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Electricity Network Transformation Roadmap

Insights from Global Jurisdictions, New Market Actors & Evolving Business Models

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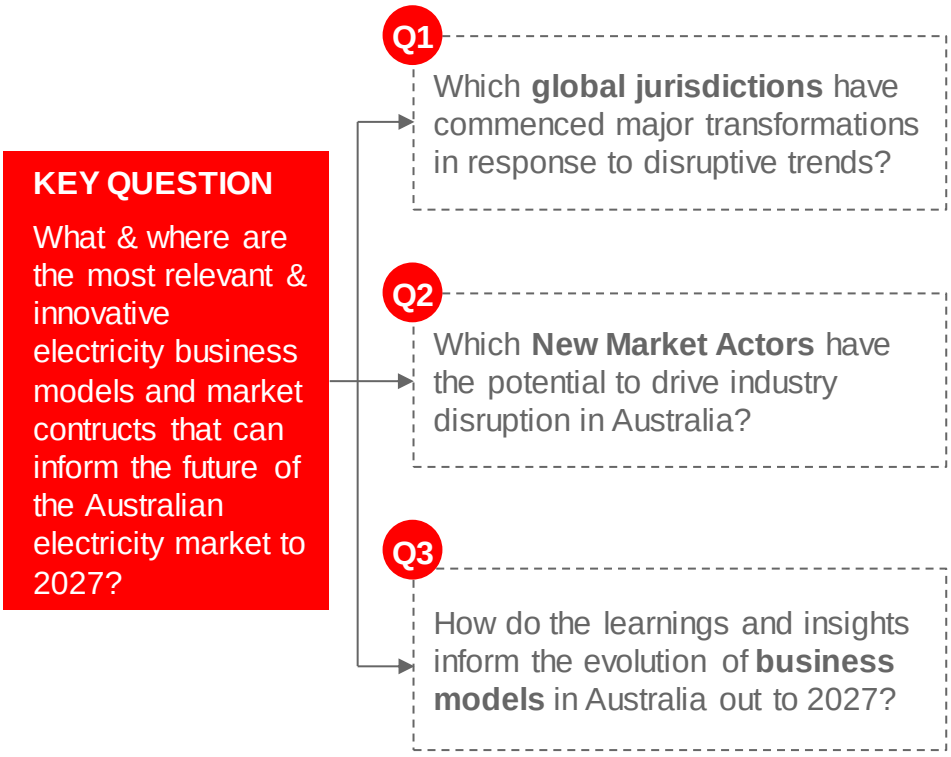
Audience & Purpose

This report seeks to derive insights and potential lessons from events and trends around the world especially for network operators. Its broad aim is to inform energy market stakeholders across the value chain, with findings and insights for transmission and distribution businesses, energy retailers (new entrants & established), regulatory bodies and policy makers. Its findings will be particularly relevant for Australian utility executives. While the report intends to inform and provide insights, it does not make specific recommendations for Australian energy market reform.

This report aims to identify lessons that would help inform plausible options for transforming the Australian electricity market to ensure it remains relevant for future customer needs. It set out to answer a key question in three parts:



A shortlist of the most insightful, interesting and relevant jurisdictions and new market actors (NMAs) was chosen for analysis. Each serves to compare and contrast with the Australian market and distil the insights that could help inform possible future directions for the Australian electricity market.

This report takes an in-depth look at 6 global jurisdictions and 7 diverse 'New Market Actors' to help inform the future of the Australian electricity market

6 jurisdictions, outside of Australia, assessed based on their ambitions, drivers, motivation and capabilities

7 diverse New Market Actors reviewed for their disruption to the status quo electricity business models

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1.0 Executive Summary

Around the world, markets are rapidly transforming their energy ecosystems. This is a response to dynamics that are accelerating in pace and are driving a seismic shift in how we generate, buy, sell and share energy. By contrasting and comparing the different emerging market structures, regulatory frameworks, approaches to transformation and their progress, Australia could learn a great deal. We want to learn from best practice and avoid the potential pitfalls along the way. We are also seeing new energy start-ups disrupting markets and responding to evolving customer needs with innovative, data-driven business models. It's tough to keep pace with these changes. Many regulators and policy makers are taking a logical but largely tactical approach devising one intervention or rule change at a time. In contrast some jurisdictions are developing far reaching reforms, putting in place long term targets and ambitious, visionary programs. Network Operators are at the centre of this disruption having been tasked with both enabling this transformation while at the same time ensuring network stability and affordable, reliable power.

What is clear is that Network Operators cannot wait for change to happen as the energy transformation is already underway. The traditional definition of the electricity customer has already changed to include distributed energy resource (DER) suppliers, technology providers, and other third parties that rely on the grid and its operational capabilities. Accelerating and further complicating the issue, New Market Actors are demanding clear standards to rapidly evolving technologies, cost certainty to connect resources, and access to the network operators' data to target and support interconnection opportunities.

While the Australian market generally compares favourably with other jurisdictions in terms of meeting the challenges faced so far – especially in terms of adapting within the existing structures – it is not clear that the current approach of incremental reforms will deliver the outcomes needed. Without a longer term vision and 'whole of market' approach Australia may not be optimally prepared for the challenges we now face.

What is surprising is that some jurisdictions and overseas markets, despite having less sophisticated networks, lower energy prices and less developed market structures than Australia are nonetheless at the forefront of energy market transformation. Why is this? Globally we see six 'fault Lines' that have come rapidly into 'play' to drive change and engender opportunities for new energy players. These cannot be ignored as they could inevitably be seen in Australia and could continue to cause disruption driving a tangible reform agenda:

1. Demand disruption - decoupling of total and peak demand is shifting the capital model
2. Consumer behaviours and 'liquid expectations' – they want control, they like 'green options' and expect delightful experiences
3. New forms of competition from all sides – many new players and emerging 'bundles' of services
4. Targets and constraints from regulators – incremental, mandates, markets
5. Capability challenges - Grid Automation, data and analytics
6. Goal Definition and Trade-offs – stability versus reform

All of the above are, in many ways, being partially caused by the prevalence and uptake of DERs. The response of Network Service Providers to DER uptake and more broadly the shift to decentralised energy and greater ecosystem participation will determine the future of grid infrastructure, market structures and ultimately the business models of network operators.

This report covers six jurisdictions which were chosen based on their objectives, drivers, motivations and current capabilities. Three are particularly disruptive and interesting for the Australian context:

- **New York** with their 'Reforming the Energy Vision' program
- **California** with their optimum deployment of distribution resources and 'renewable portfolio standards'

- **Netherlands** with their twelve pillar energy transformation program 'Energy Agreement' and their platform models.

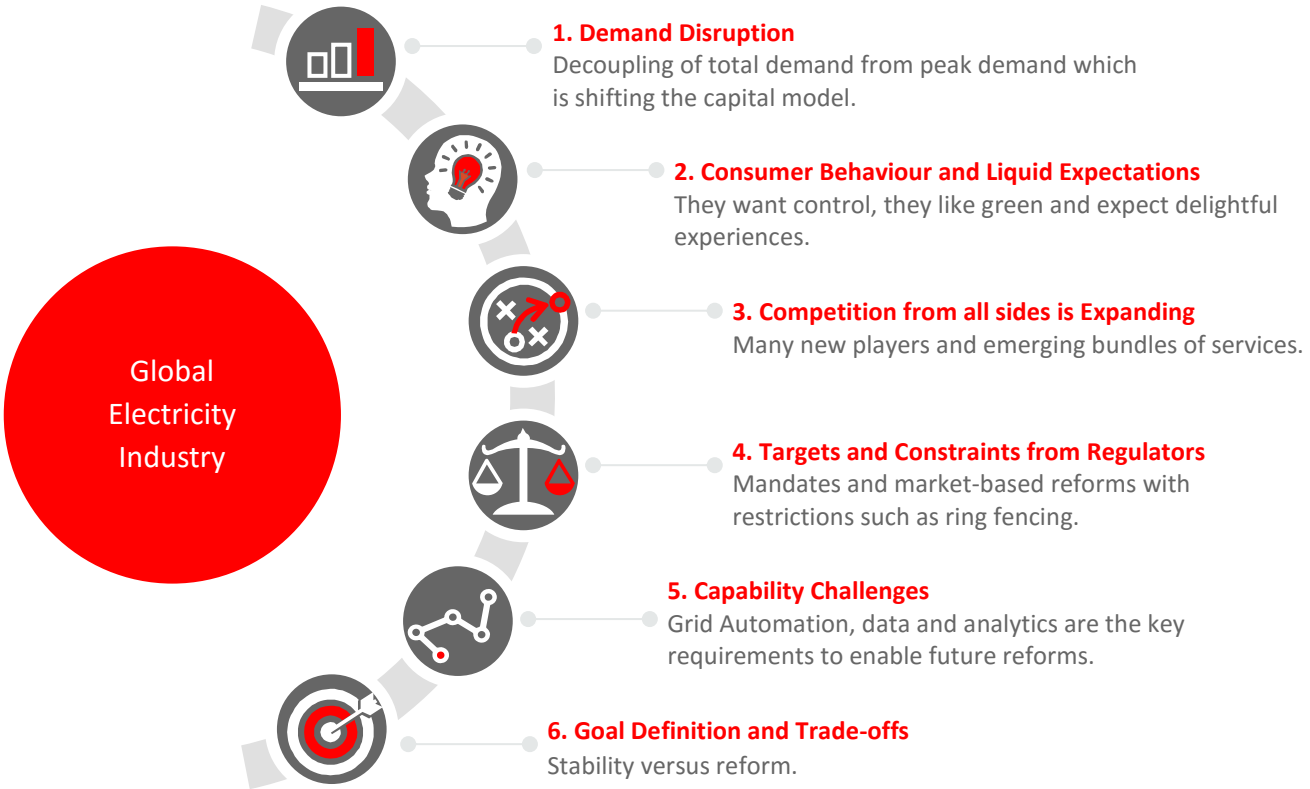
While UK, Texas and Hawaii have unique and specific insights that are covered in detail, their overall level of market transformation is muted.

The industry is seeing many New Market Actors (NMAs) appear in the market, some from unexpected areas. Many of them are in either pilot or early commercial stages but others have a strong core business that provides a platform for extended growth. This report covers seven NMAs of interest. We see their value propositions fall into 3 non-exclusive categories:

- **Data driven trading / community models**
- **Innovative customer value extensions**
- **Strategic partnership models**

Australia already has a high number of these new players due to specific market conditions that suit their propositions. However, in reviewing international models many others were investigating the Australian market for possible expansion. A common theme of all of them is how and whether to partner with existing industry players or to find a niche and create value just for themselves and their customers. Co-creation of value is a strategic question being asked and determined by existing and new players alike. The extent to which this can and will occur is dependent on innovative business models, and evolving regulatory structures.

The jurisdictional reviews indicate 6 Global 'Fault Lines' around which reform is taking place



1.1 Changing Business Models

Globally, there is now a recognition that the traditional network centric model is no longer 'fit for purpose'. They were suited to a time when customers had little choice in how they managed their electricity use and when the benefits of participating in existing utility programs and deploying DERs were unclear or not readily available to all customers. Times have changed.

To move into a new way of operating several key constraints need to be overcome. Today in many countries customer programs and tariffs do not fully consider the true costs and benefits to the grid. Many energy solutions fail to address specific locational and temporal grid needs, while shifting costs to non-participating electricity consumers.

Physical and operational grid constraints and insufficient wholesale and distribution market opportunities prevent network operators, its customers, and third parties from maximising the potential value of DERs. As a prerequisite to high levels of DER adoptions, network operators require new advanced capabilities to effectively call on DERs for customer and grid services, monitor grid conditions, automate responses, ensure performance of DERs, and maintain reliability.

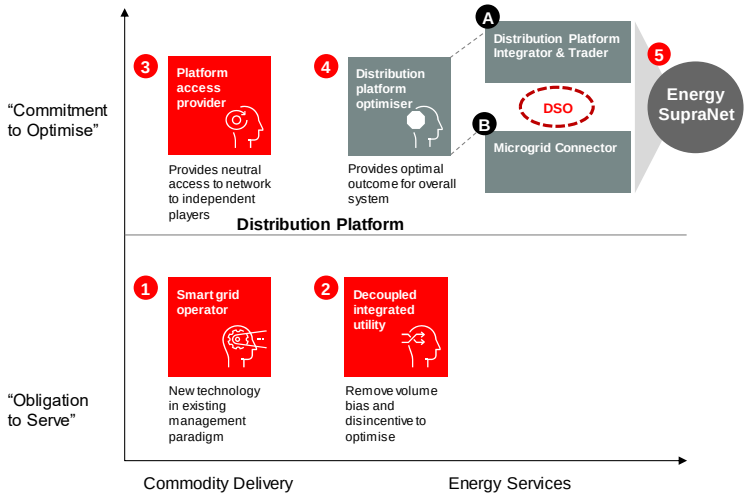
Energy technology advancements and ambitious policy goals have outpaced the existing network operator business model and regulatory processes. Existing business models promote infrastructure investment by providing a regulated rate of return on capital expenditures, and are therefore perceived as discouraging alternative options. Faced with the unprecedented rate of DER adoption, network operators and regulators are finding it hard to respond in a timely manner, build required capabilities and undertake rate reforms.

This report describes 5 business models which evolve towards the 'Distribution Platform Optimiser' - a model that integrates distributed energy resources (DER) and facilitates the market for DER services. One of the market design questions will be how can DERs be coordinated in a way that unlocks systemic efficiencies and which part will be responsible to coordinate and optimise the interaction between wholesale and distribution markets.

The most disruptive model represents a possible future called the 'Energy SupraNet'. This is the ultimate endpoint of a full connected society linking smart cities and all infrastructure components for an optimal and balanced outcome for its citizens.

By understanding, and learning from reform initiatives around the world, and seeing how new competitive players are viewing our market, the industry should be much better placed to design a future that is not only adaptable, but adds value to the entire industry.

5 Business Models on the pathway to a New Energy Ecosystem



1.2 Achieving transformation – incremental vs visions, mandates vs markets?

A global view of reforms highlights that the grid, while still an essential part of the industry, would need to change to accommodate new forms of supply and consumption. That, in turn, implies major changes to the network operators' motivations, ambitions and required capabilities. Some have likened the changes required to the internet, an open exchange or even an 'aggregator of aggregators'. These descriptions are apt in some aspects—the grid is increasingly becoming a platform for energy exchange, facilitating new businesses and as yet unseen opportunities.

These changes are being implemented across two dimensions: incremental versus visionary programs and mandates versus markets based reforms. In some areas, for example California, regulators are mandating DER interconnections and grid storage. Others, such as New York, are highly visionary and rushing to establish new open and competitive markets. New York's REV is perhaps the most innovative and far reaching overhaul of the existing network model anywhere in the world to date.

There is no doubt the role of the network operator is being redefined driven by the need to facilitate and encourage DER uptake, adoption and connection for grid optimisation and to enable an overall energy transformation. These reforms would not only define how to include new revenue sources and standards but would ultimately lead to new business model options which would require a vastly different set of capabilities than most network operators have today.

The visionary undertakings of jurisdictions like New York with its 'Reforming the Energy Vision' program, Hawaii's target of 100% renewables by 2035 and The Netherlands' peer-to-peer community models show significant ambition. These are not incremental reforms – they are driven by a clear vision of the future.

Australia, while having some of the most pressing drivers for change, has undertaken reform at a more incremental pace on the back of major reforms in the late 1990's with the establishment of the NEM, followed by disaggregation, privatisation and full retail contestability. More recently with the Power of Choice reforms and other smaller rules changes we seem to mirror many of the proposed changes in other jurisdictions. But the disruptive forces we are seeing are becoming stronger. Incremental reforms risk inconsistency and sub-optimal outcomes. Australia has not, as yet, defined a new vision or National Electricity Objective[1] or established ambitious targets that would then inform the development of new market models.

Responses are being implemented across two dimensions in response to these fault lines:

1. **Incremental vs. visionary transformation**
2. **Mandates vs. markets based reform**

[1] The National Electricity Objective, as stated in the National Electricity Law, 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.

1.3 What can we learn from the 6 jurisdictions investigated?

Six global jurisdictions were selected based on a set of criteria that included comparability to the Australian market and major reform developments occurring: New York, California, Texas, Hawaii, Netherland and the UK.

While each jurisdiction is unique and has their own challenges and opportunities, certain insights could be gained from their current progress. This report summarises these lessons by region and jurisdiction. In summary 6 insights and lessons are particularly relevant for Australia.

1. **Evolving network operator business models would potentially benefit more from longer term visions and pragmatic roadmaps rather than large ambitious programs that do not adequately consider existing levels of capability.**
    - Lessons from the New York REV program and the successes to date from California and the Netherlands show that it is important to balance the scale and pace of reform with the capability base of the existing utilities and market structure. Risks and delays can be introduced resulting in significant issues and/or project failure due to an inability of the regulatory bodies to sustain the momentum and address stakeholder concerns.
2. **A vibrant and competitive retail sector aids third party investment, innovation and could help align to overall customer outcomes.**
    - Jurisdictions that have strong retail competition facilitate innovation and 'market animation' which allows new regulatory process and incentives to succeed and promotes partnerships thereby spreading risk. The UK and the Netherlands demonstrate this.
3. **Visionary rate making reform that incorporates new revenue streams helps to align network operators with enhanced customer outcomes.**
    - New and replacement revenue streams are required to ensure alignment between consumers, new market actors and network operators. The burden of investing in new capabilities and technologies by the incumbents needs be recognised and addressed through ratemaking reform. New York is the most dramatic standout of this but there are interesting developments in California and Netherlands as well.
4. **A focus on DER interconnection standards and protocols would enhance certainty and helps facilitate DER uptake and business model evolution.**
    - Certain regions have focussed a lot of attention on standards and protocols for DERs. California's AB 327 requires a 'plug and play' approach to connecting distributed energy resources to the grid which has proved to be an effective model in stimulating investment.
5. **Wholesale market participation would open up new value streams for DERs and enhance grid reliability.**
    - DER uptake can be facilitated by wholesale market access by opening up new revenue opportunities for aggregators. California is the most progressive US state in this regard.
6. **Government aided 'experimental room' and innovation would be valuable to help establish new markets, aid infrastructure development and encourage network operators to partner to build new business models.**
    - The Netherlands like a number of other markets shows the importance of regulatory and economic dispensation to help get emerging business areas and commercial ventures started.
    - Unlock the value of the entire energy ecosystem by - stimulating Innovation, enhancing retail competition, creating network incentives and revenue streams and overall alignment of all value chain parties.

Overall these 6 insights are summaries of many individual issues and required reforms. Australia is quite mature and advanced in some of these areas but lacking in others.

Key jurisdictional developments:

New York
Whole of market transformation approach, unique in scope, vision and ambition.

- Seeks to encourage edge of grid competition via regulatory reform.
- Aimed at augmenting the distributor role to encompass a platform provider and market operator – requiring a step change in distributor capability.
- Goal is to provide a data rich environment, enabling decentralised generation and bi-directional flows.

