A New Zealand perspective

*December 2016*


# *Capturing value from disruption*

## Technology and innovation in an era of energy transformation

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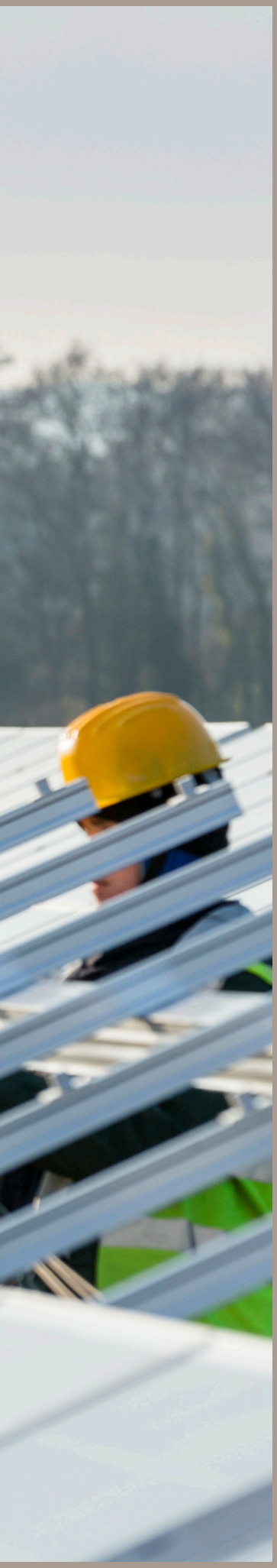


# Introduction

***In the next 20 years, more innovation will occur in the global utilities sector than has occurred to date since the time of Thomas Edison. Whether New Zealand enjoys the promise of this innovation depends on how domestic utilities and consumers embrace the potential of new technology as the vanguard for industry evolution.***

***PwC's global power and utilities centre of excellence prepared the reports 'Capturing value from disruption' and 'Customer engagement in an era of energy transformation' to assist companies in the fast-changing power utilities environment.***

This supplemental report considers how the global scenarios and customer trends could play out in New Zealand's power sector and the challenges and opportunities they present.

The pace of technology-driven change is accelerating globally and no aspect of the value chain is likely to be unaffected. From a scale-driven, centralised and standardised model, the sector is expected to evolve to one that is digital, distributed and personalised.

Our perspective on the fundamental questions underpinning industry change are set out in figure 1.

Figure 1
*Perspectives on technology change*

| | |
|---|---|
| 1 **Is it all just hype or is it real?** | ▪ While underlying technology economics are still evolving, the cost curve gaps to conventional offering parity are rapidly shrinking |
| 2 **Are technologies really disruptive?** | ▪ While underlying technologies are still evolving, their impacts on customer premises, buildings or sites are significant revenue disruptors |
| 3 **Will it really matter to customers?** | ▪ There is a shift underway in fundamental behaviors as non-utility engagement experiences create higher customer expectations |
| 4 **Why do I need to think about it now?** | ▪ The pace of technology evolution is accelerating and customers are already developing perceptions on 'who to look to' for innovation |

Technology cost reductions will drive part of this shift and be complemented by changes in customer behaviours that reshape the provider–customer relationship. Those companies that recognise and embrace this shift will be better able to find success as a valued, innovative supplier to their customers and partners.

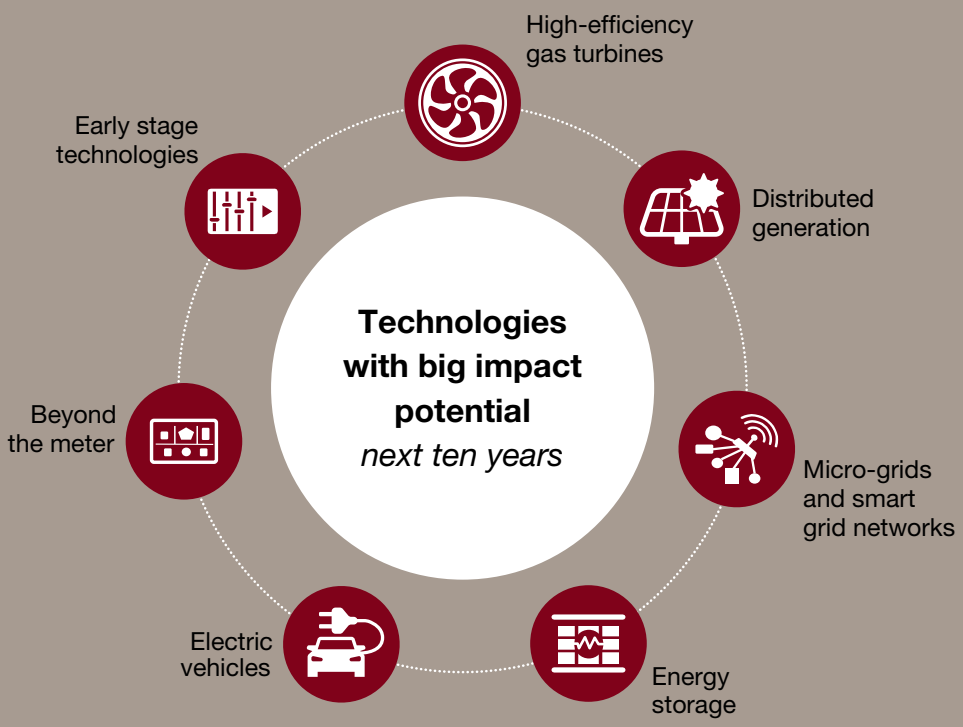
Today's utility CEOs could add significant value by working closely with their leadership teams to discuss the following questions:

- How might disruptive technologies impact our business over the next five to ten years?
- What should we do to capture value from these disruptive technologies?
- How do we leverage disruptive technologies to create competitive advantage?
- What can we do to build a sustainable innovation capability that supports new business models?

