WATER EFFICIENCY OPPORTUNITIES FOR MID-SIZED UTILITIES

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ABSTRACT

This paper draws on several Water Efficiency strategies recently developed by ISF for mid-size utilities. It describes examples of opportunities being identified by utilities and the approaches applied in analysing the potential for water conservation. In detailing some of the current 'best practice' the paper aims to provide pointers for the water industry more generally. This includes both how to identify areas of water conservation potential and in the design of programs to effectively realise savings. The paper also highlights how advances in digital technologies and data analytics can shift thinking around program design and implementation.

INTRODUCTION

During the Millennium drought, water utilities and government agencies directed extensive resources towards water efficiency programs across Australia. In many regions, these programs proved to be effective as drought responses and also contributed to step change reductions in demand. These structural changes in water use, and subsequent wastewater generation, have meant that existing urban water networks can support larger populations for longer.

With the end of the drought across most of Australia, water efficiency programs either ended or were substantially scaled back. This led, in general, to a reduction in water utilities corporate capacity and knowledge regarding water. A loss of local knowledge was commonly associated with poor data collection on what was done during the drought. This was exacerbated by the multitude of agencies (in addition to public utilities) that ran water efficiency programs, particularly at the peak of the drought.

Due to the substantial water efficiency efforts and gains already achieved in the Millennium drought, there is a perception within parts of the water industry that there are limited remaining opportunities to reduce water demand. Alternatively, some argue that water efficiency is not economic any longer. However, the challenges of urban growth, climate change and climate variability, and sustainability are ongoing, and water efficiency is now being revisited as potential solution in a number of regions. The risk of another serious drought is also focusing attention back on the potential role of demand management in securing supplies, as storages decline.

When revisiting the water efficiency proposition, water utilities ISF have worked with are finding that the perception there are limited opportunities for future demand management does not hold true. This is because previous demand management efforts were far from uniform in coverage and future water efficiency can take advantage of next generation technologies. In particular, future strategies to reduce water demand can and should be built on digital technologies and data analysis. As accurate and reliable data that can be meaningfully and cost-effectively interpreted becomes more readily available, it will be used to design, implement, evaluate and revise effective programs. In addition, there have been, ongoing improvements in the water efficiency of plumbing fixtures and appliances.

Drawing on recent examples from Water Efficiency strategies, this paper outlines how to identify new opportunities for water conservation. The examples are grouped into those that can be found by:

1. reviewing past programs
2. analysing current demand
3. looking to future and emerging technologies.

In doing so, the paper considers the value proposition of increasing investment in water efficiency for medium sized utilities in particular.

REVIEWING PAST WATER EFFICIENCY PROGRAMS

Past water conservation efforts and the uptake of water efficiency programs were far from uniform across many regions and significant opportunities are still apparent, when looked for. Revisiting past programs with new information can help identify remaining opportunities.

Comparative coverage of past programs

In the Millennium drought, across Australia the key focus of water efficiency efforts varied greatly. For example, as shown in Figure 1 South East Queensland had a very high up-take of rainwater tank rebates, whereas Sydney Water invested heavily in household retrofit programs (Figure 2). Although the form of the rebate programs varied between jurisdictions, overall toilet retrofits and rebates were much lower than other more easily replaceable fixtures, fittings and appliances, such as showerheads and washing machines (Figure 3).

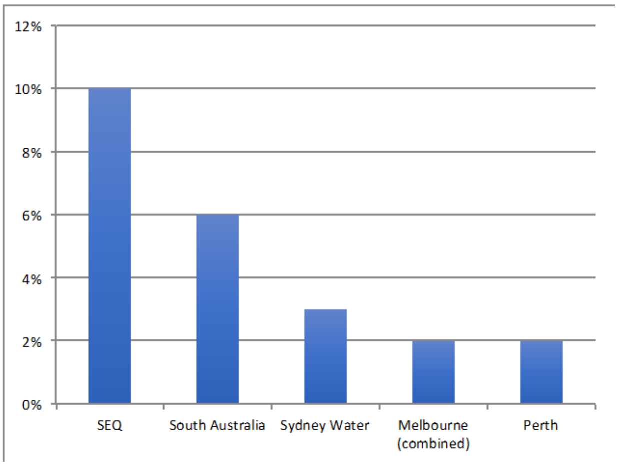


Figure 1: Uptake of rainwater tank rebates as a proportion of customers (adapted from Liu et al 2017)