California
Highly progressive region with greatest solar uptake in the US and high AMI penetration.

- Two step approach: 1) mandatory distributed resource plans; 2) distributed resource targets.
- California Public Utilities Commission has mandated long term plans for all IOUs to outline an approach for DER deployment.
- DER incentive scheme will allow utilities to earn higher ROIC for DERs, incentivising DER alternatives to grid infrastructure.

Texas
The only fully competitive electricity market in the US with low prices, full smart meter rollout and low DER incentives for DNOs

- The Electricity Reliability Council of Texas (ERCOT) takes a market guidance approach rather than leading with mandates.
- Driven by customer centric market mechanisms designed to empower customer choice.
- ERCOT is an 'energy only' market – this is a barrier to DER uptake.

Hawaii
Highly innovative environment borne from very high prices and unique conditions.

- Three step approach to transformation: 1) start-up investment; 2) regulatory mandated reform; 3) business model research.
- Centrally mandated pressure to increase DERs – underscored by 100% renewable target by 2045.
- Start-up innovation, high solar penetration and customer appetite have resulted in one of the most innovative energy environments.

Netherlands
Spawning of innovative new business models driven by a liberalised market, evolving regulations and strong consumer preference for renewables.

- Highly visionary transformation program that consists of 12 pillars and corresponding targets to: 1) increase renewables; 2) expand decentralised generation; 3) electrify transport; 4) and improve energy efficiency.
- Regulatory flexibility has lead to two DER platform providers, Powerpeers and Vanderbron, allowing bi-directional flow between prosumers.
- Partnerships have been a key driver for DNO innovation.

UK
DNOs focused on asset efficiency due to RIIO. Retailers leading innovation with DER integration and smart meter rollout.

- UK DNOs are subject to a new regulatory framework RIIO (revenue = incentives, innovation and outcomes), which indirectly supports DER integration through remuneration and 'time to connect' regulatory incentive.
- Security of supply is a top priority.
- DNOs may access aggregated power quality data from AMI rollout, innovation funding under RIIO also available

In all jurisdictions we see broad trends towards open markets and mechanisms to incentivise new entrants, customer choice and DER integration.

1.4 Seven 'New Market Actors' and what they want from the industry

New Market Actors are finding Australia a very hospitable market to test their business models. With high energy prices, relatively fast consumer adoption and a liberalised market structure seen as being advantageous, more NMAs from around the world would continue to target Australia. They would inevitably encroach on network operators disrupting demand and opening up competing relationships with customers. A central theme of our findings from NMA interviews was the co-creation of value. In some cases, value is being created by the NMA to share only between themselves and customers. However, many others are 'co-creating value' by potentially offering valuable services to network operators. It is this balance of co-creation of value and disruption to existing models that is the main challenge network operators from NMAs.

Seven 'New Market Actors' (NMAs) were chosen based on their industry-disrupting business model and value proposition. Each of them had made deliberate decisions to be 'disruptive' and to consciously create the market opportunity.

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Analytics driven battery storage system maximising value for commercial & industrial customers	*New retail business model decoupling revenue and profits from customer energy consumption*	*Enabling customers to trade with the wholesale market and extract additional value from solar & storage systems*	*Online community energy platform allowing direct peer-to-peer selling of power without a retailer*	*Telecommunications provider leveraging capabilities to enter the electricity market with a bundled value proposition*	*Major retailer building strategic partnership and leveraging scale to disrupt markets*	*One stop shop approach to DER customer solutions – off the shelf*
"Energy on cruise control"	"Costco of energy".	"Ebay of energy"	"AirBnB of energy"	"Home services supermarket"	"Virgin group of energy"	"Tesla of energy"

The interviews of these NMAs highlighted 9 issues that nearly all said were issues that needed to be addressed to facilitate their new business models.

1. **New tariff/ pricing models** – especially the proportions of fixed charges and locational pricing for localised energy supply and consumption
2. **Wholesale market interactions** – topics around how distributed generation could be traded in wholesale markets.
3. **Facilitating open access to the grid** – allowing and encouraging greater DER connections and providing transparency on network connections and standards for DER's.
4. **Ring-fencing** – clarity about ownership, operation, control, and accrual of revenues for DER and edge of grid revenue opportunities.
5. **Consumer Protections** – to allow innovative new energy supply and consumption models while always protecting consumer interests.
6. **Grid Automation**– having the capabilities and technologies to monitor and control third-party distributed generation and/ or storage.

7. **Communities and Microgrids** – providing a clear pathway for community owned microgrids to help confirm that value is captured by the local community while ensuring back-up power is still supplied.
8. **Enabling new retail models** – allowing new models of energy sharing without involving retail licensing obligations.
9. **Enabling data sharing** – increasing the access to consumption, network and technical information to allow optimisation of the grid and provide value back to consumers.

1.5 What can we learn from the 7 New Market Actors?

The key lessons from the New Marker Actors can best be summarised in their own words. Below are a selection of quotes from our interviews.

Where are we heading?

- "Our business model reinforces the use of the grid rather than disconnection"
- "Customers want 'Automatic but visible' energy"
- "We believe there will be a convergence between home services, telecommunications and energy markets"
- "Value creation is based on the integration of components"
- "People aren't buying electricity storage hardware; they're buying empowerment and transparency"

What are current challenges/ barriers to change?

- "New entrants want to enter but aren't sure of the landscape"
- "Network is not incentivised to go to competitive markets to find solutions"
- "Dispatch and measurement of load needs to be reformed as well as considerations for peer-to-peer trading"
- "One barrier is that distributed energy is not currently valued highly enough, and is currently only worth the same as spot/wholesale market"

What's required to facilitate the evolution?

- "Need to unbundle regulatory barriers so the market can sort itself out"
- "Governments and regulators need to draw the boundaries to give networks certainty between regulated monopoly and competitive ring-fencing"
- "(need to ensure) the market is open enough to ensure access to behind the meters for 3rd party providers"
- "Architect technology platforms to be multijurisdictional"
- "Barriers are getting less and less. Customers have shown appetite… Gentailer models are emerging. Now is the time to get out there and encourage customers to install systems… now is the time to experiment"

1.6 In conclusion

The Australian electricity industry has much to be proud of. It's been the subject of analysis and case studies by other jurisdictions around the world. The establishment of the National Electricity Market in 1998 has proven to be considerably successful in underpinning investment in energy supply, improved productivity and competitive electricity prices. The NEM, along with structural reforms like the opening of the retail market to full contestability and the 'Power of Choice' reforms in the past have been at the forefront of electricity market reform globally. However, the time for incremental change has passed and the insights from some of the world's most dynamic energy markets show that new directions are being rapidly forged. Some are leapfrogging traditional market liberalisation reforms or are in the process of establishing radically new market structures. Others are progressing through targets, mandates and cross industry convergence on both B2B and B2C markets. Many jurisdictions prove that the 'fault lines' are real, expanding and a response is needed.

There are also disruptive new market actors springing up taking and creating new market opportunities. In a borderless world disruption occurs quickly. Technology developments and consumer trends take little notice of existing regulations or put substantial pressure on the reform agenda. This opens the door to innovation and provide an irresistible platform for new entrants. New Market Actors are reshaping energy markets and causing regulators and policy makers to act.

Distributed energy resources (DER) are the major disruptive change and if not addressed in a comprehensive way – facilitating and enabling all eco-system players to create value while optimising the grid, we risk creating significantly sub-optimal outcomes. The new market actors are facilitating and accelerating the changes. What is needed is a compelling industry vision and a simple roadmap for change that all parties can drive. We can learn specific insights and lessons from other jurisdictions about how this should proceed with renewed vigour.

New business models for network operators are unfolding. These are not standing still but are further evolving. It is clear that the distribution optimiser model is becoming a standard goal in most similar jurisdictions around the world. However, this has a number of variants and is in many ways jurisdictionally specific.

What this ultimately means is that a 'wait and see' strategy for Australia would inevitably fail and result in lost opportunities for both Australian businesses and Australian citizens.

Enter the visionaries – the time for incremental change has passed.

Insights from the world's most dynamic markets show that new directions are being rapidly forged. Some jurisdictions are leapfrogging traditional market liberalisation reforms or are in the progress of establishing radically new market structures. Others are progressing through targets, mandates and cross industry convergence.

Plan for change – or risk being left behind.

There are disruptive market actors springing up taking and creating new market opportunities. Globalisation means disruption occurs quickly. Technology developments and consumer trends take little notice of existing regulations, opening the door to innovation and market forces providing a platform for new entrants. As seen with Uber in the taxi industry, policy makers and regulators must act now or risk having to play catch-up.

Set the Vision - start running in the same direction.

DERs are creating major disruption. If not addressed in a comprehensive way – facilitating the ecosystem to create value whilst optimising the grid, the industry risks creating significant sub-optimal outcomes. New market actors are facilitating and accelerating these changes. What is needed is a compelling industry vision and a simple roadmap that aligns all parties. Where possible, take the learnings of other jurisdictions to accelerate with renewed vigour.

The Distribution Optimiser Model – the new status quo.

New business models for network operators are unfolding. These are not standing still but are further evolving. It is clear that the Distribution Optimiser Model is becoming a target model in most similar jurisdictions around the world. However, this has a number of variants and is in many ways requires jurisdictional specific grid, regulatory and customer interventions.

What this ultimately means is that a 'wait and see' strategy for Australia would inevitably fail and result in lost opportunities for both Australian businesses and Australian citizens.

2.0

Global ‘Fault Lines’

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2.0 Global 'Fault Lines'

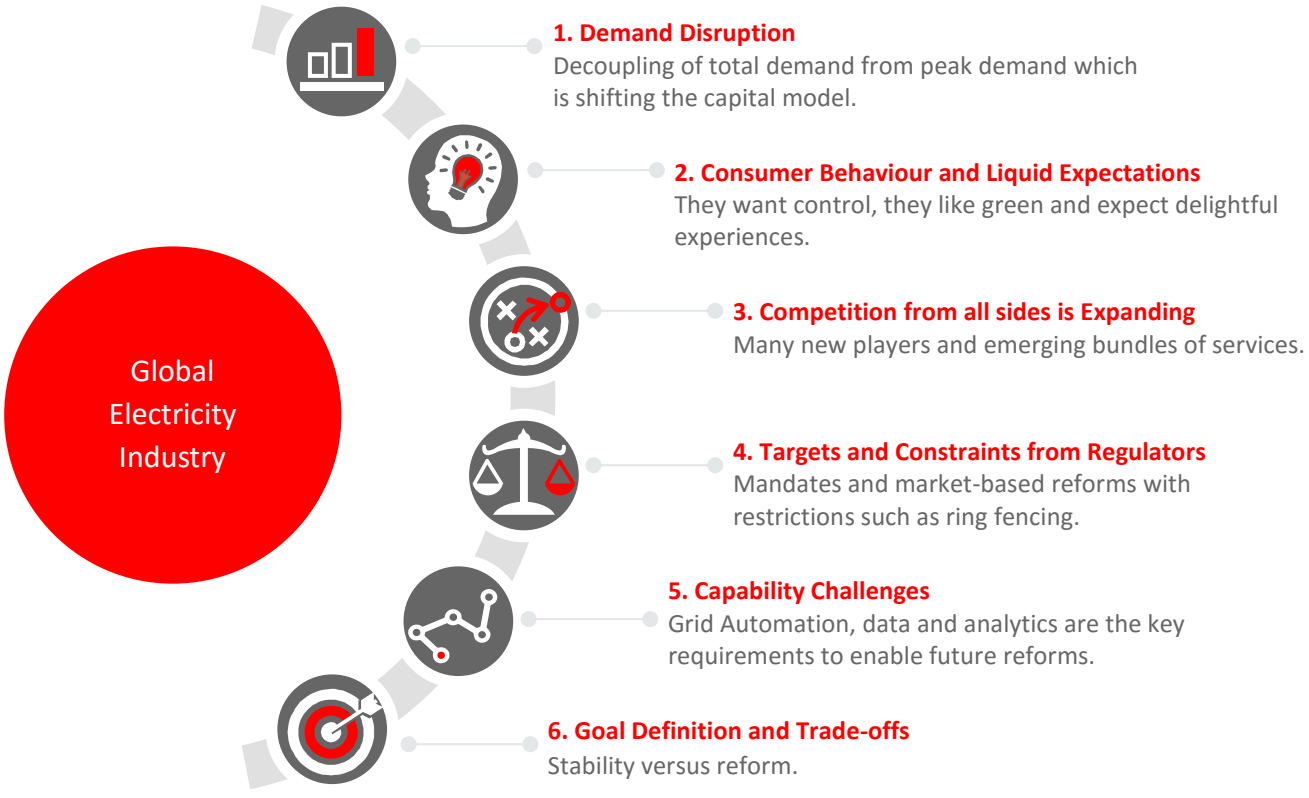
After a century of "business as usual", the global electricity industry is being reshaped by a confluence of market forces, including: demand disruption from distributed and digital energy technologies, evolving customer needs, ambitious targets (and constraints) from regulators and policy makers, and new competition from third-party service providers.

In reviewing 6 global jurisdictions we found that there were common 'fault-lines' around which reform is taking place. However, the response of these jurisdictions is very different. Some have embraced the change with an 'open' approach and others have adopted a more 'defensive' or 'closed' approach. Each have different ambitions, drivers and motivations. Significantly, they also have very different capabilities to deal with the change in terms of market structures which would aid third party investments and automation of network infrastructure providing data and insight to manage distributed generation. What is clear is that these 'fault lines' would inevitably cause fundamental change in the energy landscape.

Global Fault Lines for Network Operators

- Demand Disruption – decoupling of total and peak demand which is shifting the capital model
- Consumer behaviours and liquid expectations – they want control, they like green and expect delightful experiences
- Competition from all sides is expanding – many new players and emerging 'bundles' of services
- Targets and constraints from regulators – mandates and market based reforms with restrictions such as ring-fencing
- Capability Challenges - Grid Automation, data and analytics are the key requirements to enable future reforms
- Goal Definition and Trade-offs – stability versus reform

'Fault Lines' reshaping the global electricity industry



1) **Demand disruption (and in some of these jurisdictions – high prices) are destabilising the cost-revenue distribution model.** The problem comes as a result of the load reduction coming without a corresponding reduction in peak demand. This decoupling of total and peak demand can result in a mismatch between the distribution network costs - that are in significant part driven by peak load and revenues. Similarly, the deployment of small scale distributed generation such as rooftop solar tends to reduce the load factor by decreasing demand in the middle of the day, but does not have any impact on typical peak demand.

2) **Consumer behaviours have changed and expectations are far more liquid.** Around the world people are wanting more 'control' and self-sufficiency is an ever evolving trend driven by the desires for grid independence and the growing influence of 'millennials' on how energy is bought, sold and potentially shared. They also want green energy[2] and are also more interested in taking up and experimenting with new models. For example, Accenture's New Energy Consumer (NEC) research shows that a high proportion of millennials are interested in online energy trading marketplace (81%).[3]

3) **Competition from all sides is expanding**. Being a natural monopoly no longer insulates a distribution company from the effects of competition. Providing value to shareholders and bondholders and accessing cost-effective project financing are increasingly challenging, particularly where easier cost-reduction initiatives have already been implemented. Competition of new entrants in the energy markets is encroaching on the traditional distribution business, disrupting demand and opening up competing relationships with customers. All in an environment where the relationship with the customer has been one step removed. The risk now is one of relevance. There is also concern that new models for the energy system could ultimately threaten the monopoly license to operate. For example, microgrid deployment could see increasing areas of the low-voltage network move out of network operator ownership and control.

4) **Targets & constraints from regulators and policy makers.** Many jurisdictions are struggling with the pace and depth of the reforms required. Some have started incrementally while some such as New York have decided to overhaul much of the existing system. California has adopted a more mandates driven approach defining targets and objectives leaving the utilities to determine how best to implement the required reforms to meet them. Ring fencing of DER asset ownership and control is also a major cross jurisdictional issue. Network operators are being asked to use, connect and integrate DERs while at the same time are running the risk of being locked out of their traditional asset management role by future regulatory restrictions.

5) **Grid Automation, data and analytics are challenging.** Many regulators and utilities are being challenged to define the capability requirements to achieve their ambitions over the next 10 years. To integrate DERs and enable more open participation many are finding that they need to adopt "intelligent network" capabilities, including real-time network controls, distribution automation and device-level intelligence and also smart meters. The New York program recently came to the conclusion that their vision could not be fully enabled without a smart meter rollout and have now authorised this program showing that network operators need to focus on smart capabilities to meet reform agendas.

6) **Network resilience, Environmental and Customer goal trade-offs.** The jurisdictional goals we reviewed can be categorised into 3 areas -

    a. Network efficiencies and increasing resilience
    b. Sustainability or environmental targets and objectives
    c. Customer responsiveness and satisfaction – providing them with options and control

    However, there are often inherent conflicts with each of these. For example, Hawaii's experience of connecting large amounts of solar PV has led to grid destabilisation for which one answer was the establishment of a Customer Self-Serve tariff which prevents consumers from feeding into the grid and in return customers have their application for solar fast-tracked.

[2] In the Netherlands 60% of consumers who switch providers do so to take up a green energy plan.

[3] Accenture New Energy Consumer Research 2016

2.1 Why these 'Fault Lines' are appearing

Since its creation, the power grid has essentially changed very little. It has grown in size and scale but the core function of transporting electricity from centralised power generation to consumption points remain the same. However, it appears we have now reached a tipping point where the nature of the grid itself has shifted from a one-way transportation line to a multi-directional infrastructure creating and enabling new users and capabilities. Today, we find our power grid in-between these worlds. In the current model, customers have limited and confusing choices in how they manage their electricity use. The benefits of participating in existing utility programs and deploying DERs could be ambiguous or not readily available to all customers. Moreover, customer programs and tariffs do not fully consider the true costs and benefits to the grid. These blunt energy solutions fail to address specific locational and temporal grid needs, while shifting costs to non-participating electricity consumers.

Globally, the traditional definition of the electricity customer is expanding to include DER suppliers, technology providers and innovative new retail and community businesses that rely on the utility's grid or operational capabilities. Complicating the issue, these new market entrants are demanding clear standards to rapidly evolving technologies, cost certainty to connect resources, and access to the utility's data to target and support interconnection opportunities

Physical and operational grid constraints and insufficient wholesale and distribution market opportunities prevent the network operator, its customers, and third parties from maximising the potential value of DERs. As a prerequisite to high levels of DER adoptions, utility require new advanced capabilities to effectively call on DERs for customer and grid services, monitor grid conditions, automate responses, ensure performance of DERs, and maintain reliability.

Lastly, energy technology advancements and ambitious policy goals have outpaced the existing utility business model and regulatory process. Most existing utility business models promote infrastructure investment by providing a regulated rate of return on capital expenditures, and are therefore perceived as discouraging alternative options. Faced with the unprecedented rate of DER adoption, utilities and regulatory bodies are being hard-pressed to respond in a timely and whole of system manner.