The technologies that are likely to drive disruption and change in the utilities sector over the next 20 years are illustrated in figure 2.

This report paints a picture of how five possible future scenarios (among many possibilities) could unfold and affect utilities as technology evolution pushes forward. It then takes a look at the customer of the future. It concludes with an assessment of what it will take to win in tomorrow's market and, in particular, the need for utilities to think differently about how to embrace innovation as a market enabler.

Figure 2
***Technologies with a big impact potential – next ten years***



# Possible futures

*What could technology breakthroughs mean for incumbents and new players in the market? Whether companies are providers of power generation, managers of an electricity network or retailers of power and energy solutions, evolving technology could have a significant impact on their businesses. We've examined how five possible future scenarios could affect utilities as technology evolves.*

***These scenarios are not mutually exclusive nor collectively exhaustive, and we've simplified them wherever possible. None of them will occur exactly as described, but each one contains some elements of what the future could hold.***

The future will more likely reflect a combination of some of these scenarios, in whole or in part, or in different time frames. There may also be different scenarios that emerge that take the industry in other directions as unforeseen events occur.

## Our five scenarios

| | |
|---|---|
| 1 **Losing touch** | A future where utility companies lose touch with their customers as other players take control of the customer energy hub. Incumbent utilities provide simple delivery of wholesale energy at the cheapest price, with the energy 'hub' performing all routine and value-added functions for the customer. |
| 2 **Off grid** | Leveraging the growing availability and falling costs of economic micro-generation and micro-grid technologies, a significant proportion of individual customers invest in premises-based generation equipment and storage. The grid becomes more akin to a source of back-up power and utilities face a number of dilemmas on what role to play in a more diversified power system and how to maintain underused and costly infrastructure. |
| 3 **Mobile and virtual** | Electric vehicles become the norm, creating the need for new infrastructure investment and the opportunity to use vehicles for mass energy storage. Local utility networks and circuits face tremendous strain. Utilities have the potential to capture several sources of value from this scenario but face new competition from a range of other players. |
| 4 **Data rich** | Intelligent sensors collect energy flow and performance data across all levels of the network and regulators require utilities to allow data access to third parties. Value shifts away from traditional utilities toward those that can collect, process, interpret and convert their data to offer tailored energy management services to customers |
| 5 **Scaled down** | Large business customers start to explore installing their own decentralised generation for their own use, scaled to meet needs that grow unevenly over time. As technology continues to progress, smaller and smaller commercial and industrial customers migrate toward a new era of 'site-based' generation. Traditional utilities play less of a role with large energy consumers. |

Figure 3
***Mapping of technologies to scenarios***

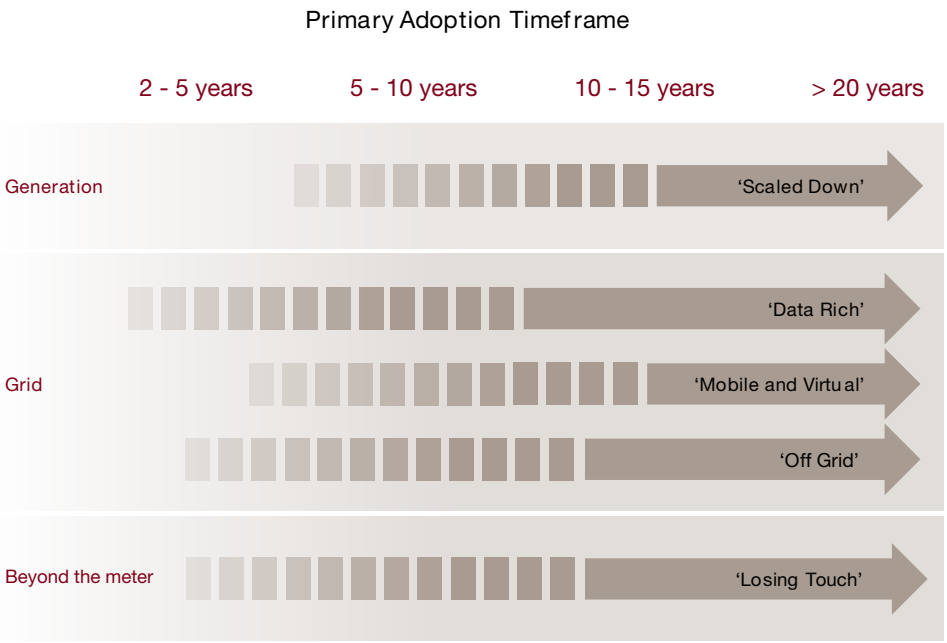
| | 'Losing Touch' | 'Off Grid' | 'Mobile and Virtual' | 'Data Rich' | 'Scaled Down' |
|---|---|---|---|---|---|
| High-Efficiency Gas Turbines | | | | | ■ |
| Distributed Generation | | ■ | | | ■ |
| Micro-Grids and Smart Networks | | ■ | | ■ | |
| Energy Storage | | ■ | | | ■ |
| Electric Vehicles | | | ■ | | |
| Beyond the Meter | ■ | | ■ | ■ | |

