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Developing resilience to England's future droughts: Time for cap and trade?

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ABSTRACT

Much of England is seriously water stressed and future droughts will present major challenges to the water industry if socially and economically damaging supply restrictions are to be avoided. Demand management is seen as a key mechanism for alleviating water stress, yet there are no truly effective incentives to encourage widespread adoption of the behavioural and technological demand management practices available. Water pricing could promote conservation, but on its own it is an inefficient tool for dealing with short term restriction in water supply. Raising prices over the short term in response to a drought is likely to be ineffectual in lowering demand sufficiently; conversely, maintaining high prices over the long term implies costs to the consumer which are needlessly high most of the time. We propose a system for developing resilience to drought in highly water stressed areas, based on a cap and trade (C&T) model. The system would represent a significant innovation in England's water market. However, international experience shows that C&T is successful in other sectors, and need not be overly complex. Here, we open the debate on how a C&T system might work in England.

1. Introduction

Despite its importance, England lacks a permanently secure water supply. Rising demand, coupled with climate change and the prospect of drought, means that periodically water becomes a scarce resource. England has experienced drought over the last 40 years (Environment Agency, 2012a), including the dry winter of 1975 and hot dry summer of 1976 when nationally water was rationed via standpipes; the 1989–90 drought which impacted on groundwater and led to spray irrigation restrictions in East England; the 1995–96 Pennine drought where road tankers transferred water from Northumbria to some Yorkshire reservoirs; the 2005–07 drought where restrictions were imposed on 15 million people in SE England; and in both 2010 and 2011, when the driest springs ever recorded in the north west and east respectively led to further restrictions.

Water companies learnt from these experiences (e.g. distribution networks are more connected, although disconnects between companies largely remain). However, measures introduced to deal with past droughts may be insufficient to deal with future drought, influenced by climate change. For 23 UK water regions Rahiz and New (2013) analysed drought characteristics of ensemble projections made using the Meteorological Office Hadley Centre regional climate model. They found profound increases in drought intensity, duration and extent for the 2050s and 2080s, with more winter (wet season) drought, particularly in the south where water resources are already stressed but the population is growing – in absolute terms England currently has the greatest population growth in the EU (ONS, 2013). Whilst water is clearly a very important resource, and often a commodity, its value varies in time, space and by activity – i.e. by who is using it, for what, where, and when. It is variously essential for life, critical for some economic activities but only useful for others, whilst some is wasted. In general the marginal utility derived from water use is typically very high at low levels of consumption, whilst there is often a very low marginal utility at high rates of use. Under scarcity, this is inefficient from a societal welfare perspective, as more utility could be derived by a better allocation of the resource in space, over time, and by use, and between users who value the water differently.

This situation is readily seen in the case of UK drought orders which allow the regulator to place restrictions on 'non-essential' uses, those having a lower marginal utility (Environment Agency, 2012a). Thus commercial car washes are suspended recognising the higher marginal benefit of supplying water for, say household use, over keeping our cars clean. Similarly, drought permits allow relaxation of abstraction limits, allowing utilities to take water

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normally reserved for ecological support functions, so as to maintain public supply. This recognises the higher marginal utility people associate with meeting their basic water needs, over that they gain from protecting the environment. It is ironic of course, that regulators issue drought permits when environmental water requirements are greatest. Environmental impacts of recent UK droughts include fish deaths, reduced breeding of wading birds and outbreaks of poisonous blue-green algae. Reducing compensation flows from reservoirs that support ecological requirements adds complexity to drought decision making (and releases prior to recognition of a drought development will in retrospect be seen as a loss of resource). Such failures are permitted under Article 1 (Section 4.6) of the EU Water Framework Directive which allows temporary non-compliance with good ecological status objectives during times of drought, so long as such conditions 'could not reasonably be foreseen'. This is a phrase open to interpretation, but its seems reasonable given mounting evidence (Burke et al., 2010; Rahiz and New, 2013) to expect that future droughts may be more extreme, thus in effect the directive argues for drought planning rather than crisis management.

