# Chapter 6
# Economic Instruments


Inefficient water use is often a result of inadequate incentives for users to reduce their water use and consumption (Leflaive and Hjort 2020). To address this, economic instruments can be devised to influence customers' water consumption behaviour. This may be achieved by offering financial rewards (rebates and tax credits) and/or imposing monetary costs (penalties and fines) (Kayaga and Smout 2011). Economic instruments such as tariffs can also help generate revenue which may be used to expand and improve water services (Damkjaer 2020; Leflaive and Hjort 2020). We have identified at least three commonly used types of economic instruments, namely

1. Tariffs refer to the price paid for a given quantity of water service supplied by a water service provider. They serve as the primary means for the service provider to generate revenue and cover all costs associated with the provision of water services.
2. Water rebates are incentives from government bodies/local municipalities to consumers to influence their water consumption levels and promote water-use efficiency. Rebates may be applied as a partial refund on water bills or to encourage the uptake of water efficiency appliances.
3. Fines for excessive use refer to the price paid for water wastage. It is typically imposed in areas where water resources are scarce or depleted due to climatic conditions or over withdrawals.

## 6.1 Tariffs

Tariffs, the most commonly used economic instrument for WDM, denote the price paid for water supplied through a piped network by a water service provider to households, retailers, industries, etc. (EEA 2017; Kayaga and Smout 2011; Ricato 2019). They are typically determined by the municipal government in line with a particular framework established by higher levels of authority, such as provincial, state, and national governments (ADB 2019). Tariff structures may be influenced



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by various factors, such as operational and maintenance costs, capital availability, consideration of environmental costs,[1] and political factors (EEA 2017). Tariffs serve as the primary means for the service provider to generate revenue and cover costs associated with water treatments and the provision of services (Damkjaer 2020; FAO n.d.; Leflaive and Hjort 2020). Hence, they are the main determinant of the services that a utility provides and the monthly bills of water users (Ricato 2019).

Tariff rates can be determined to reflect the operational and maintenance costs for a water service provider and the value of water resources, to encourage water conservation efforts (EPA 2016; OECD n.d.). Tariff rates are set so as to reflect the costs of these services at different rates (e.g. the greater the water consumption, the higher the cost), which may influence waste and inefficient water use by the end consumer (Bello-Dambatta et al. 2013; EPA 2016). Underpricing may deny utilities the revenue needed to improve service quality and hinder the expansion of coverage (Leflaive and Hjort 2020). As an optimum economic solution, tariff prices can be set to reflect three key elements: (1) supply costs,[2] (2) resource costs[3] (accounting for resource scarcity), and (3) environmental pollution costs[4] (OECD 2013, 2016). The effectiveness of tariffs as instruments for water-use efficiency and conservation depends on end-users' sensitivity to price signals (Leflaive and Hjort 2020; Reynaud and Romano 2018). Although the degree of impact of tariffs on water conservation is uncertain, they still remain the key instruments to ensure cost recovery of water services (EEA 2017). As tariffs and tariff hikes have been shown to have an effective but time-limited impact on changing consumption behaviours, complementary measures such as public information and education campaigns can strengthen WDM measures already in place (FAO n.d; Leflaive and Hjort 2020; Pinto and Marques 2016).

There are several tariff structures in place. The leading tariff structures are as follows:

(a) **Fixed tariffs** refer to a flat charge, regardless of consumption levels. As flat charges are not set according to the consumption levels, a proxy of consumption levels provides the basis for the charge (FAO n.d.). Flat rates are commonly based on pre-assessed factors such as the number of household residents, number of rooms, types of water-using fixtures, and the diameter of the pipe connecting to the water distribution network (EEA 2017; FAO n.d.). Due to the fixed charges, this provides ease of administration and stable cash flow to water service providers. However, as consumers have limited control over their final water bills, this tariff structure may not encourage water-use efficiency (Damkjaer 2020; Leflaive and Hjort 2020; OECD 2010).

(b) **Volumetric tariffs** refer to fixed per-unit consumption charges at a rate that is proportional to the level of water consumption, regardless of total consumption

[1] Charges dedicated to environment protection (EEA 2017).

[2] Supply costs include (1) operation and maintenance costs and (2) capital costs (OECD 2010).