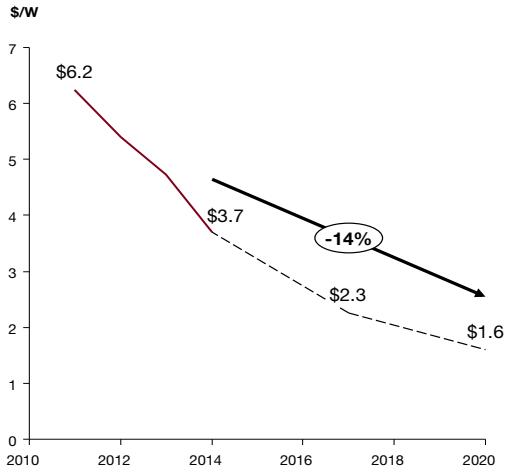
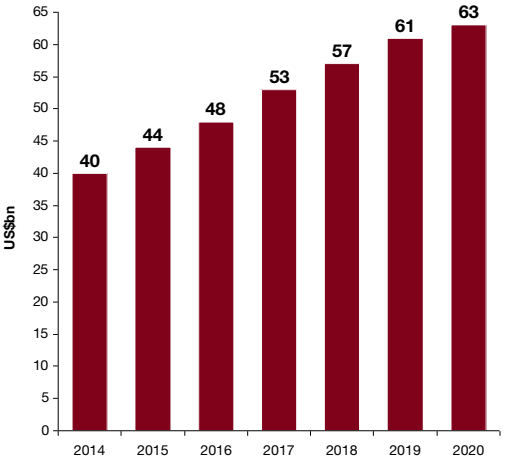
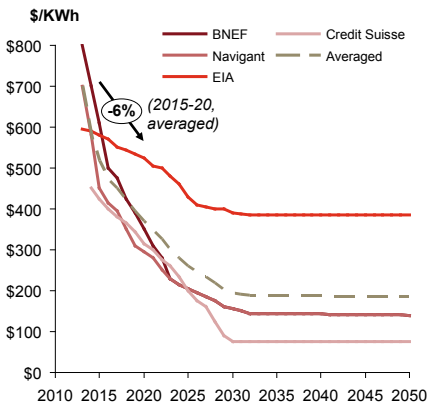
The time frames over which the various scenarios could unfold vary according to technology development, regulatory incentives and /or customer attitudes. Some are closer to actualisation or more likely to occur than others. We expect that the full impact of most of these scenarios are slightly 'over the horizon', but most have a grounding in what is actually transpiring today.

The view of when these scenarios might develop in this imperfect future, illustrated in Figure 4 is not meant to be deterministic, but is rather a view on when the underlying technologies might develop and allow them to happen.

On the following pages we assess each of our scenarios in terms of their technology drivers, the implications they create for utilities and potential utility responses, the customer benefits and the New Zealand context.

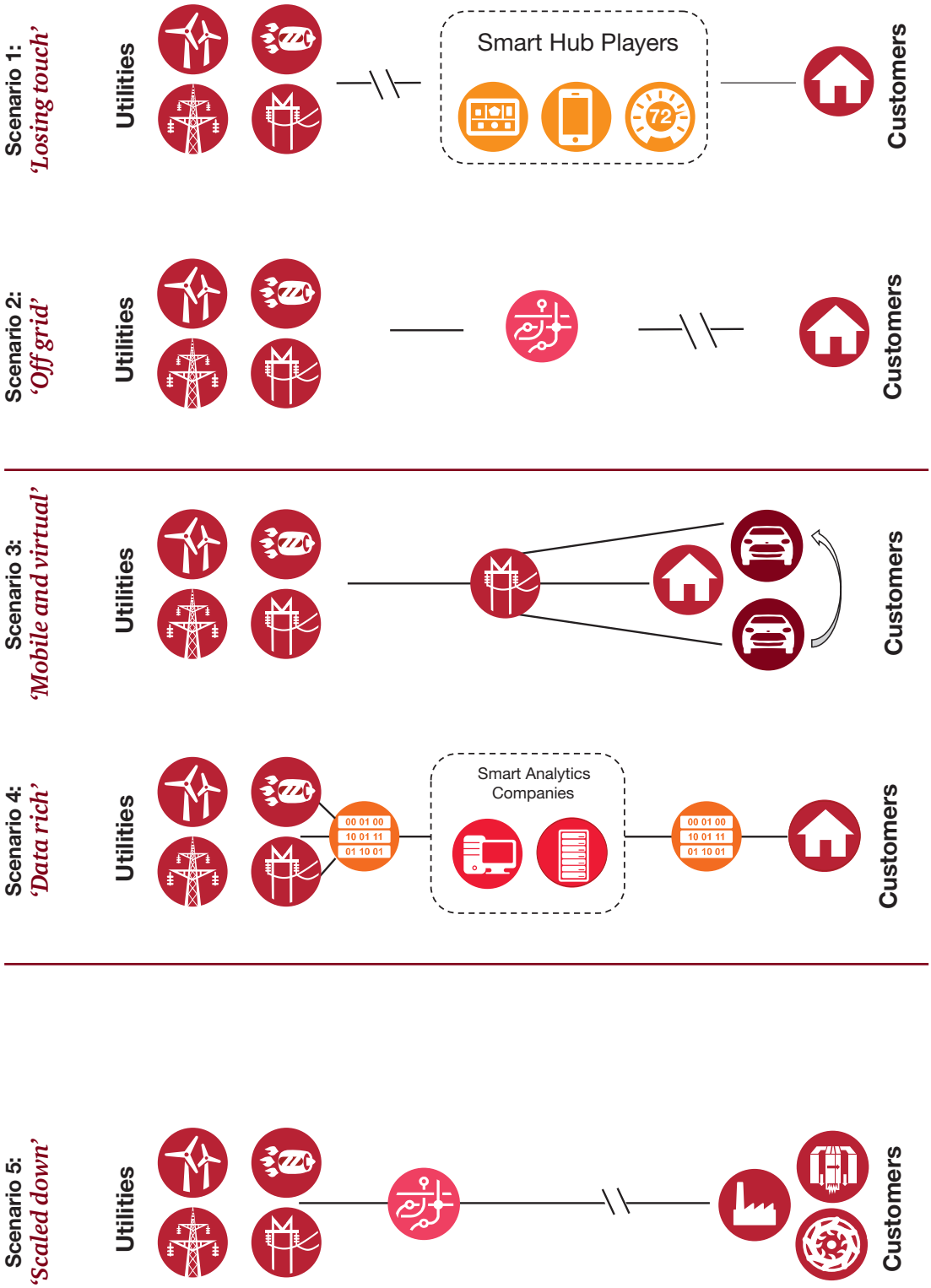
Figure 4
***Mapping of technologies to scenarios***