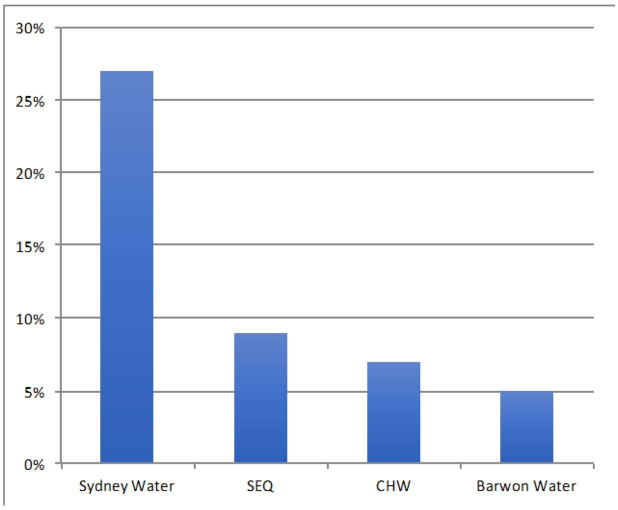


Figure 2: Uptake of indoor retrofits as a proportion of customers (adapted from Liu et al 2017)

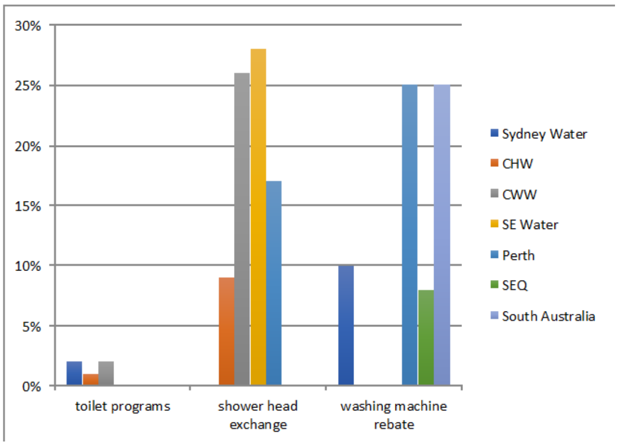


Figure 3: Uptake of a variety of water efficiency programs as a proportion of customers (adapted from Liu et al)

The comparison of uptake rates opens up a number can help identify missed program types and reveal programs that had low uptake in comparison to other regions. Regions without a history of retrofit programs for example may have significant numbers of older housing stock with inefficient fixtures still in place.

As well as analysing comparative uptake for programs, a more general understanding of the history of increasing water efficiency of fixtures and appliances can also be useful. Taking toilets as an example, efficient four WELS star toilets are now becoming the dominant stock in Australian houses and building but were still emerging during the drought (Figure 4). These toilets can lead to substantial water savings (Figure 5), over and above the savings that are achieved by replacing older stock that is more likely to leak.

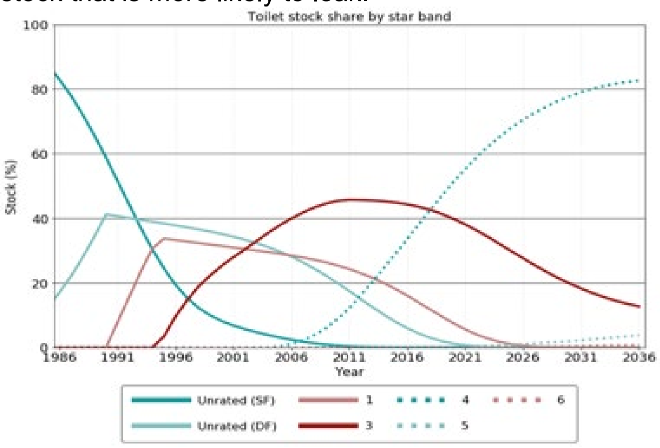


Figure 4: Stock of toilet modes in Australia by star WELS band (Watson et al 2018)

