OPERATIONALISING SMART METER NETWORKS: BENEFITS FOR UTILITIES AND THEIR CUSTOMERS

Tony Wise – Smart Meter/AMI Lead APAC, Jacobs Engineering Pty Ltd

ABSTRACT

In March 2019, James Bevan, the Chief Executive of the UK Environment Agency, described the"Jaws of death – the point at which, unless we take action to change things, we will not have enough water to supply our needs." In the UK, that point is projected to occur around 2040.

That was a massive wake-up call, especially given the perception that it always rains in the UK.

New Zealanders have a unique cultural relationship with water, and New Zealand has a relatively high average annual rainfall. With limited storage and relatively high-water use, many councils and water utilities face a similar scenario to the UK, where water demand is projected to exceed supply.

It's been estimated that 21% of water supplied to urban areas is lost on the way to its end-use (Transforming the system for delivering three waters services June 2020). Leaks can exist for months or years before being found. Also, customer-side leaks contribute to waste and higher demand. In Wellington, significant capital expenditure could be required as early as 2026 to meet the potential growth in water demand.

This paper summarises the benefits, challenges, and reality of deploying Advanced Meter Infrastructure (AMI). It explores how to move on from trials to delivering a meaningful reduction in water demand.

AMI networks can be essential in identifying and locating leaks in a water distribution network. AMI can also help councils identify customer leaks, reducing demand and preventing damage. Councils can also share timely and accurate customer water use information with customers empowering them to understand the linkage between behaviours and their actual water consumption. Yarra Valley Water found that about 8% of all customer properties had some form of a leak and learned that most customers appreciated being told about leaks on their properties. These communications contributed to an increase in customer satisfaction with Yarra Valley Water as a utility provider.

Successfully implemented AMI programs typically require a business case that identifies benefits, including reduced operational costs and improved customer communication and engagement. The business case also serves as a mechanism to identify business requirements and further define the project's specifics.

Designing, specifying, and selecting suppliers is also complex. Smart metering is the ‘toughest of the tough’ Internet of Things (IoT) use cases. Several technologies, including wireless, metrology and IT, are used to make up a successful AMI solution.

Meters are expensive, located in harsh environments, and must last up to 15 years to make the business case work. Low-power wireless technologies such as Bluetooth, LoRa, Sigfox, and NB IoT have leapfrogged each other over time. Getting the communications and metrology technology right are some of the biggest challenges.

Many utilities examine Smart Metering with trials. These are useful to see the benefits firsthand and understand the challenges. However, trials are a means to an end without clearly articulated success criteria and a predefined path forward. They don’t provide a water utility with the ability to operationalise the benefits of an AMI system. Establishing a successful long-term project that ‘holds the supplier's feet to the fire’ and ensures the appropriate parties own the risk factors such as battery life is critical. This paper explores how this can be achieved.

KEYWORDS

AMI Smart Meter IoT Digital Water Customer Engagement Leaks Business Case

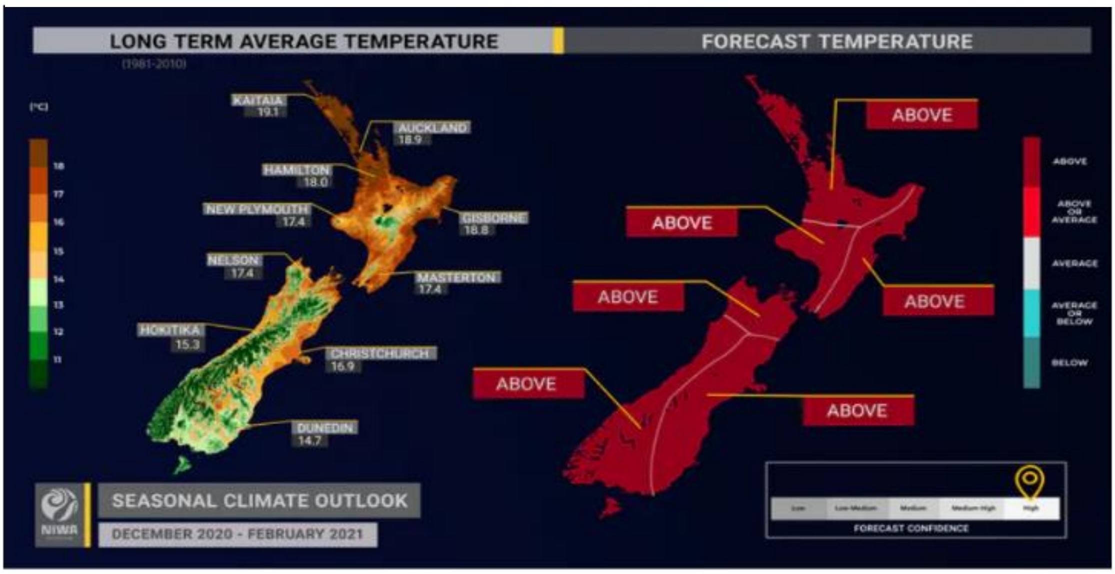
INTRODUCTION

It was in 2019 that the Chief Executive of the UK Environment Agency, James Bevan, publicly stated that, barring a significant change, Britain would run out of water in less than 30 years. Likening the imminent point of water shortage to the "jaws of death," his statement has become a wake-up call for Britain and the rest of the world. The cultural and geographic differences between Britain and New Zealand are apparent; however, in the case of water supply and demand, there are surprising similarities. Like the UK, New Zealand is experiencing climate change and population growth, significantly impacting the islands' water supplies.

NEW ZEALAND'S DWINDLING WATER SUPPLY

There is a great deal of evidence to show that New Zealand's water supply is quickly diminishing. Temperatures are increasing across both islands, and evaporation rates are rising, reducing the amount of water that remains in the soil, aquifers, catchment areas, and dams. According to the New Zealand Ministry for the Environment, annual precipitation has been below average in nine of the years between 2000 and 2014 (The Ministry for the Environment and Stats NZ, 2020) and droughts are becoming more severe and frequent in the Wellington region, particularly in the Wairarapa (Greater Wellington Regional Council 2021).

Figure 1 Season Climate Outlook December 2020-February 2021 (Greenhalgh, O'Brien, et al, 2020)



Since the beginning of 2020, Auckland has received significantly less rainfall than usual, and by 15th April 2020, the total volume of water stored in their local dams dropped below 50% for the first time in more than 25 years. In February of 2021, they instituted outdoor water use restrictions for the first time in over 20 years, even though they were hitting their conservation goals because the dams that provide two-thirds of Auckland's water in the Hūnua and Waitākere ranges were only 60% full. Between 2019 and 2021, the average rainfall across all of Auckland was 2088mm, compared to the typical 2798mm. This 710.5mm deficit severely impacts the storage and availability of water across the region.

