Price and Behavioural Signals to Encourage Household Water Conservation

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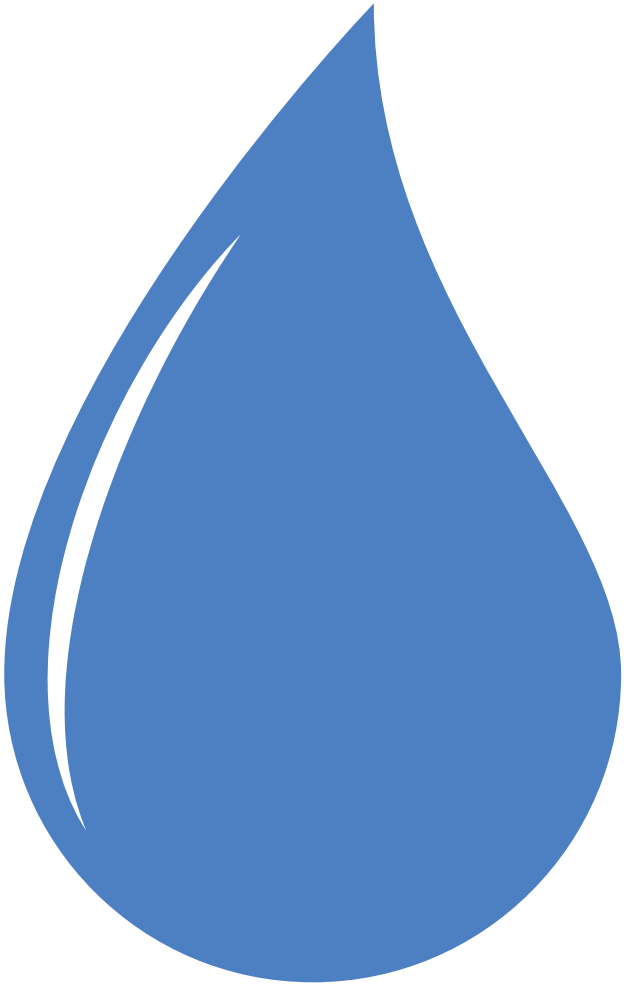

Water scarcity is a global concern. Even in non-drought environments the political, economic and environmental costs of developing new water resources may favour conservation. Recent CCP research for Anglian Water reviews the effectiveness of two demand-side interventions to reduce residential water consumption: Increasing Block Tariffs (IBTs) and behavioural interventions.

In theory IBTs can side-step affordability concerns and are an attractive option, however the authors highlight the operational challenges of implementing effective IBTs. Robust evidence on behavioural interventions is limited, although socially comparative feedback appears to encourage water conservation. Nevertheless, since existing evidence is typically obtained in drought situations, one may question its validity for designing interventions in non-drought situations such as the UK. The authors suggest that an essential first step before implementing an IBT is understanding a locality's water consumers and their water demand. Many UK households have an unmetered water supply and this presents challenges both for gaining the necessary understanding and producing an evidence base around behavioural interventions.

Population growth and climate change create uncertainty about the ability to balance supply and the demand for water in general. The UK, and the south-east/east of England in particular, face an increasing drought risk over the next 50 years. There are now even greater challenges in developing new water resources due to the economic and environmental costs involved and political opposition.[1] An alternative to resource options is to use demand-side options, involving both price and non-price tools (see Figure 1) to reduce household water use. Recent CCP research[2] explored whether Increasing Block Tariffs (IBTs) and behavioural interventions trialled in other industrialised countries already facing a high drought risk could be useful in the UK.

The law of demand suggests that increasing water prices should reduce the quantity of water consumed. However,