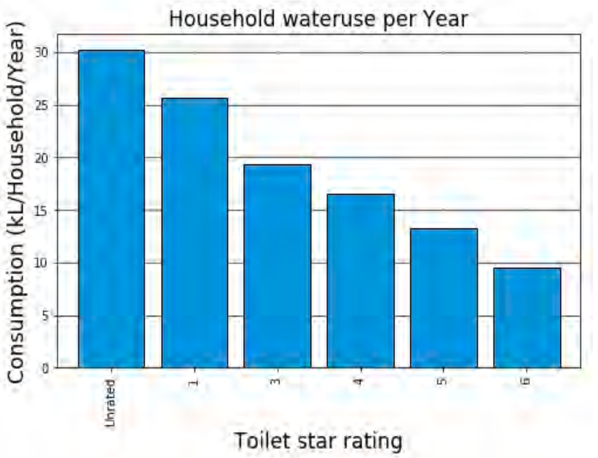


Figure 5: Comparative savings of toilets (Watson et. al 2018)

Table 1 provides a brief history of the changes in the water efficiency of appliances and fixtures in Australia, over time.

As Figure 4 and Table 1 demonstrate, since water efficiency programs were first rolled out at scale over 15 years ago, there have been continuing changes in the efficiency and effectiveness of water using appliances. This means that it is not just a simple case of finding successful programs that had low penetration or were not run in the last drought and applying these in a particular region. An understanding of how a region has developed and where, for example, there are areas of older housing that have not be updated needs to be applied. This type of detailed knowledge of a region is an area where mid-size utilities can have a distinct advantage over larger metropolitan utilities.

Refocusing past programs

The second area where an analysis of uptake rates and a review of past program participants may identify opportunities is redirecting or refocusing past programs. For example, an evaluation of a toilet retrofit program in one area found much lower than expected savings. The lower savings were significantly influenced by single person households dominating the program uptake. A leading practice, data driven program would include early revision embedded in the implementation strategy and this in-built evaluation would likely produce very different final program results.

While the market will naturally drive some change, the change is focused in areas of new housing and higher socio-economics where renovations and replacement happen. This may leave large segments of some communities with much lower water efficiencies that others.

Table 1: Timeline of efficiency events (Watson et. al 2018)

Date	Details
1981	Caroma released first dual flush 11 litres / 5.5 litres half flush
1988	National Water Conservation Rating and Labelling Scheme - voluntary scheme established and administered by Melbourne Metropolitan Board of Works (later by Sydney Water).
1993	AS 3500 which specified the maximum allowable water use per flush for toilets. Caroma redesigned their toilet to 6/3L.
1998	Launch of Australian Building Greenhouse Rating (ABGR) focused on energy
1999	National Water Conservation Rating and Labelling Scheme taken over by Water Services Association of Australia (WSAA).
2002	Green Building Council of Australia (GBCA) established
2003	Green Star certification launched
2004	ABGR renamed as the National Australian Built Environment Rating System (NABERS) to expand its reach beyond energy, to water, waste and indoor environment quality.
2005	Water Efficiency Labelling and Standards Act 2005 Caroma 4.5/3 L toilets enter the market
2006	On 1 July 2006 it became mandatory for urinals taps toilets and washing machines to carry WELS rating label.
2007	The first 5 star WELS rated toilets and urinals are registered
2008	The first 5 star WELS rated dishwashers are registered
2011	Setting of minimum standard for clothes washing machines in WELS 6 star urinals become available.
2013	6 star dishwashers become available.
2016	New 4-star ratings for showers (lower flow rates than 3-star showers but need to pass spray force and coverage tests) in WELS. 0.5 L flow rate reduction for 5-star urinals in WELS 6 star toilets become available

In addition, past rebate programs were not always structured so as to be accessible to lower socio-economic groups. Washing machines are a good example of how the structure of the rebate can bias against socio-economic groups. To encourage change rebates for higher efficiency washing machines were paid after purchase and often only covered the gap between a 4 or 4.5 star machine and a 5 star machine. In contrast sales of machines occur in the 3-4.5 star range (Fane et al, 2018). Reviews of these programs (even ones targeted at concession customers) have highlighted that customers facing financial hardship do not have the finances available to purchase more expensive machines even though the additional cost could be repaid within 1 year if water and energy savings are considered (Table 2).

