Applying the Hilmer Principles on economic regulation to changing energy markets

A report prepared by Synergies Economic Consulting and George Yarrow for the Energy Networks Association

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Executive Summary

In 1993, the Hilmer Report presented a ground breaking review of national competition policy, which established the framework for the regulation of Australia's public utilities, including electricity, for the following two decades.

A key recommendation of the post-Hilmer policy measures towards public utilities was the structural separation and regulation of those segments considered to be natural monopolies, the networks ('NSPs') and system and market operation, from those considered to be contestable, notably generation and retail supply, which were to be largely unregulated. These recommendations were adopted and in large part define the industry structure that operates today.

More recently, and in the last five years particularly, there have been remarkable changes in the technologies of electricity production and delivery, profound changes in the characteristics of demand and significant changes in external pressures on the sector. The Energy Networks Association (ENA) has asked Synergies Economic Consulting and George Yarrow to assess whether that structurally separated model remains the best suited of the realistically available alternatives in meeting the long term interests of customers, or whether it needs to evolve.

Historic context

The policy and regulatory regime that arose for the electricity sector post Hilmer developed out of a context of government control of vertically integrated, state owned, self-regulated utilities, not at that time operating on commercial lines. The industry was inefficient, exhibited no competition, even in segments that could support competition, and was characterised by state-by-state investment and development with modest interstate coordination and trade.

The main thrust of the Hilmer reforms in the electricity sector was therefore to separate out the 'natural' monopoly elements from competitive elements,[1] provide non-discriminatory access to the networks to allow competition in related supply-side activities (e.g. electricity generation), and to regulate the natural monopoly elements to discourage monopoly pricing and encourage more efficient operation.

In the electricity sector, separation into generation, transmission, system control and market operations, distribution, and retail supply was largely successful. The limited

[1] We note in passing that what constitutes a 'naturally' monopolistic activity in modern classification schemes – which themselves differ from those used in classical economics – is itself context-dependent; the boundaries can shift with changes in technology, input prices and demand, for example.

scope economies across the activity levels, reflected for example in the specialised technologies deployed in each layer, meant that the benefits of separation in terms of enhanced competition significantly exceeded any loss of scope economies.

Hilmer's regulatory cost benefit test

The Hilmer reforms were based on a cost benefit test, to the effect that regulation should be adopted only when the costs of regulation were less than the benefits. A more general statement of that test is that the form of regulation that is put in place should, when benchmarked against a viable alternative form, be selected so as to ensure that the benefits exceed the costs. When expressed in this way it points more clearly to a system of regulation in which there can be greater tailoring of the rules to the particular circumstances of the market and the decisions of the participants in that market. Put another way, it can be more easily appreciated that the relative merits of (realistic) alternative regulatory approaches, assessed on the same criteria (e.g. the long term interests of consumers), will vary with circumstances (e.g. as technologies change).

The principal basis for adopting the initial post-Hilmer framework based on structural separation of business activities was administrative. There was, in effect, a decision that the costs of policing behaviour in a vertically integrated electricity market in order to minimise the adverse consequences of anti-competitive behaviour — the approach most familiar in the enforcement of competition law — were likely to be greater than the benefits that might arise from sustaining the relatively limited economies of scope that might otherwise be available.

The alternative of reliance on competition law alone was at the time (and arguably since) poorly suited to the task. Under rules derived from general competition law, regulators would have faced very large costs in securing their objectives. More likely, such rules would have failed to militate sufficiently against the misuse of market power, with the result that there would be a substantial risk that competition would not emerge in those market segments that could support it, with all the attendant costs of the resultant efficiency losses. The efficiency losses would likely have been particularly egregious given the emergence of the sector from its state-owned, self-regulated roots.

Economic regulation of a vertically integrated sector as we currently understand economic regulation, akin to the telecommunications model, would probably have resulted in very high direct regulatory costs in order to address the information asymmetry between the regulator and the market participants, to minimise the risk of self-dealing, misallocation of costs and related strategic behaviour by the regulated entities.

Balancing policing costs and the benefits of greater competition

This reflects the fundamental trade-off in determining the best regulatory approach for a business or sector, namely the cost of policing business conduct, including the costs that policing imposes (e.g. in terms of constraints on business form, service offerings, and inflexibility), versus the benefits that can be expected to derive from greater competition. The preference immediately post-Hilmer for the electricity sector was to select a set of rules, including vertical separation, that would at least in principle not require large policing costs in order to foster a sufficient increase in competition. Selection of that rule set at the time made considerable sense. For most of the two decades since 1993, the separation of the structural separation of electricity networks ('NSPs') from generation and retail supply has been apposite; but it should be remembered that the belief held at the time with strong justification, that policing costs of any structure other than vertical separation would be substantial, was contingent on three key considerations that are harder to justify today:

- the prior history and legacy of state ownership, integration, self-regulation and near total exclusion of private sector participation;
- that scope economies between the stages of production, and the potential inefficiencies from 'vertical externalities'[2] and price distortions, were limited due to the maturity of the sector and the specialisation of assets, skills and capabilities to discreet segments; and
- that alternative regulations imposed under a structure that retained some degree of vertical integration — for example, financial separation or ring-fencing but without legal or physical separation — would not have been as effective.

A changing sector since Hilmer

Whether or not restrictions on NSPs competing in related markets lead to more-than-compensating enhancements of competition in other dimensions depends on a series of trade-offs that, in turn, depend on features of the relevant economic context.

The objective of regulation has not fundamentally changed, to ensure that sector as a whole best meets the long-term interests of consumers. But technology and cost changes in the industry present a challenge to achieving this objective, which calls for consideration of whether the long-term interests of customers would be better met by evolving from simple 'business as usual' regulation of the monopoly networks regulation (through structural separation) to a model that might more effectively capture the increasingly

[2] A vertical externality exists where expansion of a business activity at one level of a supply chain confers benefits (e.g. via lower costs or increased demand) on a separate business operating at a different level. Vertical integration is one, but only one, way to 'internalise the externalities' and increase the payoffs from expansion, including by innovation. Video games is an oft-cited example of the problems that can arise in the development stage: absent software that can run on it, there is no demand for an innovative console; absent an innovative console, there is no demand for software than can run on it.

significant efficiency benefits of scope economies and reduced vertical externalities. To be sure, NSP's are likely to retain monopoly power over some network activities for the reasonably foreseeable future; the regulatory concern remains that of seeking to prevent leveraging of such power into other activities in ways that are adverse to competition and innovation. What *has* changed since Hilmer, however, are the trade-offs to be faced in pursuit of this regulatory task.

The Harper Review, while otherwise quite limited in its comments on utility regulation, recognised this in setting out the importance of as 'light [a] touch' as possible and, in a changing context, the 'need [for] flexible regulatory arrangements that can adapt to changing market participants,… and to new goods and services that emerge with rapidly evolving technology and innovation.'[3]

A possible approach — calibrated regulation

Hilmer espoused the general principle — the 'necessity' principle — that restrictions (including networks' ability to participate in contestable markets) should only be considered where there is no less restrictive way of ensuring network ownership does not adversely affect competitive market processes and dynamics. Whether or not the 'no less restrictive' criterion is satisfied is clearly a question that cannot be settled once and for all in relation to energy networks: the answer will depend on the specifics of the relevant context at a particular time. The question for now, therefore, is whether it is satisfied in the new context that has emerged as a consequence of the emergence of climate change issues and of technological developments, many of which are themselves responses to the environmental challenges.

Without seeking to determine what the best form of regulation might be for the network sector going forward — an exercise beyond the scope of this paper — it is nevertheless possible to sketch out some of the alternatives to the *status quo* that appear to us merit serious consideration. In doing so, it is stressed that the alternative options identified are not mutually exclusive.

To best meet the long-term interests of customers, the regulatory paradigm may have to evolve from the current model of structural separation and the presumption that NSPs should be excluded from (or have a trivial involvement) in contestable market, to one in which there is more latitude for NSP involvement in contestable markets.

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[3] Harper, I., Anderson, P., McCluskey, S. & O'Bryan, M. (2015). *Competition Policy Review, Final Report* 24.

The fallacy of the 'one-size' fits all

The foregoing raises the intriguing prospect that rather than regulators defining a single set of rules, prescribing industry structure (or more accurately proscribing certain forms of business relations), regulators could potentially offer a 'menu' of rule books suited to the particular business choices that market participants, cognisant of the choice of rules, decide to adopt.

One of the issues raised by a blanket prohibition of NSP participation in potentially competitive activities is that, being a 'one-size fits all' approach, it lacks proportionality when applied across a range of different, specific contexts. Consistent with the notion of 'distinguishing among things that differ', good practice regulation usually rests on heavily on the principal of proportionality.

The most obvious example is when businesses below a certain size are exempt from particular regulations, precisely because compliance costs are judged disproportionately high relative to any perceived benefits from compliance. But there are more radical possibilities; a distributor that separates out its network assets from its distribution system operations ('DSO') in a manner that is transparent to the regulator, and then instructs its DSO to competitively tender for the inputs it needs to provide high value services to customers (such as storage, wholesale power, network augmentation, demand side responsiveness etc.), is a very different regulatory proposition from the traditional distributor seeking to sell storage services to retail customers.

The concept of a differentiated rule book

The regulator, facing a range of business structures, has a set of tools that it can use to structure differentiated rule books. These include, for example, ring-fencing, accounting separation, information disclosure, network cost models, standardized costs, more cost-reflective network prices (possibly similar to telecommunications interconnection and network element pricing), and even prescription and proscription. The extent to which a particular set of rules supports competitive neutrality and non-discrimination might then depend upon, or be calibrated against, the extent to which a particular network business's choices raise or lower policing costs and the risks of anti-competitive behaviour.

The question of whether the Hilmer principles of competitive neutrality and non-discrimination are consistent with the imposition of differentiated regulatory obligations on participants that may be competing to serve customers boils down, in the end, to whether the relevant, differentiated restrictions are well calibrated (i.e. appropriate and proportionate), particularly in relation to their likely implications for the long-term interests of consumers given feasible, alternative regulatory arrangements.

An example in UK gas?

A flavour of this approach is to be found in the policies of Clare Spottiswoode, Director General of Gas Supply in the UK in the 1990s. At a time when there was considerable pressure from the competition authorities to vertically separate (by ownership) the production, transmission/distribution and supply activities of the privatised British Gas, which the government of the time did not support, Ms Spottiswoode declined to become partisan on the issue. Rather, she suggested that Ofgas would simply tailor the form of regulation to the business structures that it encountered. Continued vertical integration would almost certainly require more intrusive regulation than vertical separation. Faced with this menu, and in light of the economic context that it faced, British Gas itself opted for separation, which occurred without it being mandated.

Could calibrated regulation operate in Australia?

In the Australian electricity market, it might be feasible, for example, to adopt a regulatory rule-book that provided for:

- network business that remained content to avoid participating in the competitive market segments (or who limited their involvement substantially) might remain under broadly current arrangements;
- distribution businesses that adopted a split structure, separating into two business units under a common ownership —a distribution network assets business and a distribution system operation business (such as are emerging in the US) — might operate under a regulatory model more akin to telecommunications; or
- network businesses that decided to participate in contestable market under their current form might be offered a set of rules with a much greater emphasis on accounting separation, information disclosure and ring fencing, perhaps necessitating greater regulatory compliance costs, but with greater latitude to compete to offer services to customers.

The form of regulation is calibrated to the reasonable choices of the market participants. The essential step in calibrating the design for any or all of these combinations is to balance policing costs and potential benefits.

Summary

Hilmer, in essence, set out a necessity principle to restrictions on competition, that the benefits of restrictions outweigh the costs and that restrictions are the least necessary to accomplish their goal. It follows that the results of applying this principle will be sensitive to context.

There is ample evidence that the context of the Australian electricity market has changed substantially since 1993; it is a much more dynamic market and policy environment, replete with external pressures and technological change that have important economic consequences. It follows that if applied today the Hilmer principles might result in differences in the regulations that should apply to the electricity sector.

Hilmer rightly emphasised the importance of competition. Competition in the electricity sector will be fundamental to discovering and exploring the best mix of services, technologies and innovations for customers and the best means of delivering them that this dynamic environment can deliver. Given the changes in circumstances since Hilmer, restrictions on NSP participation in these competitive markets are likely to be more harmful today than they were of past. This needs to be considered in developing a regulatory paradigm that is most likely to ensure the long term interests of customers.

In considering the regulatory paradigm, we would caution against 'one size fits all'. There are likely to be considerable long terms gains to customers from calibrated regulation — multiple 'rule books' each adapted to the business choices of market participants, rather than one rule book which in practice dictates those business choices.

Response to specific ENA questions

The ENA presented Synergies Economic Consulting and George Yarrow with four questions aimed at assessing, given the market circumstances and economic factors outlined above, whether the current electricity industry model and regulation that emerged after the Hilmer reforms remain the best of the realistically available alternatives for meeting the long term interests of customers. Our responses to those specific questions follows.

Question 1

Assess the applicability of the Hilmer Committee's overarching framework, including the Policy Principles, conclusions on separation of natural monopoly elements and potentially contestable activities to energy networks' participation in new contestable markets:

i. Does the framework imply that the only optimal policy response to the competitive and technological developments in the energy network sector is to enforce strict legal separation between ownership of natural monopoly elements of the traditional electricity network supply chain and distributed energy resources (i.e. grid-based or customer-based storage, solar PV, or demand response technologies)?

ii. Is the application of such restrictions consistent with avoiding or minimising regulatory barriers to networks directly serving and innovating to meet the needs of their customers?

iii. What is likely to be the true 'bottleneck' in newly energy service markets, and what alternative low or no cost mechanisms may exist to resolve any bottleneck concerns?

i. The imperative today, in the face of external factors such as concerns over emissions and endogenous factors including rapid technological change, is to encourage innovation and competition in the long-term interests of consumers. Since competition is such a powerful force in stimulating discovery and innovation, and technological change is blurring the boundaries between what have traditionally been considered 'naturally monopoly' and contestable activities, there are reasons for considering that the hitherto natural monopoly elements of the supply chain can and should play a more significant role in that competitive process. This indicates that the structural separation of contestable and natural monopoly elements of the supply chain, as previously defined, may no longer be the best policy stance (of the realistically available options) for meeting the long-term interests of customers.

ii. Regulatory arrangements established in the late 1980s and early 1990s in the UK electricity sector, and developed in Australia in the early 1990s, reflect economic and policy environments that are no longer an accurate picture of the sector. If the current and evolving industry is to deliver the promising range of new services now on the horizon, it will be important to ensure that the market rules are appropriately adapted to the new circumstances. New services that are disruptive or in their formative stage, and services that we are unaware of because they have not yet emerged from the competitive process, may well arise more quickly from business that are to a degree vertically integrated. Current regulation could therefore impede their development.

iii. There are a number of 'bottlenecks' that could impede the emergence of new services: prohibitions on business arrangements and transactions best suited to creating innovative services; failure to recognise that some network services are now subject to increased competition; overly-rigid classification of new technologies into the strictures of existing supply chain definitions; failure to recognise that transaction costs when vertical separation is mandated can in some circumstances reduce efficiency; information asymmetry; and pricing that does not reflect the short-term fluctuation in costs, which can be fundamental to investments in some emerging technologies.

Collectively, these suggest that a form of 'Calibrated Regulation' would deliver benefits, where the regulatory 'rule book' is tailored to the business models freely chosen by industry participants, cognisant of the regulatory consequences their own choices will entail. This could well be preferable to the current model in which, in essence, industry participants have adopted business models mandated by the regulator's rule book.

Question 2

> Assess the implications of the Hilmer report's discussion of the need for competitive neutrality and non-discrimination in the regulation between private sector market participants and whether this is consistent with the imposition of differentiated regulatory obligations on participants that may be competing to serve customers.

There is no bright line rule that determines when the benefits of competitive neutrality and non-discrimination in regulations are likely to be in the long term interest of customers.[4]

[4] It is unfortunate that the word 'discrimination' typically carries negative connotations in political language and that its more general meaning, 'the ability to distinguish between/among things that differ', which can have positive

The underlying issues involve 'second-best' trade-offs that require an assessment of the balance of effects across different economic activities.

What we can say is that significant differentiation in the regulatory treatment of NSPs and others seeking to offer contestable services to final customers will be contrary to the long-run interests of customers when it reduces the effectiveness of the supply chain as a whole. That, in turn, depends upon the business structures, relationships and service offerings that the network businesses choose to adopt. If the regulatory imposts on participation are so onerous as to obviate the significant scope efficiency gains that are likely to arise from provision of some contestable services by vertically integrated businesses, then this is more likely; similarly, if regulations prevent vertically integrated entities from internalising vertical externalities.

Hilmer's necessity principle should apply: restrictions on competition (including networks' ability to compete) should only be considered where there is no less restrictive way of ensuring network ownership does not adversely affect competitive market processes. The efficiency consequences of restriction on competition are likely to be greatest at times, like the present, of significant innovation, technological change and disruption, when there are alternatives to vertical separation.

Question 3

Identify the potential impacts on competition in new and emerging energy service markets of either restrictions on network businesses' participation, or inappropriate discriminatory regulatory treatment.

It is difficult to assess the impact on competition of restrictions on NSP participation with any precision because of the innovative and disruptive nature of the contestable services in which they might best compete. The reason we prefer to rely upon competition rather than the dictates of regulators to deliver superior outcomes to customers is because competitive outcomes, particularly as regards disruptive innovations, are uncertain and unpredictable. Markets rely upon the process of competition to discover and provide the best mix of services, technologies and innovations to customers.

We do know that NSPs are well positioned to work with their customers to provide information and help identify the solutions that are in their long-term interests, including helping them make sense of the variety of new options and services that are emerging. And, due to the nature of the assets they own, their interests are long-term, which makes

connotations (e.g. as when choosing a restaurant or a wine), is often forgotten. In economics, the effects of price discrimination are context dependent. They can be positive for competition and consumer interests in some circumstances and negative in others. Hilmer was addressing contexts in which there could be a presumption of negative effects. The salient point is that the context has changed in ways that call the presumption into question for at least some of the services that are or might be offered by a NSP.

them more congruent with long-term policy objectives due to the increasing opportunities over time for customers to disconnect from networks. Removing incentives for NSPs to compete therefore imposes important costs that policy-makers and regulators should consider.

Hilmer identified that restrictions on the ability of a business to compete freely can usually only be justified in terms of their indirect consequences, which can be both negative and positive. It is important to be aware that imposing one restriction (say a prohibition of providing a contestable service) quite often leads to the further imposition of costly measures (such as public subsidies) in the attempt to secure a desirable public policy goal. To avoid excessive regulatory 'creep', regulatory 'rule books' must be vigilant of and adapt to changing contexts, not only when considering incremental measures, but also by from time to time revisiting past measures that may no longer be as appropriate as they once were.

Question 4

Identify the implications of evidence to date on whether market barriers to entry exist.

i. Is taking advantage of scale and scope economies arising from synergies to own and operate distributed energy resources appropriate?

ii. To what extent can new markets develop solutions to overcome information problems as an alternative to regulatory solutions to market failure?

i. Pervasive technological change in electricity supply at all levels of the supply chain makes potential economies of scope in distributed energy activities a much more significant factor in promoting the long-run interests of customers than was the case when the Hilmer reforms were established. Restricting the ability to seek out and realise such economies can therefore be expected to have a larger, direct, adverse impact on efficiency. In considering regulatory proscriptions, policymakers need to avoid unwarranted presumptions/pre-judgments about market development. Participants should only be precluded from exploiting scale and scope economies if doing so would result in larger indirect adverse effects (from materially limiting competition), and if there are no alternative less restrictive but effective measures. This is context dependent; and the context today clearly differs from the immediate post-Hilmer context.

ii. From an institutional perspective, markets themselves 'regulate' commercial behaviour — they are rule-books to support transactional activities. Markets, including good examples in US electricity markets, can and do develop solutions to overcome information problems in ways that are complementary to or act a partial replacement for public regulation (rules for participating in commodity exchanges are a good example).