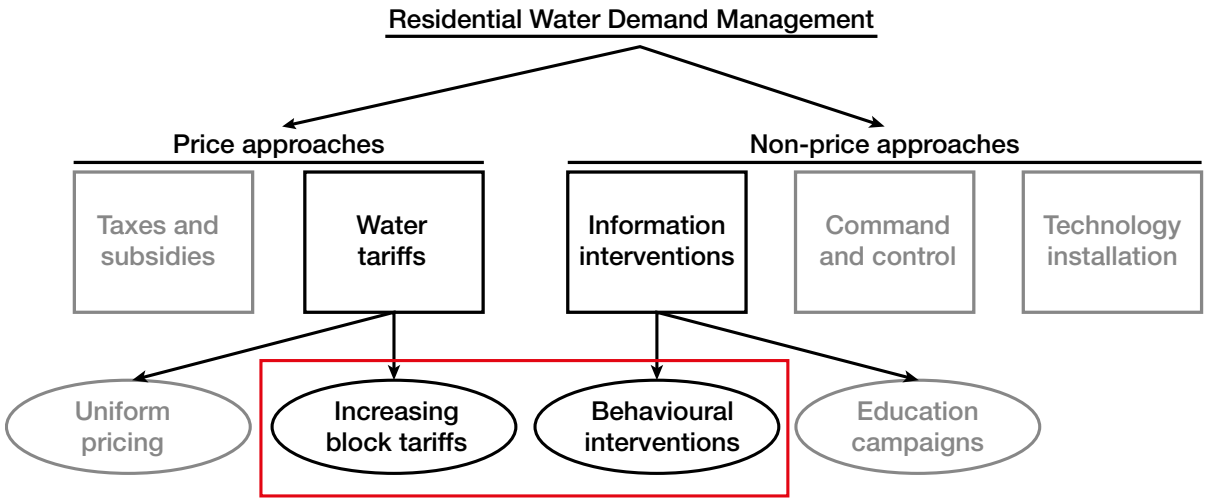

Figure 1: Price and non-price approaches to residential water demand management

water demand is price inelastic,[3] i.e. consumers do not tend to be very responsive and cut their consumptions when facing price increases. To achieve a significant reduction in demand the water price would have to increase substantially, which may lead to poorer households consuming water below an advisable level and/or facing financial hardship. A price mechanism where the per-unit price varies with consumption, such as an IBT, seeks a balance between the affordability and conservation objectives. Under IBTs, different unit prices are charged for two or more pre-specified blocks (quantities) of water. Intuitively the idea is to construct a first block corresponding to the essential amount of water consumption during a billing period, and then consider subsequent blocks of consumption as increasingly a luxury product and price accordingly. Figure 2 illustrates a three-block IBT with conservation objectives. Compared to the uniform price tariff, $\mathbf{p^u}$, the IBT involves a lower price for consumption up to quantity $\mathbf{q_1}$, a higher price for additional consumption up to $\mathbf{q_2}$, and a much higher price for consumption above $\mathbf{q_2}$.

Among industrialised countries, IBTs are widely used in the US, some parts of Europe, such as Spain and Portugal, and parts of Australia including Melbourne, Perth and Sydney. Unsurprisingly, these areas are associated with a high drought risk. A review of those existing applications of IBTs offers two general insights: first, the structure of IBTs can vary considerably across geographical areas and time periods, and second, the effects of IBTs are mixed – some have reduced residential water consumption effectively, while others did not reduce demand, or sometimes even increased total consumption. This suggests that for an IBT to reduce water consumption successfully, it needs to satisfy two conditions: 1) the design of the tariff structure (including prices, block sizes, billing period, and the number of blocks) needs to reflect high quality data regarding local demand, and 2) consumers need to perceive and respond to the IBT's price signal correctly. Both conditions are challenging to meet in the UK.

Many UK households remain unmetered and their water bills are not based on their consumption. The limited evidence on the price elasticity of water demand in the UK suggests the scope of using water tariffs to reduce water consumption in the UK is currently smaller than some other areas of the world.[4] The low variation in water expenditure across income groups may indicate that UK households' water demand generally involves a low level of discretionary use. In addition, the ability of firms to experiment with new pricing structures depends on the flexibility of the regulatory regime. IBTs require experimentation to develop an effective block pricing schedule. However, it is an open question whether the UK's political and regulatory setting would permit such experimentation and the charge of high unit prices for high consumption blocks. Despite greater emphasis on sustainable water use in recent years, the development of conservation-oriented tariffs in the UK has been slow. One of the main obstacles of introducing IBTs in the UK is the concern that water may become unaffordable for some large households under those tariffs.