Table 2: Indicative cost comparison for washing machines with different energy and water ratings

2 star energy 3.5 star water 7.5kg machine				
	yr 0	yr1	yr5	yr10
purchase price	$477			
energy $		$180	$898	$1,797
water $		$67	$335	$671
total $	$477	$724	$1,711	$2,945
4 star energy 4.5 star water 7.5kg machine				
purchase price	$588			
energy $		$83	$417	$834
water $		$47	$233	$466
total $	$588	$718	$1,238	$1,888
COST DIFFERENCE	**($-111)**	**$6**	**$473**	**$1,057**

It is not uncommon for regional areas served by mid-sized utilities to have significant areas of socio-economic disadvantage. Understanding actual local stock (as opposed to global sales data), eliciting drivers for higher water use and matching program type and structure to the specific customer is critical. Again, this is an area where mid-size utilities, with detailed knowledge of their region can have an advantage.

Rain tank tune ups

The historic installation of rainwater tanks in homes is another area of potential water efficiency gain. Rebate schemes in all major Australian cities have provided millions of dollars of incentives for customers to purchase rainwater tanks both with and without indoor connections. In addition, building standards often require or encourage the installation of rainwater tanks for new homes. However, it is not clear whether the long-term costs, actual savings, maintenance requirements and implications of indoor connections during restrictions are well understood by customers.

Studies in Melbourne and Queensland have shown that 25-35% of rainwater tanks have limited functionality due to issues with pumps, faulty installation, faulty switches and cleaning issues (Moglia 2015). Further Mukheibir (2014) reported that people who have a mandated tank are less likely to maintain them.

Regional areas commonly have significant proportions of households with rainwater tanks. Programs designed to target poorly performing tanks can achieve cost effective water savings by fixing up the tanks that are already in place. This targeting of existing tanks via a subsidised maintenance program can also be used identify how rainwater tanks are currently used across the region and the proportion that are performing poorly. This is useful information for demand forecasting as well as program design.

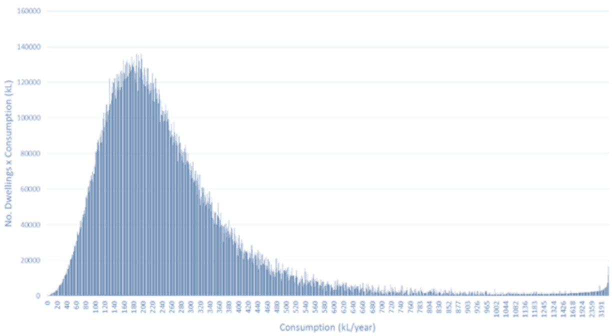
UNDERSTANDING CURRENT DEMAND

Historically, uptake of water efficiency options may have been limited in particular sectors of the community. Analysis of current demand data allows enhanced targeting of water conservation efforts.

Targeting high users

While average demand within a target sector may seem reasonable, examining the demand distribution can provide insights for targeting programs. For example, Figure 6 demonstrates the significant demand distribution and tail of high-water residential users for two separate locations. The curves illustrate the value of targeting high use customers, not relying on averages.

Depending on the underlying drivers of the high demand a range of targeted programs can be considered. For example, if high demand is driven by large properties outdoor education and rainwater tanks could be considered. However, if the high demand was driven by leaks and inefficient water use by large low-income families there may be substantial efficiency gains from leak repair and rebate programs for high water using appliances (such as showerheads and washing machines).



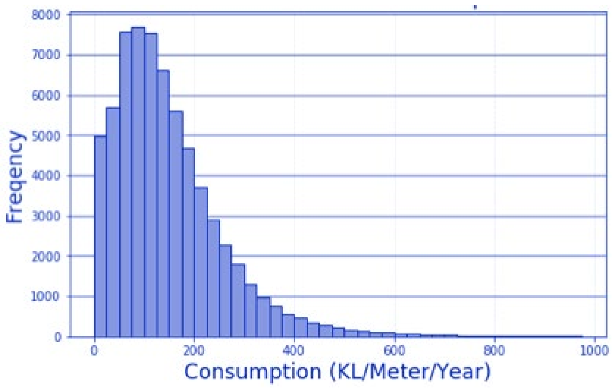


Figure 6: demand distributions for households showing substantial differences from the average.