Additional material

This Executive Summary is accompanied by a more detailed background paper which explores this material in greater detail. It elaborates on the importance of matching the regulator's 'rule book' to context, and then details how the electricity market context has changed over the 20 or more years since Hilmer published his ground-breaking report. It then explores, in more detail, the considerations behind our answers to the ENA's questions. It closes with two appendices: the first provides an overview of some of the new technologies, new services and disruptive technologies that are emerging in the electricity sector; the second sets out one of the main economic concepts, vertical externalities, which needs to be considered when assessing the relative merits of different regulatory models.

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1 Introduction

In 1993, the Hilmer Committee published its ground breaking review of national competition policy ('Hilmer Report'),[5] which established the framework for the regulation of Australia's public utilities, including electricity, for the following two decades. A key principle of the post-Hilmer policy measures towards public utilities was the structural separation of those segments considered to be natural monopolies from those considered to be contestable.

For most of the two decades since 1993, structural separation of electricity networks ('NSPs') from generation and retail supply has been apposite. However, more recently, and in the last five years particularly, there have been remarkable changes in the technologies of power production and delivery and profound changes in the characteristics of demand.

Synergies Economic Consulting (Synergies) in cooperation with Professor George Yarrow have been commissioned by the Energy Networks Association ('ENA') to assess whether the Hilmer Committee original overarching framework for the regulation of the Australian electricity sector needs to evolve and adapt to best meet customers' needs in the light of these changes.

1.1 A framework for considering separation

The extent of innovation and change in the electricity sector is sufficient to question whether the sector is entering a new development cycle, which if it is to deliver the most benefits to customers, will require a re-examination of the extent of vertical integration and, perhaps, some modifications to the current regulatory model based on structural separation.

Stigler has examined the 'cycle' of vertical integration that can characterise the development of an industry.[6] In the early stages of an industry's development firms will typically undertake a number of complementary activities or functions. There are distinct advantages in having complementary activities under the same roof.

Considered separately the complementary activities tend to exhibit positive externalities, either in terms of cost (expansion of activity A reduces the costs of activity B) or in terms of

[5] Hilmer, F., Rayner, M. & Taperell, B. (1993). *National Competition Policy: Report by the Independent Committee of Inquiry*, Australian Government Publishing Service, Canberra ('*Hilmer*') available at http://ncp.ncc.gov.au/docs/National%20Competition%20Policy%20Review%20report,%20The%20Hilmer%20Report,%20August%201993.pdf (last viewed 30 November 2015).

[6] Stigler, G.J. (1951). The Division of Labour is Limited by the Extent of the Market. *Journal of Political Economy*, LIX(3), June.

demand (expansion of activity A increases the demand for activity B) or both. Where A and B are activities occurring at different stages of the supply chain, these are referred to as 'vertical externalities' (see Appendix B).

'Internalising the externalities', by bringing the activities under the same roof, tends to result in greater development incentives and faster growth. The effects may be particularly large when one or both of the activities is completely new, i.e. when dealing with innovation in activities. That is, in industries undergoing a new cycle of development as a result of disruptive technologies, vertical integration, not separation, is frequently likely to be the more socially efficient business structure for meeting the long term interests of customers.

As the industry grows, the increasing returns available from one or more of these internalised functions may be better exploited by allowing other firms to enter the market and specialise in their provision. In particular, Stigler considers that this 'abandonment' is more likely for those functions that are rival[7], although that is not necessarily always the case. A process of 'dis-integration' or contractual simplification is then observed as the sector matures and market conditions settle down.

Innovations in electricity generation and supply — such as storage, distributed renewable generation, smart grid technologies, smart metering and radical changes in the relative value of different technologies,[8] which have ramifications (i.e. complementarities) throughout the supply chain, including the existing networks — suggest that the balance for the sector has shifted. Disruptive change has, arguably, brought about a new cycle in the electricity sector in which a greater degree of vertical integration could be in the long term interests of customers.

The imperative today, at a time when external factors such as concerns over emissions and endogenous factors including rapid technological change, is to encourage innovation and competition in the long-term interests of consumers. But competition is a process of discovery, particularly in markets that are undergoing an unusual (by recent historical standards) amount of technological change. In such markets, there is a need for flexibility and to keep options open. Otherwise constraints such as inapt regulation that limit or stifle the scope for that discovery to occur will be inconsistent with the long-term interests of customers.

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7 That is, the greater the rate of output of one process, the higher the cost of a given rate of output of other process or processes.

8 For example, emission controls significantly changing the relative value of renewable, gas fired, coal, nuclear and hydro generation.

1.1.1 The regulatory challenge

The regulatory challenge is to adapt the regulations in a timely and appropriate manner so as to ensure that final customers can benefit from the scope economies that could arise from greater involvement of NSPs in the provision of services that are contestable. However, since the NSPs are likely to retain 'natural' monopoly characteristics over some part of their existing network services, to ensure that these consumer benefits are not eroded by monopolistic practices such as inappropriate allocation of costs from contestable activities to monopoly activities or use of monopoly power to thwart competition in contestable activities (leveraging of market power). Facing these circumstances, the regulator has in broad terms three choices:

- to prohibit NSP involvement in contestable activities, or to arbitrarily limit their involvement in contestable activities to, for example, designated shares of their revenue;
- to allow NSP participation in contestable activities but formally regulate that activity in a manner akin to regulation of current regulated services; or
- to allow NSPs to participate in contestable activities, but to appropriately ring-fence those activities from 'natural' monopoly activities or otherwise supervise business conduct in a manner that provides a reasonable approximation to competitive neutrality.

Structural separation of the networks from the other elements of the electricity industry, a model that is likely to be more appropriate in stable environments exhibiting limited opportunities for scope economies,[9] prevents the transfer of costs from unregulated (ideally, the contestable activities) to regulated activities (ideally, just the natural monopoly service), but it also prevents the effective transfer of other factors that may be valuable, such as knowledge, skills, experience and possibly information.

Structural separation also ensures that the contestable activities secure regulated services on non-discriminatory terms. However, the pricing of these regulated services becomes a critical determinant of outcomes when disruption, innovation and start-ups in a new cycle become more important in delivering efficient outcomes. Vertical separation tends to lead to a degree of price averaging and double marginalisation — there is little record of policy

[9] The mature industry idea goes back to the Stigler concept and are characterised by relatively sedate levels of technological change and innovation, increasing returns available from specialised functions meaning they are better provided in vertically separated organisational structures where they can generate scale economies. In such circumstances, the adverse economic consequences of strict separation of contestable and natural monopoly elements of the supply chain are small (because scope economies are typically smaller or, in so far as they exist, replicable at low cost with sensible contractual arrangements and exchanges).

success in reflecting short-run marginal costs in regulated price structures at the distribution level— particularly where the electricity networks involved have complex and volatile marginal cost characteristics. But efficient development of at least some of the disruptive and innovative technologies is likely to be finely dependent on responding to the underlying marginal cost characteristics of the networks, development of short-term storage options being a good example. This suggests that internalisation through vertical integration between networks and some of these disruptive technologies has the potential to deliver better long-run outcomes for customers.

In principle it is possible to duplicate some of the benefits of vertical integration through more sophisticated contracts and network pricing, but it is doubtful how much progress can be made in this regard given the design principles adopted in the NEM. Even then, such contracts could be difficult/costly to specify and enforce when conditions are increasingly dynamic.

In making these remarks, we do not imply that what is at stake is an 'either-or' choice between complete vertical integration and complete separation of activities. In a very large number of markets, the differing suppliers are vertically integrated to greater or lesser degree (including not at all) or engage in different mixes of complementary activities, and the relevant business structures are adjusted over time (the structural evolution captured in the Stigler model being just one of the observed patterns that are to be found empirically). Such diversity and adaptation of business structures is itself a positive characteristic of competitive market processes and an aspect of the discovery of the most efficient supply structure in the face of myriad, differing and changing sets of circumstances.

The point is rather that the prevention of operative business models based on a degree of vertical integration is likely to preclude the diverse and 'mixed' supply side structures that have been found, via testing in competitive markets, to be conducive to increasing economic efficiency across a wide range of market contexts.

It is also the case that we must remain mindful and vigilant of the likelihood that significant elements of the power supply chain, most notably some network services, system control and market operations, will retain their natural monopoly characteristics, even if it may erode to some degree over time. As such, access to these services on non-discriminatory terms will continue to be essential to promote competition in related markets and regulatory scrutiny to ensure efficient provision of and pricing of the natural monopoly services, will remain important cornerstones for ensuring the long-run interests of customers are met.

1.2 Structure of the report

Our conclusions are presented above in an Executive Summary and short report, which directly address the questions posed by the ENA. This main report elaborates on these by providing additional background material and argument. In section 2 it describes the historical context from which Australia's current regulatory framework evolved. This then leads to four key questions, as follows:

- section 3 asks whether structural separation of NSPs from contestable markets remains the best regulatory policy, or whether it imposes barriers to NSP's providing services that would be in the long term interests of customers;
- section 4 identifies whether existing restrictions on NSP participation in the market (or differentiated regulatory treatment where they can compete) might impede competition that is otherwise in the long term interests of customers; and
- section 5 examines whether the existing regulatory framework imposes barriers that frustrate the development of scale and scope economies, particularly in the distributed energy resources, and whether market arrangements that improve information availability can operate as an alternative to regulation, as it is currently framed, to improve the functioning of markets.

As noted above, the electricity supply industry is in the throes of innovation perhaps even disruption. For the first time since the widespread deployment of national transmission and distribution networks with near universal coverage, there are realistic alternatives for some customers to disconnect from the grid. And these alternatives could well expand in the future. Appendix A sets out some of the innovations that are giving rise to the new competitive environment in which power networks operate.

2 Historical context

2.1 State involvement in electricity sector

Prior to 1993, when the Hilmer Committee's review of National Competition Policy was published, the Australian electricity market was dominated by state owned utilities (for example, the State Electricity Commission of Victoria owned and operated power generation[10] and transmission, the Government of Victoria owned a share of the Snowy Mountain Scheme, distribution was in the hands of the Municipal Energy Undertakings (essentially local councils), and final power prices were set by the government). Similar models based on state ownership were in place throughout Australia, embodying a high degree of vertical integration, and a high degree of government control over investment and pricing. There was limited inter-state trade where interconnectors were in place,[11] although measures to increase cooperation were underway.

At that time, this model of state ownership with municipal ownership of distribution was widespread outside of North America. Government ownership of utilities generally, under statutory monopoly that precluded any competition, was widespread; it was almost universally criticised as inefficient, particularly after the successful, partial separation[12] and privatisation of the England and Wales electricity sector in the mid-1980s, following on from the privatisation and regulation of UK telecommunications. That criticism certainly extended to the Australian electricity sector, at a time when state budgets were under enormous pressure[13] and states were seeking a greater revenue contribution from their utilities.

Although Hilmer substantially influenced the structure and development of the electricity sector in subsequent years, an equally strong and contemporaneous impetus for reform came from Victoria. For both ideological reasons, and as a means of unlocking the value tied up in its utility sector and devolving future obligations, Victoria in the period from 1994 to 1999[14] followed the UK model of privatisation into separate generation businesses based on single power stations, a separate transmission business, five integrated

10 At this time, SECV was in the process of selling a share on one of its power stations, Loy Yang B, to Mission Energy, with a power purchase agreement in place.

11 At that time, QLD and TAS were not interconnected with the other SE Australian states.

12 The new regional electricity companies (RECs) were vertically integrated as between distribution and supply/retailing and they were also allowed to operate some generation assets. The major separation, on which most international attention has been focused, was between major generation facilities and transmission. Initially the RECs also collectively owned the National Grid, but this was divested relatively quickly.

13 To the extent that the State of Victoria was struggling to manage its commitments to Loy Yang B, necessitating the deal with Mission.

14 The structure was established in 1994, the assets were privatised over the period 1995-1999.

retail/distribution businesses, all operating under the aegis of an independent economic regulator and independent market operator.

2.2 Adoption of the Hilmer Review recommendations

The Hilmer Committee review was set in this context, recognising that persistent state control had resulted in inefficient outcomes in the utility sector. The Committee observed that:[15]

> Competition policy is not about the pursuit of competition *per se*. Rather it seeks to facilitate effective competition to promote efficiency and economic growth while accommodating situations where competition does not achieve efficiency or conflicts with other social objectives.

This context was reflected in its terms of reference, which included policy principles aimed at the perceived shortcomings of and statutory monopoly (see Box 1 below).

Box 1. Hilmer review: policy principles

a) No participant in the market should be able to engage in anticompetitive conduct against the public interest;

b) As far as possible, universal and uniformly applied rules of market conduct should apply to all market participants regardless of the form of business ownership;

c) Conduct with anti-competitive potential said to be in the public interest should be assessed by an appropriate transparent assessment process, with provision for review, to demonstrate the nature and incidence of the public costs and benefits claimed;

d) Any changes in the coverage or nature of competition policy should be consistent with, and support, the general thrust of reforms:

   i. to develop an open, integrated domestic market. for goods and services by removing unnecessary barriers to trade and competition;

   ii. in recognition of the increasingly national operation of markets, to reduce complexity and administrative duplication.

Accordingly, the Committee's main focus was on competitive conduct rules and policy elements aimed at these sources of inefficiency, including:

- regulatory restrictions on competition (such as legislated public monopolies);
- the structural reform of public monopolies;
- access to essential facilities;
- monopoly pricing; and
- competitive neutrality.

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15 *Hilmer* xvi.

While states in Australia adopted different approaches to privatisation, a combination of the Victorian reforms and the Hilmer recommendations on policy in this area, established that the Australian electricity markets would:

- strictly separate services deemed to be natural monopolies (NSPs, system operation and market operation) from contestable services (generation and retail supply);
- independently regulate the natural monopoly components (the NSPs, system and market operation);
- present, as far as possible, a 'level playing field' between private and government owned market participants through a number of mechanisms such as:
  - corporatisation of the key elements of the electricity supply chain in those jurisdictions that did not privatise; and
  - non-discriminatory rules for access, and removal of any privileged access based on ownership; and
- in so far as state governments sought to manage prices or outcomes for certain customer classes (e.g. regulated prices to small customers or low volume users), to do so through transparent instruments that did not limit competition.

The initial stage of the current national electricity regulatory framework was also developed, based on this structure with economic regulation applied to monopoly network components. This regulatory design has not fundamentally changed since then, reflecting the relative stability of electricity market conditions until recent years, although it has gone through a number of administrative changes with powers devolving from state to national level and with the introduction of more clearly defined policy and governance frameworks.

2.3 The importance of context

There is no doubt that these structural and regulatory changes, post Hilmer, have given rise to the profound changes and improvement in the SE Australian electricity markets from which customers have benefited.

Compared with today, the Hilmer reforms were implemented in a very different environment and in response to some very different drivers. The very rigid system of regulation that was introduced post Hilmer was adopted to ensure that the legacy of operation under government statutory monopoly did not persist. It was not selected as a nuanced set of measures to get the best outcome from a restructured industry that has largely moved on from the practices of its vertically integrated monopoly heritage.

Not only have the worst excesses of the pre-Hilmer regime subsided, but the sector as a whole is in the process of significant disruptive change. Obvious examples include the emergence of renewable sources of generation such as wind and solar. More subtle but just as profound changes include the emergence of storage, time of use metering (which has yet to yield anything close to its full potential), and the emergence of smart technologies that allow for greater control of network performance.

Some of these innovations have created opportunities for markets for new services that cannot be compartmentalised into the strictly vertically separated levels that are entrenched in the current regulatory paradigm. If these markets are to develop rapidly and successfully, existing service providers which are largely confined to specific vertical levels, such as NSPs, are likely to be important suppliers. At present, they cannot participate, or cannot compete on the same basis, as unregulated businesses. Hilmer recognised the importance of competitive neutrality and that regulation itself could distort competition, noting that: 'firms competing in the same market face different regulatory or other requirements, potentially distorting competition and raising efficiency and equity concerns'.[16]

2.3.1 Changing energy markets

Australian energy markets are changing in response to a combination of factors including technical change, price change (some of which is driven by government subsidy), policy imposts, most notably driven by climate change policy, and consumer preferences. For example:

- there has been a notable shift towards wind generation driven by the combined forces of technological improvements in wind generation and renewable generation targets;
- rapidly rising electricity prices and reductions in solar PV prices (driven in part by subsidy) have resulted in substantial uptake of 'behind the meter'[17] solar PV installations, which has resulted in changed demands place on NSPs and centrally coordinated generation; and
- storage either in front of or behind the meter is beginning to emerge as a viable adjunct to renewable generation (especially solar PV), and a substitute for new generation, transmission and distribution capacity.

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16 Hilmer, F., Rayner, M. & Taperell, B. (1993). p.293.

17 Behind the meter refers to generation technology that connects to residential or small customer premises on the customer side rather than the distributor side of the electricity meter.

The pace of change has created risk and opportunities. New (unregulated) participants are entering the market with innovative products and services that challenge the traditional service delivery paradigm.

There are, of course, a number of initiatives underway within the existing policy and regulatory framework that can help these types of innovations improve customer outcomes. Changing electricity pricing so that prices convey more information about the underlying costs of supply, for example by moving to cost-reflective network pricing ('CRNP') and time of use metering, will no doubt help customers make better decisions on demand side management, adjuncts to grid supplied power such as solar PV and storage and even, for some customers, disconnection from the grid. And consumers also increasingly seek access to information and tools to enable them to make fully informed choices about the new products and services that are entering the market.

One of the recent initiatives is a roadmap published by the ENA, in partnership with the CSIRO, to develop a blueprint for transitioning Australia's electricity system to foster innovative electricity systems that focus on better serving the needs and aspirations of future customers. It will identify an integrated program of actions and measures for Australia's energy transition over the period from 2015 to 2025.[18]

The importance of information

One of the issues presented by such rapid change and the initiatives that are in place to respond to some of these changes is the importance of information to customers and to investors in the sector. The challenges include finding ways both to produce greater information in aggregate and to convey relevant information to those to whom it is of value.

In the first instance, electricity prices do not currently convey sufficient information about the underlying costs of supply and hence fail to provide signals that would encourage efficient utilisation of the network and enable consumers to better manage their own demands, including by reducing their energy bills. CRNP and time of use metering are measures that address this so that customers can make improved (in the sense of more efficient) consumption decisions.

Pricing improvements can be expected to deliver significant improvements in resource allocation. By way of example, very few electricity customers face prices that signal the short-run marginal cost of power, including the costs associated with risks of supply failures. There are a number of reasons for this, but perhaps the most important has been

[18] Available at http://www.ena.asn.au/electricity-network-transformation-roadmap (last viewed 30 November 2015).

policy reluctance to expose larger groups of customers to more cost-reflective market prices, which is understandable when most customers have had limited options for managing the consequences of such prices. However, new technologies are opening up greater opportunities for demand side management, including by households and including by use of storage options. These open up the potential for much higher gains from use short-term price/cost signals than have been feasible hitherto.

The consequences of any undue prolongation of inadequate pricing in combination with limited opportunities for customers to respond to pricing are clear. For example, responsive time shifting of loads can economise on peak capacity requirements and it becomes more feasible to acquire information about the value that customers placed on reliability. These benefits will not be achieved in the absence of pricing reform. Excessively averaged pricing will continue to inflate peak demand to inefficiently high levels and the consequent inefficiently high capacity provision will be reinforced by continued reliance on administratively determined rules for network adequacy and reliability. Initiatives have now been put in place to assist customers in understanding and articulating the value they place on reliability, which should improve decision making on network adequacy and reliability, but further advances would be possible if these values could be inferred from across the market behavioural evidence on customer responses.