[3] Resource costs refer to the opportunity costs of using water, accounting for resource scarcity (OECD 2010, 2011; Reynaud and Romano 2018).

[4] Pollution costs refer to costs associated with environmental deterioration/externalities through the release of pollutants by urban water systems (OECD 2010, 2011; Reynaud and Romano 2018).

(Ricato 2019). Although this tariff structure encourages efficient water use, it disadvantages low-income households that may not be able to moderate water consumption (Leflaive and Hjort 2020; OECD 2010). Additionally, volumetric tariffs may lead to lower-cost recovery for the water service providers if the variable component represents a large proportion of the water bill and customers drastically reduce their consumption (EEA 2017).

(c) **Increasing block tariff** (IBT) is a type of volumetric tariff and the most common measure used by water service providers worldwide.[5] The IBT is a stratified tariff that is based on a water user's consumption range. The tariff rate includes a base charge for fixed costs that rises when the water consumption increases and reaches a certain threshold (block). The price per unit remains constant for this block, beyond which a higher volumetric price is charged for each additional unit of consumption, until the highest block (EEA 2017). To generate revenue recovery for the water service provider (EPA 2016), IBT also entails a low charge for essential use and a higher charge for less essential (upper blocks) water use (Bello-Dambatta et al. 2013). It follows the concept that higher costs for the upper blocks discourage water wastage and cross-subsidise the water use of low-income households (Fuente et al. 2016; Grafton et al. 2014). However, this measure has been critiqued for disproportionately disadvantaging low-income households, who on average are larger in number (Boland and Whittington 2000; Nauges and Whittington 2017; Meran and Von Hirschhausen 2017) and for whom the minimum consumption charge may be unaffordable (Neto and Camkin 2020). Notwithstanding these perceived shortcomings, IBT has been shown to have contributed to a reduction in overall water consumption (EPA 2016).

(d) **Decreasing block tariffs** (DBT) refer to volumetric tariff rates that decrease with successive consumption blocks (Ricato 2019). DBTs may be appropriate in areas with an abundance of raw water sources, as the average water costs would decrease with an increase in water supply (Damkjaer 2020; EEA 2017). Hence, this tariff structure may disincentivise water conservation and favour big consumers (Leflaive and Hjort 2020; OECD 2010).

Most major cities in the ASEAN region have adopted the IBT system although only a few account for full-cost recovery (FCR) in their tariff structure, such as Singapore and Jakarta (Indonesia). Singapore has, since 1973, implemented IBT tariffs as a pillar of its water demand management (Araral 2010). At present, the tariffs are based on volumetric consumption, covering the full cost of production and supply (PUB n.d.). Additionally, Singapore charges both a Water Conservation Tax (WCT) to encourage water conservation and to reflect the incremental costs of additional water supplies, and a waterborne fee (WBF) to recover the costs of used water treatments and to maintain the used water network (PUB n.d.). However, in the context of developing countries, it is not uncommon for governments to subsidise water tariffs to ensure universal water access.

[5] E.g. Cyprus, Indonesia, Italy, Singapore, Spain, etc. (EEA 2017).

For example, in the Philippines, the private concessionaires Manila Water and Maynilad have implemented a 'socialising' IBT pricing scheme that ensures affordability for households. Maynilad offers a 20% discount on water bills to domestic customers whose water usage is 10 $m^3$ or less per month (Maynilad 2020). Similarly, Manila Water offers a discounted charge of PHP 83.14[6] to 'lifeline' customers or low-income households with water usage of less than 10 $m^3$ per month, after which the block pricing applies (Manila Water n.d.). Industries and commercial companies, meanwhile, are charged higher rates to cross-subsidise domestic consumers.

In Copenhagen, Denmark, the water supply is operated by HOFOR, a municipality-owned water service provider. HOFOR's tariffs are set by the city, based on a number of factors, including cost recovery (for expenses for drinking water supply and diversion of water), state green taxes, and VAT (HOFOR n.d.). The cost includes pipe maintenance, groundwater protection, and expansion work for future demand and crises (HOFOR n.d.). Their water prices are among the highest in Europe at DKK 39.85[7] per $m^3$. All households pay the same price per cubic metre of water used, as there are no block tariffs (HOFOR n.d.). Although HOFOR is a non-profit company, it updates its tariff levels annually to ensure cost recovery.