GROWING WATER DEMAND VS SUPPLY

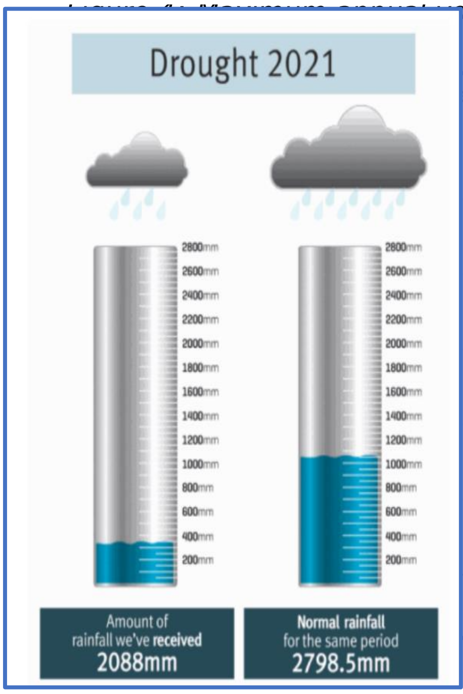
As a result of this significant climate change and population growth, the renewable water resources in New Zealand have been significantly decreasing per capita. In 2017, there were 69,486 m^3 per inhabitant per year, down from 132,015 m^3 per inhabitant per year in 1962 (Worldometer 2021). An initial 10% reduction in demand would be required over the next six years in the capital to offset growth over the same period, the same as a reduction of 40 litres per person per day in gross demand (Ornaghi, C. and Tonin, M. (2021).

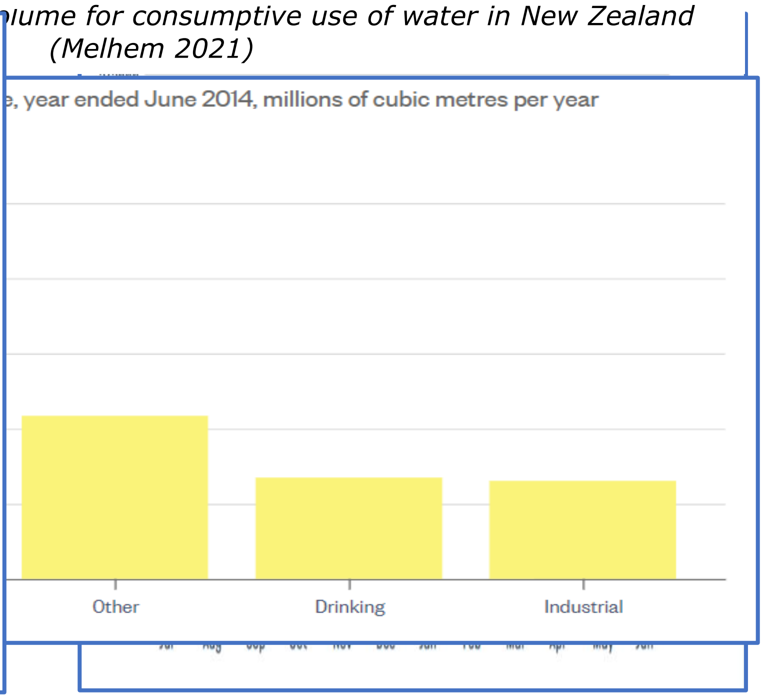
As the country's hub of business and home to two-thirds of the population, Auckland grew by 187,000 between 2013 and 2019. The population is projected to continue, with a projected 2.4 million living in the metropolitan area by 2051, up from today's 1,630,092 (Niall, 2021; World Population, Auckland, 2021). Much of the population is taking conservation measures very seriously; however, with hotter and dryer summers, the growing population consumes more water, even with individual reduction efforts, pushing the demand for water (Watercare 2021, p. 12).

Figure 3 Auckland rainfall From November 2019 to 5 July 2021 (Watercare 2021)

Figure 2 Average daily demand by month (m^3) 2009 – 2021 (Watercare 2021, p. 12)

lume for consumptive use of water in New Zealand (Melhem 2021)





In Wellington, the population has grown ~5.3%, increasing from 395,695 in 2013 to ~416,828 in 2021 (World Population, Wellington 2021). Outpacing the individual consumption of Melbourne residents, who use ~150 litres per day, Wellingtonians consume ~220 litres/day (Woolf 2021). Water demand is not only increasing from residential use. Water consumption continues to expand within the agricultural industry, with 2014 figures noting that over 5 billion cubic metres of fresh water were taken from ground and surface water for irrigation (Stuff 2021). Between 2002 and 2017, New Zealand's irrigated land doubled and now takes up half of the country's freshwater use (Melhem 2021).

LACK OF STORAGE AND TREATMENT FACILITIES

With continued higher temperatures and evaporation rates, the more prolonged and more frequent drought conditions are reducing the amount of water that contributes to New Zealand's natural resources (rivers, lakes, underground aquifers, snowfields, and glaciers), as well as man-made dams, reservoirs, and rain catchments. The downside is that these projects are costly and have other environmental and operational implications. For instance, desalination plants could provide an additional option for potable water. Still, a recent project considered by Watercare determined that the 50,000 litres of diesel fuel per day that it would consume, adding 140% to their annual carbon emission operations, the $18m increase in operating costs, made this a project it could not financially or logistically pursue (Niall 2020). Watercare has invested over $209M to combat the effects of the drought and supply water and wastewater to over 1.7 million people (Neilson, January 2021). This, however, limits the amount of debt they can take on that they could invest in infrastructure that would help them monitor both usage and any leaks in aging pipes. It is estimated it will need to double water rates over the next decade to pay for those improvements (Neilson, February 2021).

WATER LOSS (LEAKAGE)

Because of the expense of expanding water resources and storage, expanded conservation efforts and accurate monitoring of actual use, identifying leaks or breaks in pipes, or even out-of-proportion use, are needed to ensure that the continued demand will be able to be met.

An economic report conducted for the Wellington Water committee indicated that it is not just a change in behaviour that needs to occur; immediate infrastructure improvements need to be implemented to conserve and protect the water sources. The amount of water being lost through the water networks across the country is estimated at anywhere between 6 and 31% of the total water volume that has been treated and supplied. (Wellington Water 2021). In June 2020, a report was released that an estimated two billion litres of drinking water had been lost to leaks in Wellington's pipes in the last year (MacManus 2020). Approximately 30% of the Queenstown Lakes District's public water supply is lost to leakage (Heiler & Barnes 2014).

These numbers are estimates since effective leak management—identifying, targeting, and repairing leaks—is difficult without detailed knowledge of where water is flowing at any time. The fact that many consumers do not have meters further reduces the ability to address leak problems. Auckland (as served by Watercare Services Ltd) has universal metering, serving a population of 1.3 million; outside Auckland, around ten Councils use universal metering and volumetric charging in whole or part of their jurisdictions. The number of people served by these universal metered supplies outside of Auckland totals about 250,000. This means that only about 40% of the population served by community water supplies in New Zealand are metered (Fraser, 2012).

Undoubtedly, universal metering can be used to manage demand, and it makes estimating the extent and location of losses so they can be addressed much easier. For instance, Hamilton, Wellington, and Dunedin don't have meters, but Auckland, Christchurch and Tauranga do. Statistics from Water NZ for 2018 also show Hamiltonians use 40 per cent more water per capita than Aucklanders do: 224 litres per day vs 160 litres per day. Water NZ data also showed that Wellingtonians used 229 litres per day, or 43 per cent more water than Aucklanders. Dunedin residents used over 30 per cent more than Auckland, with 212 litres (Fonseka 2020).