To move from today's world and help the evolution of the energy ecosystem there appears to be 9 key challenges and issues to solve. These are covered below.

What are Distributed Energy Resources?

Distributed energy resources (DERs) are defined as local power generation, storage, or other technologies that affect the amount of electricity required by customers from the grid. DERs interconnect to the distribution grid, may produce and consume power, and may participate in bulk transmission and distribution grid services.

DER technologies include: rooftop solar PV, battery storage, fuel cells, electric vehicles, demand response, energy efficiency, combined heat and power. Deploying distributed energy resources in a widespread, efficient manner requires complex integration with the existing grid.

2.2 Resolving the 'Fault Lines' – the top nine issues for the industry to resolve

The review of New Market Actors and global jurisdictions and the evolution of business models has shown that there are nine key areas that require intervention to enable the progression to new energy models. These issues are remarkably consistent around the world and are in many cases already playing out here in Australia, they are:

- **New tariff/ pricing models** – proportions of fixed charges, specific charges for localised energy supply and consumption (facilitates peer-to-peer models and microgrids) and demand-based and time-of-use charging are key topics for this discussion.
- **Wholesale market interactions** – topics around how distributed generation could be traded in wholesale markets including aggregation, bidding, metering and dispatch and to allow localised trading at shorter trading intervals that can fully leverage the immediate flexibility of DER load response. DER also need to be recognised for their ability to provide ancillary services.
- **Facilitating open access to the grid** – would incentives or mandates work best for network operators to allow and encourage DER connections and provide transparency on network connections and standards for DER's? The evolution of this could see a distribution system operator provide real time price signals that enable the economic optimisation of the system as a whole.
- **Ring-fencing** – clarity will be required as to the ownership, operation, control, and accrual of revenues for DER / edge of grid revenue opportunities while also allowing parties to cooperate to realise the maximum value across the ecosystem. Outcome-based/ competitive revenue models would aid optimisation across the various roles.
- **Consumer Protections** – to allow innovative new energy supply and consumption models while always protecting consumer interests such as ready access, choice, flexibility, low prices and data protection, to name but a few.
- **Grid Automation**– having the capabilities and technologies to monitor and control grid infrastructure in near-real time as an absolute necessity to facilitate open access to the grid for any technology from any location. How to apply operational controls on third-party distributed generation and/ or storage
- **Communities and Microgrids** – peer to peer models have proven successful in Australia in other industries. Consumers will seek similar models to maximise the use of DER assets they have already invested in. In addition, microgrids that provide communities with locally generated power, largely or fully independent from the grid could change the role of the grid from the primary source of energy to just a back-up role.
- **Retail models** – New value propositions are increasingly allowing consumers to generate, store, share or purchase wholesale energy directly either as individuals or through means of aggregation. Subscription models instead of consumption based models may provide temporary alternatives but the longer term outlook will still see significantly reduced overall consumption from the grid.
- **Access to data and viewing it as a new asset** - Data is already driving how new market actors create value for consumers. Consumers in turn realise the value of the data they create themselves, but are quite willing to share this data – for a return. For Network operator, data creates the ability to enhance their role in the permitting and authorisation of distributed energy resource connections as well as their optimised scheduling, such as through Distribution Platform Optimiser models.

What is also startlingly clear is that no jurisdiction has solved all of the above challenges. But those that have made the most progress have done so through collaboration and new vision development, not only within the industry, but also with new eco-system partners and adjacent industries players.

This report would also outline how network operator business models could evolve to resolve these fault lines.

To begin resolving the 'Fault Lines' industry leaders would need to focus on 9 key issues

No jurisdiction has solved all the challenges, but those who have made the most progress have done so through collaboration and a new vision across a wider ecosystem of partners

New Energy Models

9. Enabling data sharing – increasing the access to consumption, network and technical information to allow optimisation of the grid and provide value back to consumers.

8. Enabling new retail models – allowing new models of energy sharing without involving traditional retail licensing obligations.

1. New tariff/pricing models – Especially the proportions of fixed charges and locational pricing for localised energy.

7. Communities and Microgrids – providing a clear pathway for community owned microgrids to ensure value is captured by the local community while ensuring back-up power is still supplied.

2. Wholesale market interactions – topics around how distributed generation could be traded in wholesale markets.

6. Grid Automation – having the capabilities and technologies to monitor and control third-party distributed generation and/ or storage.

3. Facilitating open access to the grid – allowing and encouraging greater DER connections and providing transparency on network connections and standards for DERs.

5. Consumer Protections – to allow innovative new energy supply and consumption models while always protecting consumer interests.

4. Ring-fencing – clarity about ownership, operation, control, and accrual of revenues for DER and edge of grid revenue opportunities.

Status Quo

3.0

Jurisdictional Summary

3.0 Jurisdictional Summary

Six jurisdictions were analysed as part of this review. Reviewing jurisdictions has the potential to provide a great deal of insight into what's possible and the efficacy of reform developments. However, direct comparison can be difficult due to the vast number of local factors that must be taken into account. The 'fault lines' described above summarised the common elements and drivers of change these jurisdictions are facing. However, in terms of their approach to reform we see two main insights -

1) Some regions have very high ambitions and long term goals. Interestingly there does not appear to be a correlation between network capability and the stated ambition, vision and goals. For example, New York REV has low grid automation and no smart meters but has very high ambition. Whereas Texas is the opposite.

2) The more liberalised markets are not in all cases the ones which are best equipped to deal with the required changes. Integrated utilities have closer access to customers and more control over pricing signals and can in some instances be more innovative. Examples include Hawaii where more direct pricing signals are helping with difficult grid conditions and some municipal owned utilities like CPS Energy in Texas which has an innovative residential solar program that directly aids grid optimisation.

In all jurisdictions we see broad trends towards open markets and mechanisms which incentivise new entrants, customer choice and integration of Distributed Energy Resources (DERs) into the grid. However, these are not necessarily matched by a coherent vision or targets nor by the level of capabilities the network operators currently have to manage their infrastructure.

	Ambition	Program
New York	●	NY REV
California	◕	AB 327, RPS
Netherlands	◕	Energy Agreement
Hawaii	◕	EPR
Australia	◔	PoC,RET
UK	◑	RIIO
Texas	◔	DREAM

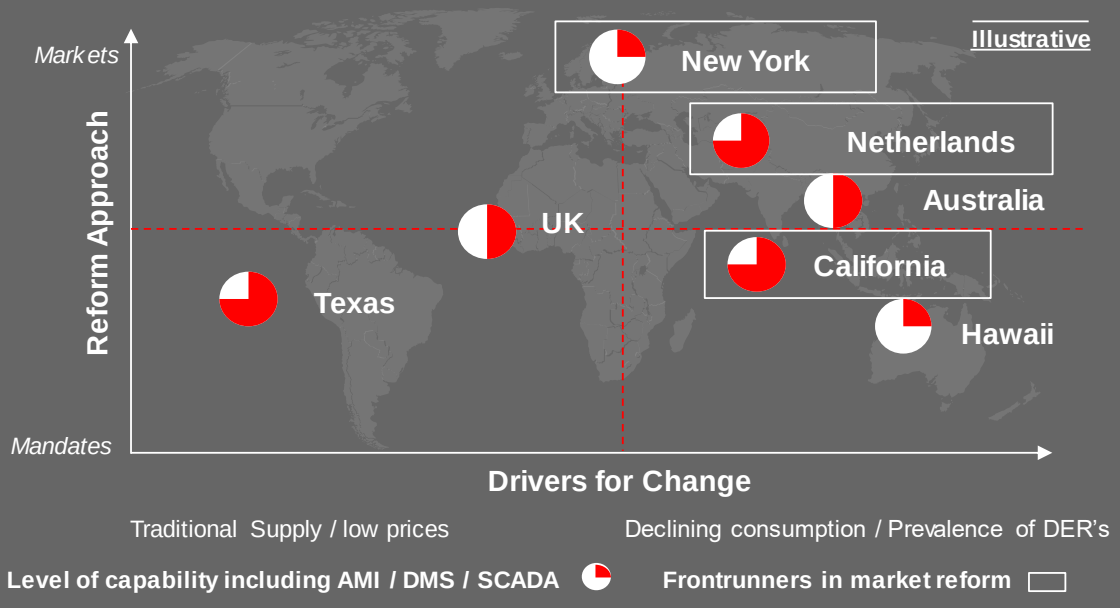
● is high

FIGURE 1 – AMBITION OF JURISDICTIONS

Some, like New York, have high ambitions for radical change but lack some enabling capabilities (e.g. smart meters). Others, like The Netherlands, have quietly established new models which open up their industry for major innovative transformation to benefit consumers. It is also clear that the electricity industry (like many others before it) is proving the adage that 'invention is the mother of necessity'. Those regions with low electricity prices, such as Texas, appear to have little appetite for change and are less concerned with integrating DER's (despite having a highly automated grid with full smart meter rollout).

The jurisdictional review also underscores the differences of the Australian market. We have relatively high prices, flat or declining demand, high penetration of rooftop solar PV and a highly competitive retail sector. These drivers for change, while not individually unique around the world, together show that our market would possibly benefit from a long term vision for reform.

Jurisdictions Comparison



	APAC	AMERICA				EUROPE	
	Australia	NY	CA	TX	HI	UK	NL
Ambition	Low	High	High	Low	High	Medium	High
Drivers	High	Medium	High	Low	High	Medium	Medium
Motivation	Medium	High	High	Low	High	Medium	High
Capability	Medium	Low	High	High	Low	Medium	High

Interestingly, some jurisdictions with less sophisticated networks, lower energy prices and less developed market structures are the frontrunners in energy market reform.

3.1 Jurisdictional Summaries and Key Findings

Summarised below are the market descriptors of the six jurisdictions covered along with the key insights and lessons that can be learnt from each.

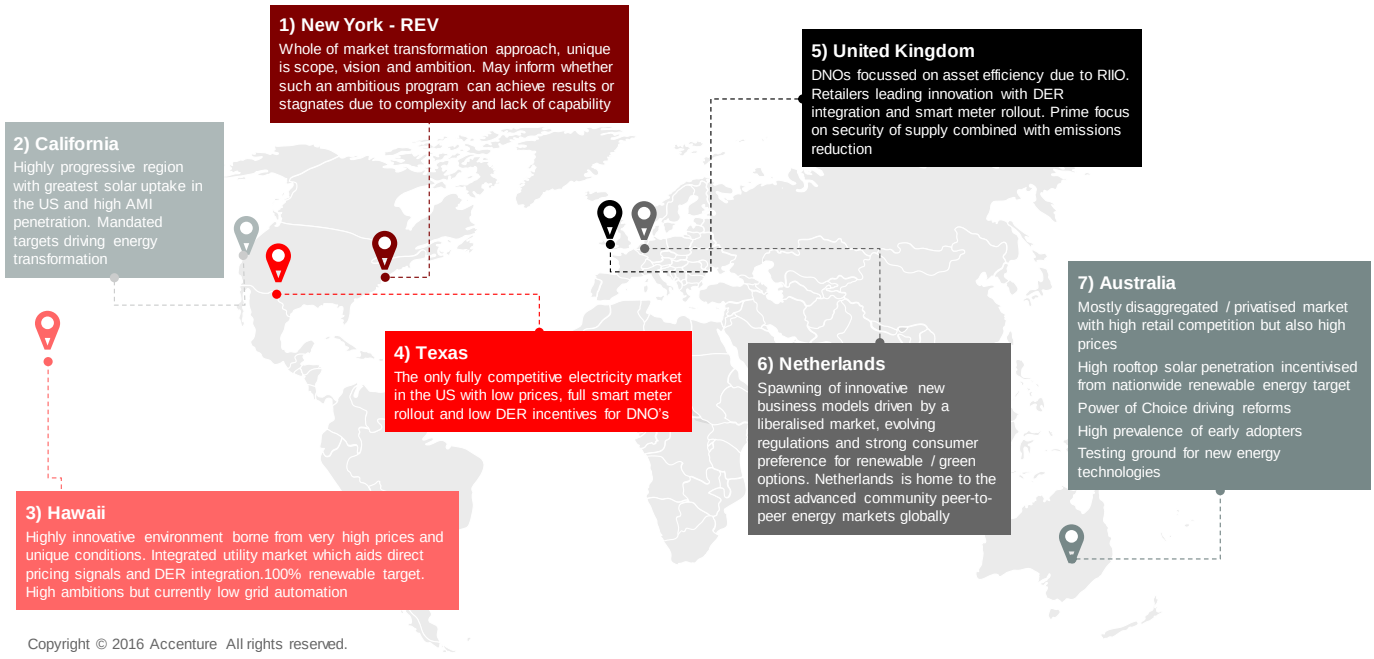
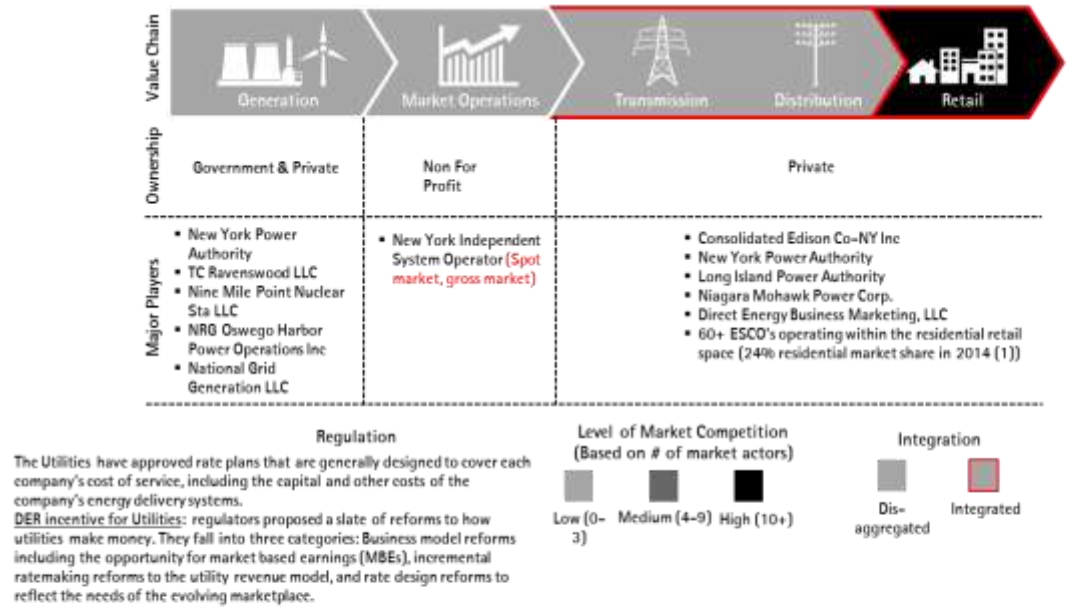


FIGURE 2 - JURISDICTIONAL SUMMARY

New York

- New York's 'Reforming the Energy Vision' (REV) program is a whole of system approach to transforming the electricity market in New York State. A cornerstone of the program is to augment the distributor role to encompass a platform provider and market operator – requiring a step change in distributor capabilities to become a market maker, facilitator of energy transactions and performance and rule oversight.
- Other elements include open data access for all market participants, supporting technology demonstration projects, undertaking ratemaking reform to incentivise participation in the new platform marketplace Two new types of revenue opportunities have already been defined — platform-service revenues (PSRs) and Earning Adjustment Mechanisms (EAMs) — that will help utilities move away from cost-of-service regulation
- The future grid is anticipated to be a data rich environment, enabling decentralised generation with bi-directional flows. Efficient investment is encouraged through a mix of utility and third party investment in the grid. An assessment framework takes into consideration the impact of investments on rates, society and the utility.
- New York REV seeks to encourage competition and innovation at the edge of the grid via regulatory reform – improving the economics of third-party capital investment in DERs and mandating the integration of DERs into the existing grid (via Distributed System Implementation Plans).
- On June 30 2016, New York utilities filed their Distribution Service Implementation Plans — which outlined how they will operate as DSP providers.



	Customers					Technology/Renewable Uptake				Market Structure	
	Population (Millions)	Switching Rate (%)	Demand Trend	Average Electricity Price (AUD c/kwh)	T&D on Customer Bill (%)	AMI (%)	Solar (% of total MW)	Wind (% of total MW)	Renewable target (%) – change from volume	Renewable target (%) – change from volume	Regulatory Incentive Mechanism
New York	19.7	10	Down	23.6	46	0.16	1 (1% utility scale)	2.8	50% by 2030	Gross	Rate Base

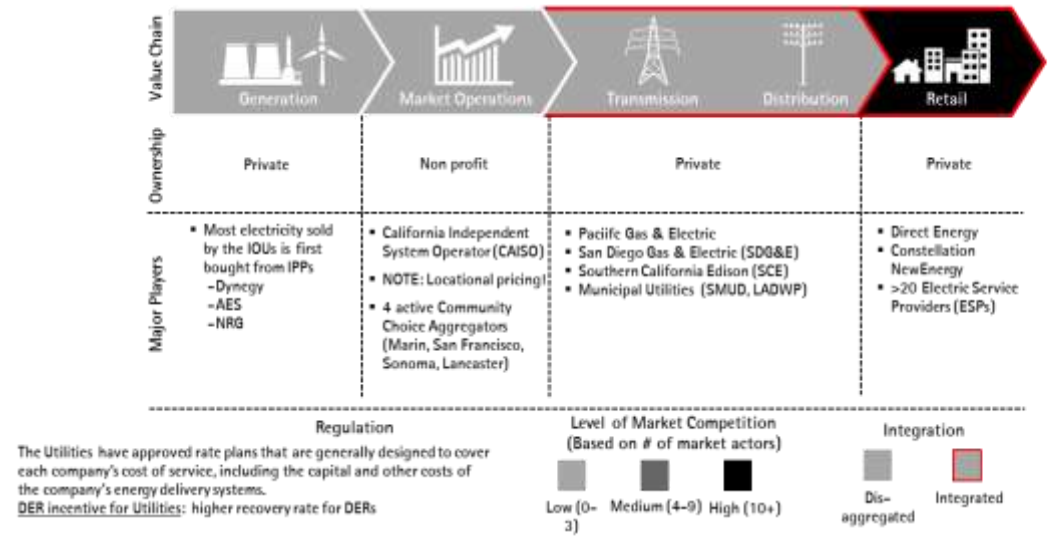
FIGURE 3 – NEW YORK MARKET STRUCTURE

Insights from New York

- **Large ambitious reform programs require significant stakeholder involvement** - The size and complexity of the New York REV approach has increased the risk of significant delays and/or project failure due to an inability of the regulatory bodies to sustain the momentum and address stakeholder concerns through a very large consultation process.
- **Reforms from low capability levels can be costly and diminish medium term benefits.** Large CAPEX/OPEX investment would be required from both utilities and third parties to modernise the grid to support the take up of DER's, as well as grid improvement initiatives such as a smart meter rollout. This would impact customer bills (for example, Con Edison recently had a rate case approved to push residential prices up by 5% to pay for smart meter rollout). It is also yet to be determined whether the financial incentives are attractive enough to justify third parties shouldering the capital risk early in the program.
- **A vibrant and competitive retail sector aids third party investment and innovation.** A cornerstone of New York REV is the need for strong retail competition. Without strong existing retail competition, the journey towards market animation is proving challenging for New York REV. This contrasts with the Australian market landscape that has benefited from many years of full retail contestability and relatively active consumer participation.
- **Rate making reform with new revenue streams aligns network operators to new outcomes**. Rate making reform is also a critical lever to decouple consumption from revenue and help confirm that network operators are incentivised to consider DER solutions as an alternative to traditional grid and generation investments. They would require new and replacement revenue streams to help confirm alignment with their broader business plans. The distributor role can be evolved to support more advanced management of the future grid, however the burden of investing in new capabilities and technologies by the incumbents needs to be recognised and addressed through ratemaking reform.