| | Technology drivers | Key price and market trends |
|---|---|---|
| **Scenario 1: *'Losing touch'*** | Intelligent 'home hubs' manage energy usage of customer devices, taking into account energy available from micro-generation, storage, and demand on the overall network<br><br>The proliferation of smart meters and the 'internet of things' facilitates beyond the meter technologies | **Residential solar PV costs (US$/W)**<br>  <br>**Source:** Source: Credit Suisse, DOE, SEIA, Strategy& analysis |
| **Scenario 2: *'Off grid'*** | There is an increasing number of generation and energy storage technologies that are economic at a community or individual-household level<br><br>In some cases traditional utilities may manage the community micro-grid, although third parties could also perform this function | |
| **Scenario 3: *'Mobile and virtual'*** | Customer uptake of electric vehicles (EV) is driven by battery advances allowing rapid charging (eg 80% capacity in 15 mins) and improved range, helped by attractive vehicle designs<br><br>EVs are loaded with consumer-focused technology for mobility, entertainment, and business | **Global smart grid market ($US billion)**<br>  <br>**Source:** Technavio; Strategy& analysis. |
| **Scenario 4: *'Data rich'*** | Intelligent sensors collect energy flow and performance data across all levels of the network<br><br>Smart meters and other smart devices become near-universal across all networks<br><br>This scenario is driven less by the technology that gathers the data and more by data use | |
| **Scenario 5: *'Scaled down'*** | Generation sources shrink in scale, becoming more modular, efficient and portable, and ultimately cost effective for a wider range of users to install onsite<br><br>These technologies are scalable to more efficiently meet needs that grow unevenly over time | **Lithium-ion battery price projections (US$/kWh)**<br>  <br>**Source: RMI "Economics of Grid Defection," 2014, Credit Suisse, Strategy& analysis** |

| | Implications for utilities | Potential utility response |
|---|---|---|
| **Scenario 1:** *'Losing touch'* | Value from technology deployment goes to the owner of the customer interface (the 'home hub')<br><br>This forces utilities to compete on price, advantaging those with the scale or plant to provide cheaper energy | Preserve competitive advantage by offering their own 'home hub' platforms<br><br>Utilities could act as providers of grid data to the 'home hub' platform operators<br><br>Utilities could also focus on low cost energy provision and being the most valued knowledge partner to customers |
| **Scenario 2:** *'Off grid'* | Falling utilisation of central energy infrastructure results in utilities being unable to fully recover costs from consumers<br><br>The effect is either rising prices or declining quality, or both, creating an even greater incentive for consumers to move entirely off-grid | Utilities could interconnect micro-grids and retain a role in their management and operation<br><br>Utilities maintain the ability to capture value between the edges of various micro-grids, selling excess electricity between them |
| **Scenario 3:** *'Mobile and virtual'* | Utilities will need to make new investments to manage the strain on the network from variability in mobile energy consumption<br><br>There will be a need for dynamic tariffs that provide value and charging security to consumers and price stability and asset recovery to utilities | Utilities could facilitate EV uptake through compelling pricing offerings that help consumers to recognise the full value of what EVs can offer<br><br>Utilities would need to ensure energy infrastructure can handle changes in demand patterns caused by EVs |
| **Scenario 4:** *'Data rich'* | Utilities are challenged by the range of innovation and struggle to maintain relevance with customers<br><br>Value shifts away from traditional utilities, who become disintermediated<br><br>Value shifts to those who can collect, process, interpret and convert data to offer value-added services | Utilities could partner with new entrants to provide energy management and optimisation services based on their customer knowledge and relationships<br><br>Utilities could capture value in other ways; eg using data to better target maintenance and forestall system failures |
| **Scenario 5:** *'Scaled down'* | Traditional supply relationships are disrupted, assets are stranded and supply margins at both the wholesale and retail level are eroded<br><br>Value moves from centralised generation and network assets to those supplying and servicing small scale industrial equipment, and to the industrial customers now producing the energy | Utilities could develop alternative micro-generation offerings with third parties<br><br>Utilities could move from selling energy as a commodity to providing energy management solutions including maintenance and management of business's onsite energy infrastructure |