AGING INFRASTRUCTURE

There are reliable indications that substantial investments are needed in the country's water storage, distribution, and tracking (metering) infrastructure to better meet water demand. Across the nation has evidence of aging, failing infrastructure, and awareness of a multi-billion-dollar national infrastructure deficit. These capital investments are outside of the means of New Zealand's small, local water providers—approximately 100 of them, which are run mainly by city councils.

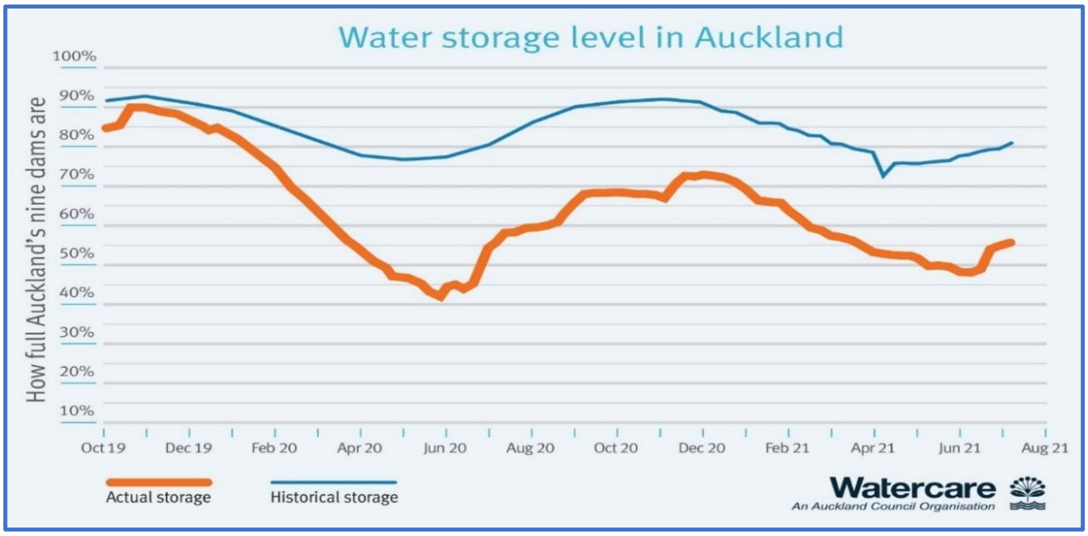
Early analysis commissioned using publicly available information on council assets, finances and connected properties found a conservative estimate of $34 billion to maintain and replace the existing asset base due to ageing infrastructure; a minimum of $27 billion of additional investment (in addition to the above) required over the next 30 years to upgrade existing three waters assets to meet environmental and current drinking water standards. These estimates did not allow the investment needed to meet population growth or address resilience issues. The current council spend is $1.5bn annually or $45bn over the next 30 years (Te Tari Taiwhenua | Department of Internal Affairs 2021, p. 16).

The requirement to provide water infrastructure for growth and economic development and the inability of some councils to meet the substantial associated costs.

WATER DEMAND WILL SURPASS SUPPLY IN 2026

The indications from climate studies, overburdened treatment and storage facilities in the face of population growth and evidence of water loss are that demand will soon exceed supply in New Zealand. According to a report in the New Zealand Herald (Campbell, 2020), Wellington's demand for water could outstrip supply by 2026.

Figure 5: Water storage level in Auckland from October 2019 through August 2021
(Watercare, Total Water Storage 2021)



Despite the dire news for New Zealand's water resources, some progress has been made in public policy on the water environment. Improved water management now sits high on the political radar. It is slowly becoming recognised that citizens need to use less water and use it more efficiently. Part of this will require technological innovation; that is, technologies that will help each consumer to become more aware of their consumption patterns and help utilities better manage the systems that distribute this precious water to those who need it.

ADVANCED METERING INFRASTRUCTURE (AMI) AS A POTENTIAL SOLUTION

To avoid severe water shortages across New Zealand by 2026, storage facilities and treatment capacity will ultimately need to be expanded. Doing so, however, will take time, require coordination across different regions, and will surely drain funding resources, especially for smaller councils, far into the future. Unfortunately, the country's water situation does not have the luxury of time to wait for additional capacity.

Equitably and effectively protecting existing water resources, in line with cultural norms and customer proclivities, could be enabled by effective demand management. Measures like cutting down on system and consumer leaks, increasing metering, and advancing conservation will be crucial to water management in New Zealand.

Deploying an Advanced Metering Infrastructure (AMI) solution across the country offers a more immediate, less costly, sustainable, and culturally amenable solution to New Zealand's water supply challenges. It is a technology that can n provide accessible information to quickly target and remedy leaks in the system or consumer facilities where they exist, and provide detailed customer usage information, tailored alerts, and accurate billing to support equitability issues and inspire conservation behaviour change.

AMI FUNCTIONALITY

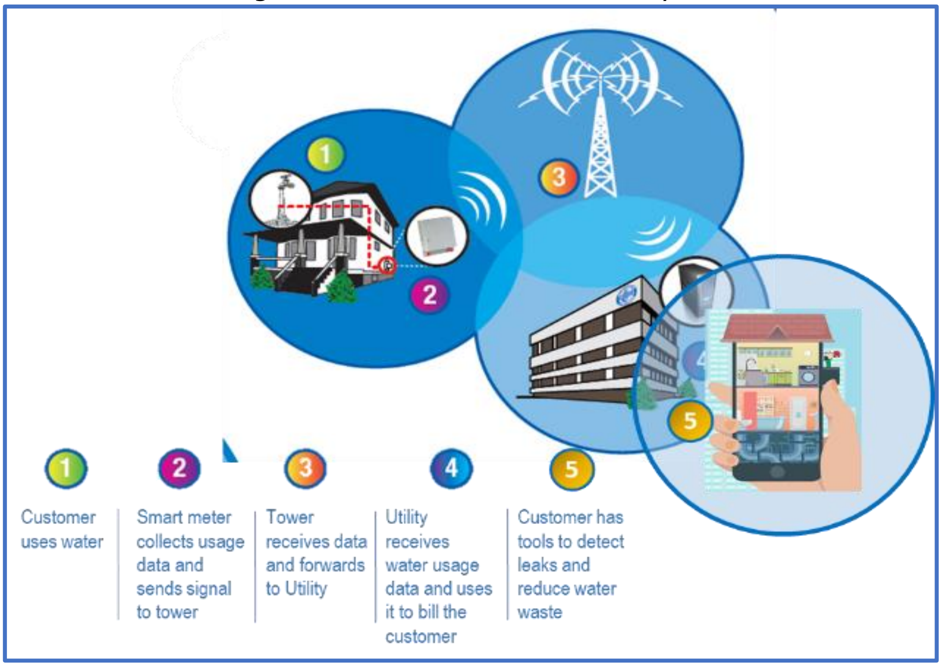
Advanced metering infrastructure (AMI) is an integrated system of smart meters, communications networks, and data management systems that enables two-way communication between water utilities and their customers. The first water AMI technologies were introduced more than 10 years ago in North America as the next evolution in automated meter reading (AMR) and an improvement to the meter-to-cash (M2C) process. AMR advanced the M2C process from recording reads manually to automatically transmitting the meter read while the meter reader drives by the meter through the evolution of radio frequency (RF) technology. Further RF advancement introduced the first generation of AMI or fixed base networks. This technology eliminated standard field meters and metering methods and allowed daily meter reading and limited meter events or alarms to be transmitted automatically via a one-way AMI network. Over the last 10 years, the industry has continued to evolve with two-way communication, hourly and sub-hourly consumption intervals, advanced meter events and alarms, leak detection, remote disconnect and other distribution management sensors.

