Chapter 7
Non-price Mechanisms

Non-price mechanisms denote non-economic tools implemented by water service providers and governments to influence the water consumption of users by reducing their water usage and/or shaping water-use practices and habits, rather than by adjusting the price of water via economic instruments (Matikinca et al. 2020; Reynaud 2013). Non-price mechanisms include, but are not limited to, education and awareness-raising campaigns, water restrictions, installation of water-saving devices that limit consumption, and water audits (Joubert and Ziervogel, 2019; Matikinca et al. 2020; Stavenhagen et al. 2018). These measures are further defined as follows:

1. Restrictions for specific water use refer to the control of water consumption in terms of quantity, water consumption time, and/or specific water uses. Such measures are applied temporarily during periods of acute water shortage to reduce peak consumption.
2. Water-saving devices refer to the uptake of water technologies that use less water for the same level of performance by reducing or restricting water flows. Commonly used water-saving devices include low-flow/dual-flush toilets, vacuum toilets, shower timers, low-flow taps and mixer faucets, water-efficient washing machines, and water-efficient dishwashers. Water-saving labelling schemes that assess the amount of water used by certain products by providing a label or rating to reflect their water efficiency levels may also be implemented to provide consumers with information on the water efficiency of labelled appliances. This aims to encourage consumers to purchase water-saving appliances.
3. Public campaigns and school curricula provide information through various media channels, including billboard advertising and social media, to promote water-efficient behaviour among target audiences. Public education programmes on water conservation are widely practised in schools globally, to impart the importance of water conservation to children and youths.
4. Water auditing is a method of identifying and accounting for all water flows within the water distribution system (EPA 2015). Water audits provide water service

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providers with important information about potential leaks, storage overflows, and unauthorised consumption.
5. Outreach and communication through utility bills include summarised data on water usage and a detailed breakdown of charges in a utility bill received by consumers.

There is increasing support in research that non-price mechanisms can result in positive behavioural changes in consumers' water usage, thereby reducing water consumption. Hence, water service providers are gradually incorporating these as part of their WDM strategies (Brick and Visser 2017; Brick et al. 2017; Matikinca et al. 2020; Tortajada et al. 2019).

7.1 Restrictions for Specific Water Uses

Water-use restrictions refer to the rationing or limiting of water availability by quantity, time of consumption, and/or for designated uses (EEA 2017). In general, restrictions are first officially mandated at the government level before being implemented by water service providers to reduce peak consumption during times of acute water distress (e.g. droughts) (EEA 2017). They are often preferred over economic instruments[1] as an immediate or temporary response when water supply is critically limited (Climate Adapt 2020). Research suggests that formal restrictions can be effective and are now commonplace (Haque et al. 2014).

There are a wide range of water restrictions that can be implemented by governments (local, regional, national) and water service providers, to reduce water consumption (Cooper et al. 2019; Robinson and Conley 2017). Water restrictions aim to encourage individuals to lower their water usage on a daily, weekly, or monthly basis. In addition, water restrictions may be temporary or permanent (Manouseli et al. 2018). However, water demand and water consumption could revert to their earlier, higher levels after water restrictions are lifted. Where recurrent or persistent water scarcity is encountered in a given context, other WDM measures may be implemented alongside water restrictions (Climate Adapt 2020; EEA 2017).

Compulsory water restrictions, in particular, can lead to significant water savings—up to 55%—for residential water consumers in a short span. They are also associated with penalties (e.g. fines) for non-compliance (Manouseli et al. 2018). During times of water scarcity or crises, compulsory water restrictions on specific

[1] The imposition of economic instruments may result in some households being advantaged over others. Although higher prices can lead to a reduction in water use, the lack of concessions for poor or large households may enable wealthy households to simply 'buy' their way out of water shortages. In addition, pricing changes may be slow to implement and politically unpalatable to governments if deemed unpopular with voters (Ehret et al. 2021).

uses of water may be implemented to prevent water shortages[2] and ensure immediate reductions in water usage to conserve scarce water supplies (Mullin and Rubado 2017). For compulsory water restrictions, households may be allowed to undertake certain activities, such as watering gardens but not lawns, at certain times of the day or week (Climate Adapt 2020; Cooper et al. 2019; Robinson and Conley 2017). For example, a 2014 study in Sydney, Australia, found that Level 1,[3] Level 2,[4] and Level 3[5] water restrictions between 2003 and 2009 resulted in water savings of 9%, 18%, and 20%, respectively, for the single-dwelling residential sector, and 4%, 8%, and 9%, respectively, for the multiple-dwelling residential sector (Haque et al. 2014).

However, the implementation of water restrictions may be limited by political will and public resistance (Stoutenborough and Vedlitz 2014). Water restrictions that limit outdoor watering to particular days or forbid certain activities may seem arbitrary to the public if the reasoning behind the implementation of water restrictions is not clearly communicated (Mullin and Rubado 2017). In some cases, individuals may ignore or bypass water restrictions, which creates difficulties for enforcement (Ehret et al. 2021; Sisser et al. 2016; Wilson et al. 2021), and result in heavy fines or temporary suspension of water supply.