## Utility–customer interfaces under each scenario



| | Customer benefits | New Zealand context |
|---|---|---|
| **Scenario 1:** *'Losing touch'* | Customers pay less for energy, as 'home hubs' improve energy efficiency, and as providers of electricity and gas are increasingly commoditised and forced to compete on price<br><br>Customers benefit from the range of value-add technologies enabled by 'home hubs' | The 'home hub' product is one that international players may well take the lead in developing and thus dominate market share<br><br>NZ utilities could seek to develop bespoke local solutions that meet New Zealand energy requirements more precisely, or could seek to enter into partnerships with global product leaders |
| **Scenario 2:** *'Off grid'* | Micro-grids offer consumers independence and reduce the need for energy transmission and distribution infrastructure, reducing the fixed costs of delivering energy | Micro-grids are particularly attractive for communities and consumers in remote locations that require significant ongoing investment in distribution infrastructure<br><br>Future advances in micro-generation and storage, combined with decision points around aging distribution infrastructure, may trigger more consumers to move off-grid |
| **Scenario 3:** *'Mobile and virtual'* | EVs provide a lower cost transport solution, with safer driving experiences further enhanced by self-driving vehicle technology<br><br>EVs can be utilised as a household scale battery, particularly during grid interruptions or when electricity prices are high enough to justify drawing down the stored energy | EV adoption is being led through corporate and industrial vehicle fleets and investment in public charging infrastructure. This experience will help consumer acceptance of EVs, and provide an avenue for EVs to filter through the consumer market<br><br>Currently, household uptake of EVs remains low and may be delayed by our traditionally slow rate of upgrading our vehicle fleet |
| **Scenario 4:** *'Data rich'* | There is an explosion of technology start-ups that rush in to utilise the data trove<br><br>Customers receive a range of service offerings from these companies<br><br>Customers benefit from value-added services such as diagnostics, predictive analysis and notifications | There are now over 1.5 million smart meters installed nationally; exponentially increasing the availability of network and customer information. In some ways that was the easy bit<br><br>Many utilities are still working out how to store, manage and use the data to provide better services<br><br>Opportunities are significant but the risk of disruption from new entrants remains high |
| **Scenario 5:** *'Scaled down'* | Reducing grid reliance improves customers' energy security and control over their own energy prices<br><br>New business opportunities may be created where customers can on-sell excess energy<br><br>The ability to build up scale on a modular basis could deliver material cost savings compared to 'lumpy' network assets | Traditional energy supply is still the most efficient solution in most cases, for now<br><br>Some large energy users, such as malls and office complexes, have begun installing large-scale solar PV as solar's energy output aligns well to their energy demand profiles<br><br>Uptake, while small, is gaining momentum |

# Early-stage technologies

*While the technologies currently in the marketplace hold the potential to reshape the electricity industry in perhaps the next decade, the longer pipeline of technologies under development shows that the industry is entering a period of continued change. This will not be a one-time shift, but an ongoing transformation as new technologies are commercialised in ways that test long-held assumptions. There are a number of significant technologies, currently in an early stage of development. We look at three key areas: generation, the grid and beyond the meter, as well as a few of the over-the-horizon technology offerings that could emerge.*

***Generation***

The introduction of new solar technologies, including perovskite-based solar cells, hold the potential to surpass silicon photovoltaic (PV) efficiency. This could finally achieve the vision of low cost, thin-film solar, with potential to print on flexible substrates that could enable building-integrated PV.

***The grid***

An increased focus on improving the resilience and reliability of the electric grid will drive development of new power system models. Open-access power system models will, in the short term, use advanced algorithms to optimise and control distribution and transmission. The US Advanced Research Projects Agency-Energy (ARPA-E) recently announced an initial funding plan for seven transformational projects that optimise efficiency of the grid.

Industrial-scale 'flow batteries', which can store energy in liquid form and quickly recharge and retain charges for long periods of time, are expected to capture a significant share of the energy storage market in the near future. These cheap, large sources of storage may be a welcome solution for large-scale applications at the grid level where lithium ion technology is still cost prohibitive.

***Beyond the meter***

Wireless power charging has the potential to increase the adoption rate of battery-powered devices, including vehicles, which will be critical to maintaining electricity demand that could otherwise decline.

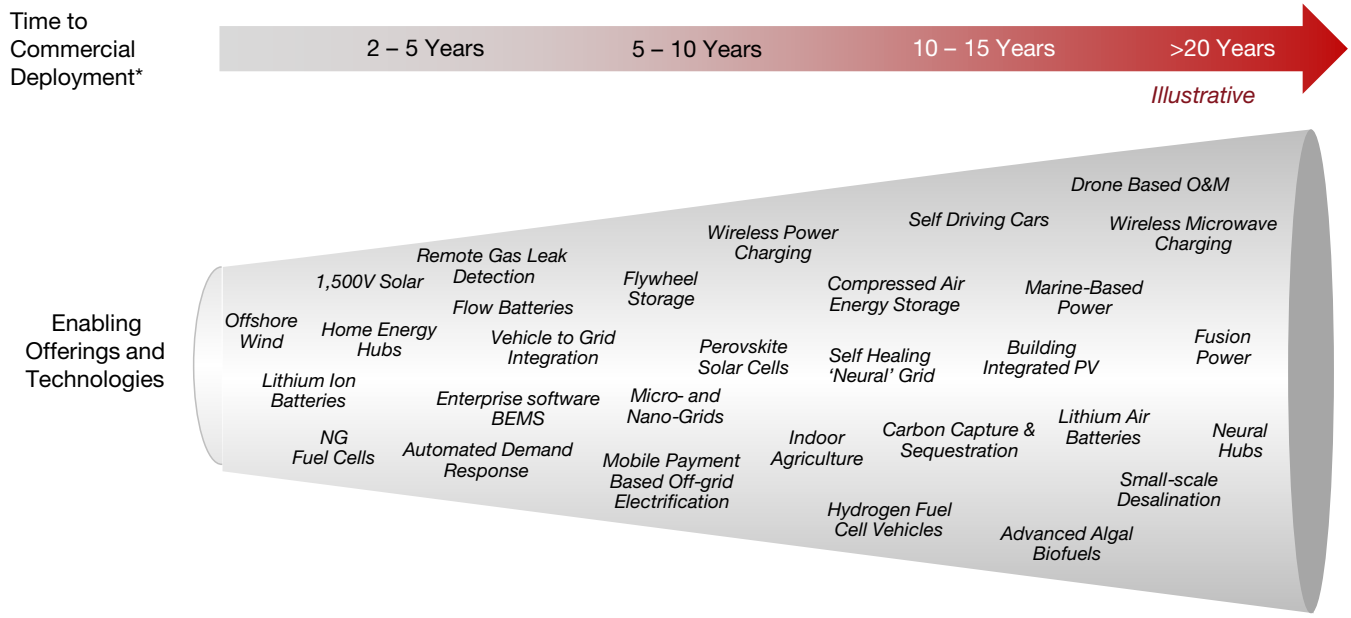
'Energy hubs', which are intelligent and thinking systems that optimise energy device performance and energy consumption, will also emerge as real-time, active and integrated knowledge tools for premises and facilities.