## 6.2 Rebates

Incentives for influencing behaviour, such as rebates, represent another economic measure. Local municipalities have been using rebate programmes to incentivise water conservation behaviour, such as a partial refund on water bills (Kayaga and Smout 2011), retrofit residential properties with water-efficient appliances (EPA 2016; Lane et al. 2012; Pérez-Urdiales and Baerenklau 2019), and installing a rainwater harvesting facility as an alternative water source (Lane et al. 2012; Vimont 2017).

Rebates have gained greater public acceptance among water users than other WDM measures such as price hikes and water restrictions[8] (Lee et al. 2011). Targeted rebates can also be implemented in combination with IBTs and assist lower-income households by reducing distributive impacts from high consumption (Hoque and Wichelns 2013; Leflaive and Hjort 2020). For example, in Johor, Malaysia, the water service provider Ranhill has implemented a water rebate programme that provides free water to households in need for the first 25 $m^3$ of water consumption. In 2019, some 3136 lower-income households benefited from this programme (Ranhill Holdings 2019).

Likewise, in Penang, Malaysia, the water service provider PBAPP[9] implemented a corporate social responsibility programme to ensure that low-income households

[6] PHP 1 = USD 0.020.

[7] DKK 1 = USD 0.15.

[8] Water restrictions that forbid certain activities may seem arbitrary to the public if the reasoning behind the implementation of water restrictions is not fully explained (Mullin and Rabado 2017).

[9] Perbadanan Bekalan Air Pulau Pinang (Penang Water Utility).

were not disadvantaged by the tariff review in 2015. Introduced in 2017, the 'Projek Perumahan Rakyat Termiskin' (PPRT) scheme provides the lowest income households in Penang with a free water supply of up to 60,000 L over a two-month cycle (Mok 2019). The programme cost PBAPP RM16,482[10] in 2017 and reached 199 families who earned RM790 per month, or less (Mok 2019).

Studies indicate that rebate programmes for both indoor and outdoor water-saving products can encourage user investments in water efficiency appliances (Pérez-Urdiales and Baerenklau 2019). Nevertheless, the use of rebates may be helpful in curbing wasteful indoor water use by incentivising a switch to water efficiency appliances that help lessen water use by restricting water flows (EPA 2016; Tsai et al. 2011).

In Australia, water authorities of all states and territories across the country provided rebates to households that installed water efficiency appliances. This was implemented between 2003 and 2011, where the most commonly subsidised devices included dual-flush toilets and low-flow showerheads. By 2011, the rebate programmes encouraged 46,357 households to replace their showerheads, 40,755 households to instal a dual-flush toilet, and 344,200 households to purchase/replace a water-efficient washing machine (Lane et al. 2012).

## 6.3 Fines

Fines for excessive water use have also been imposed in several places as a deterrent to water wastage, typically in areas where water resources are scarce or have become depleted due to climatic conditions or over withdrawals. Such measures have been put in place in ASEAN countries such as Thailand and Indonesia. For example, in Thailand, the Water Resources Act (2018) imposes fines for excessive water use during water rationing to avoid a situation where droughts could result in severe national socio-economic and hydrologic consequences. In such circumstances, individuals who do not comply may be imprisoned for up to a year or receive a fine not exceeding one hundred thousand Baht (THB)[11] or both (The Government of Thailand 2018).

In Indonesia, the national government enforces penalties for non-payment, including fines, and may suspend supply under Government Regulation No. 122/2015 on Water System Provision. In line with the tariff decision mechanism, local governments and state-owned water service providers (PDAMs)[12] can determine the severity of fines for non-payments. In addition, these bodies can suspend the water supply in situations of non-compliance. For this period, water bill payment rates increased slightly from 93.28% in 2018 to 93.67% in 2019 (BPPSPAM 2019). The water concessionaires in Jakarta, PALYJA, and Aetra have also sanctioned those who do

[10] RM 1 = USD 0.24.

[11] THB 1 = USD 0.030.

[12] Perusahaan Daerah Air Minum.

not pay their water bills on time by temporarily disconnecting their water services and imposing fines (PAM Jaya 2014).