Furthermore, households in the UK appear to pay little attention to their water consumption and water price, which may be due to the small size of water bills relative to total

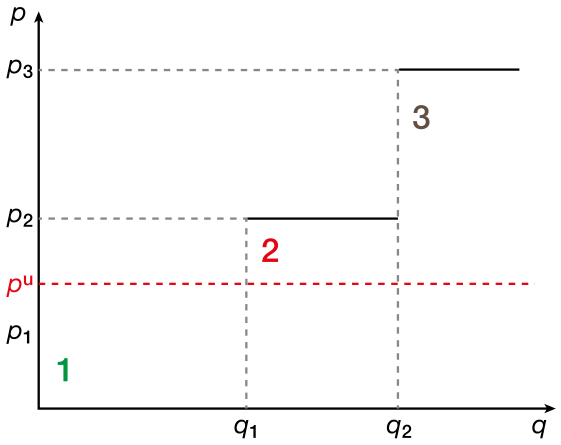

Figure 2: A three-block IBT

Information type	Example
Technical advice	Information leaflets containing water-saving tips
Norm-based information	Letters emphasising social identity and prosocial preferences, such as the importance of water conservation and how individual households' effort matters for a community
Monitoring device tailored to specific appliances	Devices or labels with technical and conservation information for showers, washing machines etc., enabling usage to be monitored at the point of consumption
General feedback	Feedback on total household water use
Socially comparative feedback	Feedback comparing water use to the average of (similar) neighbours
Emoticon feedback	Happy faces indicating social approval when water consumption is below average, and sad faces indicating social disapproval when consumption is above average

Table 1: Information types

household expenditure. Most of the empirical evidence we reviewed is from a drought situation. It seems plausible that the perceived importance of water conservation will differ substantially between households who have experienced droughts and those who have not. Compared to drier locations, water stress in the UK is not an immediate threat to households' living standards, hence, households, are likely to be less aware of the need for water conservation and are less willing to change their water use habits.

The difficulties of introducing IBTs in the UK increases the attractiveness of using behavioural signals to encourage water saving. In water conservation, behavioural interventions often present different types of information to households and are increasingly evaluated through natural or constructed experiments. In an experiment, households are usually grouped into different "treatments" which receive different types of information about water use and water saving. By comparing treatment groups to a "control" group where no intervention is applied, studies assess whether the type of information used can reduce water consumption. In our review, we seek to address the effectiveness of alternative information types considered in the literature (see Table 1), and whether households' socioeconomic characteristics influence the response to interventions.

We still know very little about the effect of behavioural remedies on water consumption because only a handful of experiments have been conducted in this area, almost all involving small samples[5] and some being affected by sample selection issues. The existing evidence suggests that technical advice on its own and without a good motivation for conservation rarely generates a significant reduction in water use. Social comparative feedback appears to be the intervention most likely to generate significant effects, however, a one-size-fits-all approach may not be effective: social comparison is most promising for high water users. When comparing interventions' short-run and long-run effects, there appears to be a complementarity between price and behavioural interventions. High water users are less price-sensitive but are more likely to respond to social comparisons. The effect of information-based interventions diminishes over time whereas IBTs can become more effective over time, so combining the two interventions may lead to both immediate effect and sustained effects.

Given the currently low consumer engagement in the UK, attitude-led behavioural interventions highlighting the importance of water conservation may help to 'set the scene', prior to the introduction of IBTs, while enabling UK water companies to learn how to maximise the effectiveness of delivering water conservation messages to households. The main insight from our review is that we require more experimental studies to obtain robust results from the UK (where the perception of drought risk is low). Future experimental studies also need to address the persistence of the effect of information interventions on conservation, how socioeconomic characteristics may influence households' responses to interventions, and how behavioural interventions interact with price incentives, such as IBTs.

References:

1. For example, there has been significant opposition to Thames Water proposals for a reservoir near Abingdon in Oxfordshire. See Group Against Reservoir Development website, www.abingdonreservoir.org.uk
2. Lu, L., Deller D., and Hviid M. 2018. Price and behavioural signals to encourage household water conservation in temperate climates, Centre for Competition Policy Working Paper 18-1. Available at http://competitionpolicy.ac.uk/publications/working-papers
3. See, e.g. Dalhuisen, J.M., Florax, R.J., De Groot, H.L. and Nijkamp, P., 2003. Price and income elasticities of residential water demand: A meta-analysis. *Land economics*, 79(2), pp.292-308.
4. Gardner, K., 2010. Residential water demand modelling and behavioural economics. Ph.D. Thesis, University of East Anglia.
5. With the exception of the experiment in Ferraro, P.J., Miranda, J.J. and Price, M.K., 2011. The persistence of treatment effects with norm-based policy instruments: Evidence from a randomized environmental policy experiment. *American Economic Review Papers and Proceedings*, 101(3), pp.318-322.