indicates the Grid Code Review Panel, Blue the Distribution Code Review Panel, and Orange shows other formal Panels that have related areas of responsibility. Note the many further key parties who have little or no linkages to these industry governance structures. The Panels are formally constituted committees of industry experts who operate under a legal framework and governance structure overseen by Ofgem.



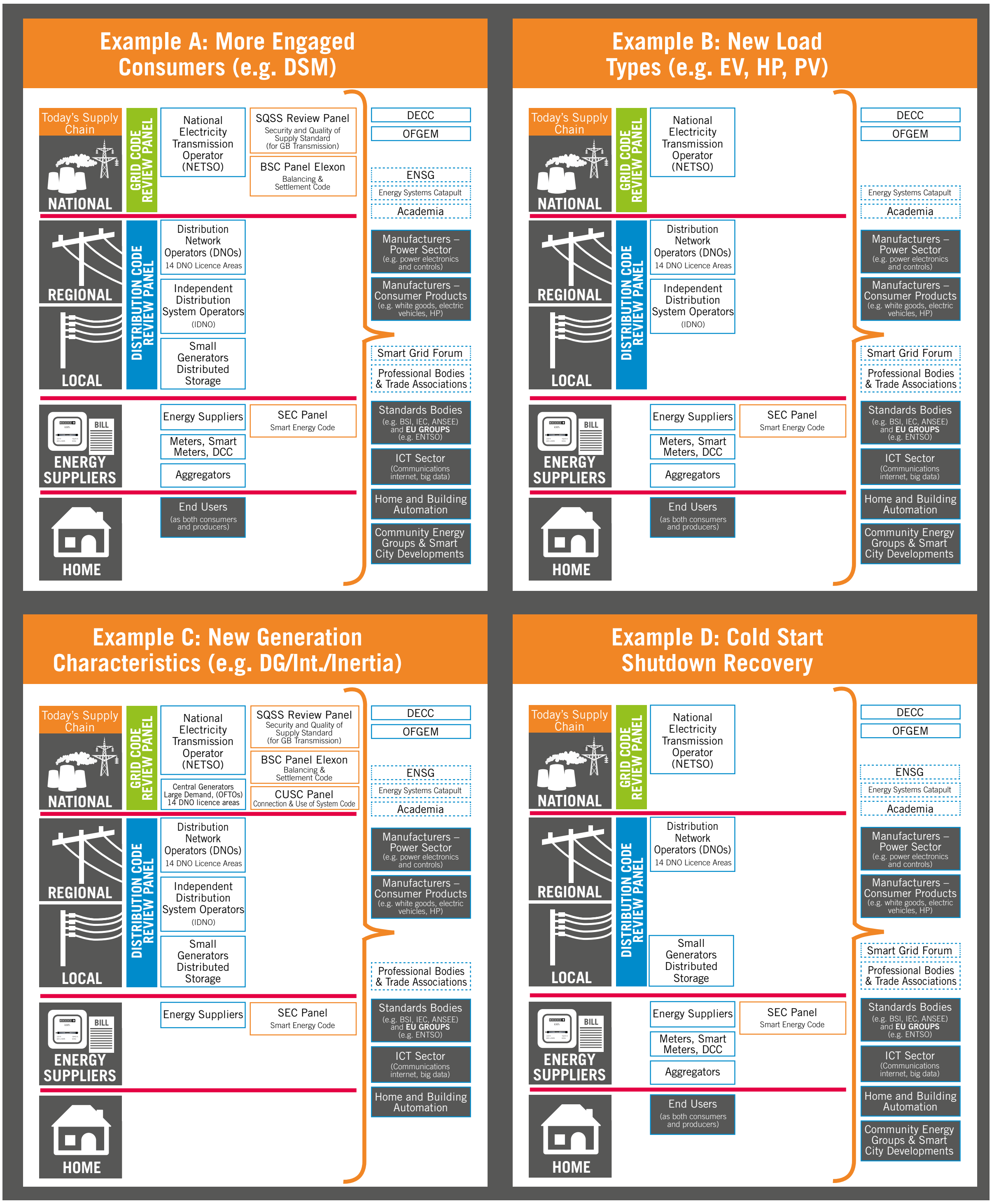
C.2 Current landscape showing major supply chain boundaries

This diagram shows the main bodies concerned with operation of the whole system, illustrating the structural nature of the fragmentation as different functions are aligned with different parts of the electricity supply chain.