7.2 Water-Saving Devices and Labelling Schemes

Non-price mechanisms that encourage water-efficient behaviour can be supported by appropriate infrastructure, such as water-saving devices, retrofits, and labelling schemes (Bello-Dambatta et al. 2013; Moglia et al. 2018). Water-saving devices are technologies that reduce water flows and improve water-use efficiency. Commonly used water-saving devices include low-flow/dual-flush toilets, vacuum toilets, shower timers, low-flow taps and mixer faucets, water-efficient washing machines, and water-efficient dishwashers (Bello-Dambatta et al. 2013; EU EURDF n.d.; Sheth 2017). Examples of water-saving devices are given in Table 7.1.

The use of water-saving devices has resulted in significant water savings for users (Manouseli et al. 2018; Stavenhagen et al. 2018). For instance, low-flow faucets can reduce the amount of water flow independent of water pressure, resulting in water

[2] Aside from creating water security concerns, water shortages can result in inconvenience and economic costs for the community and a loss of producer surplus for the water service provider (March et al. 2012; Wilson et al. 2021).

[3] No use of sprinklers or other watering systems.

[4] In addition to Level 1 restrictions, no hosing of hard surfaces and vehicles, nor of lawns and gardens, the only exception being handheld hosing (of lawns and gardens) before 10 am and after 4 pm on Wednesdays, Fridays, and Sundays; no filling of new or renovated pools over 10,000 L except with a permit from Sydney Water (water service provider).

[5] In addition to Levels 1 and 2, the number of days on which handheld hosing of laws and gardens was reduced to two days (Wednesday and Sunday); no hoses or taps to be left running unattended except when filling pools or containers; fire hoses used only for firefighting purpose and not for cleaning.

Table 7.1 Water-saving devices

Device type	Device image	Device description
Low-flow faucets	 *Source* WaterMark (n.d.)	Takes a trickle of water, shaping it into a paper-thin sheet of water as wide as an average hand. This results in a more efficient distribution of the water from handwashing taps
	 *Source* EU ERDF (n.d.)	Aerated nozzles produce a fine mist rather than a solid flow of water
Mixer faucet	 *Source* EU ERDF (n.d.)	Taps with built-in water brakes (click-stop technology) and thermo-regulating valves achieve savings in both water and energy consumption
Showerguard timer	 *Source* WaterMark (n.d.)	Halts the flow of hot water in the shower after a pre-set shower time (e.g. between 2 and 20 min)

(continued)

Table 7.1 (continued)

Device type	Device image	Device description
Dual-flush toilet	 EU ERDF (n.d.)	Dual-flush cisterns accommodate different flushing requirements
Waterless no-flush urinals	 *Source* WaterMark (n.d.)	Use gravity to drain the urine down into a recyclable trap insert. The sealing liquid floats on top of the urine contained in the trap, building up an effective odour barrier

Source EU ERDF (n.d.), WaterMark (n.d.)

savings of 50–80% (Sheth 2017). Water-efficient washing machines and dishwashers can reduce water use by 33% (Sheth 2017), and replacing a standard 3.5-gallon toilet with a low-flow toilet can reduce toilet water use by 54% (MWRA n.d.). Similarly, waterless no-flush urinals can produce cost savings of up to USD 0.72 per 1000 uses[6] (WaterMark n.d.). The installation of water-saving devices may be complemented by public awareness campaigns and water efficiency labelling schemes to promote more efficient water consumption and behaviours (Manouseli et al. 2018).

Retrofitting may require careful planning and significant costs for installation to consumers. Despite the potential long-term cost-effectiveness of water-saving devices, households/businesses may be reluctant to pay the upfront costs for installation. However, authorities may promote the uptake of water-saving devices through various measures, such as

(a) Low-cost availability of device.
(b) Direct distribution of devices among the population.

[6] Estimate based on water-efficient WaterMark products in Australia.

(c) Outreach campaigns.
(d) Regulations, quality standards, and labelling schemes.

Source EEA (2017).

Water-saving labelling schemes are programmes that assess the amount of water used by certain products by providing a label or rating to indicate their water efficiency levels (IWA 2019). The aim is to provide consumers with information about the water efficiency of a labelled appliance and to encourage consumers to purchase and use these water-efficient appliances. A variety of water efficiency labelling schemes have been developed internationally and have demonstrated effective outcomes in countries where they have been implemented (IWA 2019). Table 7.2 presents some examples of internationally implemented labelling schemes and their outcomes.