AMI enables several essential functions that are not possible where water meters are read manually or where they have not been installed at all. For instance, AMI allows utilities to measure all customers' water use, detect tampering, and identify potential leaks automatically and remotely. With the addition of various software applications, such as an online information portal or electronic messaging, AMI allows customers to check their consumption, compare it with their household's/facility's previous month's consumption (or against neighbourhood/industry averages) and make informed choices to achieve their water goals or set water budgets. With automated, programmable alerts (emails, text messages, letters, or phone calls), AMI also enables utilities to engage with their customers proactively, offer incentives and send educational messages tailored to a customer's consumption. For instance, the utility can encourage customers to reduce their consumption and learn to identify and fix potential leaks in their homes and businesses.

In short, smart meters that are effectively deployed as part of a complete AMI solution offer utilities the potential to:

- Improve their customer service and engagement efforts in support of conservation and demand management efforts that can reduce the immediate need for additional water storage and treatment capacity

Figure 6: Basic AMI functionality



- Reduce water loss across their systems through proactive leak remediation
- Establish water billing as a transparent, fair, trusted means for charging citizens for the water they use
- Improve their operational efficiency and lower their account management costs
- Collect information about its customers and system performance for better planning and customer program development

CONSERVATION BENEFITS

There is considerable industry evidence to suggest that adding water meters of any kind dampens demand, showing net benefits even in the face of the high cost of bringing them into service. Acute awareness of one's water consumption and the ability to charge an escalating fee for usage above the norm has changed behaviour to minimise use. As one recent example, Ornaghi and Tonin (2021) found a 22% decrease in consumption following meter installation, a considerably higher value than initially estimated. This result implies that the benefits of metering can outweigh its costs.

The positive impact metering can have on conservation is increased by deploying smart technology such as AMI. AMI can boost conservation by providing additional communications, tracking, and analytics that have been demonstrated to encourage water conservation behaviours. Cominola et al. (2021) found that, in an analysis of 334 households, water conservation behaviours promoted by smart meter-based consumption feedback and digital user engagement interventions are substantial and persist over time. In their study, approximately 47% of the metered households achieved a long-term 8% reduction in volumetric water consumption.

The ability of universal metering to reduce water demand has also been proven in New Zealand. Ten years ago, Tauranga City Council (TCC) implemented universal water metering by installing approximately 39,000 meters within its service territory and began charging customers based on volume. According to Bahrs and Sternberg (2010, p. 9), the program resulted in an average demand reduction of 25% and a peak day reduction of 30%, which enabled a proposed water scheme to be delayed by at least 10 years. In addition to the substantial deferment of capital expenditures, fair representation was upheld by ensuring customers pay only for the water they used. With meters, demand management initiatives have also become more efficient and sustainable; Utilities are investigating various supplementary opportunities to enhance further benefits, including smart metering, consumer profiling and water tariff options.

> A smart metering program allows customers to become more socially responsible and monitor and reduce their water use and costs.
>
> For New Zealand's Water councils, metering allows utilities to minimise demand such that they can defer and have more time to plan for necessary investments in developing reservoirs or building treatment plants. Deferment of capital expenditures can often pay for installing a universal metering program that will sustain savings through demand management over time.

WATER LOSS REDUCTION

Previously in this paper, we discussed the extent of water loss in New Zealand due to aging infrastructure that is challenged by leaks in the system as well as on the customer side of the meter. Remedying the situation with concerted leak management programs typically starts with the utility setting up District Metering Areas (DMAs). Each DMA acts as a sub-zone of the network, allowing the flow into/out of each DMA to be metered so areas of higher losses can be identified and addressed.

Creating zones and installing water meters across the country's water network would enable utilities to account for water distribution and identify, target, and prioritise their response to the proper places in the system needing maintenance more specifically. Likewise, placing meters on each customer's home or business facility is fundamental to alerting customers to leaks on their premises so they can act and reduce water waste.

Deploying AMI technology would further benefit this type of leak management strategy. Since smart meters record consumption in hourly intervals and transmit the data at least once a day, utilities can use the data to detect—and identify types of—leaks much faster for targeted action. AMI programs also generally employ a customer portal or alert system that allows the utility to tailor messages based on customer use patterns, segments, or even geographic areas. This helps to devise effective messages that can prompt the desired action and provide helpful guidance in repairing leaks. Hourly consumption data from an AMI system provided through a web portal can allow customers to access information about their water use and will enable them to:

- Evaluate their consumption patterns
- Learn strategies to use less water through direct communication and conservation tips
- Understand the impact of their actions on water usage and corresponding cost and
- Have a better handle on rationing and allotment limits/penalties during droughts.

Britton et al (2013) tested the effectiveness of communication interventions and the attributed water savings resulting from repairing household leaks. The residential leakage communication strategy resulted in a very significant 89% reduction over the study, while the control group receiving no communication *increased* consumption by 52%. The findings suggest that rapid customer leakage identification and communication can reduce citywide consumption by 5–10%.

It must be noted that the extent of the benefits from a leak identification and reduction program will depend on each council's unique situation. The council in Masterton estimated that installing water meters could, over the long term, reduce water loss by up to 30% and demand by 20%. Wellington estimates that a move to universal metering could reduce residential water demand by up to 20%, mainly through identifying leaks in supply pipes and fittings. Typically, the early benefits are reduced treatment and pumping costs. Still, if leakage management is carried out further, it can be used to inform network renewals and prolong the life of existing assets through pressure control. Suppose the supply is faced with a rising demand/or resource constraints on its source. In that case, successfully implementing leakage management practices can directly equate to deferring future water infrastructure investment.

> For metered customers, a smart metering program enables the quick identification and remediation of household or business facility water leaks that, if undetected, could cost them thousands of dollars over a year.
>
> For New Zealand's Water councils, AMI can speed the identification and repair of thousands of system and customer leaks, enabling them to: defer or reduce the need to identify new sources of water, safeguard the natural environment in line with cultural norms, and increase customer satisfaction by helping residents and businesses to remediate their plumbing issues.

REALISING BENEFITS FROM AMI DEPLOYMENT

As discussed in the previous section, deploying smart meter technology can provide utilities with functionality suited to supporting New Zealand's water challenges. Deploying AMI successfully, however, is far from straightforward. The AMI journey is a long, expensive, and complex, from accurately calculating costs and benefits of the program to obtain approvals and funds to identifying and installing the 'right' technology, to operationalising the new technology through organisational transformation and analytical insights.

Even in countries (such as the UK and the United States) where smart metering and AMI have made significant inroads, it is unlikely that a utility would be undertaking an AMI project from a position of experience; meters and AMI devices are designed to last 15-20 years. Most utilities and their staff enter the AMI journey as a novice.

Jacobs has advised utilities across the world, helping them to plan, prepare and successfully deploy AMI solutions. Our recent track record includes more than 75 AMI projects worldwide, representing 8.7 million meters and USD$2.6 billion in capital expenditure. From its position in the industry, Jacobs has seen the development of advanced metering technologies and knows the market is growing and changing rapidly; there are currently 46 million installed endpoints in Europe and North America, with a roadmap to reach 100 million endpoints by 2025.