Programs designed to target the top 5% of uses can have significant potential for water savings. These programs can often also be justified on hardship grounds as a proportion of high water demand customers have been found to also be facing bill stress. Mid sized utilities commonly have hardship programs and expanding these programs to a larger set of high users can have broad ranging benefits beyond generating water savings. These include including energy savings and, in some instances, customers being able to pay bills for the first time.

Targeting in non-residential sectors and sub sectors

As with the residential sector, targeting in the non-residential sector is beneficial. Often a small number of customers are responsible for the majority of the non-residential water use. Water efficient management plans (WEMP) or action plans were used to target high non-residential water users in many major cities across Australia during the Millennium drought. Experience across jurisdictions has found large water savings for relatively low cost for the largest water using customers. While audits are relatively easy to conduct the challenge is getting customers to prioritize actions when water forms a very small part of their overall costs. Using existing relationships and developing mechanisms to encourage the implementation of water savings plays an important role in ensuring the water savings are realised.

In addition to bespoke solutions for large users, segmenting customers into user types is useful for providing guidance and programs that can be rolled out across similar business types. Understanding where most water is used to prioritise programs is useful (Figure 7).

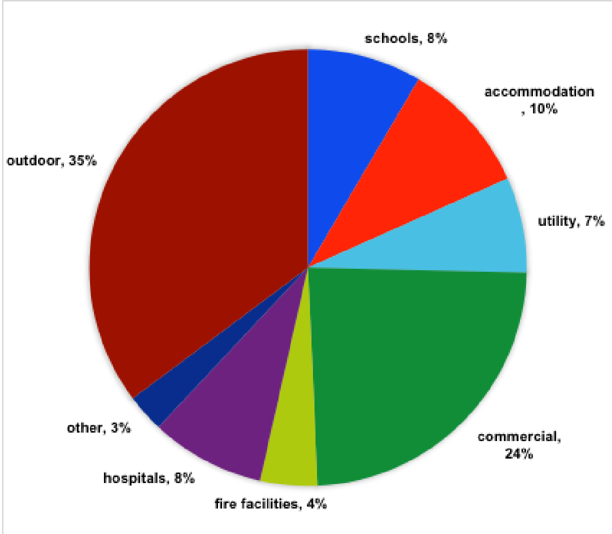


Figure 7: example of medium non-residential demand segmentation

As with the residential sector, understanding profiles within in a segment can help further target programs. For example, as demonstrated in Figure 8 there is significant variation in average demand and seasonal fluctuation between schools, providing a starting point for targeting irrigation programs.

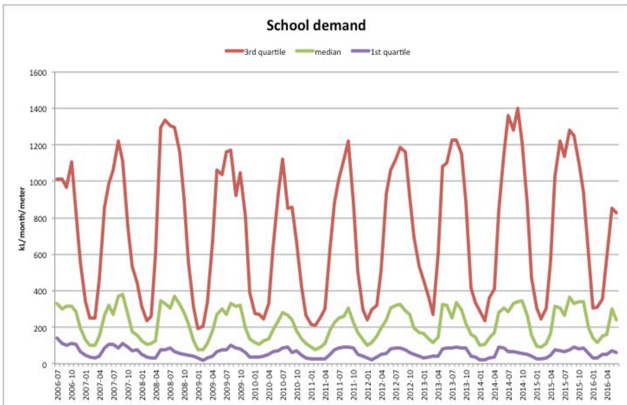


Figure 8: Seasonal and average variations in demand can vary greatly within a sector.

Highlighting the energy savings

Reducing demand for water simultaneously reduces energy needed for water heating water. The value of energy saving from water efficiency for some programs is many times the cost of the program and this critical benefit to customers can be leveraged towards uptake and improved impact.

The potential for energy savings is illustrated in bathroom fixtures where efficiency can help to counteract the high and growing level of energy consumption for bathroom hot water (Figure 9).