Internationally, the use of water-saving schemes has been acknowledged as a 'high-impact' option. In ASEAN, water-saving schemes have been implemented, such as in Malaysia and Singapore. In Singapore, the Water Efficiency Labelling Scheme (WELS)[7] was introduced in 2006 and made mandatory in 2009. Under the scheme, to date, products are labelled according to their efficiency rating, ranging from 1-tick to 4-ticks. It applies to products such as taps and mixers (basin, sink/bib, shower), household washing machines and dishwashers, urinal flush valves/waterless urinals, and water closet (WC) flush valves. From 1 January 2022, the mandatory scheme was extended to WC flush valves and commercial appliances such as commercial dishwashers, washer extractors, and high-pressure washers. The water efficiency ratings and requirements by PUB (Singapore) are indicated in Table 7.3a–c. The scheme contributed to a significant reduction[8] in water consumption across 10 years—from 155 L/day in 2009 to 141 L/day in 2019 (PUB 2012, 2020).

Malaysia introduced a similar scheme in 2013. Its voluntary water-efficient products labelling scheme (WEPLS) allows product suppliers to register and label their water-efficient products with reference to guidelines provided by SPAN.[9] WEPLS uses three levels of water efficiency ratings for all the specified product types with three product ratings: *efficient, highly efficient,* and *most efficient.* Ratings are assigned according to specified thresholds for each product category (Table 7.4). As of 2018, WEPLS has covered five products: water closets, clothes washing machines, showerheads, water taps, and urinals sold by 25 suppliers, comprising 37 brands and 288 models (SPAN 2016; 2018).

Upon meeting the thresholds indicated in the table above, each product receives a label according to the rating issued to a particular product brand and type. The label indicates the water efficiency rating as shown by the star (☆) signs, with detailed information about the product's water efficiency. Figure 7.1 illustrates the WEPLS labels in Malaysia, which must be affixed to each model and its packaging, to allow

[7] As a follow-up to the Voluntary Water Efficiency Labelling Scheme (Voluntary WELS), first introduced in 2006, the Mandatory Water Efficiency Labelling (Mandatory WELS) was introduced in 2009 (PUB 2012).

[8] In combination with several other WDM measures such as metering, tariffs, leak detection, pipe replacements, DMA creation, etc. (CLC 2012; PUB 2020).

[9] Suruhanjaya Perkhidmatan Air Negara (National Water Regulator).

Table 7.2 International water efficiency labels

Country/area	Name of scheme	Mandatory/voluntary	Reported outcomes
Australia	Water-efficient labelling scheme (indoor)	Mandatory	31,500 products registered Estimated annual water savings of 70 billion litres in 2013 Household utility bills reduced by AUD520 million in 2013[10]
	Smart approved watermark	Voluntary	Received over 500 applications, of which 350 have been deemed water efficient
Canada and USA	WaterSense	Voluntary	Over 27,000 products registered. The scheme reported savings of more than 4.5 million megalitres of water, 284 billion kWh, and USD 46.3 billion in savings in consumer water and energy bills by 2017
China	Water conservation certificate	Voluntary	Issued nearly 7000 certificates and certified more than 400 enterprises Conserved 5.28 million m^3 of water in 2017 through certification of water closets, water faucets, and showers
Europe (including the UK)	European water label	Voluntary	Almost 10,000 products registered through 120 major brands with a collective market coverage of 68.7%
Hong Kong	WSD Water Efficiency Labelling Scheme	Voluntary	Around 650 products registered

(continued)

[10] AUD 1 = 0.72 USD.

Table 7.2 (continued)

Country/area	Name of scheme	Mandatory/voluntary	Reported outcomes
India	Water-efficient products India (WEP-I)	Voluntary	Not yet in force
New Zealand	Water Efficiency Labelling Scheme	Mandatory	The scheme found a significant shift towards improved water efficiency across all product categories, but not a significant reduction in household water consumption
Portugal	ANQUIP	Voluntary	110 toilets were awarded the label representing 75% of the national market
UAE	United Arab Emirates ESMA water efficiency label	Mandatory	N/A

Source IWA (2019)

consumers to see and recognise them clearly. Any modifications made to the products must be communicated to SPAN, after which an assessment is made on need for rating adjustments (SPAN 2018).

7.3 Public Campaigns and School Curricula

Low public awareness of water use and its importance is seen as an impediment to achieving sustainable water efficiency. Changes in public behaviours may be influenced through incentives and other means of persuasion (Bello-Dambatta et al. 2013). Hence, water service providers and governments may implement 'soft interventions' such as public campaigns and education programmes to promote water conservation practices (Baalousha and Ouda 2017; Moglia et al. 2018; Stavenhagen et al. 2018). 'Soft interventions' largely target residential water users with the purpose of modifying personal water-use behaviours through information dissemination and education (Bello-Dambatta et al. 2013; Kayaga and Smout 2011). The most commonly used strategy in a campaign is to disseminate information about changes in water usage and habits to citizens in layman terms through various forms of media, including billboard advertising and social media (March et al. 2012; Sauri 2020). Awareness campaigns targeted at households have been implemented in all ASEAN countries.