Water is essentially a non-substitutable resource, especially in the short term, when it is difficult to switch quickly to an alternative source. Thus under scarcity conservation campaigns encourage a change in behaviour (shower not bath, turning tap off when brushing teeth etc.), activities that people would like to engage in (e.g. garden watering) are restricted, and in extremis water may be rationed via street standpipes. The less extreme conservation campaigns may change water use behaviour during drought and deliver demand reductions (Queensland Water Commission, 2010), but imply a loss of welfare as customers would prefer to consume more. This is illustrated by Fielding et al. (2013) who used smart meters to provide water conservation advice in a study of 221 households in Queensland. They found that different forms of water conservation advice (general, tailored to households, tailored with feedback) all reduced demand compared with a control, but that within a year savings had dissipated and water use had returned in all cases to pre intervention levels, despite customers paying on a volumetric basis. Such an outcome has also been reported by a UK water plc. (at a meeting under Chatham House rules) for all interventions it had tried.

Voluntary behavioural change has a role in demand management but appears a weak instrument reliant upon voluntary restriction and acceptance of reduced levels of service. More effective demand management implies raising prices significantly, and/or embedding the fixed conservation practices offered by technological change (e.g. low flush toilets, replacing high use appliances and fittings, installing rainwater harvesting or grey water recycling, or altering production processes and product designs to reduce water requirements) (Butler and Memon, 2006). Metering is often perceived to be a demand management tool, but in England, people opting to switch to a metered supply are self-selected and in the majority of cases do so because they believe they are low water users. Furthermore some water companies, recognising the bad press suffered by energy companies for not guiding customers to the lowest tariff, are seeking to identify all those customers they believe to be low water users likely to benefit from a metered tariff.

Numerous instruments can reduce demand but their effectiveness under a prolonged drought is questionable, given their constraints (Table 1). A recent UK water industry summit concluded that current conservation measures could soften the impact of a prolonged drought, but were insufficient to deal with a prolonged drought, and that alternative approaches that promote a package of measures, including the use of dynamic tariffs, was needed (St George, 2013:p5).

Most countries with high rates of metering use a uniform block tariff (where the unit price is independent of volume consumed) or increasingly an inclining block tariff (IBT) which is assumed to discourage 'wasteful' use, by adopting a low or zero price for an initial block of 'essential' water use, with higher prices for subsequent blocks (Worthington and Hoffman, 2008; Crase et al., 2007; Herrington, 2007). IBT's are also supported on social equity grounds as revenue from higher tier blocks offsets the low cost of the initial

Table 1
Limitations on application and efficacy of demand management interventions.

Approach	Application and assumed benefit	Implementation challenges
Metering (volumetric charging)	Demand reduction, calculated as product of count of metered properties and demand reduction per meter type (dumb, AMR, Smart)	To date, most metered households in England are self-selected low users. Diminishing returns from compulsory enrolment is likely. Retrofit metering of older flats difficult. Cost and uncertainty of forecast utility income.
Education	Water conservation campaigns raise customer awareness of value of water and lead to reduced demand through behavioural change	Poor evidence of effectiveness over long term. Even under drought, customers may be unwilling to conserve unless water industry leads by example CCW (2006). Overseas studies suggest behaviour change is short lived, even with advice tailored to individual households (Fielding et al., 2013).
Technology	Displacement devices, low flush WCs, low flow fittings, shower timers Water efficient appliances (washing machines and dishwashers) Rainwater harvesting and grey water recycling systems	Readily removed by householder if perceived to offer poor service. Regulations (Water Supply Fittings, 1999, Code for Sustainable Homes) not enforced post occupation. Purchasers choose white goods primarily on cost and energy efficiency, although water efficiency is a greater consideration in water stressed areas (MVA, 2006). Householder apathy due to installation inconvenience, health concerns (Fewtrell and Kay, 2007), low roof to occupant ratio for flats, complex agreements for multiple occupancy buildings, and (Roebuck et al., 2011) negative financial return. Technology ineffective as short term drought response due to market installation capacity.
Network management	Mains replacement reduces bursts and leakage Pressure reduction reduces bursts and leakage	Utilities aim for economic level of leakage (find and fix cost v. value of water saved) set with respect to the long run average price of water, not its (drought) scarcity value. Costs (e.g. booster pumps for tall buildings) to maintain service level.