California

- Energy transformation in California has taken a two-step approach: mandatory distributed resource plans (DRP) to be submitted by all investor owned utilities, outlining their approach to optimum deployment of distribution resources; and 'renewable portfolio standards' that stipulate distributed resource targets for retailers and a 'plug and play' approach to DER integration.
- California Public Utilities Commission (CPUC), as part of AB 327, has mandated long term plans for all IOUs outlining a holistic approach to optimum deployment of distribution resources including; benefits, costs, tariff structures, incentives and barriers/mitigations. These would need to show how all investor owned utilities (IOU's) will become 'network platforms'. The three overarching practical exercises requested of each utility by the CPUC are:
    - Identify the full value of DERs to the utility.
    - Specify where on the utility's distribution system DERs best provide value.
    - Propose demonstration projects to prove their conclusion about value and location.
- California has similar market conditions to Australia with high electricity prices and strong solar PV uptake levels, however it has a regulated retail market with most customer served by 3 utilities. It also has high penetration of smart meters and data-sharing tools such as Green Button, Green Button Connect.
- California accounts for 50% of distributed solar across the US with 50% growth over the past four years and over 80% of total energy storage. The Net Metering program is being expanded and is significantly driving rooftop solar PV adoption.
- The PUC has set centrally mandated targets (50% renewable mix by 2030) which have proved highly effective. Utilities are accountable for defining innovative solutions to reach targets. Distributed resource targets have been consistently outperformed and subsequently raised.
- California has a hybrid system of regulated retail markets and deregulated wholesale markets with a majority of customers being served by three large investor-owned utilities.
- Their proposed DER incentive scheme will allow utilities to earn higher ROICs for DERs which is designed to actively encourage less costly DER alternatives to traditional infrastructure. A pilot program has been introduced where utilities are allowed a ROE at the upper limit of the "r – k" range, in which "r" is the allowed regulatory rate of return on equity and "k" is the utility's cost of equity.
- A recent FERC ruling has allowed DERs managed by DERPs (distributed energy resource providers) with load of 500 kW to be aggregated and dispatched into the wholesale market making California the first state in the US to enable this sort of market participation.



	Customers					Technology/Renewable Uptake				Market Structure	
	Population (Millions)	Switching Rate (%)	Demand Trend	Average Electricity Price (AUD c /kwh)	T&D on Customer Bill (%)	AMI (%)	Solar (MW)	Wind (MW)	Renewable target (%) – change from volume	Wholesale Market (Net / Gross)	Regulatory Incentive Mechanism
California	39.1	10	Flat	23	40	82	13 (69% utility scale)	6.2	50% by 2030	Gross	Rate Base

FIGURE 4 – CALIFORNIA MARKET STRUCTURE

Insights from California

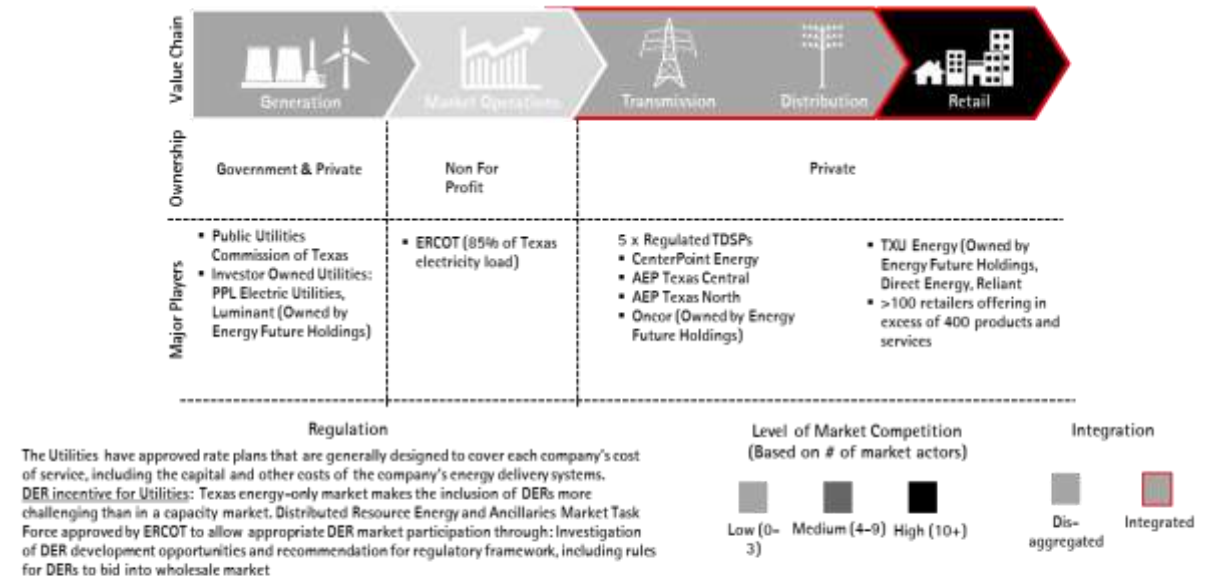
- **Regulatory mandates mixed with customer trends can stimulate a start-up culture.** A number of US energy start-ups have benefited from California's market transformation and strong appetite for DER (e.g. Solarcity, Stem & Sunverge). They have been able to test products with the early adopter consumer segment in California and establish growth while waiting for other less mature states to catch up.
- **Focussing on DER interconnection standards can help facilitate DER uptake**. California's AB 327 requires a 'plug and play' approach to connecting distributed energy resources to the grid has proved an effective model in California and stimulated investment.
- **Longer term DER roadmaps may produce more cohesion than multi-part proceedings**. California's approach to DER incentives, integration and standards has been criticised by the California Energy Storage Association (CESA), which argues that what is lacking is a "roadmap" that shows how the various proposal pending at the PUC would work in concert. Without a roadmap, the organisation says, "there is a risk that the DRP pilots will result in one-off exercises.
- **Wholesale market participation can open up new value stream for DERs and enhance grid reliability.** DER uptake could be facilitated by wholesale market access by opening up new revenue opportunities for aggregators. System operators would be under increased pressure to allow greater resource participation to enhance situational awareness and validate system reliability. California's market operator recently obtained permission for DER participation in its wholesale market.
- **Taking a measured approach to determining future path and early collaboration between regulator/utilities.** The regulator included the utilities early on in the discussions on how DERs could impact the grid and the current regulatory model, seeking utility input on where in their grids problems would arise as well as estimates on the potential costs – utilities were given 1 year to prepare filings. The regulators should have also encouraged non-

utilities to submit recommendations, like SolarCity, who shortly after the utilities filed their plans released a white paper describing how the majority of the utilities' financial needs were not focused on DER, but rather on traditional infrastructure replacement.

- **Incorporating mandates that align to DER adoption and customer behaviour.** While California has been a leader in utility mandates for renewable generation and energy storage (both utility-sided only) they have also required utilities to provide community solar programs as well as modify the rate structures and introduce time-of-use rates to encourage customer behavioural change. This two-pronged regulatory approach of pushing utilities to change their behaviour as well as providing end-users with the opportunities to embrace DERs and reduce their loads creates a well-rounded approach to address environmental issues.
- **Provide utilities with the opportunities previously denied to them.** California utilities, until very recently, were not permitted to be involved with the electric vehicle market but through a series of hearings the regulator allowed plans to be filed by utilities to build EV infrastructure and to determine what part they would seek to be incorporated into the ratebase vs. contracted with third parties. The flexibility to seek new revenue streams as advanced technology comes along could provide utilities with the incentives to grow revenues in the face of declining demand from the traditional business.

Texas

- The Electric Reliability Council of Texas (ERCOT) takes a market guidance rather than a strict mandate-led approach to integrating distributed generation – leaving utilities to determine the best course of action.
- Texas has some of the lowest residential electricity prices in the US and a significant and growing portfolio of renewables, including wind, biodiesel and solar. The sector is dominated by wind generation, producing more than any other US state. It also has a very modern grid and a full smart meter rollout.
- ERCOT has the most competitive retail environment in the country, and is therefore an attractive market for third-party aggregators to provide new services to customers of all sectors. Texas is driven by customer-centric market mechanisms designed to empower customer choice. The highly competitive nature of the Retail Electricity Providers (REPs) fosters innovation to capture and retain market share.
- A task force setup to investigate DERs - Distributed Resource Energy & Ancillaries Market (DREAM) was recently dismantled signalling an end to the high-level examination of ideas and concepts for bringing distributed resource value to the wholesale markets. ERCOT is now diving into the technical specifications and is ready for nodal protocol revision requests from various market participants.
- ERCOT is an 'Energy Only' market i.e. utilities are paid only for the energy they generate. This differs to nearly all other states in the US that follow a capacity model where utilities are paid for maintaining reserve capacity — these costs are often absorbed by customers. Not surprisingly this has stymied the move towards higher rates of DER integration into the grid. Key issues include the lack of value placed on capacity and the regulatory rules preventing Transmission and Distribution operators from capturing the full value stack from grid level storage (e.g. activities defined as generation or competitive).
- Traditionally low reserve margins offer limited incentives for capacity building investments such as storage. This lack of capacity has undermined the state's ability to guarantee long term reliability and left Texas vulnerable to natural disasters / one-off peak events.
- There are currently two mechanisms for the connection of DERs to the wholesale market – either Load Resource (>100kW) or Aggregated Load Resource i.e. a mix of different residential and commercial loads to be aggregated and registered as a single resource, primarily for demand response into the real-time energy market.



	Customers					Technology/Renewable Uptake				Market Structure	
	Population (Millions)	Switching Rate (%)	Demand Trend	Average Electricity Price (AUD c /kwh)	T&D on Customer Bill (%)	AMI (%)	Solar (% of total MW)	Wind (% of total MW)	Renewable target (%) – change from volume	Wholesale Market (Net / Gross)	Regulatory Incentive Mechanism
Texas (ERCOT)	22	40 (4)	Up	11(3)	15 (5)	>90 (26)	<1 (60% utility scale) (6)	18 (7)	10,000MW capacity by 2025 (already met)	Gross	Capital Recover

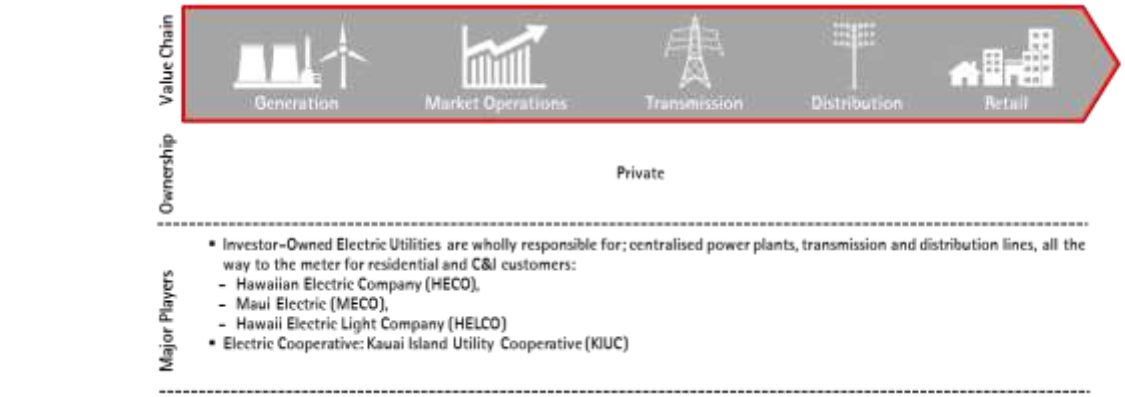
FIGURE 5 – TEXAS MARKET STRUCTURE

Insights from Texas

- **Renewables and DERs may face significant hurdles without regulatory involvement -** A lack of regulatory mandates and political interest in renewables from the conservative legislative body and regulatory agencies in Texas have created an environment of least-cost generation which does not encourage renewables, with the exception of wind which is low-cost in certain regions. With a fully deregulated retail market, retailers are not incentivised to build renewables and consumers are generally not interested in paying a premium for green energy.
- **A modern grid and high prevalence of smart meters is necessary but not sufficient to encourage DER adoption**. Texas has one of the most modern grids in the US including highest AMI penetration. A vibrant retail sector has encouraged innovative usage of interval consumption data usage. All utilities (retail and distribution) have adopted strong customer focussed strategies to encourage customer centricity and improve the customer experience. However, consumer demand for DERs is low.
- **Energy only markets reduce incentives for DER grid integration**. Texas is the only major wholesale market in the US without a forward capacity market mechanism. This has proved to be a disincentive for major DER investment especially in storage.

Hawaii

- The Hawaiian Islands' electricity grids are not interconnected, utilities are integrated and they depend heavily on imported fuel oil with more than 90% of electricity coming from this source. Consequently, Hawaii has the highest electricity tariffs in the US.
- The Public Utility Commission (PUC) openly stated that HECO the sole utility, failed to act on new strategies and business model transformation. As a result, the PUC made recommendations to HECO regarding generation, transmission/distribution-related strategies and proposed regulatory mechanisms to drive change. These included:
    - Requirements for HECO to become a facilitator, integrator and operator of a grid with high penetration of utility-scale renewables as well as distributed energy resources.
    - Develop the ability to process, synthesise and use information from network/consumption data for future success.
    - Incentives to increase renewables and accelerate retirement of fossil generation, and unbundling of ancillary services to provide price signals for alternative sources of supply.
    - New rate structures, unbundling rates to better fit customer preferences for varying levels of service, introduction of dynamic pricing structures (such as TOU) and incentives to reduce the curtailment of renewables in the state.
- Has taken a three-step approach to transformation: start up investment programs (Excelerator), regulatory mandated reform (tariff structures, subsidies etc.) and business model research investment. This program has been highly successful with over 14 companies successfully launched and generating revenue including companies like STEM the battery analytics company.
- Centrally mandated pressure to increase DER sources in the grid and improve environmental impact is underscored by a 100% renewable target by 2045.
- Hawaii has one of the most innovative energy environments globally as a result of start-up investment funding, extremely high solar penetration (1 in every 3 premises) and strong customer appetite.
- Some subsidy programs and initiatives designed to encourage DER penetration have underperformed due to complicated processes and paper-based application channels.
- Hawaii has ended their Solar Net Metering program and adopted 2 new tariffs a) Customer Self-supply (CSS) tariffs which does not compensate consumers for exported energy b) Grid supply option which provides a reduced feed-in tariff. The CSS tariffs provide expedited approvals thereby giving utilities more control over siting.



Regulation

The Utilities have approved rate plans that are generally designed to cover each company's cost of service, including the capital and other costs of the company's energy delivery systems.
DER incentive for Utilities: The PUC recommended that the Hawaiian Energy Corporation focus on becoming an efficient integrator of distributed resources and operational systems on the distribution system – strongly leveraging renewables.

Level of Market Competition (Based on # of market actors)

Low (0–3) | Medium (4–9) | High (10+)

Integration

Dis-aggregated | Integrated

	Customers					Technology/Renewable Uptake				Market Structure	
	Population (Millions)	Switching Rate (%)	Demand Trend	Average Electricity Price (AUD c /kwh)	T&D on Customer Bill (%)	AMI (%)	Solar (% of total MW)	Wind (% of total MW)	Renewable target (%) – change from volume	Wholesale Market (Net / Gross)	Regulatory Incentive Mechanism
Hawaii	1.4	0	-	35.6	30	6	20 (2% utility scale)	6.1	100% by 2045	Net	Rate Base

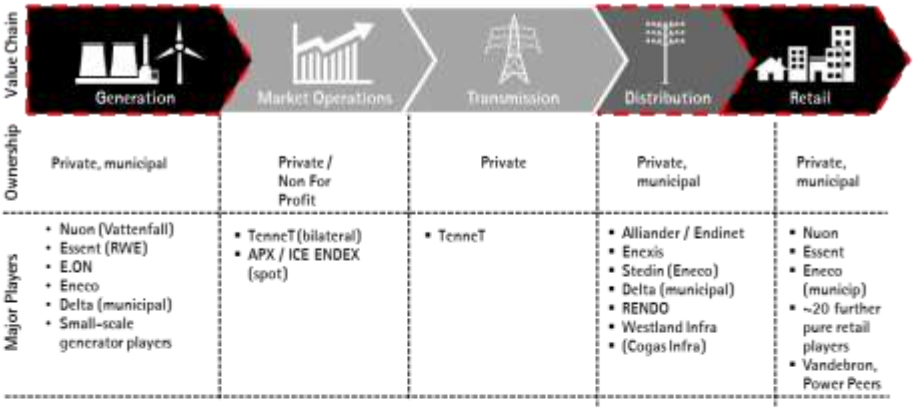
FIGURE 6 – HAWAII MARKET STRUCTURE

Insights from Hawaii

- **A fully integrated market with lack of retail competition can require strong regulatory intervention**. While Hawaiian utilities have been able to strongly control DER siting and pricing signals this has required strong regulator intervention to prevent a stifling of consumer appetite for DERs.
- **Aggressive renewable targets stimulate change**. Hawaii's 100% renewable target provides strong policy alignment and incentives driving innovation and DER adoption.
- **Start-up investment funding programs can produce innovative new business models**. Hawaii's reliance on ecosystem transformation being generated by start-ups has proved to be an extremely effective mechanism for securing change.

Netherlands

- The Netherlands is following a highly visionary energy transformation program called 'Energy Agreement' which consists of 12 'pillars' with corresponding targets to increase the share of renewables, expansion of decentralised generation, electrification of transport, and higher energy efficiency while rolling out a smart distribution grid to facilitate the transition by 2020 and beyond.
- The Netherlands is home to two community DER platform providers: PowerPeers and Vandebron. These offerings allow consumers and prosumers to individually share energy amongst each other. Key enablers for these models has been regulatory permission to act as a retailer, the structure of the Dutch wholesale market and a simple flat-fee pricing model.
- The Netherlands is dependent on electricity imports and its own portfolio is fossil-fuel dominated. 11% of national generation comes from renewable sources. However, up to 60% of Dutch households choose a green tariff when switching supplier.
- Top DNO innovations have been driven by open partnerships with technology/industrial/academic partners, and supported by local municipalities (Stedin with GE, Nissan and the city of Utrecht, Alliander with Cofely and the Technical University of Eindhoven, Enexis with Essent and KEMA).