As public campaigns and education programmes focus on behavioural changes, their impact is often difficult to quantify (EEA 2017). Nonetheless, they are both

Table 7.3 Water efficiency ratings and requirements by PUB (2022), Singapore

a

Products/fittings	Flow rate/flush capacity requirements	
Water efficiency rating	2-tick ✓✓	3-tick ✓✓✓
Shower taps and mixers (L/min)	> 5 to 7	5 or less
Basin taps and mixers (L/min)	> 2 to 4	2 or less
Sink/bib taps and mixers (L/min)	> 4 to 6	4 or less
Dual-flush flushing cisterns (litres per flush)	> 3.5 to 4.0 (full flush) > 2.5 to 3.0 (reduced flush)	3.5 or less (full flush) 2.5 or less (reduced flush)
Urinal flush valve and waterless urinals (litres per flush)	> 0.5 to 1	0.5 or less or waterless urinals
Water closet (WC) flush valves (litres per flush)	> 3.5 to 4.0	3.5 or less

b

Appliances	Water consumption requirements			
Water efficiency rating	1-tick ✓	2-tick ✓✓	3-tick ✓✓✓	4-tick ✓✓✓✓
Clothes washing machines (per washload)	NA	> 9 to 12 L/kg	> 6 to 9 L/kg	6 L/kg or less
Dishwashers (per place setting)	> 1.2 to 1.5 L	> 0.9 to 1.2 L	> 0.6 to 0.9 L	0.6 L or less

c

Commercial equipment	Types	Water efficiency requirements
Commercial washer extractor	• Front load • Top load	≤ 8.0 L/kg
Commercial dishwasher	• Undercounter • Hood	≤ 2.4 L/rack
High-pressure washer	• For general cleaning except for the following use: – Household – Steam cleaning or hot water pressure washing – Washing of equipment or vehicle	≤ 11.0 L/min

Source PUB (2022)[11]

acknowledged worldwide as useful non-price mechanisms that governments and water service providers could implement (Booysen et al. 2019; Matikinca et al. 2020; Tortajada et al. 2019). They are also considered as an effective means of promoting long-term water conservation (Gilbertson et al. 2011; Kampragou et al. 2011; Ramsey et al. 2017).

[11] PUB representative in AWGWRM. Email interview, 7 March, 2022.

Table 7.4 Water efficiency rating by SPAN

Water consumption	Efficient 1—☆☆☆	Highly efficient 2—☆☆☆	Most efficient 3—☆☆☆
Basin taps and mixers	$6.0 < f \leq 8.0$	$4.0 < f \leq 6.0$	$1.5 < f \leq 4.0$
Sink taps and mixers	$6.0 < f \leq 8.0$	$4.0 < f \leq 6.0$	$2.5 < f \leq 4.0$
Shower taps and mixers	$8.0 < f \leq 10.0$	$6.0 < f \leq 8.0$	$4.5 < f \leq 6.0$
Ablution taps and mixers	$6.0 < f \leq 8.0$	$4.0 < f \leq 6.0$	$1.5 < f \leq 4.0$
Water closets	Full flush $fv \leq 6.0$ Reduced flush $fv \leq 3.5$	Full flush $fv \leq 5.0$ Reduced flush $fv \leq 3.5$	Full flush $fv \leq 4.0$ Reduced flush $fv \leq 3.5$
Urinal equipment	$1.5 < fv \leq 2.5$	$1.0 < fv \leq 1.5$	$fv \leq 1.0$
Showerheads	$8.0 < f \leq 10.0$	$6.0 < f \leq 8.0$	$4.5 < f \leq 6.0$
Clothes washing machines	$12 < v \leq 15$	$9 < v \leq 12$	$v \leq 9$

Source SPAN (n.d.)

Fig. 7.1 Water-efficient product labels in Malaysia. *Source* SPAN (n.d.)

The nature of the messages that policymakers and water service providers strive to communicate through campaigns is crucial (Matikinca et al. 2020; Moglia et al. 2018; Tortajada et al. 2019). For instance, a persistent media focus on droughts, and messages that emphasise the importance of water conservation, can lower water demand by up to 18% in states such as California (Moglia et al. 2018; Quesnel and Ajami 2017). In the Philippines, as a precautionary measure against El Niño, water districts have launched water conservation campaigns featuring conservation

Fig. 7.2 Water conservation tips, LWUA. *Source* LWUA (n.d.)

tips for households (LWUA Memorandum Circular 004-19)[12] (LWUA 2019). These campaigns included specific recommendations to the public, such as adjusting shower habits, checking for pipe leaks, cleaning vehicles with pail and rags (instead of water), and recycling water (LWUA n.d.) (Fig. 7.2).

Likewise, the National Water Resources Board (NWRB) in the Philippines has engaged the public through workshops and conferences. For example, The International Virtual Conference on Water Demand Management, held on 18 March 2021, during the Philippine Water Week 2021 (NWRB n.d.), sought to (1) educate the public about the concept and benefits of WDM, (2) gather insights on WDM from other countries which experienced water supply problems, and (3) learn and recommend hood practices which are applicable to the Philippine setting. Various WDM-related topics were covered in the conference, including (1) WDM in the Philippines; (2) droughts, restrictions, and WDM in Cape Town; (3) end-user WDM strategies in the USA; (4) synergising water utilities and business towards water sustainability in Indonesia; (5) the Singapore Water Story; and (6) a municipal drought plan for WDM (El Dorado irrigation district).