## 6.4 Case Snippet: Singapore

Singapore has implemented an integrated and cost-effective solution to water management through economic instruments and societal engagements (Tortajada et al. 2013). Regarding economic instruments, water is priced to include full-cost recovery of supply and production and to incorporate the incremental costs of alternate water supplies (specifically NEWater[13] and desalinated water) (PUB n.d.). However, targeted rebate programmes can mean affordable water supply for lower-income households by separating unequal distributive tariff impacts from high consumption (Hoo 2019; Hoque and Wichelns 2013).

Singapore adjusted its water tariffs in 1973[14] with an increasing block tariff (IBT) structure being introduced to reduce the nation's longstanding dependence on Malaysia for water supply and to also discourage domestic water wastage (Tortajada et al. 2013). To reflect the market cost of wastewater treatments, the tariff schedules were further revised in 1975, 1981, 1983, 1986, 1992, 1993, and 1997, respectively (Tortajada et al. 2013). In 1997, the revised structure espoused a uniform tariff for domestic and non-domestic users alike; prior to 1997, domestic users were exempted from the Water Conservation Tax (WCT)[15] and paid lower tariffs than non-domestic users. The revision of water tariffs aimed to deliver the message that water is an important resource that should be conserved.

The most recent water tariff scheme came about by way of a revision in 2017 and was implemented in two phases: in July 2017 (Phase 1) and in July 2018 (Phase 2). The revision entailed a 30% increase in water prices over the two phases (The Straits Times 2017). The WCT was imposed as a percentage of the water tariff, to both encourage water conservation, and to reflect the incremental costs of additional water supplies. The sanitary appliance fee (SAF), which was applicable before 1 July 2017, was rescinded and subsumed into the waterborne fee (WBF). The WBF aims to recover the costs for used water treatment and maintain the used water network (PUB n.d.).

[13] Highly treated reclaimed wastewater produced by PUB, Singapore National Water Agency.

[14] Between 1965 and 2000, the water price (water tariffs and related water taxes) was revised 12 times. Initial price modifications were introduced for cost recovery purposes rather than to improve water conservation (Tortajada et al. 2013).

[15] The WCT was introduced in 1991, and tier 1 domestic users (consuming below 20 $m^3$ per month) were exempted from payment (PUB representative in AWGWRM. Email interview, 7 March 2022).

As indicated in Table 6.1, after the implementation of the tariff regime (Phase 2), the total volumetric price for water has increased from SGD1.80/$m^3$ to SGD2.74/$m^3$ and SGD2.31/$m^3$ to SGD3.69/$m^3$ for monthly domestic usage of less than 40 $m^3$ and of more than 40 $m^3$, respectively (PUB 2020). Singapore's per capita household water consumption decreased by 7 L/day on average, from 148 L/day in 2016 to 141 L/day in 2019[16] (PUB 2020) (Fig. 6.1). Although it is difficult to isolate the impact of water tariffs on water consumption rates, it is likely that the declining trend in per capita household water consumption was influenced by the tariff hike in 2017. During the 2020/2021 period, household water consumption increased to 154 L/capita/day due to the extraordinary conditions imposed by COVID-19, including working and studying from homes (PUB 2021).

**Table 6.1** Tariff rates in Singapore

| Monthly water usage | Units (SGD[17]) | 2000–1 July 2017 | | Phase 1—from 1 July 2017 | | Phase 2—from 1 July 2018 | |
|---|---|---|---|---|---|---|---|
| | | 0–40 $m^3$ | > 40 $m^3$ | 0–40 $m^3$ | > 40 $m^3$ | 0–40 $m^3$ | > 40 $m^3$ |
| Tariff | SGD/$m^3$ | 1.17 | 1.40 | 1.19 | 1.46 | 1.21 | 1.52 |
| WCT | % of Tariff | 30% | 45% | 35% | 50% | 50% | 65% |
| WCT | SGD | 0.35 | 0.63 | 0.42 | 0.73 | 0.61 | 0.99 |
| Waterborne fee (WBF) | SGD/$m^3$ | 0.2800 | 0.2800 | 0.78 | 1.02 | 0.92 | 1.18 |
| Sanitary appliance fee (SAF) | SGD/per Sanitary Fitting | 2.8037 | 2.8037 | 0 | 0 | 0 | 0 |
| Total volumetric price | SGD/$m^3$ | 1.80 | 2.31 | 2.39 | 3.21 | 2.74 | 3.69 |

*Source* PUB (2017, 2020, n.d.); PUB representative in AWGWRM. Email interview, 7 March 2022

[16] 2019 was chosen as water consumption in 2020 was affected by COVID-19 and lockdowns (e.g. people spent longer hours at home).