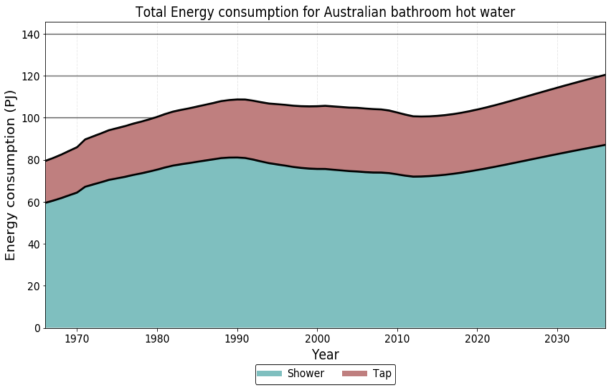


Figure 9: Energy consumption for Australian bathroom hot water (Watson et al 2018).

A small study in Melbourne by Binks et al (2017) demonstrated that, on average, the energy saved from reduced shower water use (and therefore hot water use) was in the order of 0.034 kWh per litre of total water saved – significantly more energy than is used to provide a litre of potable water and sewage services. With energy bills being such a significant cost to many Australian households, valuing the gains for customers in reduced energy use needs to be font of mind for water utilities.

LOOKING TO THE FUTURE

Digital metering technologies and data analytics will be used to develop the next generation of water efficiency programs that generate and utilise new forms of data throughout the life cycle of programs.

Utilising digital metering technologies

New technology and customer behavioural interfaces are emerging that, if employed at scale, may create another step change in water efficiency. As digital meters are rolled out, more sophisticated data collection allows messages, programs and incentives to be better targeted. In a review of 25 customer water-use feedback programs average savings around 5.5% (Lui and Mukheibir 2017). These savings come, in part, from the ability to notify customers in real time of leaks allows them to be repaired in a more timely manner, saving water and money.

The challenge with smart meters and customer water-use feedback is to keep customers engaged with their water use over time and so maintaining the savings.

Making the most of data analysis

Digital technologies will not only shift the design and implementation of programs, they will also allow faster and more efficient water conservation program evaluation and review. Rather than needing to wait to collect data, the evaluation can be built in as an integrated element in the program evaluation due to accessibility of data (Turner et al 2015).

Despite the potential for more data with advancements in digital technologies, what is done with the data is most important. Large data sets do not automatically result in more powerful insights, and much can be done with smaller data sets coupled with other sources of information including local knowledge.

Best practice program design

Best practice water efficiency programs can be designed to meet a variety of different objectives including maximising water savings in the short term to medium term, implementing programs that are cost efficient (for example economic level of water conservation), implementing programs to benefit particular customer classes (for example vulnerable customers) or managing demand side risks. A schematic for a data driven leading practice program design is illustrated in Figure 10 and includes option development; pilot design, implementation and evaluation; potential redesign; program implementation and further evaluation and reassessment of the ongoing benefits of the program.

It is important to have consistent and ongoing water conservation programs. Continuity of messaging ensures that behaviour changes are not eroded over time. Continuity of programs ensures that instructional knowledge is not lost and creates foundation capacity that allows utilities to adapt and respond rapidly should the need arise.

An analysis of why programs are not reaching their potential can provide valuable inputs into program evaluation and redesign. This involves not just a straight numerical analysis but talking to people at the implementation coal face. For example, two separate a hardship program subsidizing high efficiency washing machines both had very limited uptake. Although these programs could provide significant water and energy savings, the implementation model made it unfavourable to customers. By talking to both customers and local retail suppliers a more nuanced explanation than “there is no interest in rebate” could be found. In another example, tap products installed as part of a retrofit program were reviewed. Talking to customers about the program identified that the standard tap, although efficient, was difficult to turn off for elderly customers, a key target segment. This led to even relatively new taps leaking as they could not be turned off tightly. Upgrading to a leaver tap would provide much better outcomes and customer satisfaction for minimal additional investment.

CONCLUSION

Every region is unique and programs should be designed for different circumstance, however much can be learnt from experience in other regions and particularly in communities of and organisations of a similar size.

While some programs implemented in the past have run their course, there are still opportunities to revise and revisit programs in the context of uneven uptake and advances in technology. There are also many additional social benefits associated with improvements in water (and associated energy) efficiency and bill affordability for customers.

Data analysis, customer segmentation and program targeting help to maximise opportunities. In this respect mid-size utilities are well placed, often having closer relationships with customers and strong community organisations.