Pricing reforms are important, but are not alone sufficient to ensure that all of the potential and efficiency gains are more nearly realised; other measures have roles to play. Consumers also need access to information and tools to enable them to make fully informed choices about the new products and services that are entering the market. For example, consumers were encouraged to 'beat the rush' to install solar panels and take advantage of attractive rebates and feed-in tariffs while they remained on offer. However, not all of these consumers would have been aware of how their own installations would actually impact on their net electricity consumption in the longer term, nor would they have been aware of the potential changes in the performance characteristics of solar panels over time, as the technologies develop further.

Perhaps more importantly, there was no obvious means under the current regulatory environment whereby customers could select an alternative package of services that included not just solar panels, but also:

- purchases of services from larger scale solar (or other renewable technologies) embedded within the transmission or distribution networks;
- storage, whether located at the customer premises or embedded within the networks, capable of providing a range of services that could lower the costs to final customers; and/or

- distributed control of their own installations so as to minimise the overall cost of power supply, in return for a share of the efficiency gains.

2.3.2 Recognising when context has changed

Recognising both the changes that have already happened and the prospects for change that is still to occur, the electricity supply industry is now in a very different to what it was at the time of the Hilmer reforms. Even after the separation of transmission, distribution and generation occurred, networks were generally subject to Government ownership and there was no real competition in the provision of network services. A number of networks are now subject to private ownership and significant competitive pressures are now developing for some products and services. Overall, the scope of naturally monopolistic activities services is narrowing and this trend is set to continue and arguably accelerate.

It can be argued that the post-Hilmer reforms were sufficiently robust that they will, without amendment of the separation of business activities entailed, continue to allow the fulfilment of all of the then perceived benefits of these arrangements, notwithstanding radical changes in circumstances. Given the inevitable uncertainties when looking to the future, that possibility cannot be entirely discounted, but we do not see it as likely. *A fortiori*, we think it would be unwise to proceed on the assumption that it is likely, particularly if, given the slow pace of regulatory change, such an assumption served to curtail clear thinking on better alternatives.

More generally, it can be said that regulatory arrangements that are rigidly linked to fixed expectations or forecasts in circumstances that are subject to significant dynamic changes are a recipe for regulatory failure. Notable examples of the results include the collapse of the reformed Californian power market in 2001, the international banking crisis of 2008 and, more recently still, the unravelling of the UK government's Electricity Market Reform programme (developed around an expectation of ever rising oil and gas prices).

As will be explored further in this paper, the boundaries between natural monopoly and contestable activities were much clearer when the Hilmer reforms were first implemented; they have since become increasingly blurred. A key issue is how erosion of the natural monopoly character of the NSPs, at least in some of the activities they undertake, should be taken into account in the regulatory paradigm to ensure that NSPs can continue to make effective contributions.

Quite apart from anything else, a situation in which organisations are forced to shrink in line with a shrinking monopoly domain, without the ability to engage in new activities, in which they can be innovative and valuable participants on a competitively neutral basis, is unlikely to foster the long-term interests of customers. Nor is it conducive to good organisational performance for a range of reasons including career prospects, adverse selection among staff leaving and staff staying, and the motivational effects of organisational decline, unmitigated by the challenges of competition.

2.4 The Harper Review

The Harper Review, completed in 2015, was the first comprehensive review of Australia's competition policy since the Hilmer Report. The Panel concluded that competition policy should do the following:[19]

- make markets work in the long-term interests of consumers;
- foster diversity, choice and responsiveness in government services;
- encourage innovation, entrepreneurship and the entry of new players;
- promote efficient investment in and use of infrastructure and natural resources;
- establish competition laws and regulations that are clear, predictable and reliable; and
- secure necessary standards of access and equity.

It proposed that Australian governments agree to a set of competition principles, including that 'competition policy, laws and institutions should promote the long-term interests of consumers' and that application of the principles should be subject to a public interest test, targeted at ensuring that the benefit of any proposed restriction does not outweigh the cost. While the review did not focus in great depth on utility regulation, the Panel observed that:[20]

> We also need flexible regulatory arrangements that can adapt to changing market participants, including those beyond our borders, and to new goods and services that emerge with rapidly evolving technology and innovation. Market regulation should be as 'light touch' as possible, recognising that the costs of regulatory burdens and constraints must be offset against the expected benefits to consumers.

In commenting on 'digital disruption' created by new technology, it considered that competition policy, laws and institutions need to find the right balance between not disrupting its impact and maintaining safeguards for consumers.

The Panel reflected on the electricity sector as a case study of successful reform, including success in increasing consumer choice. As it acknowledges, greater choice means greater complexity, and this is particularly evident in the evolving electricity sector, as discussed

19 Harper, I., Anderson, P., McCluskey, S. & O'Bryan, M. (2015). *Competition Policy Review, Final Report* ('*Harper*') 7.

20 *Harper* 24.

above. It considers that 'markets work best when consumers are informed and engaged'[21] , which necessitates access to the right information and an ability to assess the competing alternatives. The Review did not set out a case for comprehensive changes to electricity regulation, but did highlight the need for flexibility to adapt to market change; flexibility to support evolving technology and innovation; a 'light touch'; and focus on the interests of customers.

2.5 Implications

2.5.1 For the electricity network businesses

The changing environment described above means that the role of the electricity network business – both distribution and transmission networks – is fundamentally changing. The networks must re-evaluate their role in the new energy supply chain, especially with regards to goods and services provided to customers 'behind the connection'. This includes energy management solutions, distributed generation and storage. Some of these offerings are complements to the existing services provided by network businesses, while others are substitutes/rivals.

Historically, transmission and distribution network businesses have predominantly been natural monopoly providers of an essential service, being connection to the grid and transfer of power from the transmission network to the final customer. In the future, the natural monopoly element of the network business will shrink as the range of feasible substitutes to network services expands. Scope economies between distribution services and other services (such as peak power delivered through storage) will become more significant in driving customer outcomes, and the scale efficiencies from which the natural monopoly characteristics derive less so.

Noting the rapid pace of change, network businesses would perhaps benefit from set of clearly expounded expectations around the types of outcomes that policy makers are seeking to promote. There is clearly a choice over the degree to which NSPs have a more significant involvement in developing and providing new products and services in contestable markets, or a narrower more network-focussed role more closely aligned to the status quo. While clearly directed policy might help network businesses conduct their activities, a superior outcome, in our view, would be to calibrate the regulatory 'rule book'

[21] *Harper* 293. We would qualify the engagement sentiment with the words "when they want to be". Successful market arrangements serve to reduce transactions costs — that is their purpose — which implies that the level of 'engagement' may need only to be modest for consumers to make appropriate decisions and exert their influence. Greater engagement tends to imply higher transactions costs, other things being equal.

to the individual business choices of the NSPs, rather than to prescribe NSP choices by adopting a single inflexible rule book.

Regardless of which path is chosen (or if the strategy is implemented poorly, or too late, which path is inherited), networks will need to develop and/or strengthen the relationship they have with their customers and continue to demonstrate the value of connection.

2.5.2 For regulation

As outlined above, the natural monopoly element of the network businesses can be expected to shrink through time, and scope economies will become more important in determining customer outcomes. This in itself presents significant challenges from a regulatory perspective given the increased risk of asset stranding.

The line between regulated and contestable services

The line between regulated and unregulated (or contestable) services will also tend to become more blurred, and inherently more complex, as new products and services can complement and/or be substitutes for existing network services. In cases such as metering, services that were formerly subject to regulation have been opened up to competition over time.[22] This development is clearly recognised. The AEMC noted, in respect of a trial of an electricity storage system by ElectraNet in consortium with, amongst others, AGL, in SA that it could provide network support (i.e. deferred network augmentation), wholesale power, support for intermittent supply from a nearby wind farm, loss minimisation, and ancillary services:[23]

> So we want market and regulatory arrangements capturing these multiple value streams so that there is strong separation between the regulated and competitive services provided by the storage asset. We want to see the benefits of the value stream accruing to the right market participant. In this South Australian example, this would mean benefits accruing to AGL including… market trading benefits… 'saved' energy benefits during periods of network congestion because AGL is owner of the wind farm…ancillary services support benefits.

This is an example of the types of new developments that are becoming feasible due to the emergence of new technologies. What is being identified here is the existence of specific vertical externalities if a market participant was considering this project on a stand-alone

22 The final stage in the opening up of metering services competition (to residential and small business electricity consumers) is scheduled to commence from 1 December 2017.

23 AEMC (18 November 2015) *The Integration Of Energy Storage: Preparing Markets For Technological Change*, speech by John Pierce, 7.

basis. By way of illustration, strong separation between regulated and competitive services means that a business offering storage services in the wholesale energy market would not take into account the impact of the storage on transmission or distribution. The AEMC rightly recognises that if these vertical externalities can be reduced (i.e. can be partly or wholly captured by the investor/innovator) there will be greater incentives to invest/innovate.

Both the identification of the issue and the general aim are clear enough, but that leaves open the question of how the aim should be achieved. Vertical integration is the simplest way of reducing vertical externalities, but the AEMC goes on to identify the chief issues that this would raise:[24]

> This means regulated network businesses being unable to use either the financial resources provided by regulated network revenues, or information that they gather as network operators, in a way that limits competition in energy services.

That is, the regulatory concern is limitation of competition in energy services.

This storage example serves to clarify earlier remarks about the importance of development cycles, as illustrated in the Stigler model. Public policy is well used to dealing with issues of promoting competition in activities that were previously monopolised, and that was the sectoral landscape facing Hilmer. The policymaker starts with one supplier and asks how other suppliers and potential suppliers can be added.

However, when dealing with drastic or disruptive innovation, the relevant starting point for thinking about the issues is not one supplier, but no suppliers. Starting at zero rather than one is arguably as disruptive for regulatory thinking as changing technologies are for established businesses in the sector. Unregulated monopoly, with its tendencies to restrict output and raise prices, may be bad for consumers, but not nearly as bad as no output at all. Indeed, if the question asked were "when would the addition of an extra supplier of a service be of most benefit to consumers?", the answer would very frequently be "when there are no pre-existing suppliers".

Vertical integration serves to promote this first, major, pro-consumer step when the new product or service gives rise to vertical externalities by enabling the innovator to capture a larger slice of, in the AEMC's words, the "benefits of the value stream".

At this point, a policy maker with a strong preference for competition might ask the question: "Is it not possible to design an incentive structure that would put potential innovators on a completely level playing field with established businesses who would be

[24] Ibid.

the beneficiaries of the externalities?" In effect, this is asking whether there might be a way of addressing the externality issues other than via integration.

The answer would be yes in the presence of an all-knowing economic planner, but the question is much more difficult to answer in the absence of such an entity. At the outset there is an information deficit or knowledge problem. For example it is unclear how a regulator can easily determine, in an environment with disruptive technologies and innovation, where the sources of scope efficiencies and of vertical externalities lie. They might arise because the NSP has information, skills and resources developed from operating the network which others don't necessarily possess and may not be able to acquire without operating a network themselves. But then the regulator has to acquire that information before assessing it, piecing it together with all other relevant information and finally deciding how it might be translated into the design of an incentive structure, for a product/service that does not yet exist and whose value has yet to be tested in the real-life laboratory of the marketplace.

The information acquisition process would also be impeded by any prohibition of 'financial resource gains' from providing regulated services. Information revelation mechanisms are usually based on providing incentives for information to be revealed, and the resulting benefits that they yield to the providers — here NSPs — are justified in public policy terms on the basis that the value of the information provided exceeds the slice of the benefits that would flow to the information providers.

If incentive regulation were abandoned in favour of mandates/coercion — which itself would raise fundamental questions as to whether established regulatory principles were being discarded — a further level of difficulties comes into view. It is exceedingly hard to mandate the provision of information which itself is rather cloudy and uncertain in nature. Initially, an NSP itself will likely not have clear sight of the benefits that it might enjoy from a particular project, since they will depend upon things like the proposed scale and operating characteristics of, say, the storage project. The NSP therefore has to engage in its own discovery process, and it is difficult to see how this can be successfully mandated in a context where it receives no compensation/incentive for so doing.

By way of example, DNSPs are extremely well positioned to work with their customers to provide information and help identify the solutions that are in their long-term interests, including helping them make sense of the various options that are emerging, as advocated by the Harper Panel. This is because their long term interests are already aligned to a significant and increasing extent. Given the large, sunk investments that the businesses have made in their network infrastructure and the increasingly contestable nature of their core service offering, they have direct incentives to ensure that their assets are used effectively. Across a number, though not all, activities or services this is likely to involve the development of lower-price options, not least to mitigate risks of substantial losses due to asset stranding. And for those activities where NSP/customer alignment is problematic, public regulation is and should remain a backstop protection for consumer interests. Removing incentives for DNSPs to compete therefore imposes significant costs that regulators should consider.

Scope for bypass

Standing back, it would appear to us that attachment to notions of strict competitive neutrality at every stage of a development cycle, including most crucially at the early stages, introduces risks of taking the road to central planning, which is usually not a road that is favourable to consumers. A principle such as competitive neutrality is, at bottom, intended to be a guide toward a particular end, defined by the long-term interests of consumers, not an end in itself. In an unfamiliar context — disruptive change — that was unexplored when the guide-book was written, it might be unwise to rely too heavily on a literal interpretation, the time for which may come again when the economic context begins to take a more familiar shape. That is, if regulators and policy makers focus on ensuring competitive neutrality by excessively impeding the participation of vertically integrated businesses in horizontal markets they deem to be contestable, they risk substantially slowing the development of markets for innovative or disruptive services; the markets where vertical integration (to manage the adverse consequences of vertical externalities or to exploit vertical scope economies) may be most important. It may be that stand-alone non-integrated businesses may struggle or fail in these markets for innovative or disruptive services, but if the cost of regulation that prevents such failure is significant delay in the introduction of new services, it is not likely to be a cost worth paying.

Returning to the general issue of leverage of market power, another assumption that has and will be tested is whether access to the natural monopoly network remains a pre-requisite for new participants entering the market, which is a key rationale underpinning regulation. Another way of looking at this is whether the network can use its natural monopoly position to create or enhance its competitive advantage in a particular market in a way that is inefficient or detrimental to competition, recognising that there are legitimate scale and/or scope economies that could be exploited to drive efficient outcomes.

The disruptive technologies and changes set out Appendix A below and the likely trends in the cost of solar and storage in particular suggest going off grid could well become a commercially reasonable proposition for more grid customers over the next decade. Microgrids also offer bypass opportunities, albeit at a level of a small zone, region or industrial/institution site rather than at the level of an individual customer. The extent and viability of this bypass is, of course, uncertain and in part dependent on future innovations. The markets for these bypass technologies would, in all likelihood, be contestable. They would comprise a bundle of services that is currently provided by a combination of the contestable wholesale market and regulated network services.

Whether the contestable market for 'off-grid' supply of these types delivers socially efficient outcomes depends fundamentally on whether the competing bundle of 'on-grid' supply can contest that same market. That, in turn, requires that NPSs, which are a core element of the 'on-grid' service are able to offer competitive packages including but not limited to:

- efficient 'discriminatory' prices for the provision of network and, potentially, connection services; and
- other services such as storage, control, network investment deferral, ancillary services etc. which might reasonably be expected to lower the effective cost to the customer of on-grid supply to levels that are competitive with the 'off-grid' alternative.

Hilmer, Harper and others have recognised the significant benefits of having competitive markets, driving efficiency, economic growth and job creation, all of which is in the long-term interests of consumers. Change needs to be driven by the market, which in this case, reflects a shift to a consumer-led supply chain, enabled by significant advances in technology.

Ultimately, regulation needs to facilitate this change, not drive it and *a fortiori*, not constrain it. One of the issues with the current framework is that it does not adequately reward innovation or risk-taking. To advance the long-term interests of consumers, innovation will be essential and the right incentives need to be created to encourage this behaviour.

Network businesses are currently in a position where they need to make some major decisions regarding their future strategic direction without having a clear view on what the regulatory framework will look like, and even if they will be 'permitted' to participate in some of the emerging markets or if so, on what terms. A key example of this is the Australian Energy Regulator's (AER's) ring-fencing guideline. This will directly impact the extent to which network businesses can engage in contestable services. Currently, the ring-fencing guidelines applicable to DNSPs are those established by jurisdictional regulators around the mid-2000s, which are now significantly outdated given broader electricity market developments.

Balancing regulatory and market distortions

What this means is that any adverse effects of market power need to be balanced against the adverse effects of regulatory interventions. As noted by Helm and Yarrow:[25]

25 Helm, D. & Yarrow, G. (1988). The Assessment: Regulation of Utilities. Oxford Review of Economic Policy, 4(2), p.x.

> The objective of regulation is to limit the abuse of monopoly power by encouraging entry or threats of entry, and to generate sufficient information to enable monitoring to take place. These objectives should be met without unduly undermining the management incentives towards the creation of comparative advantage through innovation and cost minimisation.

Depending on its responsiveness in light of a rapidly evolving electricity market, there is currently a risk that the regulatory framework will impede this development or see the proliferation of solutions that are not in the long-term interests of consumers. In this context, one of the adverse effects of strict price controls is that they increase incentives to restrict competition in related markets in which the same business can operate: an unregulated monopoly has much less to gain, and potentially much to lose if the related activities are complementary, from restrictions of competition. There is therefore a strong case to be made for the proposition that the competition problems that are the centre of current policy attention are themselves chiefly a consequence of regulation, which raises the further question (beyond the scope of this paper) of whether reforms to the structure of current price controls might, in fact, be the most expedient way of relieving the problems. The key point is simply that, in the interests of consumers, it is positively desirable for NSPs, one way or another, to have a direct financial stake in the expansion of activities that make more use of their network assets.

To date, the key risk that has been targeted by regulation is the misuse of market power to extract monopoly rents, resulting in a focus on price regulation, structural separation and stringent constraints on NSP participation in contestable markets. This will remain relevant to the extent that network businesses continue to control significant bottleneck activities, but the magnitude of potential monopoly rents is likely to decline, and the scope economies lost as a result of rigid separation is likely to rise.

This is not to suggest that bottleneck activities should not continue to be regulated, broadly, the current regulatory paradigm based on a notion of efficient costs. It does, however, suggest that there should be a shift in emphasis towards:

- fewer strict prohibitions on participation in contestable services such as arbitrary limits on revenue shares or single technology-based distinctions;
- greater emphasis on disclosure so that there is a high degree of transparency in respect of NSP's participation in contestable markets, including better TNSP and DNSP network pricing; and
- ring-fencing in a manner that minimises the risk that costs of contestable services are allocated to regulated services, but which do not otherwise frustrate the emergence of scope economies.

More radically, it suggests that there is a case for re-assessment of the structure of existing price controls to see if there are a ways of tilting the incentives they provide away from restricting the development of contestable services and toward the expansion of contestable services.

Information asymmetries

Another source of problems that regulation is intended to address is information asymmetries. However, the digital revolution brings with it increased information flows and new tools to assimilate that information that will reduce these asymmetries and assist consumers in making decisions that are in their long-term interests. Indeed, to the extent that the market leads the development of these tools and information flows, this will likely be a better solution than regulatory intervention. It is noted that the distribution networks appear already at the forefront of some of these developments.

Many of the developments cited in Appendix A below centre on the collection (through smart meters, additional sensors etc.) of information, the communication of that information, and the use of that information, for example through innovative software tools. The collection, dissemination and addition of value added services to this data can address the current information asymmetries apparent in power markets to the long-run benefit of customers. Grid analytics (see page 84) is one such example.

Competition issues will continue to be important, but their nature will change. For example, whilst anti-competitive price discrimination will be remain an issue, there will need to be recognition that more blanket prohibitions of price discrimination can themselves be anti-competitive and can lead to inefficiencies, higher costs and higher prices in notionally 'competitive' activities. As indicated by the UK Competition and Markets Authority's Provisional Findings Report[26] on its current energy market investigation, which itself is in line with a much earlier consensus of leading academic economists, this problem has already emerged in Great Britain.