Improved power consumption profiles will also drive a proliferation of connected devices that will finally enable applications that have been discussed for years, including fully automated demand response and energy management. These devices will continue to push the boundary of what is possible behind the meter and create new communication layers utilities to utilise.

***Impact on utilities***

While it remains uncertain whether these early-stage innovative technologies will achieve commercial scale, utility executives must consider that a few of them might. Several Fortune 500 companies, universities and governments are making significant investments in many of these areas, and the wave of momentum behind new energy technologies is unlikely to slow. Since there is no 'crystal ball' to help us figure out which technologies might make an impact in the future, it's important for utilities to think through how these technologies, their customers and the overall market might develop.

Figure 5:
***Early stage technology development funnel***




*Profitable deployment of large volume of assets beyond pilot stage

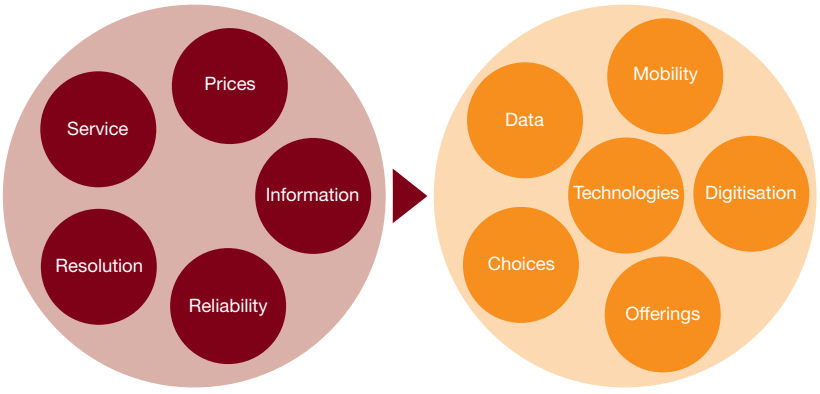
# Addressing the customer of the future

*The traditional customer focus of the industry has been on 'performance-based satisfaction'. Customer strategies that responded satisfactorily to basic concerns of reliability, safety, pricing, information provision and resolution of any problems were sufficient. Now, the combination of energy transformation and technological innovation has led to a more far-reaching set of challenges (figure 6). Customers are developing much higher expectations about how easy it will be to interact with companies in the energy sector and elsewhere.*

***Achieving customer connectivity***

Tomorrow's customers will have more power and choice. Many will expect to be in control of their own energy solutions and they will be looking beyond the existing customer relationship to team up with companies that they feel they can have a partnership with. Alongside them, there will continue to be many customers who, for some time, will be satisfied by a more traditional relationship with their utility company.

Figure 6:
***A more far-reaching set of customer challenges***




The traditional customer focus of the industry has been on *'performance-based satisfaction'*...

...the future focus will be directed to enhanced *'engagement and solutions'*

Reaching the next level in any customer service context requires an improved understanding of each type of consumer's needs and behaviour and better ways of engaging them. In figure 7 we outline a high-level overview of the different types of customer situations that market change and energy transformation are creating.

As we move along the spectrum from passive to active, we encounter a number of motivations for active involvement, including the restless customer who is searching for the lowest price and the best deal, the 'energy manager' who is seeking to take advantage of the potential of new, smarter technology, and the 'energy generator' who is seeking to become more self-sufficient in energy generation and/or storage. There is, of course, significant overlap and movement between these categories.

Each of these types of customer will need to feel that they are at the centre of the utility company's priorities.

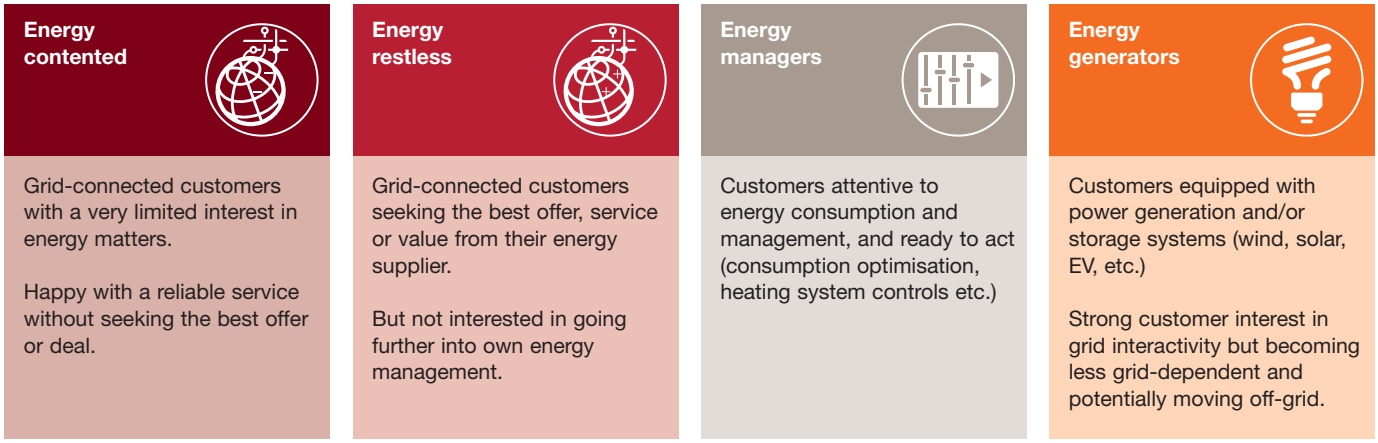
Energy transformation has consequences for customer transformation all the way along the spectrum of customer types. Customers at the passive end of the spectrum are highly valuable to companies as they are less likely to defect or want to constantly seek the lowest tariff.