	Customers					Technology/Renewable Uptake				Market Structure	
	Population (Millions)	Switching Rate (%)	Demand trend	Average Electricity Price (AUD c /kwh)	T&D on Customer Bill (%)	AMI (%)	Solar (% of total installed MW)	Wind (% of total installed MW)	Renewable target (%) – change from volume	Wholesale Market (Net / Gross)	Regulatory Incentive Mechanism
NL	16.8	10 – 15a	Down**	27.5b	44c	15 – 20 d	4%, thereof <5 % utility-scale	11%, thereof >90 % onshore f	14% of total energy consumption in TWh by 2020 (vs 5.5% today)h	Net g	Incentiveb ased

FIGURE 7 – NETHERLANDS MARKET STRUCTURE

Insights from the Netherlands

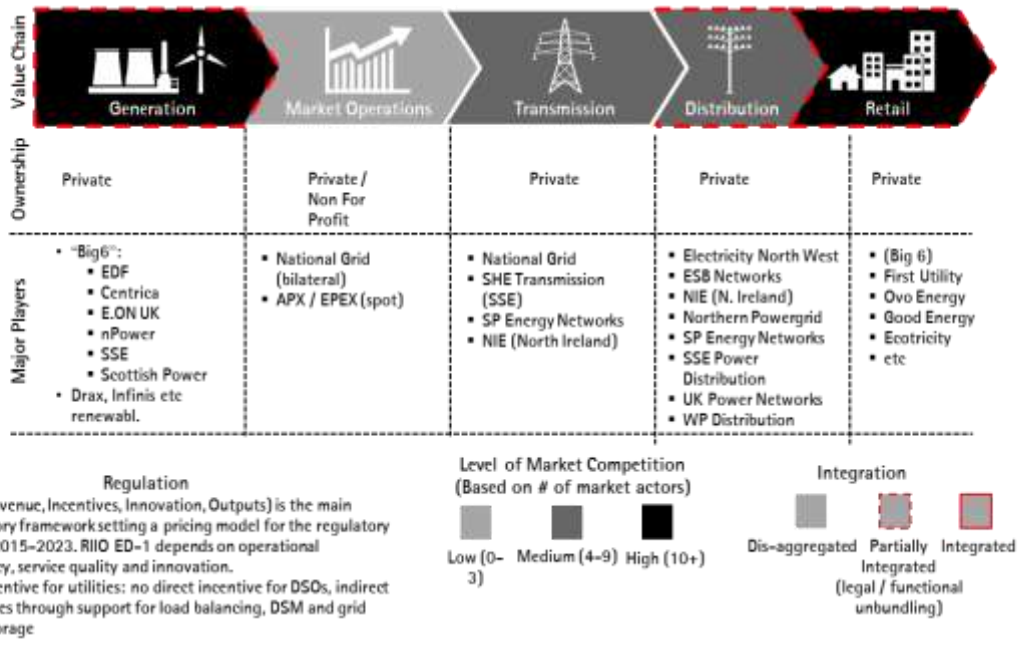
- **Combined Energy, climate and economic goals align many players.** The Netherlands 'Energy Agreement' has provided a longer term common understanding and set of targets for the short and medium term. Its aim of engendering trust and reduction of investment uncertainty has allowed energy and climate objectives to be

combined with goals in industry competitiveness, employment, and exports. Australia could learn from the success of this agreement and the overall vision and of combining these energy, climate and economic goals into a cohesive and well understood agreement.

- **Public ownership can aid in alignment.** The Netherlands has perhaps benefited from the public ownership of the distribution and transmission sectors allowing top level public policy to be implemented by government owned corporations.
- **Government aided 'experimental room' and innovation is valuable.** The Netherlands, like many jurisdictions is struggling to find the balance between facilitating a competitive market approach and stimulating nascent industries and new technologies with incentives. They have created 'experimental room' for both competitive businesses and regulated utilities to pilot new ideas and concepts. For example, the 'emerging business areas' of Alliander were pushing the boundaries of ring fencing rules. However, the results so far have put the Netherlands ahead of many others with new businesses and innovative business models.

United Kingdom

- The 12 UK DNOs are regulated by Ofgem, and subject to a new regulatory framework RIIO (Revenue = Incentives, Innovation and Outcomes) which is the cornerstone for energy transformation in the UK. RIIO indirectly supports DER integration by remunerating cost-efficient investment in the network in general and making 'time to connect' and associated customer engagement a regulatory incentive. But it incentivises DNOs to focus on cost efficiency and service outcomes.
- Security of supply is a top priority and although the UK has some of the lowest residential prices in Europe, there are significant attempts to increase competition and reduce energy prices.
- The UK is in the process of a nationwide rollout of smart meters which includes an independent Data and Communications Company (DCC) to manage smart meter data. DNOs have access to aggregated power quality data in order to manage the grid load appropriately. They are able therefore to pursue platform business models in partnership with technology vendors.
- DNOs have started to see the potential for business model transformation and are profiting from partnerships with grid technology companies and the TSO in load balancing, commercial DSM, grid analytics and grid scale storage.



	Customers					Technology/Renewable Uptake				Market Structure	
	Population (Millions)	Switching Rate (%)	Demand trend	Average Electricity Price (AUD c /kwh)	T&D on Customer Bill (%)	AMI (%)	Solar (% of total MW)	Wind (% of total MW)	Renewable target (%) – change from volume	Wholesale Market (Net / Gross)	Regulatory Incentive Mechanism
UK	64.6	10 15a	Down	28.5b	24c	4.9d	10%, thereof 58% utility-scalee	14%, thereof 64% onshoref	30% of electricity consumption in TWh by 2020 (vs 18% today) h	Net [9]	RIIO (RAB)

FIGURE 8 – UK MARKET STRUCTURE

Insights from the United Kingdom

- **Innovation and customer satisfaction Incentives can drive reform.** The UK's RIIO framework provides strong incentives for DNOs to stay relevant with customers as it includes broad measures of customer satisfaction. These

incentives seem to facilitate strong alignment between customers and third party requirements for DER connections and other general experiences. It is hoped that this framework will ensure alignment even though DNOs have very little direct customer contact.

- **Access to Smart Meter Data is required.** As DNOs are not responsible for the smart meter rollout or communications infrastructure and data they can still access power quality data through the independent Data and Communications Company (DCC) in order to manage the grid load appropriately. They are able therefore to pursue platform business models in partnership with technology vendors with more ability and confidence.
- **Importance of strong retail sector.** Much of the intelligent demand management innovation is driven by the liberalised retail energy market. These include demand aggregators and peer-to-peer trading platforms that have greater freedom to explore the right combination of investment and end customer pricing.
- **Confirm capacity buffers on route to more distributed energy.** The UK is incentivising efforts to build a sufficient capacity buffer (low-carbon baseload capacity, demand reduction, load balancing) to guarantee national supply security during the transition to more volatile sources of energy. These capacity market mechanisms would help validate security of supply by incentivising sufficient baseload capacity with potential for storage to access this market.
- **Encourage partnerships for DNOs to build new business models.** The UK's emerging market for demand reduction, load control and storage is creating opportunities for DNOs through partnerships to create new roles and earnings in load balancing and demand reduction.
- **Access to direct Innovation Funding is important.** The UK's Low Carbon Networks Fund and the Innovation Funding Incentive have enabled some DNOs to set up trials and pilots to manage DERs on their systems.

Having examined each jurisdiction in turn it is clear that there is much to be learned as we identify how best to reshape the Australian context. The 'fault lines' are emerging in our Australian context and would have a dramatic effect on the future power grid. The decisions to be made now would depend on speed and pace of those 'fault lines' and a conscious decision for the industry to come together to define a way forward. The underlying drivers and motivation for reform in the above jurisdictions are obvious. There is a direct and obvious link between current need, future perceived need and the ambitions of each jurisdiction.

3.2 Drivers, Motivation, Capability & Ambition

Some jurisdictions have a great need to reform and are more at risk of disruption than others. Australia, with relatively high prices and a high prevalence of rooftop solar is a prime example of such a case. Looking around the world we see other such examples but their drivers, motivations, capabilities and ambitions are very different. Network operators are motivated by regulatory changes but driven by local factors. Their ability to carry out their plans are tempered by capabilities especially the sophistication and resilience of their networks.

Drivers – the current pain points and the underlying need for reform

Motivation – the current regulatory or other incentives to change

Capabilities - the current enablers to achieve the declared goals including technology and market structure

Ambition – the current overall program and vision aligning industry participants on the reform journey

	APAC	AMERICA				EUROPE	
	Australia	NY	CA	TX	HI	UK	NL
Ambition	Low	High	High	Low	High	Medium	High
Drivers	High	Medium	High	Low	High	Medium	Medium
Motivation	Medium	High	High	Low	High	Medium	High
Capability	Medium	Low	High	High	Low	Medium	High

Ambition	Drivers	Motivations	Capability
Major reform program	Electricity prices	DER incentives for consumers	Intelligent network controls, smart meters, demand side management
Vision	Renewable targets	DER incentives for network operators	Market Structure, adaptability and flexibility
	Demand trends	DER ownership and usage restrictions	
	Security of supply issues	Prevalence of new innovations and new market actors	
	Consumer trends (adoption of DERs)		

Key Points

- California, UK and Netherlands are more aligned than others suggesting they have a well-defined and achievable set of goals are heading in the right direction at the right pace.
- New York, Australia and Texas appear to be less aligned suggesting the need for action in one or more areas.
- Ambition is not always correlated to underlying capability. This could be due to a lag in reform or due to very high expectations of policy makers. New York, Texas and Australia stand-out in this regard.

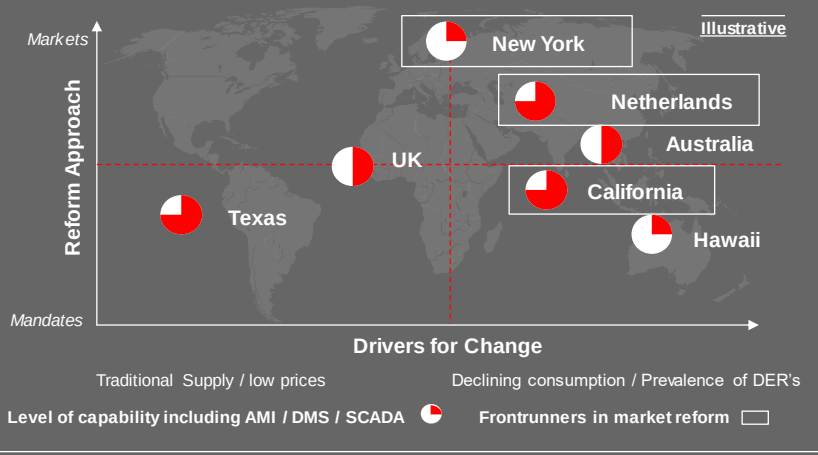


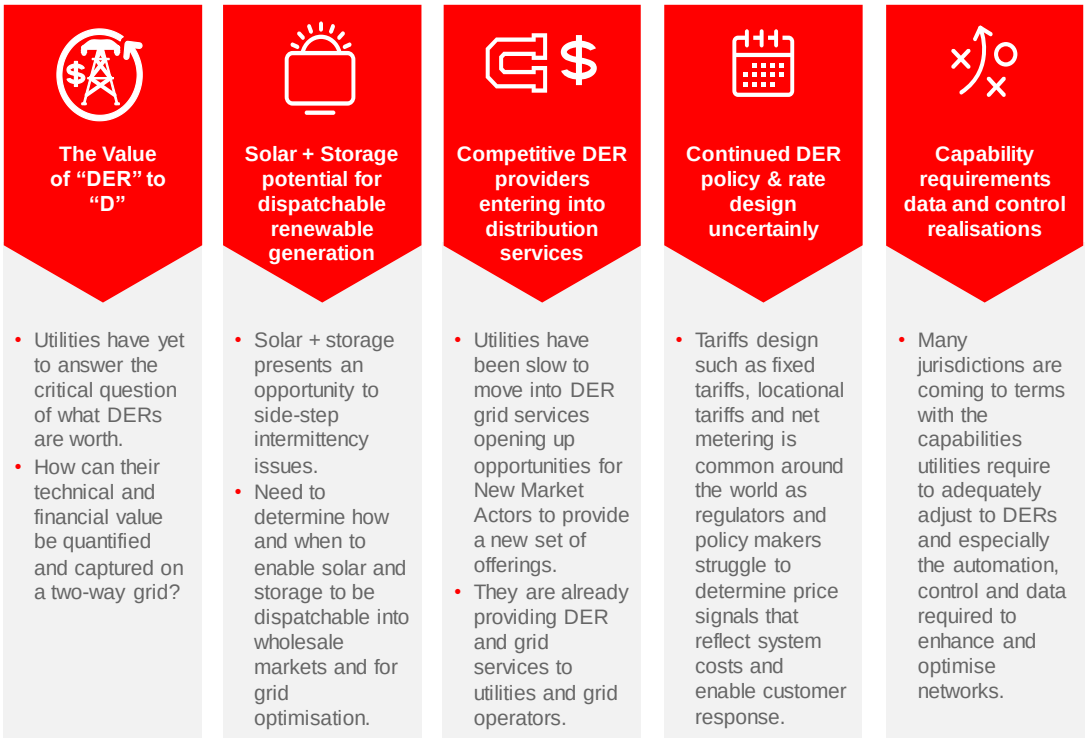
FIGURE 9 – JURISDICTION COMPARISON

Jurisdiction	Driver	Motivation
New York	New York is driven by traditional (low cost, grid resilience) as well as disruptive (renewable energy, DER integration) goals. This makes it a very ambitious agenda as grid resilience is usually seen as a prerequisite to enabling more disruptive developments. In NY this ambition is also in stark contrast to the currently low enablement via smart devices, grid visibility and control.	The NY REV agenda aims to achieve these ambitious targets mainly through a heavily market-driven approach: e.g. the regulatory changes aim to encourage private investment into the grid by highlighting constraint areas. Furthermore, NY utilises state-owned entities to lead innovation and trials rather than mandating only the current regulated utilities.
The Netherlands	The Netherlands seeks to respond to existing challenges with DER penetration (wind, solar) and also actively wants to further encourage DER uptake and increase the percentage of renewable generation within the country rather than trading green certificates with other regions in Europe, mainly the Nordic countries. There is a moderate level of grid visibility and control. A mandated and DNO-led smart meter roll-out is in its early stages, targeting 80% smart meter penetration by 2020.	The Dutch regulator, AMC, applies a mainly market-driven approach. The mandated smart meter roll out aside, the regulator encourages companies to exploit the liberalised market structure to drive the desired changes. Powerpeers, one of the NMAs profiled in this report, and Vandebron, for example, are two peer-to-peer renewable energy platforms that have been granted retailer status by the AMC so that they can contribute to a consumer-led increase in domestic renewable generation capacity.
California	Californian reforms have and continue to drive DER and renewable uptake across the state. Increasing the penetration of DER within California also alleviates its reliance on power imports and enhances the grid's resilience. This demonstrates again that different drivers can be pursued at the same time, creating synergies rather than conflicts. California is fully smart meter enabled and has a high level of grid automation.	To achieve the regulatory outcomes, California adopts a hybrid market and mandate approach, aiming to balance private sector innovation (products, services –see the example of STEM, one of the NMAs profiled in this report) while also driving the integrated, incumbent utilities to increase renewable and DER penetration as well as setting up smart gird controls.
Hawaii	Hawaii, with its unique grid situation (fully isolated, no interconnection between islands, fully reliant on imported fuel oils) faces unique challenges. Increasing the penetration of renewable energy sources (100% target by 2045) is the key driver, as is the goal to integrate residential rooftop solar PV into the electricity ecosystem. Hawaii both encourages new DER and renewable deployments, and seeks to maximise the contribution of existing systems.	Hawaii utilises a heavily mandate-driven approach. It requires the state-owned integrated utilities to take action, specifically to integrate existing DER in response to consumers with solar PV installed demanding benefits from the utilities for energy they could feed in but are prohibited from doing so as this could jeopardise grid stability. However, this mandated approach is complemented by seed funding for innovation funds for start-up companies (e.g. Stem).
UK	The UK aims to enable better DER integration (grid-scale solar and wind) in response to EU directives and to combat high electricity prices for consumers. One of Ofgem's declared goals is to secure sufficient base-load during the transition to a renewable	Ofgem is taking a regulatory incentive driven transformation through the RIIO framework that encourages and controls DER integration. This is complemented by a retailer-led smart meter roll-out.

	generation fleet. With limited network automation and no widespread adoption of smart metering, the actual implementation of this is likely to face challenges and require time.	
Texas	Texas, on the other hand, is driven by more traditional outcomes such as network resilience (TX is an islanded market for electricity) and continued low electricity prices for consumers. However, there appear to be no high priorities for Texas to change the current highly liberalised and competitive environment that has delivered most of the goals NY is still aiming for, namely low prices, renewable energy (grid scale wind, solar) and adequate resilience. Continued integration of renewables into the grid is the main challenge for Texas. This could require investment in new or upgraded transmission rather than distribution capacity. Texas is 100% smart meter enabled	Market forces have already created beneficial outcomes for consumers (low prices, choice, and innovation). A more mandate-driven approach is now being taken to steer (transmission) infrastructure investment.

3.3 Five Global DER Challenges

Around the world distributed energy resources are creating challenges and disrupting the energy industry as it struggles to adapt to more decentralised and in many cases consumer owned generation capability. We are seeing all jurisdictions are in some way focussed on 5 main issues as they transition to a model which integrates and co-exists with Distributed Energy Resources.



1) **Value of DER to D:** Utilities have yet to answer the critical question of what DERs are worth. How can their technical and financial value be quantified on a two-way grid? Much of the focus in the DER space is on the value they bring to customers as well as safe integration / interconnection of those DERS with the grid. However, utilities and regulators are thinking about the potential value of DER to the distribution system and they are working hard to refine methodologies for evaluating when and where DER installations might provide net benefits to the electric system and the compensation models to encourage take-up.

2) **Solar + Storage**: The U.S. installed over 7GW of PV in 2015, the largest annual total ever and 16% above 2014. For the first time ever, solar beat out natural gas capacity additions, with solar supplying 30% of all new electric generating capacity brought on-line in the U.S. in 2015. The issues arising from solar intermittency persist, disrupting the conventional methods of planning and daily grid operations. Storage + solar capabilities present an opportunity to side-step intermittency issues altogether. Some jurisdictions need to determine how and when to enable solar and storage to be dispatchable into their wholesale markets.

3) **Competitive Distribution Services**: Utilities have been slow to move into DER grid services opening up opportunities for others such as Solar City – the dominant residential solar installer in the US - which has a new set of offerings providing DER and grid services to utilities and grid operators.