A narrowing range of regulated services?

It is difficult to foresee the future of technologies, what opportunities they will bring for customer benefit and what these developments mean for transmission and distribution networks, although the extent of market power they enjoy should reduce and the range of services meeting the test for the economic regulation (at least in its current heavy handed form) should narrow. Two inter-linked issues appear particularly ripe for consideration:

[26] The CMA provisionally concluded (at paragraph 150) "overall, we think it is likely, on the basis of the evidence that we have seen, that SLC 25A [which prohibited regional price discrimination] contributed to a softening of competition on the SVT, although other factors may also have had an impact."

- the economic effects (on competition, on innovation, on prices) of different forms of price discrimination in different contexts; and
- the economic effects of various forms of 'separation' of business activities.

Addressing these issues can be expected to require more nuanced forms of regulation of business conduct. Simple, blanket forms of prohibitions can increasingly be expected to be counter-productive. As the scope of natural monopoly continues to narrow over time, in the longer term it is likely that lighter handed or more focused forms of regulation may become appropriate. In the short to medium term, more flexibility is needed to enable the market - and NSPs as key participants in that market - to adapt and respond to the ongoing change.

3 Implications for participation in contestable markets

In this section, we assess the applicability of the Hilmer Committee's overarching framework, including the Policy Principles, conclusions on separation of natural monopoly elements and potentially contestable activities to energy networks' participation in new contestable markets, and address:

- whether the Hilmer framework implies that the only optimal policy response to the competitive and technological developments in the energy network sector is to enforce structural separation of natural monopoly elements of the traditional electricity network supply chain and distributed energy resources (i.e. grid-based or customer-based storage, solar PV, or demand response technologies)?
- whether the resultant restrictions on vertical integration are consistent with avoiding or minimising regulatory barriers to networks directly serving and innovating to better meet the needs of their customers? and
- the nature of the actual 'bottlenecks' in new energy services markets, and what alternative low or no cost mechanisms may exist to resolve any bottleneck concerns.

We argue that the imperative today, at a time when external factors such as concerns over emissions and endogenous factors including rapid technological change, is to encourage innovation and competition in the long-term interests of consumers. Structural separation of contestable and natural monopoly elements of the supply chain is unlikely to be the optimal policy stance for meeting the long-term interests of customers, for the following reasons, elaborated on in the following sections.

In an increasingly innovative even disruptive market, technological advances are no longer limited to the discreet market layers that emerged from the post-Hilmer reforms. In such an environment, scope economies between network and some contestable services are likely to be valuable for customers. Furthermore, the networks themselves face competition in the form of feasible 'off-grid' alternatives to network supply, which may become even more commercially attractive for customers as the costs of the emerging technologies decline. There is a compelling case for allowing NSPs a greater involvement in contestable markets both to generate the scope economies (and pass them on to customers) and to compete to supply an 'on-grid' alternative to 'off-grid' supply.

Despite this, the networks will not lose all their natural monopoly characteristics for some considerable time, and remain a bottleneck to new energy services markets if unregulated. There will remain a requirement to preserve the integrity of contestable markets by ensuring a high degree of competitive neutrality (such that those that can provide the best service at least cost without implicit subsidies succeed), because the natural monopoly characteristics of the bulk of network services will remain for the foreseeable future.

However, on the basis of earlier arguments, we think that the benchmark of competitive neutrality is most appropriately applied in relation to the development of new markets over a relatively extended time period, not at every single point along the way.

This is not the only potential bottleneck to the emergence of new energy services markets. Lack of information and information asymmetry are likely to limit development. Many of the innovations emerging from the more vertically integrated US investor owned markets are based on collecting, disseminating and making better use of information. Existing pricing models also impede the emergence of new market, not least because better pricing facilitates better targeting of investments, but also because there is always the risk that prices set in regulated markets that do not represent the achievable ideal are likely to change over time. Coordination problems within the supply chain are likely to be a bottleneck on the emergence of new energy services. Industries typically remove such bottlenecks with vertical integration, but regulation that prevents or impedes this leaves the bottleneck intact. Hence, regulation itself also presents a bottleneck, not only in this regard but by its relatively slow decision-making pace and because it may prevent investments by agents with the most appropriate set of attributes.

Hilmer espoused the principle that restrictions (including networks' ability to participate in contestable markets) should only be considered where there is no less restrictive way of ensuring network ownership does not adversely affect competitive market processes and dynamics. Applying this principle suggests that the regulatory paradigm might have to evolve from the current model of structural separation and a presumption that NSPs should be excluded from (or have a trivial involvement) in contestable market, to one in which there is more latitude for NSP involvement in contestable markets with appropriate safeguards such as:

- ring-fencing as a means of ensuring that the costs of providing contestable services are not transferred to regulated services such that the NSP secures a material competitive advantage;
- appropriate information disclosure to minimise the costs of monitoring to ensure competitive neutrality; and
- significantly improved network prices at both the TNSP and DNSP level to facilitate better investment decisions (including investments in new technology and innovation), and to lessen the burden on regulatory measures to ensure transparency.

3.1 Overarching goal of regulation of the electricity sector

In considering the policy and regulatory implications of the changing energy market environment, it is essential to have regard to the overarching goal, being promotion of the National Electricity Objective (NEO), which is:

> …to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to – price, quality, safety, reliability, and security of supply of electricity; and the reliability, safety and security of the national electricity system.

A similar objective applies under the National Gas Law. As noted above, one of the key conclusions of the Harper review was to "make markets work in the long-term interests of consumers".

It is therefore essential to test any regulatory solutions based on whether they are in the long-term interests of consumers. What is in the 'long term interests' also needs to be clearly understood and articulated, recognising the diversity of individual needs and preferences that will always exist.

Overall, we would expect that this will be based on affordability, reliability and choice, all of which are inter-related. Further, the words 'long term' imply a greater emphasis on questions of innovation that might be appropriate if a shorter timeframe were to be considered, reflecting the importance of explicitly acknowledging that uncertainty as to future opportunities requires an openness to a wider range of industry structures than would have been considered acceptable in the more settled environment in the past.

The imperative today, at a time when external factors such as concerns over emissions and endogenous factors including rapid technological change, is to encourage innovation and competition in the long-term interests of consumers. Given this context, the vertical separation that arose, with strong justification, from Hilmer is now unlikely to be the best means of delivering this outcome, for the following reasons:

- technological advances are resulting in new technologies, rapidly becoming competitive with existing technologies, which deliver services traditionally viewed as being within the bundle of services provided by the [natural monopoly] NSPs along with services that are contestable, necessitating much greater involvement of the NSPs in meeting customer needs;
- scope economies are becoming more important relative to scale economies, which means that industry structure and regulation, in particular, must focus more on measures that, unlike structural and functional separation, do not impede the availability of new technologies, and with them the emergence, internalisation and transfer to final customers of the benefits of scope economies;

- successful deployment of disruptive technologies so that they can deliver greatest benefits to customers can be enhanced by the expertise, experience and skills of the NSPs. In the absence of these skills, investment in disruptive technologies is likely to be sub-optimal (in terms of optimal size, timing, placement and complementary network investments needed to deliver the most socially valuable storage)
- for some customers, NSPs are not the only source of service and off-grid is an option, further eroding natural monopoly and the social benefits of structural separation. Over time, the scope for 'off-grid' supply (whether through behind the meter storage and solar, or through microgrids) is likely to increase. And the scope of socially inefficient bypass will also rise if NSPs cannot offer to the customer a bundle of services in a competitively neutral manner as an alternative; and
- the new cycle of innovation and technological development, which carries with it considerable uncertainty, and technical and commercial risk, will probably require a combination of expertise, experience and skills including those of the NSPs, in order to deliver the full benefits to customers. Most of the technological advances summarised in Appendix A below are of this type. Accordingly, customers are likely to benefit from NSPs being able to compete in the contestable sector, recognising that NSPs must not be allowed to restrict the roll out of contestable services. The regulatory challenge is not to exclude NSPs from competing to provide these services if customers demand them while retaining a high degree of competitive neutrality.

3.2 Requirements for structural separation

The imperatives driving the Hilmer reforms in the 1990s were fundamentally different to today. To the extent that structural separation was advocated, this was a response to the widespread existence of large, government owned organisations operating under a highly integrated structure, with no real commercial drivers or accountability to consumers (see section 2 above). The inefficiency and dearth of competition under that model (in markets such as generation which were widely viewed as capable of supporting vigorous competition) were no doubt a consequence of government statutory monopoly, self-regulation and extensive government interference in operation, investment and pricing (as, indeed, was the case in the UK and many other countries reforming their publically owned utilities at the time).

Vertical separation could be viewed as effective in ensuring the rapid correction of these deficiencies, and in particular as a necessary step in ensuring the rapid emergence of competition in generation, where the gains were thought to be greatest.

The benefits of vertical separation are however eroded if there is increasing scope for some customers to move 'off-grid' by means of alternative technologies such as:

- microgrids with their own generation, potentially capable of islanding (see Appendix A.5), or even discreet from the national networks; and/or
- for smaller customers, particularly in more remote areas where NSP costs are high (assuming some form of CRNP that reflects this) using a combination of generation, storage and demand side management measures at the level of the customer premises.

In this market paradigm, scope economies might be preserved by allowing NSPs to offer contestable unregulated services to customers including, for example, a bundle of services in competition with the foregoing 'off-grid' technologies, and relying on disclosure and ring-fencing and improved pricing of the networks services themselves as a means of preserving the integrity of contestable related markets.

Hilmer emphasised that structural separation should only occur after proper consideration of the costs and benefits. The costs and benefits of separation have changed since the days of sclerotic government owned utilities in 1993 because scope economies on the back of disruptive technologies are becoming more important, there is some erosion of the natural monopolies, the industry as a whole has migrated to operate on a strong commercial footing, and independent public regulation is well established.

3.3 Networks can have an important innovation role

Some of the disruptive technologies that are changing electricity supply are summarised in section Appendix A below. Most operate across several levels of the electricity supply chain, not solely in clearly contestable and natural monopoly (network) levels that constitute the basis for the current regulatory paradigm. Energy networks have a potentially important role to play in providing services to customers that make use of these innovations. They have a number of attributes that can make them effective contributors to innovation. DNSPs, for example, have:

- a great deal of knowledge about the demand characteristics and preferences of their customer base;
- an alignment with the customer's long term interests deriving from their own interests in increasing utilisation of their own sunk assets (subject to price regulation operating in ways that incentivise such higher utilisation);
- a comprehensive understanding of the performance of their own network, and how and where to invest in that network to deliver superior outcomes; and
- the skills and resources to implement investments and design choices.

3.3.1 Networks have unique characteristics valuable for innovation

These DNSPs characteristics are likely to be important for the development of innovative services to best meet customers' needs. By way of example, all of the four characteristics listed above are needed in order to provide storage services that delivers the largest benefits to customers, through a combination of:

- scale — storage exhibits economies of scale, so large storage installations embedded in networks raise the value (or lower the cost) of intermittent renewable technologies, particularly behind the meter solar PV, than small scale;
- knowledge of customer — consumption and generation patterns are fundamental to selecting an optimal mix of storage and solar PV;
- knowledge of the network — storage can generate additional value by deferring the need for additional network investment, and the costs of storage will vary according to where in the network it is deployed; and
- efficient pricing — the uptake and use of storage will drive the value that it delivers to customers in the long term, but uptake will depend upon the level and structure of prices. DNSPs are well placed, given their position in the supply chain and subject to having incentives to do so, to develop more efficient pricing structures.

3.3.2 These characteristics are hard to replicate with markets and contracts

Initiatives such as CRNP as currently envisaged under the NER and time of use meters/pricing can provide information that will assist in the provision of innovative storage services. However, it is unlikely that they will quickly develop the sophistication that is necessary to allow the scope economies that might arise from vertical integration through markets and contracts alone. Over time there will be 'learning from experience', but that requires some early experience from which to learn.

Real time prices and CRNP at the distribution level are unlikely to be sufficiently nuanced to provide accurate signals of the underlying short-run marginal costs of network services to provide a sufficient basis for the types of innovative services that could arise. It is well understood that the short-run marginal costs of network services can be volatile and highly geographically differentiated as congestion, marginal, variable demand and generation/ storage/demand side management with diverse short-run costs interact.

One of the most important network services, reliability, is unpriced and undifferentiated at the level of the final customer. The lack of any sensible price for reliability, and the lack of effective means for customers to elect different levels of reliability in response to price, is perhaps one of the key shortcomings of the electricity market that has led to the predominance of network costs in today's high prices. This was driven largely by a policy imposition on a market that was growing rapidly in the short term but was hamstrung by lack of innovation, rigid regulation and distorted prices.

The technologies that are now emerging (exemplified by storage, distributed generation, smart grid technology, DSM and, at the broadest level, by sensors, data and control possible through the 'internet of things') are exactly the types of innovations that could make use of sophisticated volatile prices to avoid these types of outcomes for the benefit of final customers. They could, conceivably, form the basis for services that are differentiated in terms price and reliability should customers demand such choice.

The notion of CRNP is still largely framed in terms of long-run marginal cost (LRMC) and signalling to network users the long-run costs of changes in use. Long-run prices, even if based on principles inevitably subsume the valuable information (for consumption and production decisions) that is available in short-run prices. The NEM has not embraced nodal pricing, let alone sophisticated short-run pricing of distribution; and it has been slow to roll out tariffs and pricing that make effective (in the sense of encouraging greater economic efficiency) use of smart meters.

Innovations would arise that can make use of a proliferation of better and more frequent prices that accurately reflect the short-run costs of provision by location, network status and time. While CRNP that moves prices closer to LRMC may be an improvement on current network pricing, there will continue to be significant departures from short-run prices and as a consequence, they are likely to result in less efficient outcomes, and outcome where some customers do better (i.e. face prices below the short-run cost) and some worse. This is likely to entrench the need for more intrusive regulation.

As a result, improved pricing would be likely to enhance innovation in electricity supply by clarifying the benefits of investments in new technologies and new customer offerings. Better pricing would enhance ring-fencing and disclosure as a means of allowing NPSs to compete to offer unregulated (contestable) services to customers. They would, in consequence, help regulators establish a paradigm in favour of securing the scope efficiency gains from a greater degree of vertical integration while preserving the integrity of those contestable markets.[27]

[27] From, for example, the risks of inappropriate cost allocations to regulated services and/or attempts to discriminate on access terms.

3.4 How can networks participate in market development?

The key question is therefore how energy networks can participate in newly emerging service markets. Like in any market, this should be based on sources of comparative advantage in the provision of services to customers, recognising that not all network businesses will have what is necessary to exploit opportunities in contestable markets (although they may be able to invest in this capability or partner with others who have it). At least some of this advantage could emerge where participation in these markets would enable them to achieve economies of scale and/or scope, which will have direct benefits for consumers.

Recognising that the natural monopoly element of the network business is shrinking in relative importance, the key concern from a competition policy perspective should be ensuring that significant market power is not misused to distort this competitive process, including by *artificially* creating competitive advantages (or placing others at a competitive disadvantage). This in turn requires understanding precisely if, where and how market power could be misused, for example, could a network hinder necessary access to grid services or otherwise inhibit customers benefiting from innovation. It also requires understanding of the incentives to misuse market power which, as explained, are heavily affected by the forms of price controls that are applied to monopolistic activities.

Addressing this question properly therefore necessitates a re-assessment of the source and extent of market power that will be retained by the network businesses in the new environment, and the incentives to misuse that market power. Ahead of such an assessment exercise, there should be no presumption that legal separation of ownership will be required, given that the current context is unprecedented. However, some form of separation (and there is a range of alternatives) of regulated natural monopoly services and contestable services is likely to be needed, necessitating appropriate ring-fencing arrangements, including transparency and reporting. In this regard, the AER's much delayed development of its distribution network ring-fencing guidelines (and what would seem a necessary review of its transmission network ring fencing guidelines[28]) will have critical implications for the ability of network businesses to assess where and how they will be able to participate in new products and services, which in turn affects potential investment and innovation.

The challenge is ensuring that regulatory requirements do not constrain or unduly delay the technology choices that network service providers can make in delivering services to their customers. This is particularly important in relation to distributed energy solutions,

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28 The transmission ring fencing guidelines currently being administered by the AER were developed by the Australian Competition and Consumer Commission (ACCC) in 2002 when it was still regulating the TNSPs.

an issue that is well recognised in other jurisdictions: a recent article on electricity storage developments on the BBC online news site concluded with the words "One big impediment is regulation – or lack of it. Governments around the world are only now beginning to respond to this new energy landscape." [29]

Regulation should not impede the example discussed above, in which a DNSP offering centralised storage as an adjunct to behind the meter solar PV can generate substantial value derived from a combination of sources, which would not arise (or which would be much more difficult to achieve) if the DNSP was excluded. Ideally, regulation should enable the DNSP to offer an innovative services package to final customers (comprising, perhaps, a combination of DNSP controlled solar PV, storage, structured feed-in tariffs, etc.), but ensuring that:

- the DNSP involved in the provision of such a package bears the risks (and rewards) from innovation;
- the services are not underwritten by the transfer of costs from the innovative service to regulated (monopoly) services for which revenues that recover costs are allowed; but
- nevertheless, do not artificially exclude the DNSP from passing on to final customers the efficiency savings they achieve from deferred investment and better location/investment by dint of their knowledge and experience.

Consistent with Hilmer principles, it is of course highly desirable that, in providing innovative services such as these, the DNSP would be competing with providers of similar or other innovative service to supply customers selecting services from a contestable market. Regulation that prevented DNSP participation and, in so doing, impoverished the market for innovative services would run counter to the long term interests of customers.

3.4.1 The 'necessity' principle

In our view, the future energy regulatory framework needs to reflect the 'necessity' principle. Hilmer set this out stating:[30]

> Proposals for new regulation that have the potential to restrict competition should include evidence that the competitive effects of the regulation have been considered; that the benefits of the proposed restriction outweigh the likely costs; and that the restriction is no more restrictive than ***necessary*** in the public interest. (emphasis added)

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[29] http://www.bbc.co.uk/news/business-34974644

[30] Hilmer 212, recommendation 9.2 II.

This necessity principle, in our view, implies that proportionality will be a feature of good practice regulation, the notion that regulations should be proportional to the task. By way of example, since there are costs of complying with regulations, it is often sensible to exempt businesses below a certain size precisely because the costs of compliance are likely to be disproportionately high relative to the likely benefits from compliance.

To meet this goal, participating jurisdictions should provide evidence that its specific favoured objective could not be achieved by other means with a lesser impact on the effective functioning of the NEM (and markets for innovative services within it) without imposing disproportionately higher costs. Applying this to networks means that the test requires that restrictions on competition (including networks' ability to compete) should only be considered where there is, subject to the disproportionate cost condition, no less restrictive way of ensuring that network ownership does not adversely affect competitive market processes and dynamics. In other words, regulation needs to be targeted at the problem it is intended to address, noting that targeting is one of the globally recognised criteria for good regulation.

To reapply the necessity principle to an industry that is very much regulated according to the 1993 Hilmer context requires a clear definition (or 're-definition) of the problem/s that economic regulation may need to address (this is also relevant to policy targeting). It should recognise that different regulation should only apply to network services providers to the extent that significant problems could arise because:

- there is a potential to misuse market power, and it is established that they continue to have this market power to a sufficient degree;
- the adverse effects cannot be reasonably effectively addressed via the enforcement of general competition law;
- the adverse effects cannot be reasonably managed through transparency measures such as ring-fencing, information disclosure and improved network pricing; and
- any residual adverse effects can be expected to be higher than the adverse effects that might be expected to be associated with the additional regulation that is involved (such as administrative costs and avoidable delays, faulty decisions due to inappropriate benchmarking, misplaced demarcation lines between businesses etc.), which are likely to increase in a more complex, less certain economic environment.