But there are limits to passivity and such customers will not want to feel like they are being taken for granted. Energy transformation is a threat to retaining these customers as it could trigger more events that could disrupt the customer relationship.

On the other hand, the more data-rich and automated potential that comes from energy transformation offers companies ways to reinforce the value proposition to them, for example by using data to provide reassure that their tariffs are good value or using automation to provide low-involvement energy management services. The new active type of customer will be the growing market of the future, more challenging to satisfy but key to future profitability.

Economic motivations are important across the board but so too are other motivations. For example, lifestyle may be important for residential customers choosing smart home offers, while managerial time and efficiency factors will be relevant to business customers considering building automation and energy management elements of the energy ecosystem.

Figure 7:
***Different types of customer of the future***




***Personalised customer relations***

The size of many large business accounts has meant that utility companies have been able to offer a tailored and fairly dedicated customer service to these entities, covering things such as energy management, energy trading and site-specific contracts. Now technology developments mean that many aspects of this more sophisticated energy service are increasingly relevant to the emerging breed of 'energy managers' and 'energy generators' in the mass market as well.

The challenge is to develop mass market customer offerings that succeed in giving small-account customers the personalisation and individual control that they are seeking while also delivering the required economies, scale and margins the company requires. And, whether it is business customers or mass market residential customers, customer relations have to be characterised by the ease, speed and simplicity of interaction that is now possible on digital platforms.

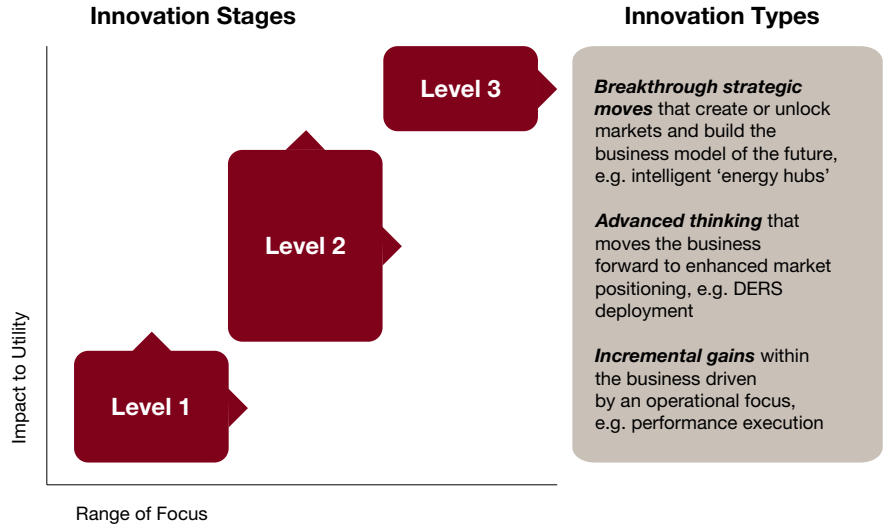
# A whole new emphasis on innovation

*In the emerging future marketplace, innovation will be a differentiator between the companies that will be recognised as market leaders and those that will simply be 'part of the pack'. Ultimately, innovation will become a fundamental ingredient of a company's 'go-to-market' strategy.*

***From incremental to breakthrough innovation***
For decades, innovation in the New Zealand power industry has been focused on asset performance improvement or on developing new renewable generation.

However, the need for innovation in the sector is now extending beyond a focus on incremental improvements, into more advanced thinking about how to move the business forward. Companies that are most advanced in their approach to innovation will have the best opportunities to open new markets (figure 8).