4) **DER and rate design policy:** The whole topic of tariffication such as fixed tariffs, locational tariffs and net metering is common around the world as regulators and policy makers struggle to determine what are the right price signals that reflect system costs and enable customer response – many jurisdictions are working on an expanded rate design toolkit.

5) **Capability requirements:** Many jurisdictions are coming to terms with the capabilities utilities require to adequately adjust to DERs and especially the automation, control and data required to enhance and optimise networks. While on some levels this would appear obvious – jurisdictions like NY have only recently determined that they actually need smart meters to truly meet their REV goals.

New responsibilities, well beyond the optimisation for an individual participant in the electricity value chain, would be required so that the benefits of DERs can be optimised for the system as a whole. This report discusses the role of a Distribution Network Operator (DNO) to fulfil this responsibility.

4.0

New Market Actors

4.0 New Market Actors – co-creating value and disrupting the industry

In creating new value for customers, New Market Actors (NMAs) are already causing disruption to the industry today. As their customer numbers grow, new entrants would increasingly encroach on the footprint and "natural space' of the distribution businesses, disrupting demand and opening up competing relationships with customers. In some instances, value is created just for customers, providing new ways for retailers to win more accounts and lock them in. In other models, value could be 'co-created' by not only adding value directly to consumers but also but also by optimising the grid by smoothing demand and satisfying location-specific reliability requirements. But there are constraints in current regulations that prohibit these NMAs to fully create this value. NMAs are therefore challenging regulators to both react to specific issues and also to create a visionary path forward to allow NMAs to plan, grow and contribute value to the ecosystem as a whole. New market actors in recent years have upended and disrupted other industries like hotels and taxi services. A question that hangs over the utility marketplace is how long before network operators are "Uberised". However, as an essential service, there is a need to manage the industry transition carefully while also facilitating NMAs. This balance of co-creating value and disruption is the challenge we face today.

4.1 The Game is being changed to accommodate the NMAs

As NMAs take theoretical concepts and put them into practice they quickly overtake the trial stage and create real value for real customers. NMAs create choice and prompt competition. This is why regulators are taking notice and are listening to their suggestions for changes in the current frameworks.

The challenges for the current industry participants are clear:

- **Retailers need to find ways to remain relevant**. With the emergence of NMAs, competition in the retail market has increased even further. Retailers currently compete mainly on the basis of price (and service) differentiation. Yet NMAs break this paradigm and create customer value in completely new ways. Business as usual response by the incumbents is unlikely to be sufficient to remain relevant.
- **Distributors need to adapt their business models.** Network operator need to shift their approach from controlling DER uptake to embracing and enabling it, so that they can evolve from current business models to become true platform operators and optimisers. These new roles unlock new revenue potentials, e.g. a sharing of benefits from economic optimisation or the monetisation of data.
- **Regulators need to define clear goals and a vision.** This vision needs to provide a particular view to consumer outcomes. As the jurisdictional analysis has shown (e.g. NY REV), current levels of enablement must not be seen as a road block for this. With their location based monopolies, distributors will always be subject to some form of regulation. The key would be for regulators to change the framework so that the NMAs could create value for consumers while still allowing for the viability of the distributors maintaining the grid, even if the role of the grid may change in the future (see discussion of future business models in this report).

So why are these relevant to Network Operators?

The scope of products and services offered by NMAs may not always directly compete with network operators however increasingly they are impacting operations and the underlying business model in three ways:

- **Change the value of the GRID.** The NMAs change how consumers use the grid and the network operators need to be ready for this impact as consumers (and therefore regulators) will expect them to e.g. Powerpeers facilitates the exchange of power between pro- and consumer. This will put additional strain on the ability of the grid to reliably integrate the increased number of DERs and multi-directional energy-flows. In stark contrast, Tesla enables consumers to store and use their self-generated energy to a much higher extent. The future value of the grid therefore lies in being much more open and interoperable and resilient to more extreme load variations. The value of the grid can be extended by interacting with NMAs and customer directly to optimise network investments and operations for the benefit of all network users.
- **Challenge current revenue models.** The NMAs challenge current revenue models at their core. Looking at Stem as an example we see that their value proposition to customers is almost entirely based on the ability to avoid the very

price-signals networks rely upon, namely peak-demand tariffs and time-of-use tariffs. Coincidentally, both have just been revised / introduced in Australia (under Power of Choice changes) and in Victoria (following the AMI rollout) – yet we could find these tariff models becoming obsolete quickly in light of NMAs like STEM exploiting the avoidance of high-price periods as the basis to their value propositions to customers. Suggestions and lobbying by Piclo, a UK-based peer to peer NMA push this point even further. They argue for specific localised or at least distribution-only network charges, given that the exchange of energy amongst their peers occurs strictly at the low-voltage level only.

- **Leverage existing elements core to network operators**. They leverage elements that are also readily available to network operators, near real time consumption data being a case in point. Network operators should seek ways to leverage this and other privileged assets to participate in the value creation and opening up new opportunities – strictly within ring-fencing guidelines, obviously. An alternate approach could be for the Network operator to market this data to NMAs and other interested parties. This would open up new value pools to the distributors

Network operators therefore need to be mindful of existing and potential NMAs that already operate in or could enter their areas and need to plan for potential impacts to their operations and revenues. More importantly, though, network operators should seek to engage with NMAs to explore how to co-create value.

How does Australia compare (do we have a lot of NMAs)?

We have many examples of NMAs – either in start-up mode or targeting Australia

In creating our report, we had no difficulties identifying NMAs in Australia. In fact, 5 out of the 7 NMAs we looked at are already operating in Australia. We see high energy prices, consumers being used to and expecting more innovative offerings and the high suitability for solar PV as the main drivers for such a proliferation of NMAs in Australia. Naturally the liberalised market structure and highly defined / constrained role of the network operators can be seen as catalysts to the presence of NMAs, too. We also see convergence in both the B2B and B2C markets. This convergence of 'Connected Lifestyles' will have an inevitable impact on the 'boundaries' of the industry.

More are targeting Australia

Looking briefly at the two NMAs not currently in Australia, one could assume that one or both concepts could also work here. The STEM model could work here as we have demand tariffs and they have just been made more 'network operator-friendly' through Power of Choice reforms (moving from kW and/or kWh to kVa). Similarly, using aggregation and contract-based hedging the Powerpeers model could also work locally, particularly given the already high solar PV penetration.

Many overseas start-ups will look to Australia as being an ideal testing ground based on the conditions outlined above. In interviews, NMAs have attested to the fact that their model/s could indeed be applied in Australia.

What will this mean for existing players?

The trend of new and left-field entrants and the disruption they bring is likely to continue and gather pace:

a. **Consumers** are open to adopting new models. They would continue to seek low cost and convenient offers that use digital channels and data to put some 'smarts' into energy. This would lead them to question the value of the old system and they would demand more from all players, including the regulator and distributors.
b. **Regulators** and policy makers would have to address these demands from the public. They would need to develop visionary, long term transformation plans and put these into practice. Australia is a case in point for short term changes; while the regulation has delivered choice and many retail offerings, two key consumer demands are not yet fully addressed: low prices and renewable energy. While some improvement has recently been made on these there is a long way to go to be in line with consumer expectations.
c. **Incumbent retailers** would be forced to provide offers that can compete with the NMAs. This would add to the range of new offers and further accelerate the disruption. Retailer may also seek to acquire NMAs to quickly build capabilities and maintain relevance (and market share).

d. **Network operator** would struggle to maintain their relevance unless they adapt to new models and offer more than just basic infrastructure and quickly expand and further enhance the range of their services to readily connect different DER technologies. Data is quickly becoming an asset in its own right and has real value that could be monetised by the Network operator even in a regulated role.

e. **International NMAs** are likely to view Australia as a viable market and testing ground. A high degree of liberalisation, existing competition, high prices and robust grids with solid grid automation and control would be crucial factors in a favourable assessment of market entry in Australia.

4.2 Seven New Market Actors

In our global scan of new market players, we came across many new and different models. From a long list we picked seven to investigate further. Three themes emerged within these seven to show how they are reshaping the marketplace and creating a new ecosystem:

1. **Data driven trading / community models** - those that mainly focus on offers that leverage data and that create connections or aggregation across multiple consumers.
2. **Innovative customer value extensions** - those that deliver traditional energy services yet do so in very innovative ways and with completely different customer value propositions
3. **Strategic partnerships** – which are aimed at creating new capabilities - fast. With these new capabilities the NMAs can then add value to consumers e.g. through bundled offers.

	Data driven trading / community models			Innovative customer value propositions		Strategic partnering	
New Market Actor	**Reposit**	**Stem**	**Powerpeers**	**Mojo**	**Telstra**	**AGL NE**	**Tesla/SolarCity**
Value Proposition	Enabling customers to trade w/ wholesale market and extract additional value from solar & storage systems	Analytics driven battery storage system maximising value for commercial & industrial customers	Online community energy platform allowing direct peer-to-peer selling of power without a retailer	New retail business model decoupling revenue and profits from consumption	Telecommunications provider leveraging capabilities to enter the electricity market with a bundled value proposition	Major retailer building strategic partnership and leveraging scale to disrupt markets	One stop shop approach to DER customer solutions – off the shelf
Ideal market environment that fully enables this business model	Direct wholesale market access for end consumers	Specific tariff structures such as peak demand and time-of-use tariffs	High consumer demand for renewable energy Automated grid that supports flexible DER connection and exchange	High electricity prices, high retail competition	Consumer demand for bundling of offers Fully liberalised and competitive retail markets	Consumer demand for bundling of offers Fully liberalised and competitive retail markets	High power prices, significant solar penetration, low benefits from net metering or FiT
Established in	Australia 2012	California 2009	Netherlands July 2016	Australia 2016	Australia Yet to commence operations	Australia 2014	California (SolarCity) 2009

							Tesla offers to acquire in June 2016
Current customer numbers	Unknown	>400 facilities >68 MWh installed capacity	Not available	~100	N/a	5,000 smart meters 3,000 solar installations	250,000 (SolarCity in 2015)
Ambition	Expand in AUS Facilitate direct wholesale access Provide grid services	Expand to other US states, NY in particular Expand provision of grid services	Consolidate in NL Expand internationally (e.g. UK, GER) Offer platform to 3rd parties	Aggregation play with its customer base True wholesale market access for its customers	Expand in AUS via efficient renewable energy; aiming to partner with other companies in new energy space	Aiming for 1 million "smart' customers by 2020	Aim for 1 Million customers by 2018 – SolarCity

Similar to the analysis of jurisdictions, we created a framework that contrasts and compares the new market actors (NMAs) and highlights relevant insights for Australia.

The ability to create new value and the degree of disruption to the established ecosystem are the primary criteria for assessing New Market Actors (NMAs). In the "value" dimension (Figure 3 below) we describe whether new value is being created by the NMA or whether existing value being shifted along the value chain. New value could be created by the NMA directly or co-created by the NMA and the customer or the NMA and others (e.g. the distributor) in the ecosystem. Shifting of existing value describes where a NMA develops a business model that allows them to increase their part of the value chain by taking away from others, i.e. a zero-sum situation.

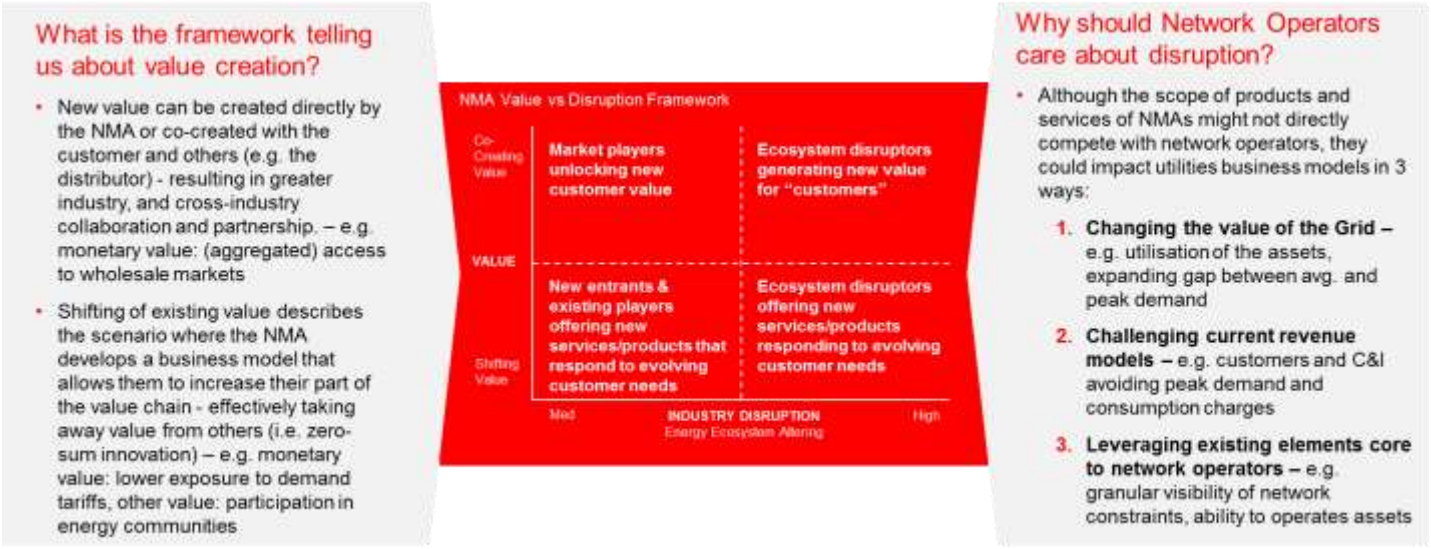


FIGURE 10 – NEW MARKET ACTORS VALUE AND DISRUPTION

- **Powerpeers - 'Air BnB of Energy'**

  "High solar penetration, an agile retail market, educated consumers and a community striving for more renewable energy that they can be shared amongst members are the key elements that make Powerpeers successful" Platform model enabling prosumers to 'peer-to-peer' trade"

  Synopsis: Example of a future shared economy style energy market place where consumers are self-sufficient enabled via a 'platform'

  Offering: Powerpeers does not sell energy. Instead it provides a platform for prosumers and consumers of renewable energy to connect and sell energy to/from each other. Powerpeers provides access to this platform for a subscription fee. While Powerpeers set the price for energy (a requirement under the Dutch regulation, under which Powerpeers is also registered as an energy retailer) it does not work on a per kWh margin. On the platform consumers can select, on an individual basis, who to buy power from. Vice versa, prosumers can also choose to who, individually, they sell power. This model fosters an energy community where individuals can trace who and where their energy comes from. Because of the intermittency of individual renewable generation, Powerpeers provide 'back up' power in case the individually selected generator does not supply the scheduled amount of energy in any 15-minute interval. Only the prosumer currently requires a smart meter. Powerpeers calculate the full end-to-end settlement on the basis of that 15-minute data

  Value: Creates new monetary and non-monetary value to the consumer/ prosumer by enabling them to contract directly, cutting out the retail function and therefore the retail margin. Customers' perception of value goes well beyond economic benefits. They see themselves as part of a community supporting the growth of renewables directly in the Netherlands.

  Disruption: Consumers buy directly from other consumers, not an established retailer and they can switch suppliers while on the same platform.

- **Reposit Power – 'eBay of energy'**

  "The grid promotes power security. We want people buying storage and using our software while remaining connected to the grid allowing them to sell energy back into the market at a profit. "That is the best way to extract value from residential energy storage and allows us to maintain a healthy grid, which is beneficial to everybody." "The idea is to buy electricity from the grid when prices are lowest, consume as much of your own solar as possible and occasionally sell to the markets when prices spike".[4]

  Synopsis: First mass market accessible energy trading platform in Australia enabling the 'prosumer' to unlock additional value and not just accept low feed-in-tariffs.

  Offering: Reposit has developed an intelligent analytics engine that enables customers with solar and storage to trade in the wholesale market (through a retailer as a proxy), maximising value and optimising their energy consumption. Due to wholesale market access regulations, Reposit customers are not able to trade in the market directly but require an account with select retailers (currently Simply & Diamond energy). Storage and trading are automated, but customers receive real time alerts regarding electricity prices and suggestions about when to shift their consumption. Evidence has shown that the biggest incentive for Reposit customers is the access to rich information, which they can access online and via an app. They do not currently deem the savings available a sufficient incentive either to alter their behaviour or warrant any inconvenience.

  Value: Through aggregation across multiple prosumers, Reposit maximises the economic benefits from excess generation by providing the combined output into the wholesale market at the most profitable times.

[4] Business Insider, 4 May 2015, http://www.businessinsider.com.au/this-little-australian-startup-has-landed-an-agreement-with-tesla-to-support-its-new-home-batteries-2015-5.

Disruption: Providing residential customers with wholesale market access and allows customers to maximise value from DERs (by reducing the payback period) it also encourages the uptake of DER.

- **STEM - 'Energy on cruise control'**

  STEM – Cruise control for your energy optimisation

  "While demand charge mitigation will continue to be a major draw for businesses, Stem is building a forward-thinking grid resource that goes above and beyond traditional peak load shaving to benefit both customers and grid operators"

  Synopsis: First company to effectively bid into US day ahead and real-time markets using aggregated customer storage systems

  Offering: Stem has developed a smart storage system that reduces electricity bills by storing energy (from grid or solar), then using that stored energy when demand tariffs create a 'penalty' situation. It aims to reduce payments based on demand tariffs and focuses mainly on C&I customers. Stem has created a unique big data/predictive analytic solution that models customers' energy profiles and makes recommendations to possibly maximise savings and reduce demand. No action is required from customer behaviour to extract value from this service. A major aspect of the product provided by Stem is enabling customer to trace back their energy to a clean/renewable source, this aligns Stem to the growing trend of eco-conscious customers within the C&I market (CSR strategy and ISO standards driven).

  Value: STEM creates new value for customers by avoiding peak demand penalties in a C&I tariff setting. The system combines savings, visibility, control and convenience for customer.

  Disruption: With its focus on demand tariffs, the STEM offering threatens cost recovery for grids infrastructure that is already built and would push network operators and regulators to find different ways to spread costs.

- **Mojo – 'The Costco of Energy'**

  "We see distributors more like Apple who own the platform, and Uber who use the platform to connect spare capacity with demand, to create value and share it with the customer. Distributors' customers are companies like Mojo and other energy services providers co–creating value."

  Synopsis: First in Australia to recover costs with a fixed fee rather than based on usage, de-coupling profits from direct energy consumption therefore aligning customer and retailer interests

  Offering: Mojo Power, formed in late 2015 in Sydney, has developed a new retail model where customers sign up to a flat-rate subscription based on the level of service support they require. In doing so, consumers get access to energy at wholesale rates without any cost mark-ups. Therefore, Mojo does not profit from its customers' energy consumption. The primary catalyst for the establishment of Mojo's business model was to mitigate the effect of mass uptake of PV and storage on the traditional retail model. Mojo's 'EnergyPass' subscription-based product decouples energy consumption from revenue growth enabling Mojo to help its consumers reduce energy consumption without any conflict of interest. Mojo offers customers the option of a smart meter.