To support existing WDM efforts, the National Water Resources Board also established the Knowledge, Learning, and Research Centre for WDM in partnership with the Western Mindanao State University on 27 January 2022. The knowledge centre aims to (1) monitor and manage knowledge-building and skill development initiatives and data gathering on WDM; (2) develop WDM policies based on national research activities; (3) conduct public awareness, outreach activities, and school educational programmes that will develop and maintain high levels of public awareness on the importance of water efficiency and boost public knowledge and participation in

[12] LWUA Memorandum Circular 004-19 attached in Appendix C.

WDM initiatives by creating tangible demand from stakeholders through proactive information campaigns, policy formulation, regulatory support, and knowledge-sharing activities; and (4) develop a WDM information program that will optimise water allocation and protection of water resources.[13]

Public campaigns may also highlight the environmental and economic benefits of efficient water use (Bello-Dambatta et al. 2013; Kayaga and Smout 2011; Moglia et al. 2018; Sauri 2013). For instance, in the Philippines, the Zamboanga City Water District (ZCWD), and AECOM International Development have set up a water audit and a WDM practices educational toolkit, which aims to educate other water districts as well as corporations and academic institutions interested to improve their water-saving practices. These interventions highlight the economic incentives of water-saving practices, and the toolkit provides information on block tariffs, water-efficient product labelling programmes, water audits, and strategy planning. It also includes comprehensive details on water meters/submeter standards, showerheads, bathroom and kitchen faucet flow rates, toilet flush volumes, and leak detection (ZCWD and AECOM 2016).

Public education programmes on water conservation have also been widely conducted in schools to impart the importance of conservation to children and youth, and in turn, their parents. Education programmes that can positively influence students' attitudes, behaviours, and habits include water conservation lessons, field trips, and educational films (Seyranian et al. 2015). Such programmes are already in place in various ASEAN countries such as Brunei, the Philippines, Thailand, and Singapore. In some cases, as shown below, water savings have been achieved, which also reduce the lack of water access for students, teachers, and other staff (MWA n.d.). We exemplify these cases as follows.

In Thailand, the Metropolitan Waterwork Association[14] (MWA) regularly stages activities to support youth networking to increase awareness about water conservation, water treatment processes, and water-quality standards. The 'Water Conservation Camp' that MWA held in 2016 emphasised water savings and included training in basic pipe repairs. The camp was conducted with 160 students from four schools in the Ratchaburi Province, Mae Klong River area, and received positive feedback (MWA 2016). By 2017, 48 schools from the Mae Khlong and Chao Phraya River basin communities attended the camp, with approximately 40 students in attendance from each school (MWA 2018).

[13] The Philippines, National Water Resources Board representative in AWGWRM. Email interview, 4 May, 2022.

[14] Water supplier for Bangkok, Samut Prakan, and Nonthaburi.

7.4 Water Efficiency Audits and Benchmarking

Water auditing is a method of identifying and accounting for all water flows within a water distribution system (EPA 2015). Water audits present water service providers with important information about potential leaks, storage overflows, and unauthorised consumption (Australian Water Association n.d.; EPA 2015; MDE 2013; ZCWD and AECOM 2016). They also help improve the knowledge and documentation of service providers' system operations, which reduces disruptions to the distribution system, enhances supply efficiency, and improves system integrity by reducing the potential for water contamination (AWWA n.d.; EPA 2016). Identifying potential problem areas also enables maintenance and repair efforts to be prioritised (NRDC 2015). Following an audit, corrective actions to water management techniques can generate ongoing savings for the water service provider to ensure reasonable 'payback periods'[15] (NRDC 2015). Although some water losses within the system may be unavoidable, audits can determine the proportion of water losses that may be 'economically recoverable' before investments in corrective action are made to the water system (NRDC 2015).

A preliminary water audit may be conducted as follows:

(a) Identify the amount of water added to the system (typically for one year).
(b) Identify authorised water consumption (billed and unbilled water).
(c) Calculate water losses (water losses = system input[16]—authorised consumption).
(d) (EPA 2015).

In the Philippines, for example, the Zamboanga City Water District (ZCWD) has established the Zamboanga Water Audit Team (ZWAT), an independent water audit team, to identify anomalies in water use and conduct water audits. The audit team comprises ZCWD employees with expertise in billing and metering, customer care, accounts management, and community relations. The team also compiled a water audit manual for the commercial and residential sectors, consisting of step-wise instructions for conducting audits, sample audit forms, audit reports, and additional reference guides (ZCWD and AECOM 2016).[17] In 2016, ZWAT also conducted four-day on-site water audit training for various commercial establishments (ZCWD and AECOM 2016).