3.5 Consequences of imposing restrictions

Having regard to the necessity principle, the imposition of unnecessary or unreasonable restrictions could not only prevent network businesses from participating in markets where they would be able to exploit legitimate sources of comparative advantage (including the potential achievement of scale and scope economies), but also stifle innovation and impede the natural evolution/development of a market that operates in the long-term interests of the consumers it serves. Regulation that is inappropriately targeted, or too wide in its scope, will fail to rectify the problem it has been designed to address in an effective way. It could also have other unintended adverse consequences for consumers and/or market participants. Box 2 illustrates some of the incentive effects that can arise from differentiated restrictions.

Box 2. Regulatory imposts that change incentives to innovate for the benefit of customers

Under the current regulatory paradigm, it is clear that NSPs face very different regulatory obligations in order to provide contestable services to final customers, if it is permitted at all. Using the two foregoing examples of disruptive technologies:

- a generator, retailer or third party seeking to offer an 'off-grid' storage/solar PV package (or islanded microgrid) would face no economic regulation whatsoever; whereas
- an NSP seeking to offer a superior service (in terms of, say, price and reliability) through a combination of behind the meter solar PV controlled by the NSP, grid embedded larger scale storage and some network augmentation cost savings passed selective through to customers with solar PV, would face considerable regulation in so doing, which might include:
  - regulatory imposed restrictions on participation in both behind the meter solar PV and grid embedded storage including, potentially, constraints on the amount of revenue they could earn from these services; and
  - constraints on price changes that would limit the ability of the NSP to efficiently differentiate network services prices to those customers who, by selecting the innovative service package from the NSP, affected reductions in the NSP long-run costs.

It may be that the rigid separation between the network and the wholesale market that this illustrates will constrain network service providers from maximising the benefit that customers derive from their service offerings. As noted above, a distributor that is able to include storage in its service offering could defer investment in distribution assets and offer lower prices to customers. This is a difficult outcome to achieve without the DNSP itself participating in the contestable markets in which storage services provide service (for example, see the ElectraNet example referenced by the AEMC described in section 2.5.2 above). For example, in a particular case determination of the socially optimal storage size might be heavily influenced by the possibility of deferring network investment, but the favoured storage size determined solely on the basis of wholesale market prices would not take account of this factor. The efficient pricing of storage services from the investment may also change significantly over time as customer demand and network characteristics change, for example if a microgrid is developed that affects network peak demand characteristics.

Regulation that excluded DNSPs from the contestable markets for storage services would require a complex information and contractual framework to ensure that the network services benefits of storage are reflected in the investment decisions both now and in the future. The costs and complexity give rise to high transaction costs and a high risk of contract failure, and these problems are at their most severe at earlier stages of a market development cycle when much remains unknown or experimental in nature. Vertical integration in combination with appropriate ring-fencing and disclosure is, in our view, likely to result in better outcomes from the final customer.

3.5.1 Regulatory implications of new storage technologies

Storage perhaps represents one of the most important regulatory challenges. Storage is not explicitly recognised or defined for the purpose of the NEL and NER. As the price of the technology is falling and take-up is growing (albeit slowly and from a very low base), there will likely be a need for its formal recognition somewhere under the national energy framework, including service classification.[31] As a starting point, the AEMC is currently undertaking a consultation process to better understand the battery-related issues that will need to be considered.[32]

Structural separation of generation and network assets was developed to promote competition in those sections of the market that could operate competitively. The ultimate goal of this separation was to improve outcomes for consumers. To date, the number of assets that have been used for both competitive and monopoly services have been relatively few so the use of ring-fencing and shared assets guidelines placed acceptable levels of burden on business and did not unnecessarily hinder competition. With the development of new technology there are more products that can provide varied services which cross the traditional monopoly/competition divide.

For example, there is compelling evidence that the larger scale storage facilities that deliver scale economies, suitably located within the distribution network (or possibly transmission network), can enhance the value to the customer of small scale renewable installations such as behind the meter household solar PV. But locating, sizing and timing the installation of such storage depends crucially on knowledge, information and experience that is the natural province of the NSP, not easily obtained from the markets, nor easily promulgated through regulation. This highlights the transforming and value adding role of networks.

31 The current position in the UK is very similar. The default position, for historical reasons only, is that storage is viewed as generation, but it is widely accepted that this is inappropriate. The most likely development will be the introduction of a new (storage) licence.

32 Australian Energy Market Commission (2015) *Preparing markets for technological change*, media release 9 October 2015, http://www.aemc.gov.au/News-Center/What-s-New/Preparing-markets-for-technological-change [accessed 26 November 2015]

The framework currently being discussed by the AEMC considers three potential arrangements for network businesses to use batteries, all of which rely on ring-fencing and cost allocation to maintain separation of monopoly and competitive services. Integration of storage with other network services can generate valuable scope economies, but complex information and skills that are the province of the NSPs are needed to deliver them. There is a real risk that poorly designed ring fencing that results in the *de facto* vertical separation of these two sets of services will frustrate them. Specifically, the challenges for an investor seeking to profit from innovation are:

- to identify all the material sources of benefit that the investment might generate including, for example in respect of storage:
  - lower wholesale power prices (leading to lower retail prices) by improving the performance of renewable resources such as wind generation, grid-embedded solar and behind the meter solar;
  - lower prices for the basic storage service achieved through scale benefits (relative to smaller behind the meter installations);
  - reduced network costs through a number of mechanisms such as reduced need for investment in peak capacity, voltage control etc.;
- establish pricing frameworks and negotiate contracts with the beneficiaries of these various services in such a way that offers benefits to both the investor and the consumer of the storage services, bearing in mind that customers will have a range of different risk and time preferences for the resultant contracts; and
- secure access to the information, skills and resources in order to make the investment at least cost, and to maintain and adjust the investment over time, including in response to further changes in demand characteristics and the characteristics of the network in which they are embedded.

Ring-fencing may be effective, provided that it does not impose artificial pricing and contracting frameworks that: (a) preclude the providers of the service from contracting on mutually agreeable terms with all those that material benefit from the investment, and/(b) deny the investor access to essential information, skills and resources (at the outset and over time) will frustrate innovation. Nor will it be effective if assets that have joint uses are inappropriately confined to either the regulated or unregulated services, or if static allocations are imposed when the economic value of the asset to each service can change substantially over time. That will run counter to the long term interests of customers.

Regulation should encourage network businesses to pursue innovative provision of network services, including the provision of unregulated services from battery storage, where the combination delivers valuable scope economies from which customers will benefit.

3.6 Bottlenecks to efficient market development

Scope economies are likely to grow in value relative to scale economies with the emergence of new technologies, and the naturally monopolistic elements of the networks will diminish as 'off-grid' alternatives emerge, fall in price and improve in reliability. Nevertheless, networks will retain natural monopoly characteristics for some considerable time. Accordingly, access to the TNSP and DNSP networks will still be important whilst they retain this status. This would include, for example, access by third parties to the DNSP to embedded storage, generation etc. on terms and conditions that are not discriminatory and do not extract all the 'innovation rent' from the investment

There are a number of additional sources of risk, or potential 'bottlenecks' that could emerge in the changing market environment. The first is information asymmetry, which has already been identified as a problem (including in the CMA review of energy markets in Great Britain). While the 'prosumer'[33] is on the rise, not all consumers have access to the right information, nor are they necessarily willing to wade through the complexities in order to determine what they really need. Further, as in other markets, some consumers will be particularly vulnerable to messaging from opportunistic players that are wanting to sell services that might not be in their long term interests.

As indicated previously, networks are well positioned to help address this problem, providing information and tools that can educate and inform consumers and potential investors/innovators alike. In this regard, it is notable that many of the innovation categories identified by the Edison Foundation Institute for Electric Innovation (which are summarised in Appendix A) revolve around information collection, processing and dissemination. The other key issue here is ownership of, and access to, information, noting the changes to the National Electricity Rules that have already been made to enable consumers to access their information.

A second important dimension to information provision is price signals. In this regard, tariff reform is of fundamental importance, noting that one of the risks that remains is how any distribution network price signals will be reflected in retail tariffs. Better pricing of network services, in the sense that prices better reflect the short-run marginal cost of provision, even if contracts and tariffs are available that allow customers to avoid exposure to the risks of such prices, can provide a platform for better decision making.

[33] In an electricity context, 'prosumer' is an entity connected to the grid that consumes and produces energy rather than solely consuming energy from the grid as was the case historically.

Third parties (such as energy management companies), retailers and the networks themselves would be better able to present unbiased information on the value of their service offerings under an improved pricing framework. Furthermore, in markets with regulated prices, there is always the risk of price reforms if existing prices are inadequate or inefficient.[34] Just the prospect of future price reform is likely to deter innovations less the price changes undermine the value of the investments. Current network prices in the NEM, if not a bottleneck to the emergence of some new energy services, are certainly an impediment.

A third area of risk is coordination failure. The energy supply chain is fundamentally changing and is extending further to behind the meter solutions. New products and services, and new participants, are constantly emerging. The pace of change is rapid and new, relevant information (and noise) continues to be created both within and outside the market. New entrants will have varying business objectives and incentives. For a market to work it needs to evolve and develop a rule-book that works for the long term interests of consumers. Market rules are, in effect, the foundational co-ordinating mechanism, but good rule-books take time to develop. There are obvious risks of undue delay in development, but also risks from over-hasty adjustments based on expectations of how the future will look (which, in conditions of change and uncertainty, generally turn out to be wrong, sometimes dramatically wrong). Co-ordination failures occur on both sides.

A fourth bottleneck (or alternatively a more specific bottleneck of the third type) on efficient market development is regulation itself, particularly in its reliance on a prior regulatory consent for NSP innovations. NSPs that can offer valuable services to customers and, by reason of their knowledge and capabilities not their market power, can do so better than other market participants should, unless the necessity criterion is satisfied, be free to do so. This should be the case even if their comparative advantage draws upon skills and resources acquired as a result of also providing regulated services. This, after all, is the very definition of a scope economy, where the costs of providing a second different service can be lowered by dint of also providing the first service. Ideally, NSPs should not need consent from a regulator (which is typically slow to arrive) to offer contestable new energy services. The policy and regulatory challenge is therefore:

- to reduce the constraints on NSPs providing services to customers, and in particular, removing the requirement for prior consent from a regulator to do so;
- in so far as the services make some use of resources that are also used to provide regulated services, to put in place *ex ante* disclosure and reporting requirements

[34] Although we note that efficient pricing cannot be expected to eliminate all risk of this type: regulatory decisions are not governed by efficiency criteria to the exclusion of all else.

that minimise the risk of excessive cost allocation to the regulated service. This could take the form of 'ring-fencing' but not so as to effectively impose vertical separation in the provision of services where there are valuable scope economies; and

- to encourage pricing and reporting by NSPs that allows third parties, should they have the requisite skills and resources, to provide similar services

3.7 Summary

Hilmer espoused the principle that restrictions (including networks' ability to participate in contestable markets) should only be considered where there is no less restrictive way of ensuring network ownership does not adversely affect competitive market processes and dynamics. Applying this principle to the foregoing suggest that the regulatory paradigm should evolve from the current model of structural separation and a presumption that NSPs should be excluded from (or have a trivial involvement) in contestable market, to one in which there is greater latitude for NSP involvement in contestable markets. Among the ways in which this could be done are:

- a transition away from structural separation to a model based on ring-fencing and transaction transparency between the natural monopoly and contestable markets, as a means of ensuring that the costs of providing contestable services are not transferred to regulated services such that the NSP secures a material competitive advantage;
- development of safe-harbour rules by regulators such that vertically integrated service offerings to customers by NSPs that satisfy certain information disclosure, transparency and commercial ring-fencing criteria are allowed without case-by-case regulatory scrutiny; and
- much more sophisticated and accurate (in terms of cost reflectivity) network pricing at the TNSP and DNSP level so that investors can make better decisions about the likely risk and return from their investments (for example, so a third party could get accurate information on the price of interconnecting its own assets at points in the DNSP network, and some assurance that the price of that interconnection is an efficient price that the DNSP would need to include in any service it provided to customers based on the same interconnection service). More sophisticated and accurate prices would provide a firmer foundation for the development of new services.

4 Consequences of restrictions on NSP participation

In the section of the report, we identify the potential impacts on competition in new and emerging energy service markets of either restrictions on network businesses' participation, or inappropriate discriminatory regulatory treatment.

It is difficult to assess the impact of restrictions on NSP participation with any great precision because of the innovative and disruptive nature of the contestable services in which they might best compete. Many of the disruptive technologies that NSPs might be well placed to implement to provide contestable services to final customers are at a formative stage.

Markets rely upon the *process* of competition to reveal the best mix of services, technologies and innovations. We stress 'process' because, as has been emphasised throughout, the structure of a market can look very different at different points in time. Measures that limit competition in these markets by excluding market participants that have many of the characteristics of effective innovators necessarily limits that competition to some degree, to the detriment of the customer. For reasons already given, the detriments may be particularly high if the exclusion is based on consideration of the effects of vertical integration, since such integration tends to be of greatest economic value in the early development stage of a market.

4.1 Disruptive technologies are at the formative stage

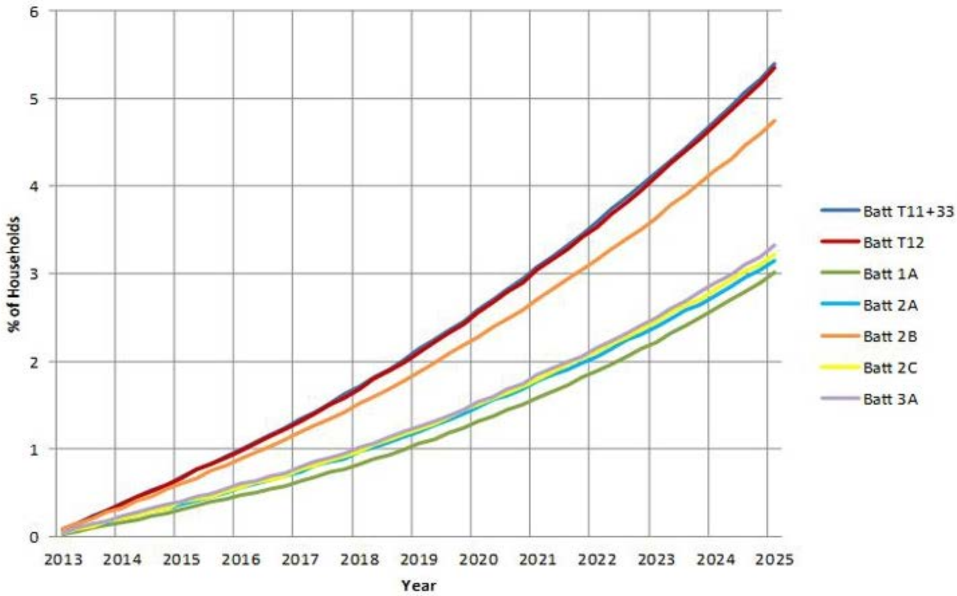
The disruptive technologies and innovations discussed in Appendix A below which are establishing new markets and market segments. The renewables sector, particularly the small renewables sector, has grown from 0 in 2001 to approximately 200,000 units in 2008, but grown most rapidly since then to around 2,500,000 units by 2014, largely on the back of direct subsidies and favourable feed-in tariffs.[35]

Battery storage technology which, of the disruptive technologies, is most likely to generate substantial scope economies with network services and intermittent renewable generation, has barely registered in Australia. Hence, for example, using Townsville as a base, the CSIRO predicted up to five percent of the residential market will have battery storage by 2025, although such forecasts are inevitably uncertain in a period of changing supply and demand, , where things are changing quickly. Figure 1 shows a number of different tariff

[35] Clean Energy Regulator (2014) *2014 Administrative Report* available at http://www.cleanenergyregulator.gov.au/ last viewed 22 October 2015.

scenarios and how they might impact battery uptake. The highest uptake scenario was found to be under the current time of use tariff structure.[36]

Figure 1. CSIRO forecasts of storage technologies in Townsville



Source: Ergon Energy, https://www.ergon.com.au/about-us/news-hub/talking-energy/technology/the-battery-conversation (last viewed 30 November 2015).

Australia is not unique in this regard; disruptive technologies are still at a relatively early stage in their likely development, best illustrated by expectations of significant declines in storage costs as the distributed and embedded storage technologies mature. Most commentators expect the costs of battery storage to decline substantially over the next 15 years. The ENA's Electricity Network Transformation Roadmap interim report estimated that storage costs could fall by approximately two-thirds in the next ten years (see Figure 2).

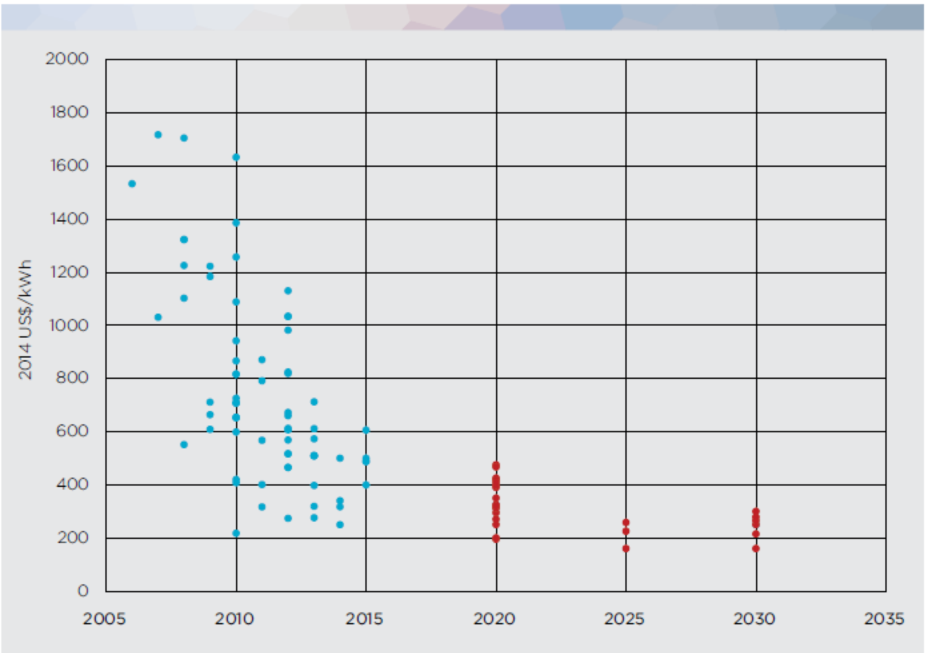
Figure 3 presents some estimates of the likely range of generation costs from different technologies.[37] The sent out costs for the conventional technologies, CCGT, coal and gas peaking, include allowances for carbon capture and compression. While these figures do not include the scope efficiency benefits that can arise from storage embedded in networks to supply some network services, it is apparent at the moment that disruptive technologies alone or in combination are barely competitive with conventional generation, even when

[36] https://www.ergon.com.au/about-us/news-hub/talking-energy/technology/the-battery-conversation (last viewed 30 November 2015).

[37] Lazard (September 2014) *Lazard's Levelised Cost of Energy Analysis – Version 8.0*, available at https://www.lazard.com/media/1777/levelized_cost_of_energy_-_version_80.pdf last viewed 22 October 2015.

an allowance is made for reducing emissions. But if the installed cost of battery storage were to fall to US$300/kWh, the generation cost from battery storage would fall to close to the estimated costs of peaking gas turbine costs *without* carbon capture. These figures, it should be noted, relate to the US.