  Value: Tangible value is created by savings on electricity consumption as margins are lower and instead recovered through a flat subscription fee.

  Disruption: Mojo disrupts retail models by breaking with the traditional consumption-based business model. Alignment between Mojo and consumers' goals will drive down energy consumption. A potential network impact is that it could further increased the imbalance between throughput and capacity, which is already a major current issue for networks.

- **Tesla / SolarCity – 'The "Tesla" of energy'**

  "SolarCity will produce the electricity, Tesla Energy will store it, and SolarCity Utilities Services will deliver it"

  Synopsis: Strategic partnership between the industry's leading battery manufacturers and one of the world's largest DER solution providers demonstrates a business model and strategy focused on servicing the whole value chain.

  Offering:

Tesla Energy - seeks to deliver infinitely scalable energy storage to remove the variability from variable power sources at low cost, leading technology. The company uses the same technology as Tesla Motors to rapidly reduce the cost of lithium ion batteries to create a wide range of battery packs for residential, commercial, and utility-scale application.

SolarCity - has recently added variations to its traditional offering, such as a utility platform solution called GridLogic and a 'Smart Energy Home System' for residential customers. The latter, includes rooftop solar PV, a Tesla energy storage system, a Nest smart thermostat and a gateway to optimise energy self-consumption (priced at parity to grid-prices).

As a combined service offering (e.g. GridLogic platform, Microgrid offering) Tesla Energy and SolarCity have the capability to build and deploy localised energy infrastructure that can disconnect from the main power grid and operate independently

Value: Tesla offers a storage solution that helps consumers increase self-consumption.
Its combination with SolaCity overcomes the traditional equipment provider role and creates further value by optimising and aggregating storage across consumers.

Disruption: This one-stop-shop approach could create an off the shelf solution for customers that offers a unique value proposition and therefore acquire significant market share.

- **AGL New Energy – the 'Virgin Group of Energy'**

"AGL New Energy believes an abundance of data sources will open up over time, such as smart refrigerators, which could be analysed and insights provided to consumers and provide to other parties"

Synopsis: Strategic partnerships/acquisitions in tech start-ups, smart metering business formation, and offering the 1st retailer-led PPA agreement demonstrate that AGL is an example of a disruptive and value creating tier 1 retailer leveraging its strength to alter the market for end customers and market participants.

Offering: AGL New Energy is a new business unit of AGL Energy which was established in early 2015 aimed at embracing changing customer needs in the energy landscape and driving innovation and the adoption of new technology. The business unit is focused on developing innovative technologies and customer value propositions in the following core areas:

  - Rooftop solar - AGL New Energy was the first of the incumbent retailers to offer a Solar Power Purchase Agreement (PPA) or 'Solar Smart Plan'.
  - Energy services - Energy services encapsulates a range of services offered to commercial and industrial customers, including building optimisation, power factor correction, energy efficiency, and steam and hot water boilers.
  - Energy storage - AGL was the first Australian incumbent retailer to offer battery storage with its AU Optronics PowerLegato product. Since then, the business has launched a range of batteries including the Sunverge SIS.
  - Electric vehicle services - New Energy recently announced a new charging product whereby customers with an AGL smart meter can charge their electric vehicles as much as they like for only AUS$1 per day. AGL EV Advantage for commercial customers offers leasing, charging, energy supply and finance services to organisations seeking to plug in to electric vehicles
  - Solar analytics (Solar Command) - The application monitors solar energy production and household consumption data and provides a 'health diagnostic' to the user.
  - Metering services (Active Stream) - Active Stream delivers a complete end-to-end digital meter solution that includes meter supply, deployment, maintenance, data collection, management and support. Active Stream is an accredited Meter Provider and Meter Data Provider.

Value: AGL NE creates consumer benefit from access to DER without upfront payment, similar to the Sunverge model, in which AGL NE also has a stake.

Disruption: As outlined, the lack of upfront payments democratises and proliferates DER uptake which will further emphasise the current control and integrating challenges.
The Sunverge stake AGL NE holds heralds plans to expand into aggregation.

- **Telstra Energy** - **Home services supermarket**

"Research has forecast an estimated 10 billion plus connected machines by 2019, from smart dishwashers that run themselves when energy costs are lowest, to an app integrating weather data with home thermostats"

Synopsis: Represents a new customer value proposition and a wave of possible new entrants able to leverage customer data and relationships to disrupt the energy market status quo.

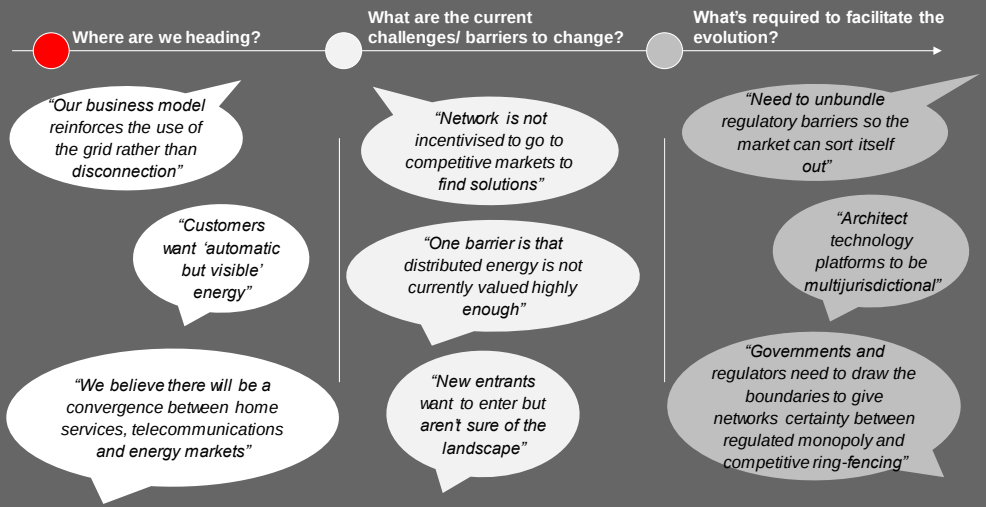
Offering: While the final customer value proposition is yet to be fully defined, Telstra Energy believes there is/will be a convergence between home services, telecommunications and energy markets. Their recent launch of 'Thrive on' indicates the move into this convergent market space and 'living services' rather than energy per se. Telstra Energy is likely to go to market as an energy retailer by utilising its key competitive advantages including:

- Ability to bundle a range of energy services within an offering along with their existing telecommunications and media products to create a 'connected home'
- Access to customer data
- Relationship with existing customer base
- Leverage the batteries already owned by the organisation
- Leverage existing capabilities (such as field services, billing and customer service)

Value: Telstra Energy is likely to create incremental new value to the consumer by bundling offers across telco and utility services.

Disruption: Telstra Energy is likely to attempt to disrupt existing energy retailers by offering a bundle of home services, telecommunications and energy that energy retailers will not be able to be match. Telstra Energy's ability to utilise its existing customer base may also reduce the market share of existing Energy Retailers.

What are the NMAs Saying?



Although their models differ, the NMAs express a consistent desire for an open and collaborative ecosystem, in which the regulator and network operator would play a significant role

5.0

Evolving Role of Network Operators

5.0 Evolving Role of Network Operators

Our research has outlined 7 specific fault lines we observed globally and we have identified responses that markets need to take so that these fault lines could be overcome. Global developments and trends clearly show an evolution of network operator business models in response to these fault lines, demonstrating a fundamental shift from an "obligation to serve" to a "focus to optimise." This reinvigorated model empowers network operators to objectively address consumer demands and grid-investment needs with a diverse set of solutions, whether distributed, central, or renewables-based.

Global Fault Lines	Resolutions to the Fault Lines
• Demand Disruption • Consumer behaviours and liquid expectations • Competition from all sides is expanding • Targets and constraints from regulators • Capability Challenges • Goal Definition and Trade-offs	• New tariff/ pricing models • Wholesale market interactions • Facilitating open access to the grid • Ring-fencing • Consumer Protections • Grid Automation • Communities and Microgrids • Retail models • Access to data and viewing it as a new asset

However, there are two prerequisites required before this evolution can gain substantial momentum and possible benefits could be maximised for participants across the whole value chain:

- **Define and capture new revenue streams**. With new entrants and changing market structures, the business model must evolve to capture new revenue streams whether regulated or not. It needs to expand into a world where being a natural monopoly does not insulate a distribution company from the effects of changing market conditions. There is pressure from shareholders, customers, capital markets, and lastly from new market actors that want to compete for part of the energy value chain (e.g., solar, battery); and these are beginning to attack regulated utility spend and traditional capital investment programs. Yet, specifically in the case of NMAs, networks need to maintain grid stability e.g. in the face of aggregation of supply and demand from DERs.

- **A new responsibility to coordinate and optimise the interaction between wholesale and distribution markets**. The network operator must have the ability to either fully coordinate and manage aggregated portfolios serving wholesale and distribution markets in real-time OR it needs to interface, provide required data and work with a new entity which has this responsibility, i.e. a Distribution System Operator - DSO. This would help maintain the stability at the local level and maximised efficiency of the end-to-end electricity system.

Without undertaking these two activities evolution would be slow and risks major disruption from new market actors.

5.1 Ramifications of not evolving at the right pace

Network operator business models would need to facilitate this transition towards the 'commitment to optimise'. The opportunity to earn a regulated return on capital investment will continue but with a greater focus on demonstrating positive outcomes for customers and a wider ecosystem of partners. The network operator should enable widespread DER integration and new opportunities for third parties and DER owners to derive value from their investments – they all need to share in the value created.

However, some new models for the new energy system could ultimately threaten the monopoly license to operate. For example, microgrid deployments could see increasing areas of the medium and low-voltage networks move out of the network operators' control thereby reducing their regulated asset base and threatening total revenues.

The ramifications of not evolving at the correct pace could include network and business model destabilisation resulting in -

- End consumers reducing or eliminating their dependence on the grid by investing in addressing their own energy needs.
- Fast paced uptake of DERs will result in limited ability to predict and mitigate the impacts of customer consumption and supply behaviour. New grid investments would be required to compensate for the lack of control, further incentivising grid defection.

At this point in time network operators are well positioned to understand the current challenges and create the opportunity to open up new unregulated revenue streams by entering the market for customer and community energy management solutions.

5.2 Five business models on the pathway to a new energy ecosystem

Given the change drivers and outlook described, what could the efficient distribution business of the future look like? Since our work for the Energy Networks Association on network business model evolution in early 2015, we have revised our view on the development of potential new business models[5]. We are now focussed on two models that are becoming more common – the Smart Grid Operator and the Decoupled Integrated Utility. However, there is a strategic mind shift required to move to a 'platform model'. We have defined 2 models which utilities around the world seem to be planning for – Platform Access Provider and the Distribution Platform Optimiser (DPO). The DPO has two variants which we believe could be achieved on the journey to the future 'Energy SupraNet'.

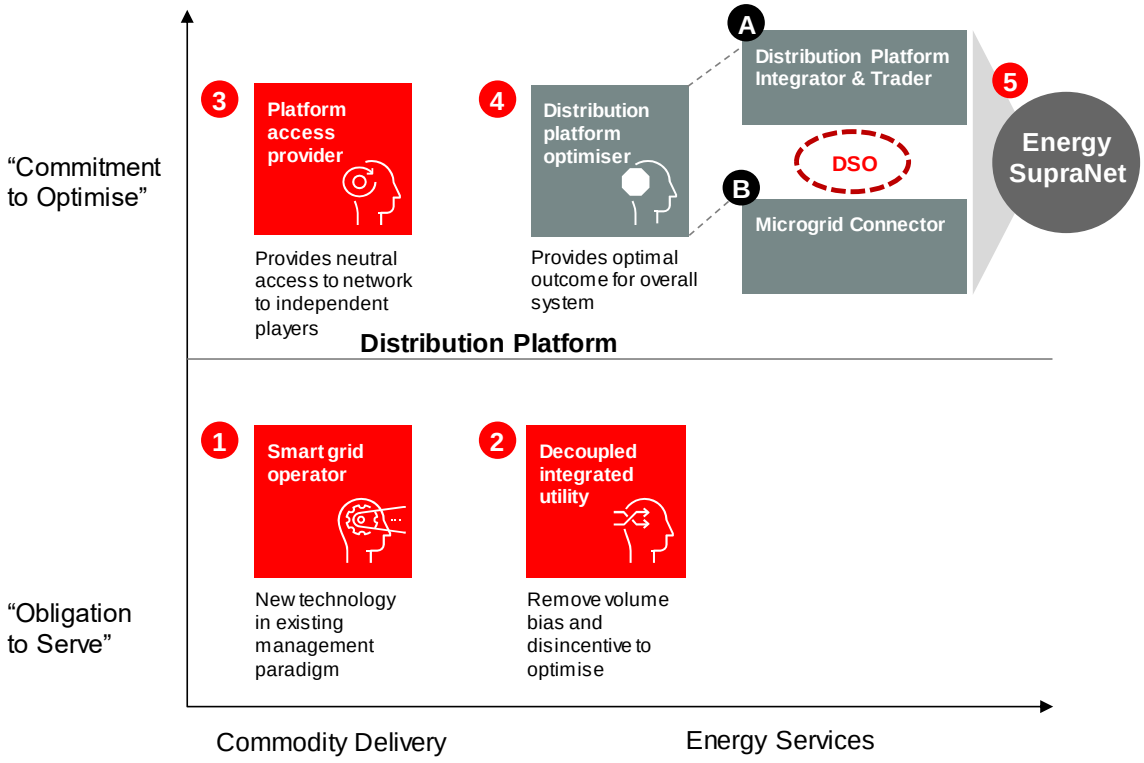


FIGURE 11 – BUSINESS MODEL FRAMEWORK

[5] Network Business Model Evolution - *An investigation of the impact of current trends on DNSP business model planning*. Written for the Energy Networks Association February 2015 and also summarised in the Electricity Network Transformation Roadmap Interim Report 2015.

1) **The smart grid operator** – **leveraging new technology in the existing management paradigm**. Most utilities in the markets we investigated are currently operating this business model and are in the process of shifting their smart capabilities to manage in the new world of DERs. A smart grid operator could manage supply infrastructure via two-way digital communication and has intelligent monitoring, analysis and control. Importantly, this business model encourages consumer participation in grid operations and has the information to manage this interaction including advanced metering infrastructure.

2) **The decoupled integrated utility** – **removing volume bias and the disincentive to optimise**. In regions where network operators are more integrated a major shift has begun to allow utilities to adjust their rates to better reflect the value of providing back up power as distributed generation becomes more prevalent. These changes include revisions to traditional cost-of-service ratemaking, including mechanisms such as straight fixed-variable rates that allow for the recovery of fixed costs through peak-usage demand changes and lost-revenue adjustment mechanisms that address the impact of conservation on utility sales. This business model therefore has removed any disincentives to integrate DERs.

3) **The platform access provider** – **providing equal access to the network to independent players**. This business model has some optimisation of the grid with control of DERs and loads through pricing signals or Demand Response mechanisms, without universal management of all connecting infrastructure. The grid is built and maintained with a level of robustness that minimises restrictions on network connections and facilitates two-way flows of energy. This model may result in only partial optimisation of the entire supply system, as retailers, aggregators, distribution, transmission and wholesale markets may all play a role in management of distributed loads and sources of supply in response to conflicting incentives.

4) **The distribution platform optimiser (DPO).** A business model which manages and coordinates all elements end-to-end, to provide the optimal outcome for the overall system. The model has sophisticated grid operations and manages a portfolio of assets, even customer sited-assets, as a single optimised system. It unlocks new market and customer value streams through system optimisation, efficiency and utilisation while integrating new assets (DER integration in particular), technology and market frameworks. A new set of responsibilities will be required in this model to optimise across the DPO, DO, retailers, aggregators, NMAs and the wholesale market. This necessitates to set up separately the responsibility of a Distribution System Optimiser (DSO, discussed below).

   And we further define the DPO model to be characterised by -

   - A Network that not just provides access to DERs but enables and optimises the overall grid by doing so
   - A managed demand and supply clearinghouse or balancing mechanisms.
   - An outcomes-based incentives regulatory program that encourages participation in a market that aims to balance demand and supply through control of load and DER's.
   - Dynamic price signals and interconnections between participants in the energy value chain.
   - Standards for interconnections – a plug-and –play environment.
   - And it has a pervasively digital ecosystem.

Distribution Platform Optimiser Characteristics	
Key Capabilities	• Market Operations - Clearing of localised market transactions and local market dispatch (maybe a separate entity) • Integrated planning - planning for optimal system outcome across capital investment, demand management, and grid integration and operation • Grid Optimisation - managing real-time optimal results in load management, peak shifting, and power system effectiveness (voltage, power, supply) • Revenue & Tariffs - a price framework for optimisation through price signals and dynamic interconnections
Value Metrics	• Total renewable utilisation & integration • Demand optimisation (e.g. peak, valley) • Total system losses
Cultural Traits	• Innovation – New ways to optimise • Process improvement – continuous improvement of system outcomes • Collaboration – across value chain

FIGURE 12 – DISTRIBUTION PLATFORM OPTIMISER CHARACTERISTICS

There are two variants of the distribution platform optimiser depending on the role of the grid operator and the integration of the utility:

A) **Distribution Platform Integrator** – which physically connects and integrates DER capacity in a time and location manner through pricing signals sent to a separate entity/set of responsibilities, called a Distribution System Operator – DSO, who would optimise for physical, financial and market constraints across grid operators, retailers, wholesale markets, customers, etc. The grid operator facilitates the connection and dispatch of DERs in its network area, however the optimisation and decisions are ultimately made by the DSO. This model can also use its own DERs to transact with the wholesale market. In this model the grid operator is not the distribution system operator (DSO – see section below) managing dispatch of DER aggregated load. Depending on market structure and regulatory conditions this might allow network operators to own limited amounts of dispatchable DER generation.

B) **Microgrid Connector**. This variant has the network operator focussing on transmission and feeder distribution assets predominantly concerned with establishing and connecting either utility or community owned microgrids to safeguard and facilitate the connection of large centralised generation. These could be 'greenfield', 'brownfield' (zonal virtual grids) or isolated microgrids. This model would most likely suit those network operators who have large growth corridors in their network area as it would allow them to focus on business partnerships with developers, open up new revenue streams, and allow the utilisation of the existing network more efficiently. It is also a sustainable model and can future proof the network operator against the challenges of the new players, technologies and erosion of revenues by competitors.

A potential fifth business model may emerge in the future when technology and infrastructure are sufficiently advanced:

5) **Energy SupraNet** – **Internet-of-Things and Smart Grid combine to enable real time, two-way flow optimisation of all connected devices**. This futuristic model uses technology and interaction at the device level (generating, storing and consuming devices) and enables the entire system grid and many-to-many consumer / prosumer demand based on real-time pricing. The Energy SupraNet connects the vast network of devices that generate, consumer and store energy.