Figure 8:
***Incremental to breakthrough innovation***

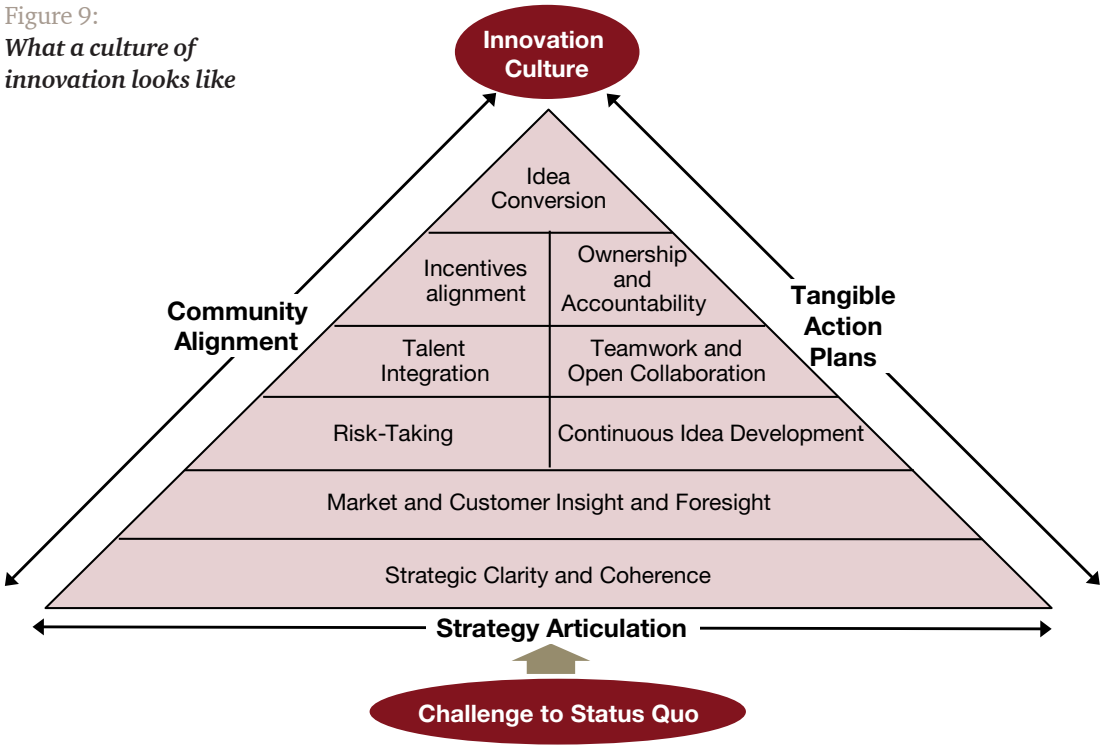


***Organising for innovation***
While executives tend to rightly think that innovation is everyone's responsibility, a business typically needs a specified role identified to evaluate and drive innovative opportunities. Importantly, this role does not need to be responsible for delivery. Too often, companies forget that the purpose of innovation is around developing new ideas, not market execution itself, which is the business unit role.

Companies will also benefit from maintaining connections to new ideas and innovations from outside the organisation. Since companies do not have infinite resources to devote to this task, they may benefit from partnering with third-parties that have a clear focus on new and promising technologies.

***Embedding a culture of innovation***
Building a culture of innovation (figure 9) can challenge the patience of management. Companies should expect this could take more than five years and demand visible and consistent commitment over that time.

Figure 9:
***What a culture of innovation looks like***



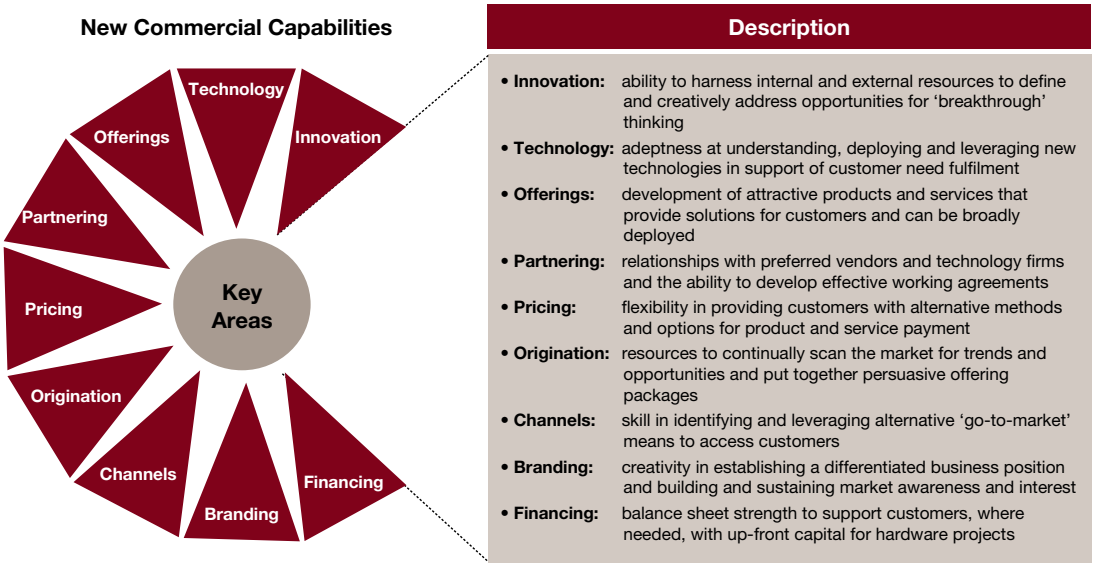
# Winning in tomorrow's market

*In tomorrow's utility market environment, maintaining strategic flexibility will be a valuable advantage, given the high degree of uncertainty over future direction, pace and conditions.*

As technology evolves and customer behaviours change, incumbent utility roles will need to evolve in tandem. From a legacy of gradual acceptance of new technologies to one of rapid adoption of emerging technology and continuous optimisation of business models, the future utilities industry will need to accelerate its own pace of change.

Just as there are uncertainties over the future availability, economics and performance of future technologies, there are also ambiguities about where, when and how utilities will respond to or capitalise on these technologies. This uncertainty will not be resolved in the near term. Utilities will need to learn to be adaptive to market conditions and comfortable with ambiguity.

Figure 10:
***Capabilities for winning***



Utilities have choices on how they will choose to leverage technology disruption. They could participate in a passive, deployment-only mode, or play an active market and customer-enablement role. In the latter they could use available technology to create new revenue streams from emerging products and services. Utilities will be able to select from alternative business models from narrow and specialised participation to bundled, end-to-end services. Alternatively they could adopt a highly asset-focused business model.

How much the utilities industry benefits from expected technology and innovation change depends on how each company views its place within the emerging landscape.

Utilities have a golden opportunity to transform how producers and consumers alike think about energy, its use and its value. Companies that can do this will survive and thrive in a future that no-one imagined was possible just a decade ago.

# Get in touch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