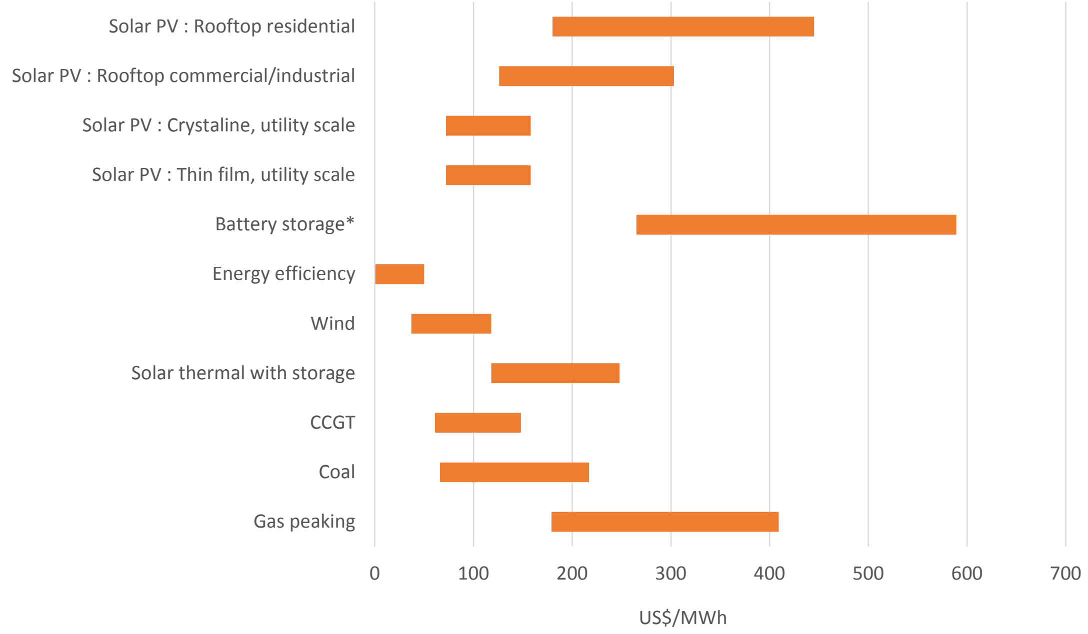
Figure 2. Forecasts of changing battery storage costs over the next 15 years



Source: Nykvist & Nilsson 2015.

Source: Energy Networks Association (3 December 2015) *Electricity Network Transformation Roadmap: Interim program report,*

Figure 3. Unsubsidised levelised costs of energy (US$/MWh)



* The batter storage cost estimates are based on an installed cost of US$500-$750/kWh, a US$60/MWh energy purchase cost for recharging, a single daily cycle, a 75% to 85% efficiency and fixed operating and maintenance costs of US$22-$27.5 per kWh of storage capacity.

4.1.1 Implications

Collectively, these suggest that the next decade will see considerable changes in the way in which electricity is supplied in Australia, with lower cost storage, whether alone or in combination with other technologies, able to provide a large gamut of services covering the whole supply chain including network support (i.e. deferred network augmentation, voltage control etc.), wholesale power, support for intermittent supply from a nearby wind farm, loss minimisation, ancillary services, substitution for 'on-grid' supply etc. The ElectraNet example quoted by the AEMC (see 2.3.2 above), the large variety of innovations partially involving network services set out in Appendix A below, and measures in other jurisdictions such as the UK to encourage flexibility and innovation rather than reliance of specific prescribed services to meet customer needs all highlight the desirability of encouraging widespread participation in the development of these services, including by NSPs.

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4.2 Solar PV uptake in Australia

Uptake of solar PV in Australia has been quite substantial, with 2¼ million small scale renewable systems installed by the end of 2014, predominantly at the household level, three quarters of which are rooftop solar panels.[38] However:

- arguably, from a societal efficiency viewpoint the combination of policy and pricing signals promoted poor technology choices across the market. Better choices might have been made if larger scale systems embedded in networks had been adopted, with some storage or future storage options, and greater control over time of use etc., then sold to customers interested in a solar option;
- the tariff structure for feed-in power was not cost reflective and distorted decisions, and subsidies encouraged rapid uptake of poor technology choices;
- lack of DNSP involvement and, where desired by the customer, control over the operation of the PV technology behind the meter means that there is no agent that has a strong interest in maintaining the day to day operation and the longer-term performance (i.e. maintenance to prevent deterioration) over time; and
- piecemeal but relatively high uptake has meant that network changes may have to be made to get the most out of the technology, even though greater benefits at lower cost could potentially have been achieved if network consequences had been incorporated into the original investment and roll out decisions.

4.3 Other jurisdictions are showing greater flexibility

4.3.1 The UK

In 2010 Ofgem completed a detailed review of energy network regulation to determine whether the RPI-X form of regulation applied was still fit for purpose. The review concluded that a new regulatory framework was required and the RIIO (Revenue = Incentives + Innovation + Outputs) framework was introduced.

The review recognised that the electricity industry was facing different economic and technological circumstances than those that applied when the RPI-X form of regulation was established. The British government had set ambitious climate commitments and rapidly developing technology was changing the role of networks businesses, both of which were driving the need for significant investment in networks by 2020.

[38] Australian PV Institute (2015) *Australian PV market since April 2001* available at http://pv-map.apvi.org.au/analyses last viewed 22 October 2015.

Ofgem concluded these developments would require networks to be more flexible, innovative and customer focussed to ensure the required investments were undertaken to deliver value for money over the long term. The regulator recognised that an increased focus on innovation is a reflection of the scope economies that can arise between monopoly network services and other services, which were increasing with the availability of new technologies:[39]

> Britain's energy mix is changing and the way our gas and electricity networks operate needs to change too. We provide essential backing to innovative projects which aim to help make the energy networks smarter, accelerate the development of a low carbon energy sector as well as deliver financial benefits to consumers. The projects help develop crucial knowledge and expertise which is being shared across the industry.

The report concluded that the established regulatory framework would not sufficiently encourage or reward network companies to take a leading role in meeting the challenges of a new era. An implicit criticism of the existing framework was that the focus on short term operating cost efficiency led networks to be risk averse.[40] The framework did not encourage investment in infrastructure and innovation that would reduce long term costs. Rather it encouraged businesses to reduce customer service levels in order to meet short term targets.

Two changes intended to address these issues are a lengthening of the regulatory period, which allows businesses more time to retain cost savings, and moving to an outputs based approach to incentive mechanisms. The targets of customer satisfaction, reliability, safety, connection terms, environmental impact and social obligations were designed to allow Ofgem to distinguish between cost reductions that reflect genuine efficiency and those achieved at the expense of service delivery. It also allows Ofgem to hold businesses accountable without a bias towards particular delivery methods, providing incentives for innovation, although not unlimited scope to vertically integrate.[41] The framework was designed to minimise the negative effects of regulation on innovation and reduce the

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39 https://www.ofgem.gov.uk/network-regulation-riio-model/network-innovation (last viewed 30 November 2015).

40 Although many of the changes advertised in the RIIO reforms were largely cosmetic and, on closer inspection, much of the RPI-X arrangements remained intact, there had for many years been a minority view in Ofgem (largely propagated by economists) that the more fundamental underpinnings of the regime, including the regulatory approach to capex as well as opex, was seriously deficient in its treatment of research, development and innovation in networks (the R&D record in the post privatisation period had been close to abysmal) and that a more radical re-think was in order. RIIO significantly strengthened the existing, earlier innovation incentive schemes that had been established, but by nowhere by as much as, and by different means to, those that holders of the minority view advocated. The latter view advocated an incentive structure based on market testing, with successes much more heavily rewarded and failures not rewarded at all.

41 Indeed, as discussed elsewhere, one of the highlighted problems with RIIO is that it makes the regulator something of an arbiter on matters of innovation, almost the antithesis of innovation through competition.

regulatory burden on businesses that occurs in a framework that requires continual adjustments for new technologies.

Some examples of network innovations under RIIO that involve technologies (storage) that provide other services are summarised in section Appendix A.2.

4.3.2 The US

There is a greater degree of vertical integration in the US power industry than in Australia, particularly in the form of private investor owned utilities that provide generation, transmission, distribution and retail of power to final customers in discreet US regions. They are typically regulated under a complex mix of state and federal regulation, but nevertheless are vertically integrated by ownership. There are a large number of innovative projects emerging from the US that likely have benefited from the vertically integrated structure. For example: [42]

- Duke Energy has developed a Distributed Energy Resource Management System to integrate distributed energy resources into the electrical grid more efficiently. It improves control over the utility's portfolio of distributed energy resources, including solar generation, energy storage, demand response, and electric vehicles;
- Northwestern Energy has established a storage facility that displaces four hours of peak demand using off-peak energy at off-peak prices, reducing the need for high marginal cost peaking plant. It also reduces the consequences of renewable intermittency, including by directly integrating solar PV and storage, reduces T&D network line loses and defers T&D investment;
- PNM, the Public Service Company of New Mexico, has a storage project that helps to smooth and shift solar PV generation so that it is better integrated with the grid, reducing the need for network peaking capacity;
- SDG&E, San Diego Gas & Electric, has a microgrid demonstration that encompasses local power generation, storage, automated switching, and active customer participation, delivering a more robust and resilient network and service to its customers.

These are associated with a number of other services, such as improved data collection and analysis, that do not involve investment in storage, microgrids or distributed generation but which allow better design, targeting and operation of these new technologies.

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[42] See Edison Foundation Institute for Electric Innovation (December 2013) *Innovations Across the Grid: Partnerships Transforming the Power Sector* for a more exhaustive catalogue of projects.

4.3.3 Implications

What these examples illustrate is that considerable advances in innovative services to final customers, including information-based services and not simply new technologies added to existing networks, are emerging rapidly elsewhere. Restrictions on NSPs in Australia participating to the same degree is likely to impede their development, contrary to the long term interests of customers.

5 Evidence on market barriers

In this section we identify the implications of evidence to date on whether market barriers to entry exist. In so doing, we address whether:

- taking advantage of scale and scope economies arising from synergies to own and operate distributed energy resources appropriate? and
- to what extent can new markets develop solutions to overcome information problems as an alternative to regulatory solutions?

We reiterate that the extent of technological change in the electricity supply and the pervasiveness of the impacts of new technology at all levels of the supply chain makes scope economies much more important to the long-run interests of customers than was the case when the Hilmer reforms were established.

The contestable services that might benefit from these scope economies are not so large or mature that they are best separated out, for independent suppliers of those services to secure scale benefits. And these scope economies are, we believe, difficult to secure through contracts at this time; price uncertainty, the possibility of regulatory interference, differences in the time periods over which market participants are willing to bear risk, uncertainty over the emergence of new technologies and services that might affect the service in question, and the novelty and the technology itself also make contracting costly and difficult. Hence, it is important that regulation does not frustrate the generation of these scope economies whether through proscription, by removing incentives for NSPs to participate, or by imposing discriminatory participation costs that are large in comparison with the scope economies.

While there may be scale efficiencies in some of these new energy services, for example unit capacity costs for larger scale storage are typically lower than small scale storage, in contrast to scope economies, there is no reason why NSPs are better able to achieve or exploit those scale benefits than third parties with non-discriminatory access to the networks.

It is also apparent that markets can develop solutions to overcome information problems as an adjunct or replacement to regulatory solutions. There is ample evidence from other jurisdictions, particularly the US, that innovators are willing to add value to information that is collected from a variety of sources (including, for example, smart meters and network embedded sensors) that can improve customer outcomes. The regulatory challenge is, then, exactly what information should be collected and the extent to which it should be disclosed.

Finally, we note that prices are a cornerstone of efficiency. Better and more efficient network prices are likely to open up opportunities for the provision of innovative services to final customers because the prices will assist in revealing the value of those services to customers and investors both. They will also lessen the risk that customer adoption or investment choices is based on exploitation of pricing anomalies. The transparency afforded by better prices will also lessen the reliance of formal regulation and prescription as a means of ensuring that NSPs are not discriminating between access seekers (including themselves) to gain an unwarranted competitive advantage in the contestable markets where they choose to operate.

5.1 Rigidities imposed regulation

There is some consensus within the literature that existing regulatory structures are not well adapted for promoting innovation in utilities.[43] Governance environments have tended to favour traditional, large-scale, supply-oriented approaches to electricity provision, resulting less innovation and slower transformation of entrenched industry structures.[44] This indicates that regulatory reform is needed to enable businesses to adjust to emerging technologies.

Distributed generation, energy storage systems, and an increased focus on energy efficiency, which collectively have ramifications throughout the supply chain, not simply in the wholesale power market, are presenting challenges to the existing utility provider business model, forcing regulators and utilities to re-evaluate whether the existing frameworks are appropriate.[45] These challenges can include difficulties classifying new technologies or services within the existing regulatory framework.[46] Battery storage technology, for example, may be able to be implemented for a range of different uses, potentially simultaneously, frustrating attempts at classification.

As a result, there are likely to be scope efficiency gains if NSPs can contest markets for customer services that make use of these technologies on an equal footing with others. This has important flow-on effects for the design of regulations that establish ring-fencing, disclosure and cost allocation principles.

Distributed generation, similarly, can have significant benefits for electricity networks. However, barriers from existing regulatory frameworks can have the effect of entrenching certain business models. Roll out of distributed generation may be frustrated by the lack of

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[43] For a discussion see for example Jenkins C (June 2011) RIIO Economics, Examining the economics underlying Ofgem's new regulatory framework, *Florence School of Regulation Working Paper*.

[44] Kusemko, C (2015) Energy Governance, Suppliers and Demand Side Management, *IGov EPG Working Paper* 1503

[45] Satchwell, A., & Cappers, P. (2015). A Framework for Organizing Electric Utility Regulatory and Business Models. *The Electricity Journal*, 28(8), 119-129.

[46] NREL (2014) *Status Report on Power System Transformation: A 21st Century Power Partnership report*, p69-70

an efficient market mechanism, or the implementation of a market that is at odds with NSP business models.[47]

5.1.1 Misalignment of incentives and capabilities

Misalignment between policy goals and the incentives for utilities are problematic. Regulation that creates uncertainty about who should bear the capital costs and receive the benefits of novel investments will stifle innovation.[48] Regulation that precludes participants from earning returns from innovations they are best placed to deliver is similarly problematic.

Another factor which could lead to slow or inefficient implementation of new technologies is regulation's tendency to create silos of technical expertise that is difficult to mobilise for innovative investments that would benefit from it. One of the factors identified by utilities as critical to the success of adopting smart grid technology was the need for new areas of expertise, such as network engineering and software development.[49] When implementing new technologies:

> The rate of adoption is influenced by the resources and capabilities they can draw on to deploy and utilize smart grid technologies effectively… interviewees discussed the need for changes such as breaking down organizational barriers and siloes, and creating cross-functional teams to implement different projects.[50]

For example, it is evident that optimising a storage facility within a network so as to maximise the total benefit to customers requires intricate knowledge of the operation, performance and development options of the network in which it will be placed (at both a point in time and over time), not merely knowledge of current wholesale prices or the storage technology itself. The most valuable knowledge may well lie within the NSP, in which case regulation that constrains NSP involvement in storage is likely to limit the benefits that storage can deliver.

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[47] Poudineh, R., & Jamasb, T. (2014). Distributed generation, storage, demand response and energy efficiency as alternatives to grid capacity enhancement. *Energy Policy*, 67, 222-231.

[48] Siano, P. (2014) Assessing the Impact of Incentive Regulation for Innovation on RES Integration, *IEEE Transactions on Power Systems*, 29 5, 3.

[49] Dedrick, J., Venkatesh, M., Stanton, J. M., Zheng, Y., & Ramnarine-Rieks, A. (2014). Adoption of smart grid technologies by electric utilities: factors influencing organizational innovation in a regulated environment. Electronic Markets, 25(1), 17-29.

[50] Dedrick, J., Venkatesh, M., Stanton, J. M., Zheng, Y., & Ramnarine-Rieks, A. (2014). Adoption of smart grid technologies by electric utilities: factors influencing organizational innovation in a regulated environment. Electronic Markets, 25(1), 26

The performance of investments embedded in networks are quite often acutely sensitive to changes in network characteristics, demand and supply over time, an obvious source of risk to the investor. Collectively, these are likely to be difficult to marshal and manage through contracts between an NSP and a third party. Furthermore, under the current regulatory framework, those contracts would risk facing the same type of regulatory intervention that the NSP would face if it sought to provide the services alone.

This kind of agency problem is just one example of the kind of coordination failures that the current industry structure can generate. Prior to industry reforms, the presence of government owned monopolies made large-scale information decisions and integration considerably easier to accomplish. Indeed, a major reason behind any form of vertical integration is so that each actor along the supply chain is enabled and incentivised to take the interests of the all the integrated elements of the supply chain into account.[51] However, the decentralization and segmentation of the electricity supply system creates difficulties in coordinating information, implementing new business models, and upgrading information technologies.[52]

> Moreover, advances in technology render energy systems and infrastructure increasingly complex, now comprising individual smart meters, distributed generation and various different energy sources feeding into one grid… Decisions taken on the level of investment, the type of technical solution and the mode of regulation on each scale therefore matter for the stability and resilience of the overall infrastructure, and for its ability to respond to sudden changes such as shocks. Such complex systems not only call for information sharing across scales and jurisdictions as well as among involved actors (public or private) in order to provide for efficient overall solutions; they also crucially rely on mutual learning that is not based on formalized and centralized structures fostering it. The latter would simply prove inefficient to foster the type of coordination that is needed to foster learning and policy innovation.[53]

A regulatory framework which was flexible enough to allow the use of assets across distribution, transmission and the wholesale market would facilitate more efficient investment in battery storage solutions.

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[51] Brennan, T. J., Palmer, K. L., Kopp, R. J., Krupnick, A. J., Stagliano, V., & Burtraw, D. (2014). A shock to the system: Restructuring America's electricity industry. Routledge

[52] Schuelke-Leech, B. A., Barry, B., Muratori, M., & Yurkovich, B. J. (2015). Big Data issues and opportunities for electric utilities. Renewable and Sustainable Energy Reviews, 52, 937-947, citing: Weiss, M., M.K. Patel, M. Junginger, A. Perujo, P. Bonnel, and G. van Grootveld (2012) On the electrification of road transport - Learning rates and price forecasts for hybrid-electric and battery-electric vehicles. *Energy Policy*, 48(0): p. 374-393.

[53] Goldthau, A. (2014). Rethinking the governance of energy infrastructure: scale, decentralization and polycentrism. Energy Research & Social Science, 1, 134-140., citing - Buchan D. The Energiewende – Germany's gamble. Oxford: Oxford Institute for Energy Studies; 2012.

5.2 Examples of barriers imposed by regulation

5.2.1 Storage

UK Power Networks' Smarter Network Storage ('SMS') project (see Appendix A.2) is an example of an innovative investment that seeks to so this, although UK Power Networks maintains that evolution of regulatory frameworks is needed for such innovations to prosper. Nevertheless, the SMS project represents an outcome of the RIIO regulatory initiative in the UK which places greater emphasis on innovation to meet customer needs. RIIO's approach to regulation, which provides incentives rather than proscribing approaches, has been described by an NSP thus:

> So it [RIIO] doesn't specify that you have to install so many cables, so many overhead lines, so many transformers. It just tells you, you have to fix the problem. That really opens up the opportunity for us to use innovation in that way.[54]

This, however, is only a modest regulatory advance. Literature on the SMS project names Ofgem as the major source of funding, but Ofgem has no money of its own. The reality is that this is consumers' money, which Ofgem then decides how to allocate, i.e. it is a form of directed planning of investment. Given that the relevant investment here is in a potentially contestable activity, this is itself a form of regulatory creep/leverage which, like other decision making of this type, comes with very poor efficiency incentives.