[17] SGD 1 = USD 0.74.

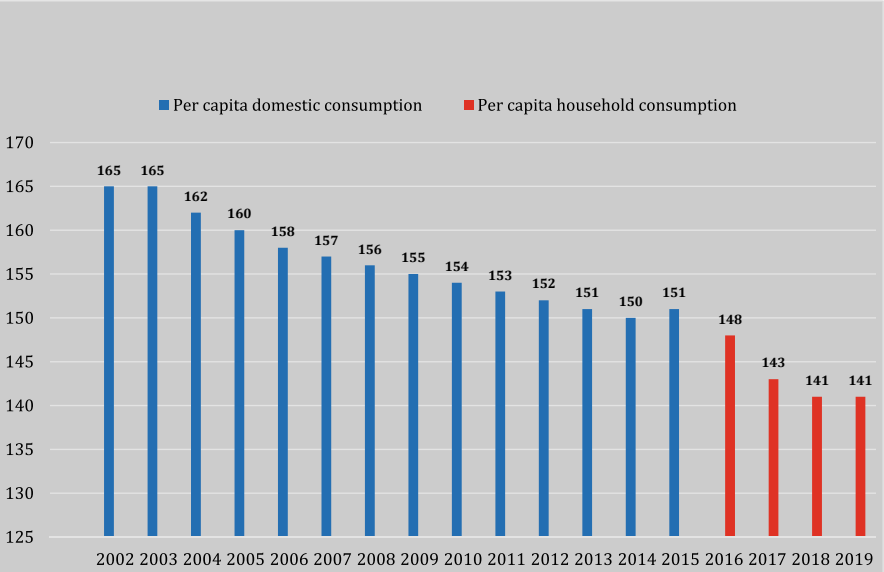


**Fig. 6.1** Household water consumption in Singapore.[18] *Source* PUB (2020)

In 2017, the government increased the annual GST Voucher—U-Save rebate[19] for eligible Housing and Development Board (HDB) flats to help households cope with the tariff price changes. The rebate amount ranged from SGD40 to SGD120 per year, based on the type of flat (PUB n.d.). On average, eligible HDB households receive between SGD220 and SGD380 in U-Save rebates per year, which are credited to their respective utility accounts (PUB n.d.). Instead of implementing a low unit charge for the initial blocks of IBTs, which impact all consumers irrespective of their income levels, the targeted rebates approach provides assistance to lower-income groups while collecting revenue for those who can afford to pay (Hoque and Wichelns 2013).

## 6.5 Key Takeaways

1. Economic instruments are aimed at influencing customers' water consumption behaviour via economic means such as tariff structuring, water rebates, and fines for excessive use.

[18] From 2016, the indicator has been revised to measure water consumption within household premises only (PUB representative in AWGWRM. Email interview, 7 March 2022).

[19] Rebate voucher for eligible households.

2. Tariff mechanisms are the most commonly used economic instrument for WDM in ASEAN. For an optimal economic solution, tariff rates can be structured to reflect the operational and maintenance costs for the water service provider and the value of the resource to encourage water conservation.
3. Most major cities in the ASEAN region have implemented the increasing block tariff (IBT) system. However, only a few, including Singapore and Jakarta (Indonesia), account for full-cost recovery (FCR) in their tariff structure. In Singapore, these measures partly contributed to a reduction in household water consumption by 2 L/day per capita on average, from 143 L/day in 2017 to 141 L/day in 2019.
4. Rebates incentivise water conservation behaviour through measures such as partial refunds on water bills, retrofitting residential properties with water efficiency appliances, and installing a rainwater harvesting facility as an alternative water source. Such measures have been implemented in Johor and Penang, Malaysia.
5. Fines for excessive water use have also been implemented as a deterrent to water wastage, typically in areas where water resources are scarce or have become depleted due to climatic conditions or over withdrawals. Such measures are in place in Thailand and Indonesia.

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