   This model would require control of all energy consuming and storing devices to help achieve the optimal outcome for all. The wholesale market would be available to all using real-time settlement – pricing signals would be transmitted directly to consumers. All connected energy users would trade energy flows in real time (perhaps facilitated by blockchain), either within microgrids, or across the main regulated grid, but this would happen in the background enabled, but not directly

controlled or facilitated by the SupraNet. This model could largely decrease the role for intermediaries, such as retailers or NMAs, pending the appetite of consumers to directly interact with each other.

In the same way consumers choose a superannuation plan based on risk appetite (balanced, growth, defensive) they would select a plan for their house – optimal feed-in, standard or critical events only. Access to real-time data is the key enabler of this model.

Many utilities are starting to make these transformations to new models incrementally, but there are few examples of utilities that have fully transitioned as the technology required to enable the supra net is only starting to be widely used and requires significant integration and interoperability. It remains to be seen if the Energy SupraNet could truly be offered by a single provider or if it would naturally evolve from a more open and collaborative ecosystem.

Given the move towards a more highly optimised system - incorporating advanced network controls, embedded and customer storage and customer participation – the key question being asked around the world is – what overall network operator model should be adopted so that incentives are aligned and that optimisation would be as efficient as practically possible?

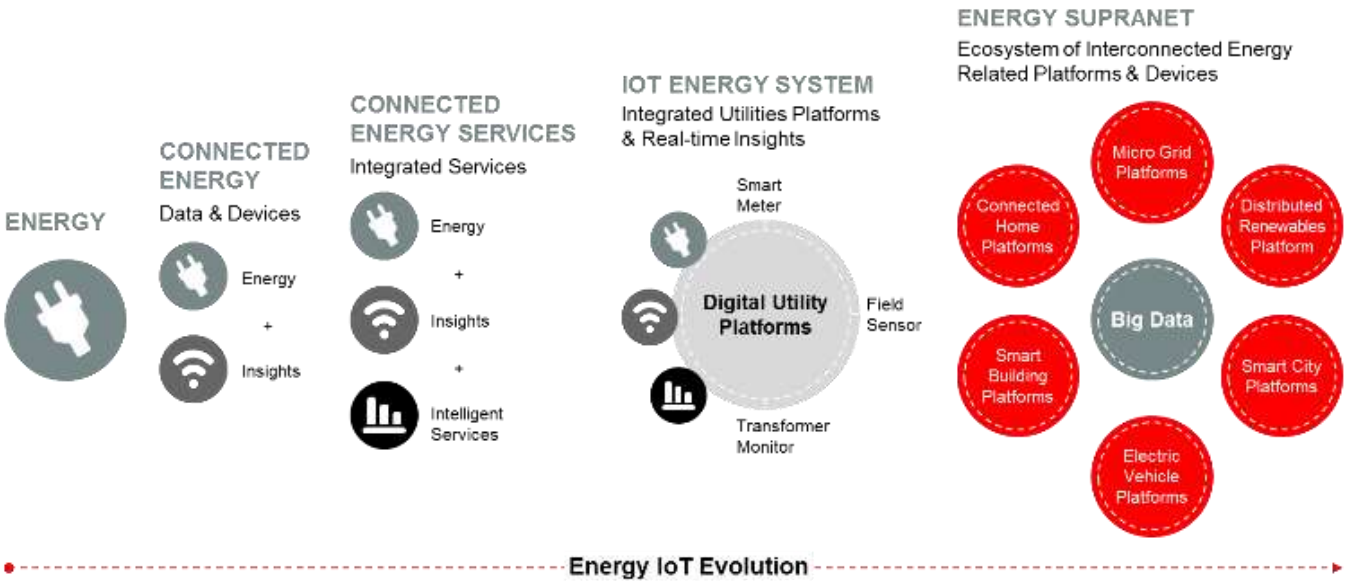


FIGURE 13 – ENERGY SUPRANET – IOT SYSTEM OF SYSTEMS

Before the 'Energy SupraNet' becomes technologically possible (within the next 10 years) we see the "Distributed Platform Optimiser" as the only viable model to evolve towards. However, the pace and magnitude of business model change would depend on many factors including regulatory, consumer and technology. The question faced by network operators today is how quickly this evolution should proceed.

Network operators would need to engage retailers, demand/supply aggregators, consumers, and appropriately incentivise and reward sustainable behaviour. If not, retailers and demand aggregators may influence customer behaviour without adequate consideration of the impact on the distribution network. Retailers and demand aggregators would take advantage of existing market mechanisms to influence customer consumption and generation patterns to make money from:

- Offering aggregated supply or demand capacity into wholesale energy markets, without consideration of network impacts when that capacity is dispatched.
- Offering services into existing ancillary services markets, which aim to stabilise the network at a system level, without making similar services available to network operators.

To overcome these challenges network operators would need to become more sophisticated in defining standards, protocols and compensation mechanisms to influence the behaviour of retailers and demand aggregators:

- **Standards** are necessary to prevent network destabilisation that may result from sudden introduction of new loads or injection of supply.
- **Protocols** are required whereby distributors may interact with aggregators and end consumers to effect price/event signalling and control.
- **Incentives** must be offered for customers, retailers and demand aggregators to use the infrastructure available to them to provide network support services. Otherwise, those parties will look for alternative avenues to extract value from their energy management capability.

5.3 A New Responsibility - The Distribution System Operator (DSO) and its functions

To manage and optimise DER integration for the entire energy system new responsibilities would need to be assigned to help achieve the necessary levels of coordination required across all parties.

It is well understood that the individual players along the electricity value chain have their specific priorities, such as maximising returns from generation, stabilising the distribution network or providing maximum savings to customers. These priorities and their timing often don't align and even in some cases conflict. For this reason it may not be optimal to assign the role of DER system coordinator to existing players such as retailers, aggregators, network operators or even the wholesale market operator.

A new responsibility (or party) therefore may need to be created for coordinating DERs in a manner that ensures stability and unlocks systemic efficiencies. This could be referred to as the Distribution System Operator. It would also coordinate and optimise the interaction between wholesale and distribution markets. It could be the existing network operator or alternatively a separate market operations entity. The basic functions of the new DSO could consist of:

- The distribution and wholesale market operator coordinate to ensure the mutual reliability of transmission and distribution services.
- The distribution and wholesale market operator have full visibility of resource activity and system conditions on their respective grids, and exchange data at the frequency and granularity necessary for reliability.
- Most distributed energy resources owners have primary reliability relationship with the distribution operator and receive dispatch and control instructions for both wholesale and distribution interactions.
- DERs providing services only to the wholesale market receive dispatch instructions directly from the wholesale market operator, but such dispatch is visible and accounted for in utility operations and may be overridden by the utility based on distribution system reliability conditions.

The DSO does not take on responsibilities of the individual parties in the market. For example, aggregators would still interact with end-customers, as would retailers. Generators would still interact with the wholesale market operator (ISO). The role of the DSO would be to facilitate an optimum system wide outcome by solving for an overarching goal at the wholesale and distribution market levels.

The allocation of the DSO responsibilities to players in the existing or emerging value chain varies by jurisdiction and intent. In the more regulated markets with only a few entities involved, the responsibilities could be allocated to one of the existing player, including the DO. In markets that are largely deregulated and fragmented, allocating the DSO responsibilities to one (of many) existing players may be more difficult. In a third model, the DSO responsibilities could become an extended set of functions the ISO usually fulfils. As with other elements of change, regulators will look to mandate or market based responses for this challenge.

A recent parallel in the Australian context was the introduction of the 'Metering Coordinator" role under the Power of Choice reforms. Rather than prescribing who of the existing entities would fulfil this role, it was left to the market to address this, leading to new business being set up (by retailers, distributors or new entrants) to take on these responsibilities. While this responsibility was set up as contestable, certain aspects of a DSO may be able to be classified as regulated activities.

One of the major market design questions will be how DERs can be coordinated to unlock efficiencies?… enter the DSO

DPO/ DSO/ ISO Roles and Coordination

- The (Distribution Platform Optimiser) DPO, Distribution System Operator (DSO) and Independent System Operator (ISO) coordinate to ensure the reliability of transmission and distribution networks while optimising the use of DERs and optimising the wholesale price of energy.
- The DSO and ISO have full visibility of resource activity and system and market conditions, provided by in part by the DPO.
- The DPO aims to optimise its network and the utilisation of DER within the coverage of its platform.
- Most DER owners have a primary relationship with retailers who can aggregate their services and who receive dispatch and control instructions from the DSO. The DPO provides constraints/incentives into theses instructions via network limitation and (locational) pricing signals.
- Large scale DERs, providing services only to the wholesale market receive dispatch instructions directly from the ISO.

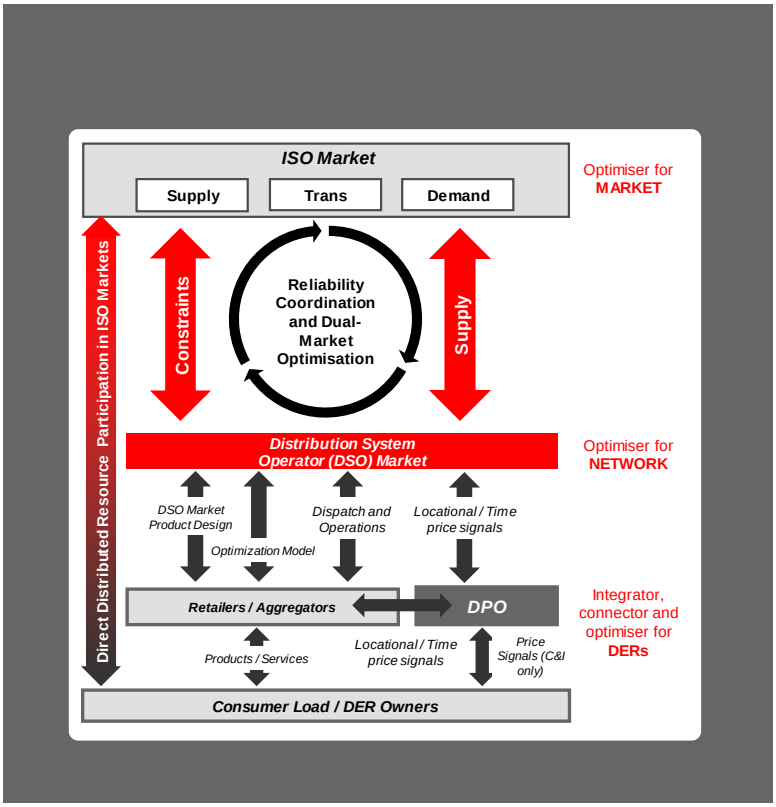


FIGURE 14 – THE DISTRIBUTION SYSTEM OPERATOR (DSO)

5.4 Transition to the Future State

The transition from traditional electric distribution grid to optimised power system requires incremental and deliberate changes to the existing service model. Over time the utility is increasingly able to utilise DERs, while also limiting any uncertainty that would negatively impact customers. To guide this transition, the utility concentrates on three distinct strategic objectives: Grid Optimisation, Regulatory and Business Model Reform, and a New Customer Model and Services.

1. **Grid Optimisation** – Expand the utility role from a basic "obligation to serve" to include the "commitment to optimise" through investments that modernise the distribution grid.
2. **Regulatory and Business Model Reform** – Develop a hybrid regulatory framework that augments existing opportunities to earn a rate of return on utility investments with outcomes-based incentives focused on meeting operational and customer outcomes. This is a required precursor to move to the DPO business models as the current regulatory frameworks limit the activities of a network operator and provide incentives that may not be optimal in the light of increasing DER penetration and use for the benefit across the grid.
3. **New Customer Model and Services** – Increase customer choice, education, and access to new services and markets that maximise the value of DERs – reducing the cost shift to non-participating customers.

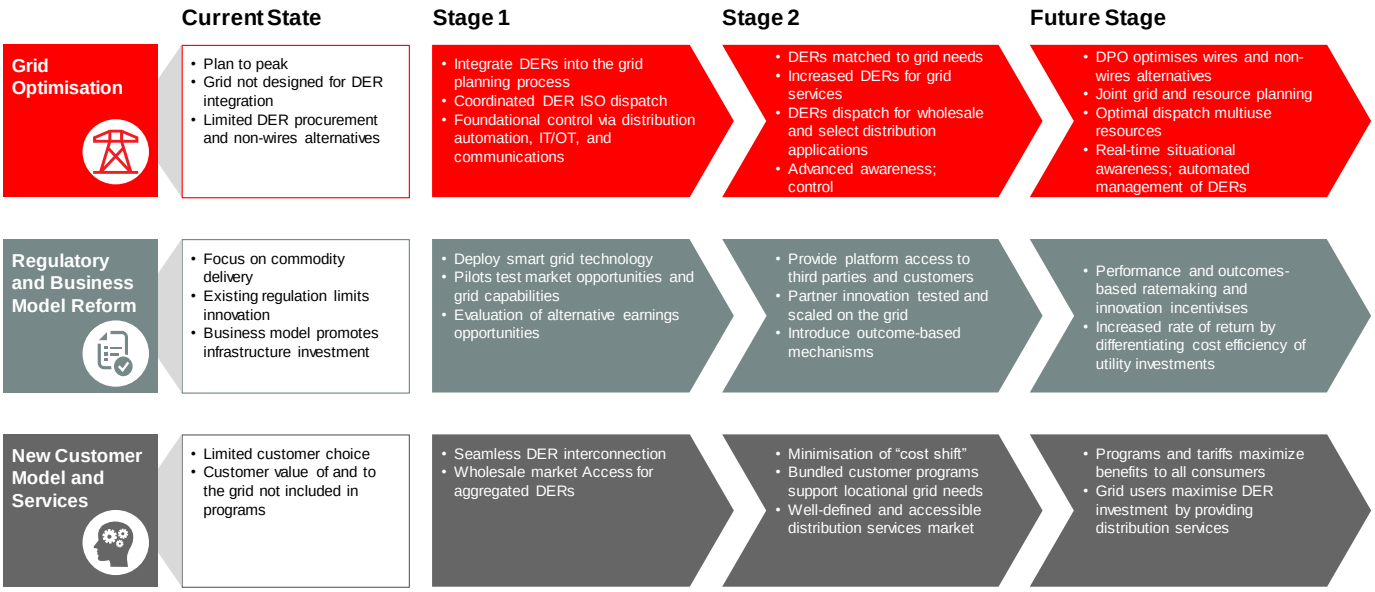


FIGURE 15 – CURRENT TO FUTURE STATE ROADMAP

6.0

Appendix

Appendix A - The view from industry executives

Accenture's global executive survey has been conducted over the past three years. The 2016 version interviewed over 85 utility executives in 18 countries[6]. The survey aims to better understand the shifting market dynamics of electricity distribution and to help utilities navigate this change. This includes helping distribution companies understand how they can transform their business models through digital investments and new capabilities, in order to enable growth and innovation.

Key Findings:

1) The current traditional model is not fit for purpose.

Industry executives report significant issues with the traditional model and expect an ecosystem evolution to take place between now and 2025. The major disruption anticipated for utilities will be the evolution of business models to integrate distributed energy resources and facilitate the market for DER services. Executives also expect to be able to purchase energy or ancillary services from distributed generation, storage, demand-response providers or electric vehicle owners within the next 10 years.

2) **Move towards to integrating and optimising DERs and facilitating markets.**

Given the move towards a more highly optimised system - incorporating advanced network controls, embedded and customer storage and customer participation – what overall distribution model should be adopted to ensure that incentives are aligned and that optimisation can be efficient as practically as possible?

66 percent of utility executives in the US and 73% in Europe expect their company's role to evolve in the next 10 years towards one that integrates distributed energy resources (DER) and facilitates the market for DER services.

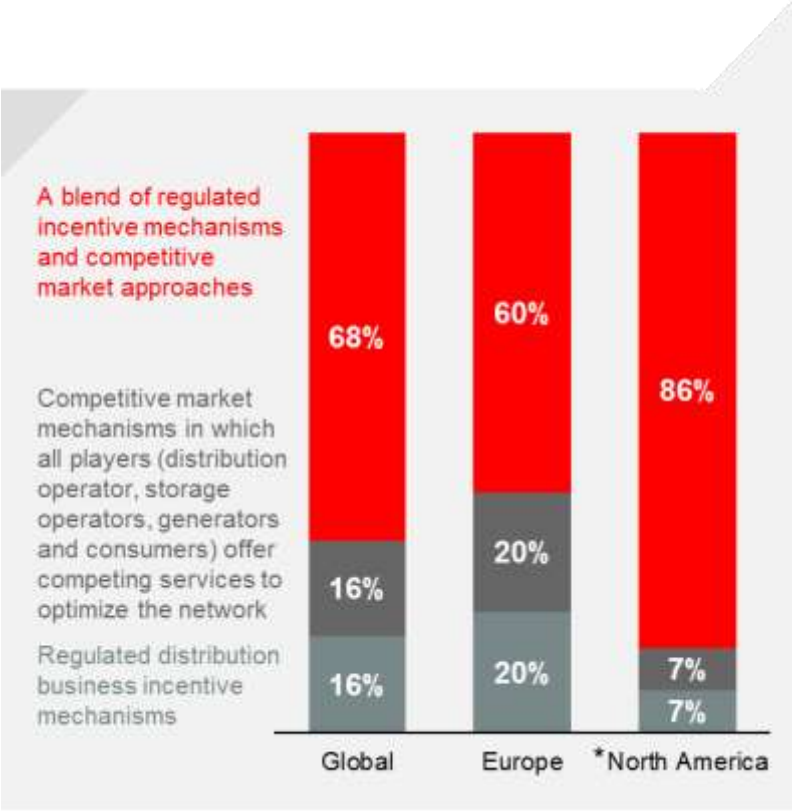
Executives recognise the Distribution Platform Optimiser model as providing the most sustainable long-term solution for the utility and all users of the system. The difference between the US and Europe could be because the US has a number of states with integrated utilities and largely state-owned monopoly utilities so distribution businesses are not standalone entities servicing third parties across the value chain.

[6] The Accenture Digitally Enabled Grid 2016 survey was conducted between September 2015 – January 2016. Respondents included utility executives involved in the decision-making process for smart grid-related matters in their company. Utilities represented: 65% integrated, 35% standalone

3) **Market model approaches to achieving the new distribution model in the next 10 years.**

A fully open competitive markets for services could potentially provide the greatest degree of optimisation in the long term. However, in the shorter term the practical constraints such as data availability, network visibility, customer sophistication etc. mean that a more pragmatic balance of competition and regulated incentives is likely to be a more cost-effective approach. The executive survey indicated that industry executives expect a blended approach to be the most likely within a ten-year horizon.

68% of executives believe that a blend of regulated incentive mechanisms and competitive market approaches is the key to encouraging new distribution optimisation services in the next 10 years.



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