In a rigidly separated regulatory environment, it is difficult to see how innovative investments can be identified and made when the effective returns to that investment derive from a multitude of distinct services provided in both regulated and unregulated market segments. The deficiency in incentives is a critical weakness.

5.2.2 Smart meters

In the UK, Scottish and Southern Energy (SSE) plan to spend £54.6m during the first five years of RIIO-ED1 review period, supporting the mandated national programme to install smart meters in domestic and small commercial premises, as well as £16.3m building and using IT systems to allow the use of information from smart meters to operate the network more efficiently.[55] However:

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54 Hall, S., & Foxon, T. J. (2014). Values in the Smart Grid: The co-evolving political economy of smart distribution. Energy Policy, 74, 600-609.

55 Scottish and Southern Energy Power Distribution (2014) Smart Metering Strategy, issue 2, at https://www.google.com.au/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#

> The UK also has a specific barrier to [Smart Grid] development stemming from the particular structure of its network regulation: while most EU Member States will see Distribution System Operator (DSO) driven smart meter rollouts, it will be UK suppliers that will provide and pay for smart meters and data collection. Since UK DNOs stand to gain many of the benefits from complex smart meter functions, while the suppliers are interested in only limited functions, there is mismatch between costs and benefits.[56]

There is some merit in this criticism, and it can be noted that the Ofgem decision (to privilege suppliers) was itself a controversial one within the agency and that the most favoured alternative was consumer ownership (or rental) of smart meters, closer to the approach favoured by the AEMC. This would have not prevented DNOs from acting as a supplier of meters (for sale or rent), or prevented arrangements that would have enabled access to meter reads by DNOs, and its chief rationale was simply to pass the power of choice to consumers, who appear well capable of selecting their own electronic devices in other markets.

In Victoria, local network service providers are currently exclusively responsible for metering services for small customers,[57] meaning that costs are recovered in accordance with regulatory determinations for network service pricing. Victoria is in the process of opening up competition for metering services. The AEMC considers that there is insufficient evidence to support regulation of access to smart meter functionality and access charges. However, inefficiencies could potentially arise when the 'gatekeeper' to a smart meter's functionality is competing to supply energy services with a proponent that requires access the smart meter's functionality to also provide similar services.[58] Some degree of rule-making may therefore be required, albeit that it may be modest and narrowly targeted.

5.3 Markets as adjuncts to regulatory solutions

There is considerable scope for markets to develop their own solutions to specific problems without need for regulatory interventions. As institutions, markets are themselves rule-books whose purpose or function is to reduce the costs of exchange transactions. They are therefore inherently regulatory in nature: the rule-book (much of which is typically informal) governs or regulates transactional conduct. A glance at the

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56 Xenias, D., Axon, C. J., Whitmarsh, L., Connor, P. M., Balta-Ozkan, N., & Spence, A. (2015). UK smart grid development: An expert assessment of the benefits, pitfalls and functions. Renewable Energy, 81, 89-102.

57 Minister for Energy and Resources - Victoria (2013) AMI Rule Change Request (Jurisdictional Derogation - Victoria), at 1-2

58 AEMC (2014) supplementary paper – regulatory framework: Framework for open access and common communication standards, EMO0028

(formal) rule-book for participation in a trading on a commodity or stock exchange is sufficient to illustrate the point, although market rules in their entirety encompass things such as the informal market culture as well.

In recent years we have seen remarkable innovations that have overcome information problems.[59] Innovations in the electricity sector, for example information disclosure from increased network monitoring in combination with market-driven analysis and use of the data, could replace some of the functions of regulators in resolving information problems.

Public regulation can, of course, substitute for the gradual, unassisted evolution of market rules (which can be a slow process), but in general public regulation is best seen as complementary to private initiatives in the development of market rule books. Indeed, it is when regulation seeks to work against market tendencies that it most risks becoming an impediment or barrier to market development.

By way of example, there has been a dramatic increase in the deployment of rooftop solar PV in Australia driven in large part by a policy directed at just that outcome supported by a number of different subsidies. These have included inflated rates for feed-in generation from the solar installations, and subsidies to the installations themselves. This trend has been plagued by information problems including, but not limited to:

- the value to the consumer of the technology relative to alternatives including sole reliance on network supply and demand side measures (typically expressed in break-even times);
- the reliance on regulated tariffs for that value, rather than the social value of the technology (the former do not usually reflect the latter);
- the degree to which the value is dependent on continued maintenance and upkeep, and the availability and price of suppliers of maintenance services;
- the degree to which value can be enhanced, in the long term interest of the customer, by measures such as behind the meter storage, network storage, and centralised control of feed-in power from the units.

These information shortcomings are as relevant to the supplies of services as they are to the customer. In the current environment, it is next to impossible for a third party to appraise and then capture the benefits of embedded storage in the distribution network that aims to complement behind the meter solar PV, or for a supplier of maintenance

[59] A good example is the gathering of traffic information from smart phones to provide information on traffic congestion that can be relayed to navigation handsets.

services to assess and capture the likely benefits of providing a regular maintenance service for behind the meter solar PV.

As a result, customers are highly reliant on governments and regulators to disseminate information on these, and to set charges and tariffs that aim to foster efficient outcomes and policy goals.

5.3.1 US examples

One of the notable features of the innovations that are emerging from the US is the large number of projects that are based on improved data collection and disclosure, delivered through a range of technologies such as smart meters and better and more densely distributed sensors. These services add value using this data in a variety of ways, such as: better design and integration of storage, network and renewable (solar PV) generation; identification of possible targets for contestable service deployment such microgrids; improved network performance and reliability; better customer engagement (such as information on end use efficiency and potential savings that can arise from it, and the benefits of behind the meter technologies); and better outcomes for customers by direct control of customer usage and generation.

5.4 The importance of pricing

Much of the information necessary to improve the long term outcomes for customers from solar PV and storage technologies could be provided by innovative firms. At one level, this might constitute improved information that would help customers make better decisions, similar to consumer advisory services.

But a much more important innovation would be for the suppliers of services to manage the risks that customers might be most concerned about in return for an appropriate margin that compensates for that risk. An example might be a combination solar PV/storage service with a guarantee of a percentage reduction in a household's electricity bill over a period of years, with any reduction in excess of that accruing to the supplier. In order to manage that risk and to then offer better services to the customer, the supplier needs a number of important inputs such as:

- knowledge of prices and price formation so that they can appraise how changes in market conditions and in underlying network performance affect the performance of their investment;
- means to manage that risk, such as scope to change the size and location of storage within the network; and

- a high degree of certainty in relation to the processes by which (necessarily uncertain) future prices will be determined, i.e. a high degree of regulatory or policy certainty.

In the absence of much better network pricing (in the economic sense that it reflects the costs of provision), and an understanding that the pricing rules will not continually change, it will be difficult for new information-generating markets to develop solutions that help to minimise the role of regulators.

5.5 Summary

In summary, the current state of evolution of electricity supply strongly suggests that taking advantage of scope economies and of capturing vertical externalities will be important in improving the long run interests of customers. In the current environment, which has a high degree of disruption and uncertainty, this is less likely to happen if NSPs are constructively or legally excluded from participating in providing contestable services to final customers. It is also important for the long term interests of customer that scale economies are exploited, but the current regulatory framework is less of an impediment to securing scale as opposed to scope economies.

It is also apparent that markets can develop solutions to overcome information problems as an alternative to regulatory solutions, although things perhaps work best when the two parts of the market rule-book — those rules determined autonomously by market participants, or in some cases, market proprietors, and those rules determined by public authority — are well aligned.

There is ample evidence from other jurisdictions, particularly the US, that innovators are willing to add value to information that is collected from a variety of sources (including, for example, smart meters and network embedded sensors) that can improve customer outcomes and lessen the need for burdensome regulation. And this would no doubt be further enhanced under improved network pricing.

A The new competitive environment

This section discusses the new competitive environment in terms of the technologies that are likely to have significant impacts on the electricity market in the near future. It sets out how they are, individually and collectively, blurring the traditional lines between electricity networks and the wholesale electricity market. This is not meant as an exhaustive list, by any means, of the innovation and disruptive technologies emerging in the sector, but rather as an illustration of the extent of change. While the elements are discussed separately, it is important to note that the future of the electricity grid likely combines all of the elements discussed to create a more dynamic electricity market with greater consumer participation (in both consumption and generation) and more competition.

A.1 Distributed generation

UK Power Networks Flexible Plug and Play project was designed to trial new technologies and commercial arrangements to connect distributed generation assets, such as wind or solar power, to constrained areas of the UK's distribution network.[60] A suite of technologies was used to enable more flexible connections of generators to the grid. Flexible connections allow these generators to be connected to the network in such a way that their generation output can be controlled by network operators based on demand and other network requirements. The flexible solution gives the customer an option for a different type of connection, which is at a cheaper price, but with the likelihood of generation curtailment at peak times.[61]

There are two types of commercial arrangement in place for curtailment for the generation embedded in the distribution network - Last in First Off ('LIFO') and pro-rata. LIFO arranges generators in a queue and curtails them in the order that they applied for their connection to the network. Pro-rata is an approach that curtails generators connected to the network based on each generator's proportional export contribution to the constraint at a moment in time. [62]

The cost of Active Network Management ('ANM') technology used by network operators to curtail generators was covered by UK Power Networks for the first eight (larger) customers, but directly from later customers. This is a form of price discrimination — it is

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60 http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Flexible-Plug-and-Play-(FPP)/ (last viewed 30 November 2015).

61 UK Power Networks (2014) Flexible Plug and Play: Quicker and more cost effective connections of renewable generation to the distribution network using a flexible approach - SDRC 9.7

62 Ibid, 16

akin to an 'introductory offer' —illustrates the general point made earlier that some forms of price discrimination can be favourable for innovation and competition, even when adopted by a monopolistic business.

Flexible connections are one example of two different segments of the network co-operating to achieve better outcomes than would have been possible if more prescriptive regulation dictated the services they could provide. ANM allows network operators some control over power generation to better manage the operation of networks, and also allows distributed generation where a standard, non-curtailable connection would have been cost prohibitive. NSPs with access to flexible connection technology can avoid the need to upgrade the capacity of their network. It can also result in a larger number of generators being connected, improving resilience and flexibility (and competition) within the wholesale electricity market.[63]

A.2 Battery storage

Battery storage technology for residential or grid scale use is a rapidly developing area, with prices falling and many new products available on the market. Batteries are available in a number of different chemical structures including lithium ion batteries, lead acid batteries and zinc bromine flow batteries. The type of battery storage employed will depend on the desired use, for example some applications require fast response times while for others longer life cycles are more important.

A.2.1 Storage services

Storage technologies provide a range of services that include those that are usually the domain of the wholesale market, such as energy arbitrage, and those that are usually the domain of the networks, such as frequency regulation. They include:

- assistance with integrating large scale renewable resources (wind, solar) into the power system;
- providing electricity to meet short-term demand peaks by charging from various sources when the price of electricity is low and discharging when the price of electricity is high. This is sometimes referred to as energy arbitrage and could be used to compete with traditional peaking plants;

[63] Kane, L. and Ault, G (2014) A review and analysis of renewable energy curtailment schemes and Principles of Access: Transitioning towards business as usual, *Energy Policy*, 72 67–77.

- providing ancillary such as, reserve, frequency regulation, voltage support and even a black start capability;
- substitute for additional distribution network capacity, by meeting short-term demand peaks through storage located close to the customer;
- at the level of the final customer, storage can provide energy arbitrage 'behind' the customer premises meter, potentially increasing practicality and utility of solar; and
- eventually, it might permit or contribute to some customers to move off-grid.

There have been a significant number of trial energy storage projects in the UK. Energy storage can and has been used for voltage control, power flow management, system restoration, and network management.[64] Further, there are several distinct ways in which battery storage could be integrated with the power network. These include:

- network assets (within the grid, as part of the distribution and transmission network)
- as independent batteries (owned by independent operators and located anywhere in the network)
- directly connected to renewable or distributed energy generation facilities (such as wind turbines or microgrids)
- by end customers (within homes or businesses with rooftop Solar PV).[65]

The regulatory framework can have a significant impact on how energy storage systems (ESS) are rolled out in practice:

> The ownership types, regulatory frameworks and location of the ESS would influence the business model, which can either be regulated and/or competitive. Additionally, the regulation in place would determine the owner of the energy absorbed or injected into the grid from the ESS. In essence, the energy stored in the ESS could be owned by the ESS owner or by other stakeholders on the grid.[66]

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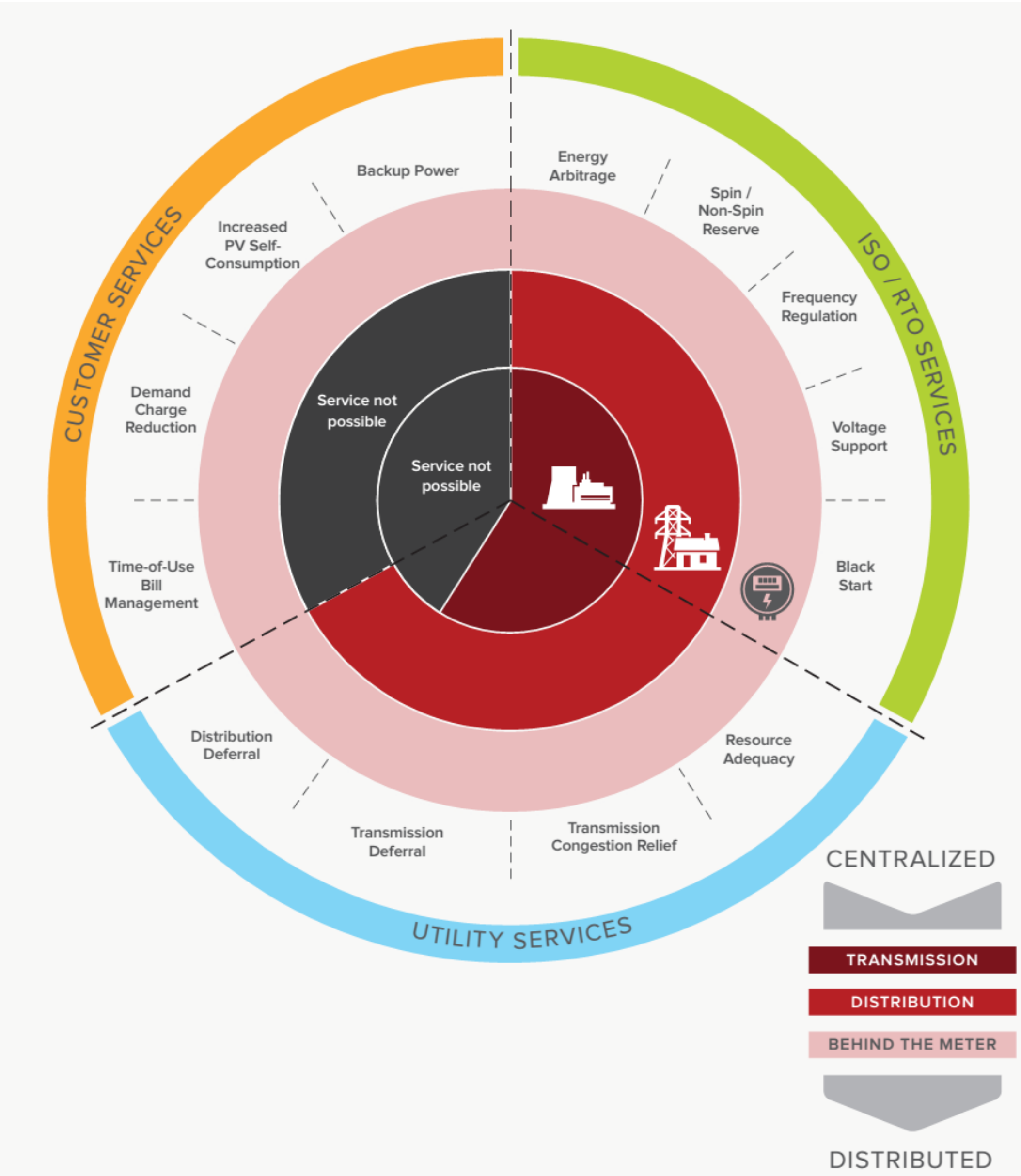
[64] Lyons, P. F., Wade, N. S., Jiang, T., Taylor, P. C., Hashiesh, F., Michel, M., & Miller, D. (2015). Design and analysis of electrical energy storage demonstration projects on UK distribution networks. *Applied Energy*, 137, 677-691.

[65] Reutter, F. (2015). Battery storage business models and their positive real-time balancing externalities. In Eisenack, K et al (2015) Contributions to the institutional economics of the energy transition, Oldenburg *Discussion papers in Economics, University of Oldenburg*, V-385-15

[66] Anuta, O. H., Taylor, P., Jones, D., McEntee, T., & Wade, N. (2014). An international review of the implications of regulatory and electricity market structures on the emergence of grid scale electricity storage. *Renewable and Sustainable Energy Reviews*, 38, 489-508.

The economics of batteries do not solely depend on their ability to facilitate lower peak demand. If the regulation allows, a store may provide a range of services, some concurrently, in order to deliver the maximum return on investment. For example, a single grid-attached battery, operating in front of the domestic meter, could provide energy arbitrage, frequency control, voltage control and reserve (see Figure 4). In this case, the battery would be providing both wholesale market and network services contemporaneously. As such, the categorisation of the battery as providing either monopoly or contestable services is ambiguous.

Figure 4. The range of different services provided by storage



Source: Rocky Mountain Institute (October 2015) *The Economics of Battery Energy Storage.* The terminology is derived from the US where utilities encompass transmission and distribution networks businesses, ISO/TRO services relate to transmission system operation and to the wholesale market.

A.2.2 Examples of storage

The recently announced Tesla Powerwall has sharpened attention on households moving off-grid using a combination of solar PV and storage, no longer relying upon or needing the costly transmission and distribution networks that lie at the heart of modern power networks. Although this may be possible for some, particularly in regions where grid supply is very costly, this is unlikely to be in the long term interest of most customers.

UK Power Networks has begun testing a Smarter Network Storage (SMS) 6MW/10MWh lithium-ion storage facility to be integrated into the distribution network, as an alternative to hardening a local substation.[67] The current major challenge to further implementation of storage systems is cost, as storage used for a single application, such as network support, can be inefficient. Business models for maximising the value of storage are challenging to implement in practice, and UK Power Networks have maintained that evolution of regulatory frameworks is needed. For example, they suggest that:[68]

- there is a regulatory propensity to treat storage as quasi-generation rather than a discrete activity or asset with distinctive characteristics, not unlike the approach that the AEMC appears to be favouring in Australia;
- there would be merit in having storage as a distinct class of licensed service provided by DNSPs (with separate license obligations and freedoms);[69]
- a DNSP exemption from legal, functional and accounting separation for smaller scale embedded storage deployments; and

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67 Deign J (2015) A UK Distribution Utility Makes the Business Case for Battery Storage, at http://www.greentechmedia.com/articles/read/making-the-business-case-for-uk-energy-storage

68 Bradbuty S, Hayling J, Oaoadopolous P and Heyward N (September 2015) *Smarter Electricity Storage Electricity Storage in GB: SNS 4.7 Recommendations for regulatory and legal framework (SDRC 9.5)* available at http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/Report+9.5+19Oct_v2.1_%28Final+Photos%29.pdf (last viewed 30 November 2015).