C.3 Distribution of responsibility for whole system challenges in the current landscape

For these four examples of whole systems challenges (see Appendix A) the relevant bodies are highlighted in bold. Each problem involves multiple bodies – different for each problem - with diffuse accountability and responsibility. Note, the message is not in the detail of these diagrams, it is in the dynamic pattern they highlight. For illustration, observe how Example C requires a focus at the transmission level while Example D requires closer engagement of distribution and consumer parties.

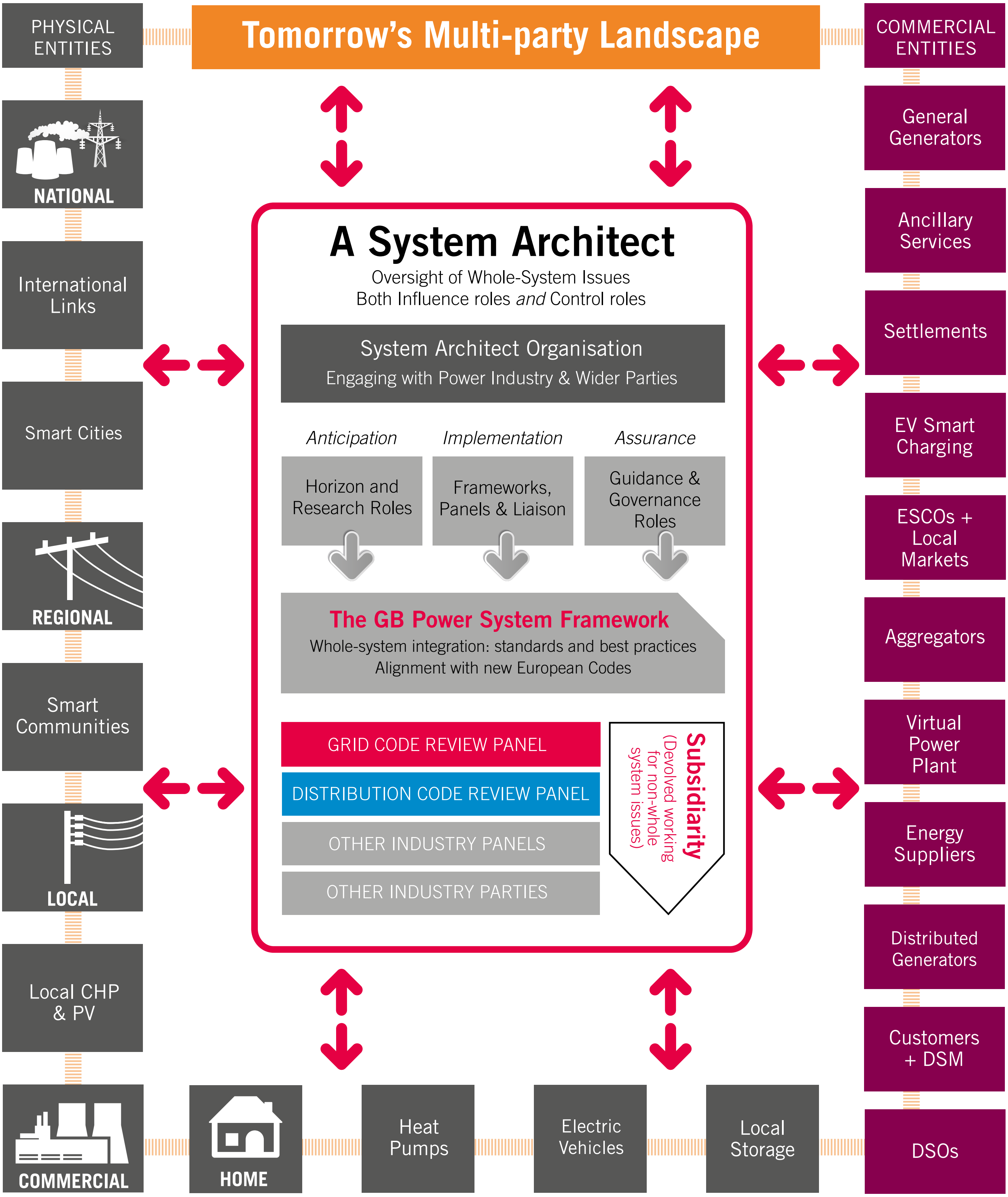


Appendix D: Two options for the design of the System Architect role