Water audits also allow water service providers to monitor their water losses and compare their experiences with their peers, such as service providers and businesses in the industry, a practice known as benchmarking (EPA 2015). Benchmarking supports healthy competition among water service providers (e.g. public image) and improvements in performance through comparison (EEA 2017). For instance, to improve the water efficiency of the non-domestic sector, Singapore's PUB established the Mandatory Water Efficiency Management Practices (MWEMP) scheme in

[15] Periods to recover the cost of an action/investment.

[16] Volume of water entered into the water distribution system.

[17] Refer to Appendix B for sample audit activity and production reports.

2015. In accordance with MWEMP, large water consumers[18] must declare their water consumption levels, water efficiency plans, business activity indicators, and water recycling rates to PUB annually. Based on this data, PUB establishes water efficiency benchmarks for businesses in selected sectors, such as retail operations, offices, hotels, data centres, commercial laundries, wafer fabrication, semiconductors, and biomedical manufacturing (PUB 2021).

The benefits of water efficiency benchmarking are summarised as follows:

- Measure the performance of a business over time.
- Compare the performance of one business against other similar businesses.
- Identify where water efficiency can be improved.
- Establish realistic water reduction targets.
- Improve confidence in water efficiency.
- Save businesses money and energy by reducing their water consumption.

Sources EEA (2017); PUB (2020); Smart Water Mark (2021); Sydney Water (2021); Water Corporation (2021).

7.5 Outreach and Communication Through Utility Bills

Water consumers may change their consumption levels not only in response to price signals, but it also to more information about their water use (Stavenhagen et al. 2018). Water utility bills on paper or digital platforms constitute an essential outreach tool to educate consumers. Information in bills may include summarised data on consumers' water use as well as a detailed breakdown of charges in that bill (EPA 2016). For example, graphical data on a given consumer's average daily consumption over a period of time enables comparison of water use over time to that of other consumers (City West Water n.d.; EPA 2016, 2019). For relatively high-consumption users, information on their usage compared to that of an 'average' water consumer, and a 'conserving' water consumer, can promote conscious consumption (EPA 2016).

In Indonesia, Adhya Tirta Batam (ATB), a private concessionaire, has launched a mobile application that provides customers with detailed information on their bills, including their monthly water consumption trends (ATB 2019). Likewise, in Vientiane, Laos, the Nam Papa Nakhon Luang (NPNL) launched the 'Nampapa Nakhone Luang App' mobile application in 2017. The app provides customers with detailed information on their monthly bills and consumption trends for the preceding three months. The application also includes a 'water calculation' feature that estimates the monthly water charge that is inclusive of maintenance costs and tax, based on factors such as the year, quantity, and pending charges from previous bills (NPNL n.d.; Apple n.d.). The application interface can be found in Figs. 7.3 and 7.4.

[18] PUB defines large water users as those whose net water consumption exceeded 60,000 m^3 in the previous year.

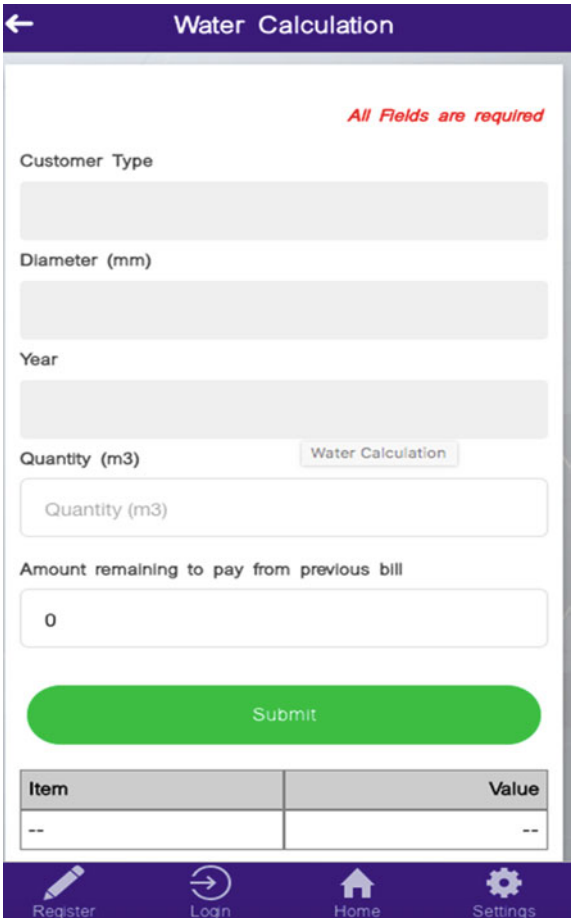

Fig. 7.3 NPNL application interface. *Source* NPNL (n.d.)