69 The UK licensing system allows for great flexibility in rule-making. A license is effectively a sub-set of rules that can be set for engagement in a defined activity and even for different types of business and business models. This allows both targeting of obligations aimed at specific issues and some degree of choice for businesses as to which set of rules they wish to be subject to. This flexibility may account for the relatively relaxed approach to vertical integration in the UK: if problems occur, there is a straightforward way to address them, so there is no great pressure to legislate in advance for problems that might occur, but more likely won't occur. At the moment a DNO (equivalent to a DNSP) can own a battery storage facility, but cannot operate it (although since the licensing arrangements were obviously not designed with the new technologies in mind, there are some legal uncertainties). As discussed earlier, the likely outcome is the introduction of a new class of licence, as advocated by UK Power Networks among others. The most substantive problem is simply delay. This is partly unavoidable – it is difficult to construct licence conditions at such an early stage of the development process, when much is still to be learned about the nature and potential of the new technologies – but also partly attributable to the inertia that is characteristic of all regulatory processes, recognising that some are more inert than others.

- since storage does supply services in competition with generation (as well as services of direct consequence to the DNSP), trading activities from the storage should be handled by a third party registered supplier, which could be a DNSP affiliate; and
- encourage DNSPs, where they identify storage as an option to provide distribution services, to secure solutions through competitive means.

The aim of the project is to determine how the provision of storage services to distribution networks, electricity traders, and the transmission system can be combined.[70]

A.3 Smart meters

Currently, accumulation meters are the most common type of meter used in the NEM. These meters only perform basic metering functions, recording the amount of energy used but not the time of use. Smart meters, on the other hand, provide near real time information about the amount of electricity used and when it is used. Depending on the meter, this information may be available remotely, which enables a variety of services including managing energy consumption or sale of solar generation in response to pricing signals. Leveraging the full benefits of smart meter services requires participation across the entire electricity supply network.

Under current rules, only the local network service provider can be responsible for metering services if accumulation meters are in place. However, a rule change recently made by the AEMC opens up the provision of metering services to more competition. The rule change will come into effect on 1 December 2017.

In Ontario, smart meters have been used to implement time-of-use energy charges residential customers. The goal has been to shift the generation load toward mid-peak and off-peak periods. Currently, load shifting behaviour across the service territory has resulted in average peak demand reductions of up to 5.6%.[71]

A.3.1 Services

The data from smart meters could complement the workings of both the wholesale electricity market and the network businesses.

[70] UK Power Networks (2014) Smarter Network Storage overview, at http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/

[71] Ahmad Faruqui et al., Impact Evaluation of Ontario's Time-of-Use Rates: First Year Analysis (Cambridge, UK: Brattle Group prepared for Ontario Power Authority, 2013).

Network businesses could use metering data to improve the management of network operations, as the ability to respond to changes in demand immediately is key to maintaining a well-functioning system. This is growing increasingly important as the amount of non-dispatchable generation increases and will become even more important in a scenario where many consumers are simultaneously changing their consumption levels in response to pricing incentives. A network business operating in the future contestable market of metering provision would also want to use the data obtained to complement operations in the monopoly provision of network infrastructure, blurring the line contestable and monopoly services.

The data requirements of network businesses are likely to go far beyond the data they can collect from meters they provide. In order to operate a network with sizeable amounts of distributed generation and storage and more flexible pricing, networks will need to have near real-time information about all customers' electricity usage or output.

A.4 Energy management services

Many smart meters enable consumers to have increased control over their electricity consumption and production decisions. Consumers can adjust their level and time of electricity consumption in response to incentives provided in their electricity tariffs. If they have a solar PV and/or battery system installed, they can also decide when to consume the electricity generated and when to sell electricity.

Most households wishing to take advantage of the possibilities enabled by smart meters and exercise more control over their electricity consumption will require additional services to implement the change, offering a market for, *inter alia*, innovative energy management services, software platforms and aggregators.

One way in which this service could be provided is through a software platform that allows the user to control electricity consumption in response to price signals or potentially trade electricity with other users. This software could provide the ability to regulate the use of home appliances and control the flow of electricity between solar PV units, a battery storage system and the grid.

Another method is to establish a contract with an aggregator. These aggregators could package a service to many residences whereby the aggregator controls the level of electricity use and the level of solar electricity generation that is sold or stored for later use. The residents can reduce their power bills with minimal effort and the aggregator offers scheduled loads and/or solar output into the wholesale market for a profit.

A network business participating in these contestable market could incorporate into their service pricing the potential benefits that sophisticated control over consumption and pricing could yield in terms of improved management of network congestion, better use of network capacity and deferred network investment. With distribution prices now representing the largest single component of the retail tariff, the efficiency gains from improved network performance are potentially substantial.

A.5 Microgrids

In the traditional electricity grid, electricity is transported from large, centralised power generators to individual customers. A microgrid is a local energy grid that is usually powered by distributed generators, batteries and/or renewable energy sources such as solar. A microgrid may be connected to the traditional grid, which enables energy arbitrage and provides a backup source of power, although a microgrid can break off from the grid and use its own local energy generation. As a result, microgrids can be used to increase the reliability and resilience of power networks, as well as provide other system services. Microgrids are most often seen in facilities such as universities, although a number of new residential developments are also considering establishing microgrids.

Microgrids can be used to supplement an electricity network connection, act as a distributed generator in providing power to the grid or be used to disconnect customers from the electricity grid.

The emergence of new retail pricing policy frameworks and business models mean that microgrids can be profitable energy service providers, rather than just ways to reduce reliance on the electricity grid.[72] The evolving nature of the electricity network customer base presents a number of challenges for existing regulatory frameworks. These include active management of distribution networks, coordination of the operation between microgrids and public electricity systems, and islanding mode operation.[73]

Microgrids challenge the fundamental structure of the electricity market. In addition to moving away from the current model of centralised generation with a large, interconnected transmission and distribution network, a microgrid challenges the separation between generation and distribution. While there are a range of possibilities for structuring the ownership and operation of a microgrid, it is likely that a single owner of the distribution and generation assets will be the least cost option in many circumstances. In the case of a microgrid that has disconnected from the distribution network, customers will be wholly reliant on the microgrid once established. Even for connected microgrids, opportunities for competition once established are small. Traditional considerations of

72 Miller et al (2015) Status Report on power System Transformation, NREL Technical Report, NREL/TP-6A20-63366

73 Pudjianto, D., Strbac, G., van Oberbeeke, F., Androutsos, A. I., Larrabe, Z., & Saraiva, J. T. (2005, November). Investigation of regulatory, commercial, economic and environmental issues in microgrids. In Future Power Systems, 2005 International Conference on (pp. 6-pp). IEEE.

competition and vertical separation need to be reconsidered in the new context. While there may be considerations for regulations to protect consumers once a microgrid is established, a single business should be able to offer a complete microgrid solution in a competitive market.

How does this blur the line between market segments? At a fundamental level, microgrids can essentially function as both generators or end consumers for the electricity grid, while providing distribution and transmission networks at a small scale. As technology reduces the cost of storage or distributed generation, the electricity network could become increasingly fragmented, reducing the scope of customers from which networks can recover costs. Distributed generation has benefits and costs for networks, and regulatory regimes must be flexible enough that novel business models can emerge to capture created value and foster efficient uses of this technology.

Microgrids also raise the question of whether distribution network services are contestable in some regions. In new residential estates for example, developers could choose between traditional networks or their own microgrid.[74] In this sense, network businesses are competing with microgrid operators for new business, the latter offering services based on a vertically integrated supply model. Even in established towns, traditional network businesses could soon have to compete to keep existing customers. The small town of Tyalgum in New South Wales is currently undertaking a feasibility study to assess the benefits of disconnecting from electricity grid.[75] While the magnitude of and possible timing of this future scenario remains highly uncertain, it could become a pertinent issue particularly in relation to the semi-rural and rural parts of distribution networks in the not too distant future.

A.5.1 Examples of microgrids

The University of California at San Diego (UCSD) operates a microgrid which provides over 90% of the campus' energy needs. During wildfires in 2007, UCSD increased their energy generation going from 3 MW of imported power to 4 MW of exported power in 10 minutes at the request of the utility network provider, in order to prevent outages in the San Diego grid.[76]

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74 Hunt, G. (2015) New Hunter Valley suburb could be built off the grid, Media Release, 5 November 2015, http://www.environment.gov.au/minister/hunt/2015/pubs/mr20151105.pdf [accessed 25 November 2015]

75 Timms, P. (2015) *Tyalgum: Will this small northern NSW town be the first in Australia to voluntarily go completely off the grid?*, ABC News, 8 October 2015, http://www.abc.net.au/news/2015-10-08/tyalgum-hopes-to-become-the-first-australian-town-to-go-off-grid/6834332 [accessed 25 November 2015]

76 Bentham Paulos, (2014) "UC San Diego Is Building the 'Motel 6' of Microgrids," Greentech Media, , http://www.greentechmedia.com/articles/read/byrom-washom-master-of-the-microgrid.

In the UK, the Woking Borough Council installed the first local-authority-private-wire combined heat and power (CHP) system in 2007, providing heating to offices, a local parking lot, two hotels, and leisure centres. The trial raised a number of regulatory issues that existed at the time, particularly Ofgem rules which limited total amount of power that could be sold by private wire firms.[77]

A.6 Smart networks

Smart grid technologies allow the network operator (or network owner, depending upon the market model) to more precisely control the flow of power across a network, alleviating the negative network externalities that are a common feature of complex networks of conventional design. For example these technologies can reduce loop flow constraints (in which constraints on power flows on collateral network paths limit flows on other network elements to less than their design capacity), reduce network congestion, lower the cost of wholesale power production, defer network capacity expansion, and support more flexible and less costly location decisions for new demand and supply.

A.7 Distributed System Platforms (DSPs)

There is consideration in the US of moving from the conventional vertically separated model in which NSPs are standalone operators of the networks to a model based on distributed system platforms.[78] DSPs have been described thus:

> The DSP operates an intelligent network platform that will provide safe, reliable and efficient electric services by integrating diverse resources to meet customers' and society's evolving needs. The DSP fosters broad market activity that monetizes system and social values, by enabling active customer and third-party engagement that is aligned with the wholesale market and bulk power system….
>
> …the DSP will enable transparent market based customer participation, creating a flexible platform for new energy products and services to improve overall system efficiency, grid reliability and differentiated energy sources to better serve customer needs. The DSP will promote retail level markets and formulate entry of new retail energy service providers. The DSP will provide robust information for consumers, third

77 Hammer, SA (2007) The little city that roared…how Woking's microgrid has changed the face of urban energy policymaking globally. Or has it? Center for energy, Marine Transportation and Public Policy, Columbia university

78 See http://www.greentechmedia.com/articles/read/5-key-proposals-for-new-yorks-grid-transformation (last viewed 30 November 2015).

parties, and energy suppliers, making possible customer participation and engagement across all customer classes. [79]

Under this model, the DSP supports a broader range of services in order to meet the needs of customers, allowing the integration of activities that might currently be considered to the province of regulated and unregulated levels of the supply chain, for example demand side management as a substitute for network services. The DSP does not undertake some of the traditional 'asset' related functions of the NSP such as system maintenance, capital investment, engineering etc. which remain with the network services provider.[80]

The initiative has been spurred by the large potential savings that integration, facilitated by DSPs, could engender. For example, Con Edison (the utility that supplies New York), has identified US$1b of savings from deferred DNSP substation upgrades that could be realised through a combination of customer load management programs and more modest network upgrades.

Similar lines of thinking are currently being explored in the UK, not only in the energy sector but also in sectors such as water where, for example, there is an emergent demand for the provision of an increasingly wide range of 'ecological services' that are closely linked with investment in and operation of water networks. Moreover, these are not entirely 'blue sky' exercises: payment systems in banking already operate in a number of ways that prefigure the developments in contemplation in the more traditional utility sectors — the physical and informational infrastructure in such systems acting as a (shared) platform for the development of a burgeoning range of different services, stimulated by the opportunities afforded by advances in digital technology. Indeed, the new Payment Systems Regulator, established in 2015, is the first UK regulator to have promotion of innovation of one of its three primary objectives — the others relate to the interests of service-users (providers and customers, including end consumers) and promotion of competition.[81]

A.8 Other possible innovations

The foregoing sources of innovation in electricity supply have arisen as a result of substantial investment in and improvement in the underlying technology over many

[79] State of NY Dept. of Public Service (22 August 2014) *Developing The Rev Market In New York: DPS Staff Straw Proposal On Track One Issues* 6.

[80] At first instance, the DSP and the NSP would be co-owned but appropriately ring fenced.

[81] For an introduction to regulatory issues see C. Decker, S. Rab and G. Yarrow, *Assessment of the suitability of different regulatory approaches to economic regulation that could be applied to payment systems*, available at: http://www.fca.org.uk/static/ documents/psr/rpi-regulatory-approach-report-for-the-psr.pdf (last viewed 11 January 2016).

years. Lithium-ion battery storage, in particular, has benefit from two decades of incremental improvement resulting from substantial R&D expenditure. This has improved both the performance of the underlying technology and improvements in manufacturing through scale. That process continues (see section 4.1 above). These are not overnight 'blue sky' innovations.

So in examining possible other avenues of innovation that might be expected to change the electricity supply chain, one might look at other areas of technological development which are in similar development stages. One likely areas is what is currently termed 'the internet of things'. A typical example of an innovation that would fall within this, albeit for a different network, might be:

- an internetworked sensor placed on the road side which measures road surface temperature and the propensity to ice;
- transfer of that information to a service such as Google Navigation or to internetworked navigation systems stored on vehicles (including self-driving vehicles); and
- warnings or vehicle speed controls.

That is, the internet of things involves linking, via the internet, sensors with control equipment. Over the course of time, one could envisage a host of energy-consuming and generating equipment located throughout the electricity supply chain, but particularly at customer premises:

- providing real time information on consumption and usage in greater detail than currently installed smart meters; and
- allowing a customer-agreed level of control over the level and timing of the use of equipment that a controller could make use of, in return for an appropriate share of the rent that this would generate.

For example, this could include control of energy intensive household equipment such as pool pumps, air conditioning, dryers etc., but could also extend to control of solar generation injections into the network and, in so far as such installations are effective, storage.

The idea that some degree of centralised control, where the customer chooses whether or not to delegate that control, can deliver substantial benefits to customers is hardly new. Ripple control, separate peak and off-peak meters and tariffs etc. have been in use for decades, where the 'internet of things' can move beyond these basic models might be the incorporation of information gathered from the networks themselves that might allow third parties (whether affiliated to NSPs or not) to provide such service.

A.9 A taxonomy of developments

But what has changed is the degree to which the full benefits to customers from disruptive and innovative technologies rely upon scope economies between the networks and contestable services.

The foregoing provides just a sample of the disruptive innovations currently underway involving networks providing services that differ from the traditional, core, regulated network services. The Edison Foundation classifies a number of valuable innovations that are reliant upon close links between NSPs and contestable service providers, or in economic terms, scope economies. The classification draws exclusively on North American experience, where due to the legacy of investor owned utilities, there is substantially greater vertical integration than in the case in Australia or the UK.

The innovation classification includes:[82]

- grid edge optimisation that improve control over voltage at the edge of the network resulting in energy saving and distribution cost benefits to final customers;
- grid reliability and restoration to reduce the likelihood of failure and decrease time for restoration, thereby improving supply reliability to the final customer. Broadly, it is based on improved communication, sensors and measurement, diagnostic software and resource management;
- grid visibility and asset management which, through better and denser sensors, advanced metering and communications, provides more accurate information on network status and conditions that can be used to improve asset management and, potentially, as an important input to cost-reflective network pricing at a more geographically disaggregated level;
- grid analytics that rely on more geographically and temporally disaggregated data from smart meters, grid sensors and other sources to improve grid performance, improve reliability and provide services tailored to the specific needs of final customers;
- renewal and distributed generation in combination with storage, the latter which can provide services that augment existing network services as well as intermittent generation sources;
- customer engagement whereby utilities are using new approaches and technologies to better understand and influence the decision making patterns and energy management behaviours of their customers; and
- demand response and energy management, whereby technology, pricing signals, and market rules are enabling customer responsiveness giving rise to network and energy cost savings to final customers.

[82] The Edison Foundation Institute for Electric Innovation (December 2013) *Innovations Across the Grid: Partnerships Transforming the Power Sector.* The Foundation, which is part of the Edison Electric Institute, is funded by US investors owned utilities which collectively provide the largest share of US electricity supply. They state on their web site (http://www.eei.org/about/affiliates/iei/Pages/default.aspx last viewed 30 November 2015):

> The Edison Foundation Institute for Electric Innovation promotes the sharing of information, ideas, and experiences among regulators, policymakers, technology companies, thought leaders, and the electric power industry. It also identifies policies that support the business case for the adoption of cost-effective technologies.

B Vertical externalities

An externality in economics arises when the transactions of a firm gives rise to costs or benefits to another party that was not involved in the original transaction. A positive externality arises when the third party benefits; by way of example, research and development by a business can result in the free or low cost dissemination of knowledge to third parties, the benefits of which are not captured by the firm undertaking the R&D. A negative externality arises when costs are imposed on a third party, the most obvious example being the business that pollutes the environment without charge or penalty. In both cases, the original party does not take into account the costs or benefits to the third party in making their own consumption or production decisions.

There are a number of mechanisms by which these externalities can be 'internalised' or taken into account in the decision making of the original party. These might include, for example: assignment of property rights followed by trade or bargaining among property rights holders, as outlined by Ronald Coase in his seminal works (most effective when transaction costs are low);[83] taxes (such as polluter pays models); or integration between the first and third parties.

The term 'vertical externality' as expounded by, for example, Tirole[84] refers to situations where the externalities occur at different levels of the same supply chain. An illustration is where a downstream firm — such as a retailer of electricity, solar PV or storage — makes an output decision that increases the demand for an intermediate product, such as a distribution network service, but does not take into account the incremental profit that the intermediate supplier enjoys as a result of that increase in demand when it (the downstream business) makes its output decision. In effect, the retailer maximises its own profit by reference to the price it pays to the intermediate supplier. As a result, when the price of the intermediate good is above marginal cost (which is very often the case), there is too little demand for the intermediate good, too little supply of the downstream good, prices to final customers are generally higher and the outcome is inefficient.[85]

Because vertical externalities are essentially a consequence of vertical separation and upstream prices that do not reflect marginal costs, the pricing rigidities imposed by

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[83] Coase R H (1960) The Problem of Social Cost. *Journal of Law and Economics* 3 (1) 1–44 and Coase R H (1937). The Nature of the Firm. *Economica* 4 (16) 386.

[84] Tirole J (1988) *The Theory of Industrial Organization* (MIT Press Cambridge) 174.

[85] Double marginalisation is a form of vertical externality, in which an upstream monopolist sets a monopoly price to a downstream monopolist, which in turn makes its output decisions based on that monopoly price. Double marginalisation can arise whenever upstream and downstream markets are imperfectly competitive.

regulators, such as prohibition of some forms of price discrimination even when based on true measures of costs, are likely to give rise to vertical externalities.

The term vertical externalities relates more generally to any instances where a downstream/upstream firm *does not take into account* the impact of its decisions on the incremental profit effects that they confer on an upstream/downstream firm. It can therefore also apply to cost effects, as when an expansion in downstream demand might enable an upstream firm to benefit from increased economies of scale.

Vertical externalities are not, however, the same as vertical scope economies, which arise when two or more products at different levels in a supply chain can be supplied at lower cost by a single firm than by several firms each supplying one. Vertical externalities can exist with or without vertical scope economies.

As is the case with other externalities, there are a number of market and non-market mechanisms for reducing inefficiency that might otherwise arise from vertical externalities. These include, for example, multipart or non-linear pricing which implies that the downstream firm, when deciding to increase output, faces prices for the incremental intermediate goods it will require which more closely reflect upstream marginal cost (a form of price discrimination). However, this can be a very challenging outcome to secure through contracts and pricing frameworks, particularly (though not exclusively) in markets that are in a state of flux or where the outcomes of competition in terms of the range, price and quality of services are uncertain. In such situations, which are particularly common in early stages of market or product development, vertical integration, which internalises the vertical externalities, may deliver superior outcomes in the form of stronger incentives for product development and faster growth.