The examples in this Appendix draw on the learning points from the IET's research into System Architects in other sectors (Report entitled 'Transforming the Electricity System: how other sectors have met the system design challenge' October 2014). In particular the principles from Models 2 and 3 in that report have been developed here.

D.1 The Subsidiarity Model

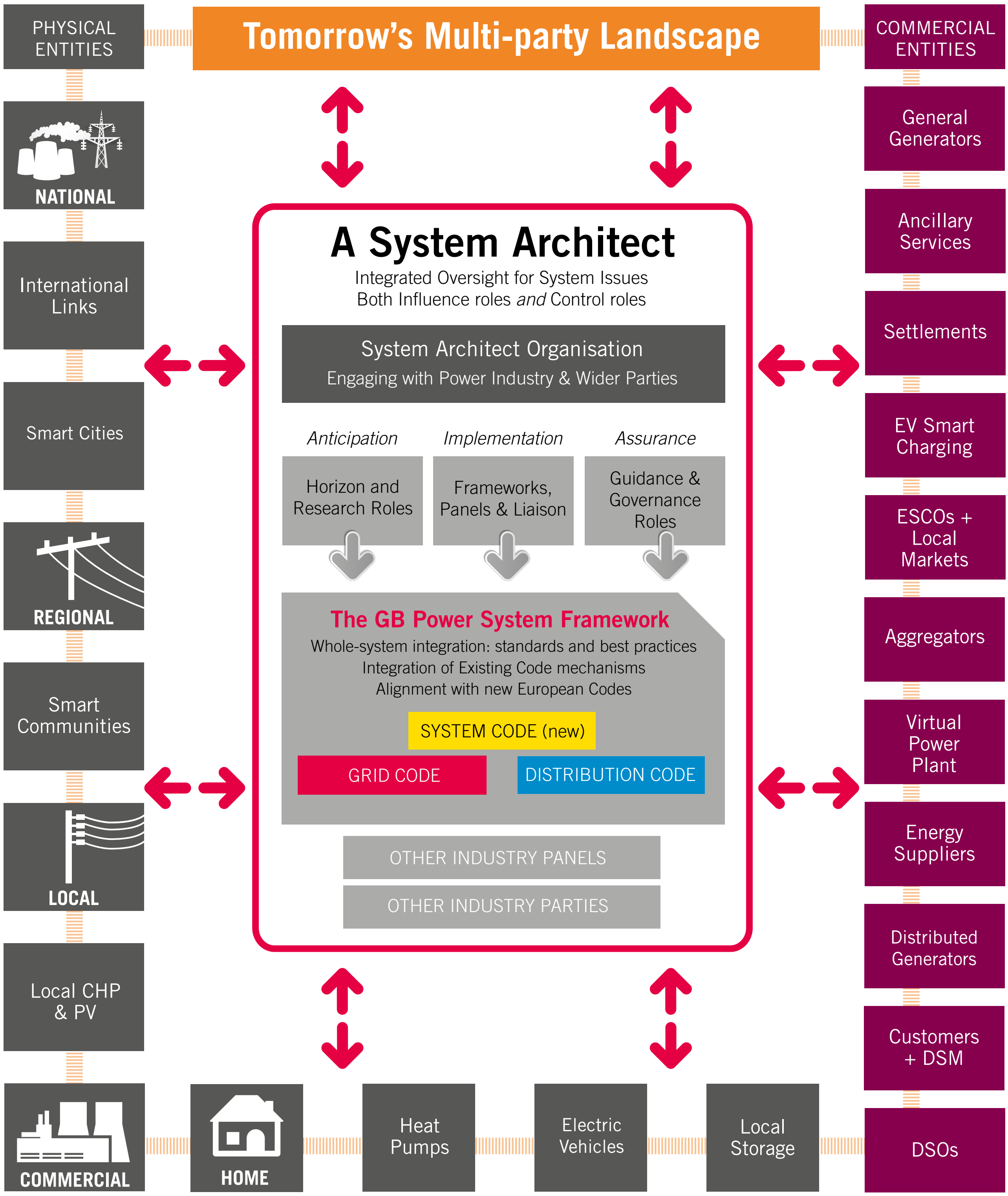
The diagram illustrates one of many potential options for the development of a System Architect role. In the subsidiarity model, the System Architect would be responsible only for those matters requiring whole system perspective, leaving existing bodies to address issues specific to grid and distribution etc. This system works within a policy, regulatory and innovation framework owned and defined by government.