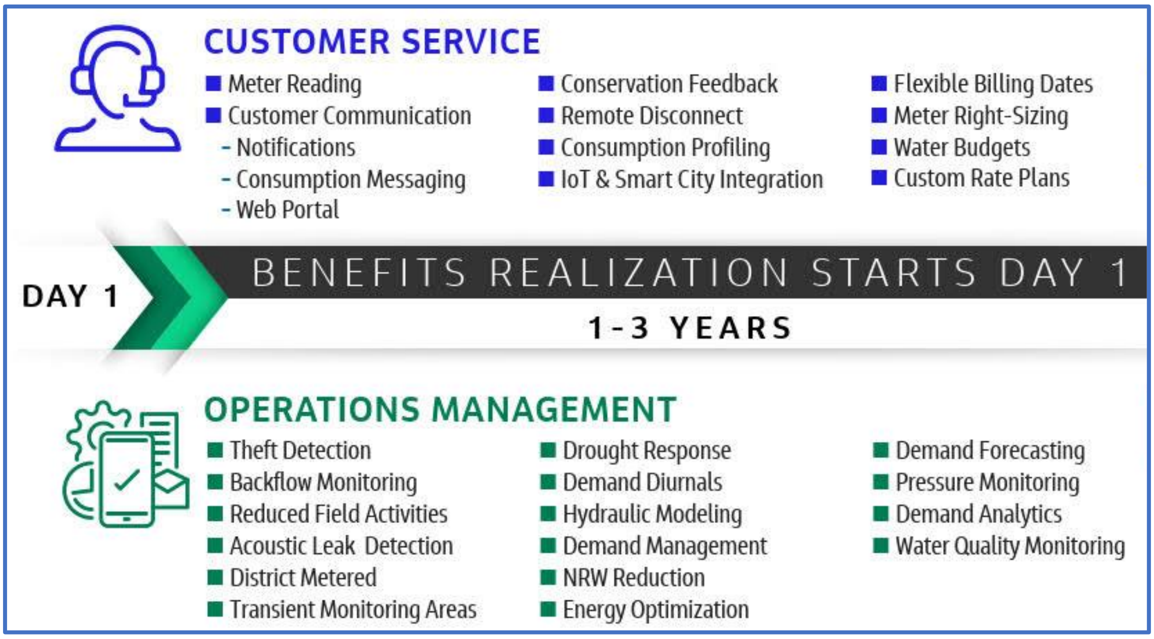
In Jacobs' view, AMI projects differ significantly from other capital/engineering projects with which utilities are more typically familiar. Being acutely aware of the risks and effective ways to mitigate them will improve the utility's ability to realise the technologies' full benefits. Based on its AMI case studies worldwide, Jacobs understands that the most successful utility makes decisions not the based on newest or most advanced but on what suits its operations, systems, goals, customer preferences, and topographical constraints.

This section provides an overview of best practices and critical considerations offered by Jacob's direct experience designing and implementing AMI programs with large and small utilities across the globe.

DEVELOPING AMI VISION

AMI offers many functions and benefits, but not all are relevant to every utility. The foundation of a successful AMI program starts with reviewing and carefully choosing the use cases that align with the utility's vision. Some common AMI Use Cases are provided in Figure 8. This phase of the work helps a utility avoid getting distracted by the myriad of technical options accompanying AMI so it can continually and progressively make decisions based on its business objectives. Identifying use cases is essential to successful projects since they will become the basis for calculating the AMI business case, designing a feasible deployment strategy, and building the technical specifications for procuring the proper AMI meter solution.

Figure 7: Figure 8: AMI Use cases



Understanding that utility operations are complex and inter-connected, Jacobs believes that the most robust assessment and prioritisation of use cases will be informed by input from all areas of the utility, but especially by those that will be directly involved with AMI operations. Typically, Jacobs includes all meter-to-cash functions (meter reading, maintenance, billing, customer service, credit and collections) in its functional analysis but will also extend the assessment into support services such as IT, HR, asset management, and demand management/conservation, and engineering/system planning. Having all these operational areas weigh in on the AMI vision will ensure the appropriate technologies, deployment strategy, and the vendor will be retained.

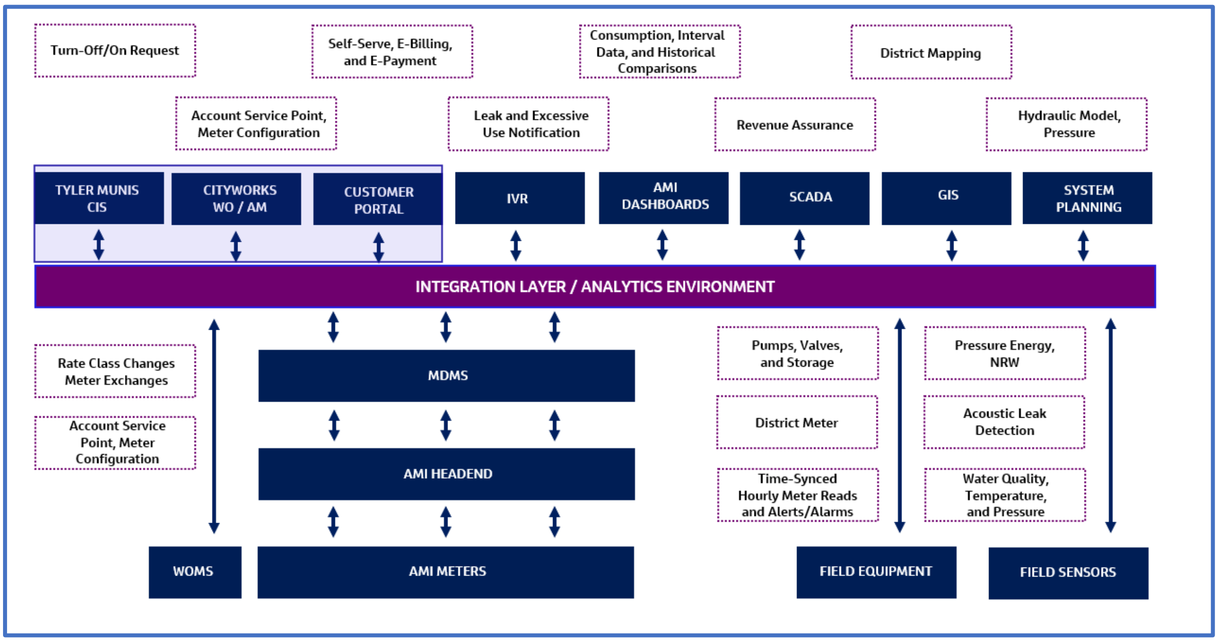
DATA AND SYSTEMS INTEGRATION OPTIONS

The lifeblood of AMI is the data it collects, but unless that data can be translated to actionable information, the utility won't realise the full benefits. AMI can help utilities, for the first time in over 100 years, understand precisely how and when individual customers consume water. This enables a wealth of operational benefits from policy setting around demand management and capital planning to predictive insights on energy optimisation and wastewater treatment volumes.