Mid-size utilities have the opportunity to leverage the vast experience across Australian, particularly that gained during the last drought and place it in the context of region-specific opportunities and constraints to maximise the benefit of water efficiency programs. By using best practice program design that incorporates robust data collection and analysis this approach can provide benefits to mid-sized utilities well beyond the immediate water savings.

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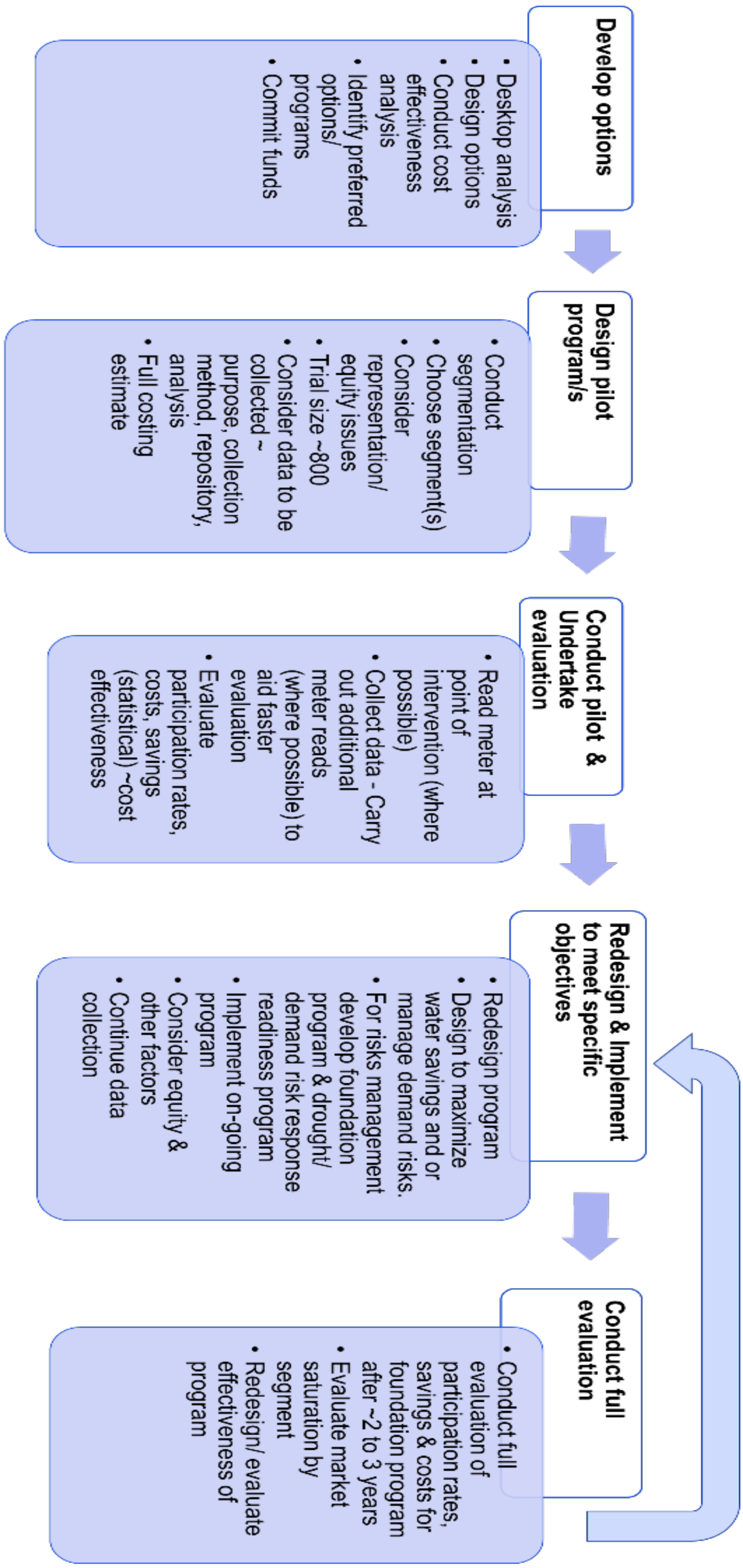

Figure 10: Data driven leading practice program design