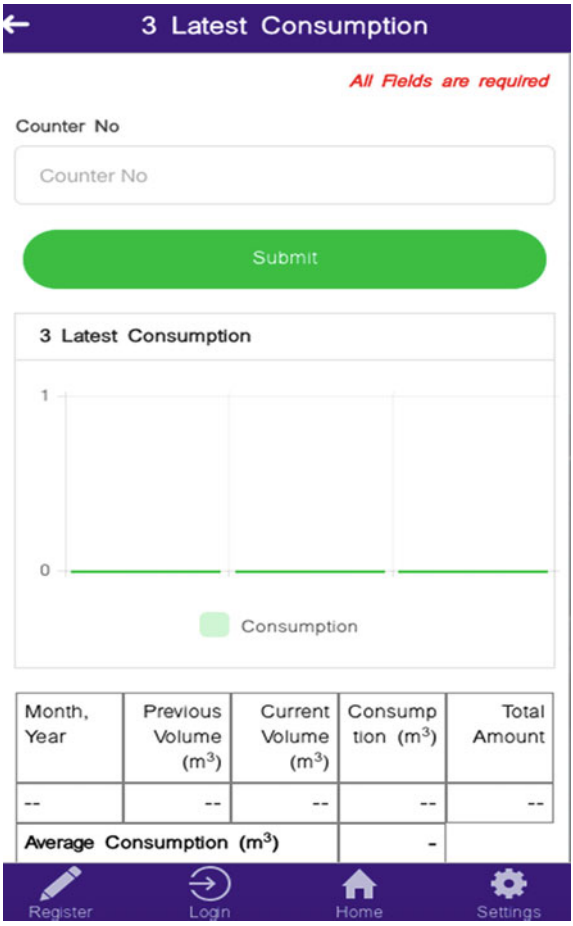

Fig. 7.4 NPNL application interface. *Source* NPNL (n.d.)

7.6 Case Snippet: Jakarta, Indonesia

Water provision in Jakarta is delivered by a unique public–private arrangement. Although a 25-year concession agreement was signed with two private entities, PALYJA and Aetra in 1998, water provision in Jakarta, by law, is still provided by PAM Jaya, Jakarta's state-owned enterprise, as the water assets' owner. Under this concession agreement, PALYJA and Aetra undertake water service operations in Jakarta, ranging from production and distribution to billing and collection (Aerta 2018).

PALYJA and Aetra are acknowledged as having competent customer services, particularly their customers' water bill payment experience. Both companies have utilised a variety of payment channels, ranging from post offices to e-commerce, facilitating the ease with which their customers can settle their water bills. The use of an electronic billing system allows customers to check and pay their monthly water bills online via e-banking platforms without having to visit a physical payment booth (PALYJA n.d.; Aerta 2018). PALYJA has introduced the so-called bill on the spot or BOS mechanism, which allows the PALYJA's metering staff to print the customer's water bills and receive payment when they check the water meter every month (PALYJA n.d.; 2016).

These structures have been put in place partly to address late or non-payments by customers. It was reported that these strategies were effective, evidenced by a 91.9% surge in on-time payments in PALYJA's concession areas[19] in 2016 and a 92.78% improvement in Aetra's concession areas in 2018. Apart from these 'nudge' approaches, PALYJA and Aetra have, at the same time, imposed strict sanctions on those not paying their water bills on time which involved temporarily disconnecting the water services and fines (PAM Jaya 2014).

To ensure that measures are enforced, PALYJA and Aetra have employed identical public outreach strategies on both their online and offline platforms. Offline outreach to customers has been conducted through direct meetings at the district hall or brochures which provide information on connection installation, payment methods, campaigns on the impact from the use of groundwater, and water-saving techniques. Both companies have also used multiple social media platforms to launch public campaigns and to disseminate information on service disruptions. PAM Jaya's social media accounts occasionally publish information on water-saving awareness. In 2016, PALYJA reported a relatively high customer satisfaction rate of 82%, while Aetra attained a comparable customer satisfaction rate of 85.43% for the same year (PALYJA 2016; Aetra 2018).

[19] Areas of operation.

7.7 Case Snippet: Brunei Darussalam

The Department of Water Services (DWS) under the Ministry of Development (MoD) is the Water Authority in Brunei. It has the custody and administration mandate of the country's waterworks and is responsible for the supply management and distribution of water. Several measures related to non-price WDM mechanisms have been implemented in Brunei, including public education campaigns, school curricula, product labelling schemes, and water audits.

The DWS regularly publishes posters and pamphlets to encourage water conservation. These posters and pamphlets contain information relating to typical household water consumption in Brunei Darussalam, the need to save water, and useful water-saving tips (MoD n.d.) (see Figs. 7.5 and 7.6). DWS also distributes water-saving posters and stickers targeting government buildings, building complexes, mosques, and hospitals throughout Brunei Darussalam. As of July 2021, water-saving posters were distributed to the Ministry of Health building and shopping complexes within the Brunei-Muara district. Likewise, water-saving stickers were distributed to RIPAS hospital, mosques and hospitals in the Tutong and Belait district, and government clinics within Brunei-Muara district.