One of the most critical enablers of AMI is the integration of AMI data so the data can be used for billing, operational analysis, customer engagement, and leveraging the effort of other utility departments. Because of the importance of data integration, Jacobs assists its utility clients in performing a comprehensive assessment of its billing and other systems to identify gaps. By creating an analytics platform that integrates AMI with the utility's other applications, Jacobs delivers utilities, no matter their size, a value-added solution that can unlock operational value from their investment. Jacobs can review correlations between the time of use and utility operations data provided by AMI with various other data sets, such as SCADA data, customer and meter attribute data, asset data, and operation and maintenance records.

As seen in Figure 9, successful integration between AMI and a utility's other operating applications provides excellent value both from the AMI meter reading data and data

Figure 8: Successful integration between AMI and a utility's other operating applications



collected from the field during deployment. It is key to achieving the identified use cases.

COMMUNICATIONS NETWORK

A vital component of any AMI solution is a robust, reliable communications network, which transfers meter data through a collector and delivers it to the utility head end system for analysis and response. Determining the 'best' communication network to support a utility's AMI program is rife with complications, as there are pros and cons with every choice—from proprietary networks to standards-based networks that could allow for third-party devices beyond meter reading to be 'heard' over the AMI network—and decisions must be aligned both to the program's objectives and resources, as well as to the topography, existing infrastructure, and cellular networks within the utility's service territory.

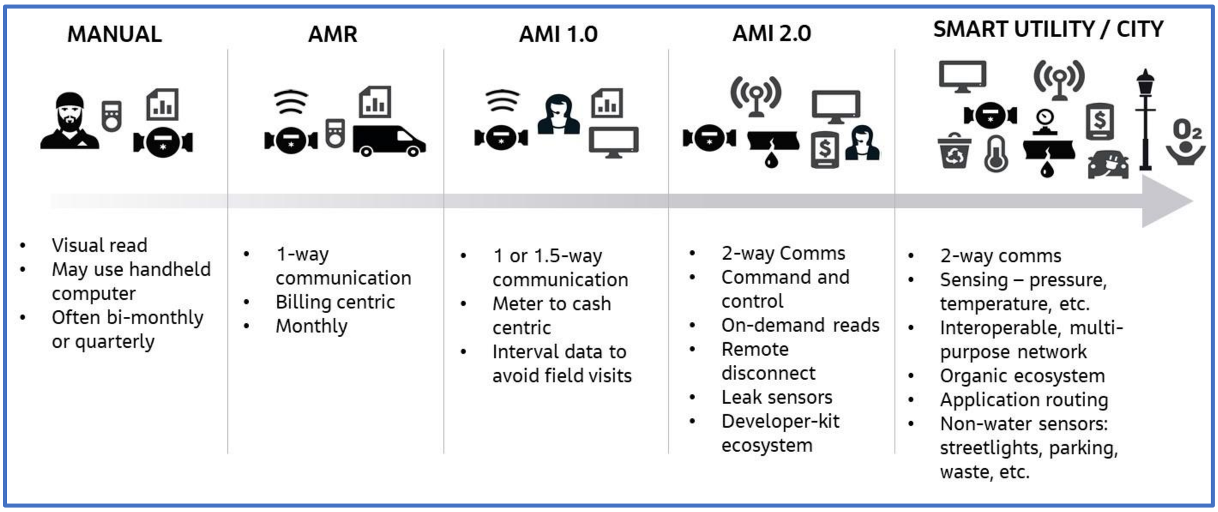
The Low Power, Wide Area Networks (LPWAN) could be

- bespoke and specifically designed for water networks,
- LoRaWAN based on unlicenced 923 – 925MHz spectrum
- NB IOT telco-based services based on 4G and licenced spectrum

OWNERSHIP MODELS

Various network ownership models must be considered when deploying an AMI solution, each with its advantages and disadvantages. It behoves the utility to investigate alternative ownership models which can either provide the ability for the utility to leverage its owned network or benefit from scalability provided by a vendor-owned network. Figure 10 illustrates the evolution of meter reading over the past 10-15 years, related to changes in-network options.

Figure 9: Evolution of AMI/Smart Technology



MAKING THE BUSINESS CASE FOR AMI

AMI requires a significant upfront investment in capital and human resources. AMI technology will also render substantial and ongoing operational benefits—some which are measurable and some that can be difficult to calculate. To help its clients choose the proper technology and deployment strategy and enlist the approval of its governing/funding bodies, Jacobs has developed a model for calculating and comparing the economic feasibility of many advanced metering options.

The primary objective of its AMI business case model is to provide confidence in the potential value of AMI for a region and its customers. The model analyses each potential positive and negative quantifiable impact associated with different AMI scenarios to compare to the base case and determine the 'best' way forward. Real-time scenario analysis allows the utility to evaluate alternatives such as duration of implementation, age of meters to replace, the use of static meters, and the implementation of remote disconnect devices, as illustrated in Figure 11.

Figure 10: Business Case Analysis, including Metering Scenarios

Scenario Controls

◉ NaaS ○ Long-Range ○ Standard — Install Duration: 3 years

☐ Remote Shutoff ☑ Static Meters

AMI Business Case Outputs:	Worst Case	Expected	Best Case
Initial Capital Cost	$52,600,000	$49,100,000	$43,600,000
Annualized Benefit	$5,900,000	$10,500,000	$14,900,000
Simple Payback (years)	10	6	4
Net Present Value	$ 20,300,000	$ 80,500,000	$ 139,400,000
Internal Rate of Return (IRR)	10.2%	22.9%	41.5%

Business Case Elements	Min	EV	Max
Additional Revenue			
AR1: Reduced Adjustments due to Leaks and High Bills	$ 3,200,000	$ 12,000,000	$ 31,900,000
AR2: Improved Payment Culture (Water+Sewer)	$ 3,300,000	$ 6,600,000	$ 9,900,000
AR3: Salvage value - Meters & Lids	$ 700,000	$ 800,000	$ 800,000
AR4: New Meters, Improved Registration - Water	$ 36,800,000	$ 46,100,000	$ 50,700,000
AR5: New Meters, Improved Registration - Sewer	$ 22,000,000	$ 27,500,000	$ 30,300,000
Cost Savings			
CS1: Reduced meter reading costs	$ 24,300,000	$ 26,500,000	$ 27,700,000
CS2: Reduced Field Service Representatives	$ 4,900,000	$ 6,500,000	$ 10,600,000
CS3: Reduced field service vehicle use	$ 500,000	$ 700,000	$ 1,200,000
CS4: Water Savings from Improved Leak Identification	$ -	$ 4,600,000	$ 9,200,000
CS5: Optimized Pumping Costs from Lake Murray	$ -	$ 1,800,000	$ 5,300,000
Avoided Costs			
AC1: Reduced Meter Testing	$ 1,000,000	$ 1,300,000	$ 1,600,000
AC2: Base Case Meter Replacement	$ 5,200,000	$ 13,100,000	$ 13,100,000

Jacobs has used its proprietary AMI business case model for years, performing benefit-cost analysis for small communities to country-wide efforts to determine and demonstrate program feasibility. In addition to justifying the project's financial benefits, the analysis calls out other benefits the utility will realise through the implementation of AMI. These non-quantified benefits are as crucial to justifying the project as the financial drivers and include improved customer service, environmental, and operational benefits.