PHYSICAL ENTITIES
Tomorrow's Multi-party Landscape
COMMERCIAL ENTITIES
NATIONAL
International Links
Smart Cities
REGIONAL
Smart Communities
LOCAL
Local CHP & PV
COMMERCIAL
HOME
Heat Pumps
Electric Vehicles
Local Storage
DSOs
General Generators
Ancillary Services
Settlements
EV Smart Charging
ESCOs + Local Markets
Aggregators
Virtual Power Plant
Energy Suppliers
Distributed Generators
Customers + DSM
A System Architect
Oversight of Whole-System Issues
Both Influence roles and Control roles
System Architect Organisation
Engaging with Power Industry & Wider Parties
Anticipation
Implementation
Assurance
Horizon and Research Roles
Frameworks, Panels & Liaison
Guidance & Governance Roles
The GB Power System Framework
Whole-system integration: standards and best practices
Alignment with new European Codes
GRID CODE REVIEW PANEL
DISTRIBUTION CODE REVIEW PANEL
OTHER INDUSTRY PANELS
OTHER INDUSTRY PARTIES
Subsidiarity
(Devolved working for non-whole system issues)

D.2 The Integrated model

This diagram illustrates a more comprehensive reform: the incorporation of important elements of the existing machinery into a new System Architect body, responsible for overall architecture development. This system works within a policy, regulatory and innovation framework owned and defined by government.



About this briefing

This Briefing Paper has been prepared in support of the discussion that was initiated by The IET in December 2013 by the report ‘Electricity Networks: Handling a Shock to the System’. The IET identified the emerging challenge for maintaining essential technical co ordination across the power system, for example as generation becomes distributed and consumers become active parties.

This Briefing paper has been prepared to assist communication among senior stakeholder parties and comments will be welcomed. It was prepared on behalf of the PNJV Phase 3 steering group by:

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IET Venues

IET London: Savoy Place*
London
T: +44 (0) 207 344 5479
www.ietvenues.co.uk/savoyplace

IET Birmingham: Austin Court
Birmingham
T: +44 (0)121 600 7500
www.ietvenues.co.uk/austincourt

IET Glasgow: Teacher Building
Glasgow
T: +44 (0)141 566 1871
www.ietvenues.co.uk/teacherbuilding

*Savoy Place will be closed for refurbishment from summer 2013 until autumn 2015. During this time IET's London home will be within the Institution of Mechanical Engineers building at:

1 Birdcage Walk
Westminster
London
SW1H 9JJ

If you are attending an event during this period, please check the venue details carefully.

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