Fig. 7.5 Water-saving tips from the Department of Water Services, Brunei Darussalam. *Source* Ministry of Development (2012a)

Fig. 7.6 Water Facts from the Department of Water Services, Brunei Darussalam. *Source* Ministry of Development (2012b)

Regarding school curriculum, the Ministry of Education plans to establish 'green schools programmes' that focus on activities based on five environmental concerns,[20] which include reducing water consumption and improving water conservation. The guidebook for initiating green schools in Brunei Darussalam also serves as a benchmark for all schools (government and non-government), ranging from primary to pre-university levels (Ministry of Education n.d.). Similarly, the DWS frequently conducts water conservation awareness programmes in primary schools through means of quizzes, jigsaw puzzles and colouring. As of 2021, the programme was implemented in 8 schools (see Fig. 7.7).

[20] Energy, waste management, green school space, water, and health (Ministry of Education n.d.).

Fig. 7.7 Water conservation activities in primary schools, Brunei Darussalam. *Source* Department of Water Services representative in AWGWRM (6 May 2022)

To support public campaigns and water conservation efforts, DWS conducts water audits on government buildings to monitor water losses. In 2020, following a water audit in the DWS building, they replaced several water fittings with water-saving fittings. In 2021, DWS conducted water audits in government buildings such as the Department of Building Services, Department of Water Services, and Public Works Department and submitted recommendations to replace existing water fittings with water-saving fittings.[21] DWS aims to continue conducting water audits on other government buildings and encourage the use of water-saving fittings, particularly those that have been registered with the Brunei Water-Efficient Products Labelling Scheme (BWELS).

[21] Brunei Darussalam, Department of Water Services representative in AWGWRM. Email interview, 6 May 2022.

The BWELS encourages the participation of water fitting vendors to register with BWELS and print water-saving labels on approved products. BWELS uses three levels of water efficiency ratings for all the specified product types with three product ratings: *good, very good*, and *excellent.* Ratings are assigned according to specified thresholds for each product category (see Table 7.5).

Table 7.5 Water efficiency rating by DWS

Water fittings	Flow rate requirements		
	Good ★	Very good ★★	Excellent ★★★
1. Basin taps and mixers 	> 4 to 6 L/min	> 2 to 4 L/min	≤ 2 L/min
2. Sink taps and mixers 	> 6 to 8 L/min	> 4 to 6 L/min	≤ 4 L/min
3. BIB TAP 	> 6 to 8 L/min	> 4 to 6 L/min	≤ 4 L/min
Water fittings	**Flush rate requirements**		
	Good ★	**Very good** ★★	**Excellent** ★★★
4. Water closet (flushing cisterns) 	> 5 to 6 L (full flush) > 3 to 3.5 L (reduced flush)	> 4 to 5 L (full flush) > 2.5 to 3 L (reduced flush)	≤ 4 L (full flush) ≤ 2.5 L (reduced flush)
5. Urinal flushometer 	> 1.5 to 2 L/flush	> 1 to 1.5 L/flush	≤ 1 L/flush

Source Brunei Darussalam Department of Water Services representative in AWGWRM (6 May 2022)

Upon meeting the thresholds indicated in the table above, each product receives a label according to the rating issued to a particular product brand and type. The label indicates the water efficiency rating as shown by the star (☆) signs. As of May 2022, 2 water fittings companies registered with BWELS for three sanitary wares brands. At present, one company has already printed and utilised the labels as approved by DWS. The timeline for implementing the voluntary participation scheme of water fitting companies with BWELS is from 2020 to 2025.[22] The proposed BWELS label is shown in Fig. 7.8.

Fig. 7.8 Proposed BWELS Label

Source Brunei Darussalam, Department of Water Services representative in AWGWRM (6 May 2022).

7.8 Key Takeaways

1. Water service providers and governments can implement many non-price mechanisms to encourage water conservation among both residential and non-residential water users. Measures include, but are not limited to, education and awareness-raising campaigns, water restrictions, water-saving devices and labelling schemes, water efficiency audits, and consumer outreach through utility bills.

[22] See Footnote 21.

2. Non-price measures have been widely implemented in various forms and combinations throughout ASEAN, with demonstrated effectiveness in outcomes.
3. In certain contexts, compulsory water restrictions can lead to savings of up to 55% for residential water consumers in a short span of time, but temporary restrictions may not be sustainable in reducing water demand in the long run.
4. Water-saving devices are designed to encourage water conservation by restricting water flows. Appliances such as low-flow faucets and water-efficient washing machines and a low-flow toilet can reduce water use by 50–80% and 33%, respectively. Replacing a standard 3.5-gallon toilet with a low-flow toilet can reduce toilet water use by 54%. Similarly, waterless no-flush urinals such as in Australia (WaterMark products) can provide cost savings of up to USD 0.72 per 1000 uses.
5. Education programmes and public awareness campaigns, e.g. films, advertisements, social and print media, radio, and school curriculums, represent some non-price mechanisms. Regular media attention on droughts and messages that emphasise the importance of water conservation can lower water demand by up to 18% in states such as California.
6. Water audits are an essential step towards identifying water losses by quantifying flows within a distribution system. With the use of smartphones and mobile phones on the rise in ASEAN, water service providers could capitalise on digital platforms to conduct educational outreach on water conservation and enable customers to access their monthly water bills and estimates of their average quantity of water use per day.

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