In a typical AMI business case, the meter change out strategy will define what assets need to be replaced or retained, which, along with the selected technology options, are used for the budgetary cost estimate(s). This strategy includes the initial capital cost for equipment such as meters, meter interface units (MIUs), collectors, installation, project management, IT system integration, and contingency. To complete the life cycle cost analysis, the utility should not fail to calculate ongoing operations and maintenance costs for software as a service (SaaS), backhaul, collector maintenance, etc.

The Business Case results will inform the operational and capital expenses projected over the system's life. This information will support the ability of the city to determine actual costs of service (COS) and how AMI affects them.

PROCURING THE RIGHT SOLUTION

Establishing the AMI vision, functionality/use cases, and business case provide clarity to the utility. These decisions must also be translated into the procurement process to ensure that potential AMI vendors can demonstrate their capabilities and achieve the envisioned strategy and benefits later.

Many proven AMI solutions are available today, but each AMI vendor’s solutions are slightly different across metering products, network communications, software applications and services. The RFP must help the proposing vendors to describe how their particular solution meets the utility’s goals and performance-based requirements, based on value for money, and without being so prescriptive as to eliminate full participation from the market or result in significant price increases.

Jacobs uses performance-based specifications in the RFPs it helps its clients develop, such that the utility is protected and the vendor is held accountable for achieving measurable service levels. For example, network performance language requiring 100% coverage with 72-hour read success of 98.5% and 24-hour interval data availability of 95% are typically needed for AMI vendor performance. Jacobs can then develop meaningful evaluation criteria, criteria definitions, weights, and scoring methodology that will serve the selection committee in its review of proposals. Some criteria that Jacobs has developed in its projects are shown in Figure 12 below.

Figure 11: Typical Vendor Proposal Criteria

Criteria	Definition
Strength of Proposer (25 pts.)	References, experience, financial stability and solvency, revenue growth and profitability, relative R&D investments, and ability to acquire bonding and insurance.
System Capabilities (25 pts.)	Degree to which proposed system addresses technical specifications, performance requirements, and desirable functions.
Ease of O&M (10 pts.)	Ease of ongoing use and maintenance of system, including component installation, programming and repair; use of software; interface with billing system; and diagnostic and reporting capabilities.
Integration Support (5 pts.)	Vendor’s ability to develop, document, and support interfaces with client’s billing system and other IT systems.
Data Management (5 pts.)	Data integrity, security, accessibility, backup/recovery, flexibility, cross system balancing, auditing capabilities, report generation, queries, and non-proprietary interfaces.
Support (5 pts.)	How the Proposer will deliver maintenance and operational support, as well as training. Response modes and times.
Warranty (5 pts.)	Period and extent of warranty coverage on meter reading system components; overall system performance guarantees; protection in the event of excessive failures.
Life Cycle Cost (20 pts.)	Total cost of the proposed system over the expected 20-year life.

This approach to the RFP development and selection places the risk and responsibility on the vendor to propose explicitly how their solutions will achieve required performance levels. It also ensures that the selection remains transparent and consistent, protecting the City from any legal ramifications of the procurement process.

AVOIDING PITFALLS IN IMPLEMENTATION

Once initiated, an AMI project will consist of hundreds of thousands of small customer service transactions and tens of thousands of work orders. The work orders must be executed on schedule with quality to maintain progress and budget. The technology must be installed correctly the first time (to avoid a second visit). The contractor must represent the Council or Water Utility to the highest standards possible by adhering to appointments, leaving a clean worksite, and effectively communicating with customers. For the implementation of an AMI program to succeed, effective program management and individual project management must go hand in hand, which is difficult without prior experience or in an area where AMI is nascent. Jacobs bridges this knowledge gap by providing insight from other successful programs and industry/technological insights and applying it with local intelligence to ensure alignment with the cultural, customer, and operational norms. It is beyond the scope of this paper to address all aspects of AMI implementation. Only key elements that Jacobs believes deserve consideration are described in the section below.

CONTRACT NEGOTIATIONS

During contract negotiations, it is essential to set up the means to hold vendors to their commitments while still recognising that technologies and related costs tend to change quickly. It will be necessary to make allowances, particularly when they present the opportunity for greater efficiency, higher quality, and better integration, or when they threaten to raise costs. For instance, the AMI contract should include a network guarantee for evolving cellular technology, a data collector quantity limit to protect the utility from higher network costs than what was proposed, protection against excessive failures, and other responsibilities the vendor may try to amend through mid-project change orders.

SEQUENCING

The order in which smart meters are installed should not be discretionary or based solely on convenience. Installation work should be strategically planned to uphold equitability standards and facilitate normal meter reading operations in areas where the new technology has not yet been installed. Establishing criteria for completing old routes before allowing the contractor to move into new areas will prevent the contractor from avoiding more difficult installations, facilitate inspections, avoid meter reading redundancies, and minimise disruption to the public.

DATA CAPTURE AND OPERATIONALIZATION

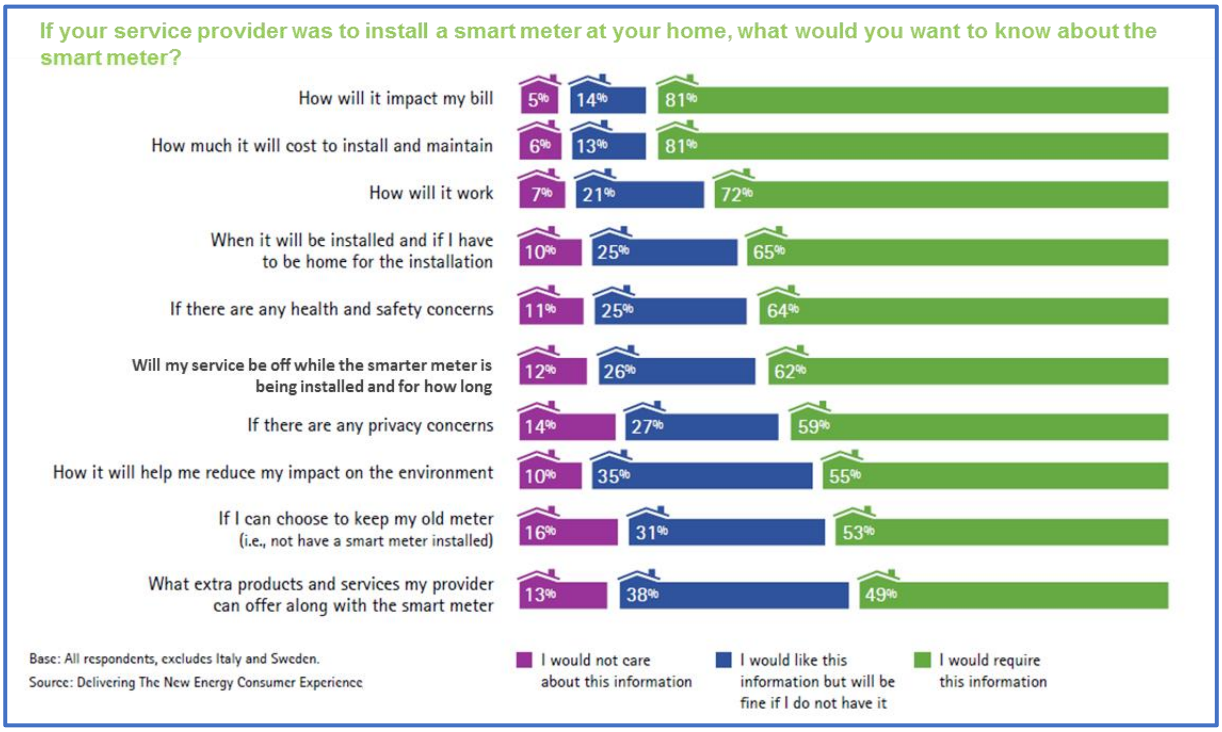
The quality and accuracy of the AMI data collected and reported are of most importance to a new AMI program. A robust program control and monitoring system that considers AMI data quality is critical to project success. Before installation begins, the AMI vendor should be required to build the interfaces between the AMI software applications (work order management, billing system, and customer portal) to share AMI data. The vendor solution(s) must be reviewed for hardware and software architecture, platform, integration, design, configuration, functionality, and scalability that align with the utility's requirements. Once the interfaces are designed, and in place, user acceptance and testing activities must be conducted to ensure workability and compliance. The intent should always be to have the system interfaces designed, developed, and tested before deployment.

ENSURING STAKEHOLDERS ARE POSITIVELY ENGAGED

Industry experience proves that engaging customers in developing and deploying new technology such as AMI is foundational to program success. It not only reduces suspicion and resistance that can cause roll-out issues but also can strengthen the utility's reputation as an organisation that has its customers' best interests in mind. A strong customer relationship will also allow a City to understand its customers' preferences and interests and enable it to introduce and gain positive acceptance of future services. Figure 13 shows the most common areas of interest from the customer perspective that Jacobs has determined as a utility embarks upon an AMI journey.

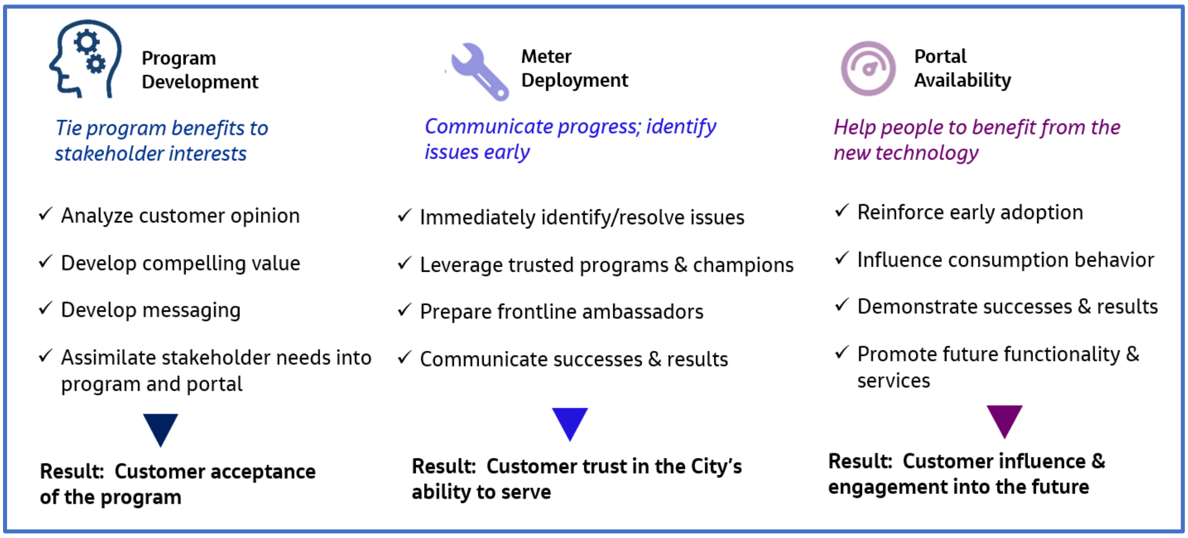
New Zealand has a unique customer base and water service culture, making public engagement of primary importance. At a minimum, the program should establish a positive response by adopting messages that resonate with the local audience. AMI, for instance, is naturally consistent with Urban Water Principles (Nga Wai Manga), the purpose of which is to guide decision-making that promotes sustainable behaviours and the creation of water-sensitive urban spaces. A utility can capitalise on its AMI plans by aligning them to customer interests and preferences.

Figure 12: The customer perspective during the AMI journey



As shown in Figure 14**,** an outreach strategy is based on recognising that customer and other external stakeholder opinion is best managed by activities intended to inform and involve. Such work should start early and continue throughout (and even beyond) implementation.

Figure 13: Outreach strategy during AMI implementation



Assuming that increased water conservation is a crucial objective of an AMI deployment in New Zealand, customer engagement is key to achieving it. Jacob's experience, backed by industry research, has proven that changing customer behaviour towards conservation requires consistent, persistent, real-time information. Helping customers learn to access an associated AMI portal, learn to address any leaks on their property, and adjust their consumption behaviour based on information provided will not happen without a concerted, long-term engagement strategy. Much of the rationale for AMI is based on reducing demand; a failed customer outreach plan may result in a failed AMI project.

PROCESS IMPROVEMENTS AND ORGANIZATIONAL TRANSFORMATION

Another way that AMI programs fail to achieve intended benefits is a lack of organisational preparation and staff engagement. It is inadvisable to introduce new technology into broken or ineffective processes and to staff who are uninterested or resistant to change. This can be avoided through early communication, staff involvement in developing new processes and roles, and training about the latest technology to ensure a smooth transition.

Fundamental to Jacobs's AMI implementation approach, staff insights are always incorporated into the functional analysis and program design. Also, staff are engaged in revamping processes, policies, and job responsibilities that will be affected by adopting AMI technology. Some common procedures to review and adjust to incorporate AMI functionality include:

- Billing exceptions (high use, low use, zero use)
- Leak detection and remediation
- Meter malfunction (failure to communicate; tampering; theft)
- Meter maintenance
- Customer billing inquiries and adjustments
- Conservation communication
- Service activation and transfer of service (turn on/turn off)
- Demand forecasting/System planning
- Virtual and temporary disconnections

A utility organisation post AMI deployment will look and function much differently; by enlisting staff in the design of their future, the transition to new ways of working will be smooth and effective at realising benefits.

CONCLUSIONS

New Zealand is not alone in confronting the challenges brought about by climate change. The higher temperatures, inconsistent rainfall that results in either flooding or widespread water shortages, and reduced snow cover all impact the amount, and quality, of available water. Man-made issues such as increased population across the islands, higher density in urban centres, and changes in farming and irrigation practices intersect, and at times, collide with the philosophical and legal description of water ownership. Water has an intrinsic value, even if the definition of that value is not universally agreed upon.

AMI offers a clear opportunity to protect New Zealand's water supply, helping water providers and their customers to identify and remediate leaks, better manage consumption, and collect information essential to designing new systems and sources that serve increasing demand equitably. Smart metering is a powerful tool that can help us change our behaviours and identify when water is being wasted or unintentionally over-consumed. It is an investment in our water future.

The technology may be new to New Zealand, but it is widely deployed in the rest of the world. By enlisting practical insights from other projects, engaging experts that have learned the hard lessons, and involving stakeholders who can make the technology work within local constraints and expectations, New Zealand's councils can ensure the benefits of AMI are fully realised. It is a realistic, sustainable, and equitable solution to the islands' water supply issues.

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"[Click here to type Acknowledgements]"

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