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Reimagining Spaces of Innovation for Water Efficiency and Demand Management: An Exploration of Professional Practices in the English Water Sector

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ABSTRACT: Social practice theories have established an important counter narrative to conventional accounts of demand. The core argument of this body of research is that, having focused on informing and incentivising behavioural change, demand management has largely neglected the social and material dimensions of everyday action that shape how and why resources are used. Despite making a compelling case for reframing demand management, there is limited evidence of practice-based approaches having gained a foothold in policy and business practices. This raises important questions regarding how and why certain modes of intervention are pursued at the expense of others and, more broadly, the factors that shape the pace and direction of innovation in demand management.

In this paper we turn a practice-lens towards the professional practices of demand management. Using mixed methods, we demonstrate how specific modes of intervention emerge as priorities within a social, political, semiotic and material landscape of professional practice. Our empirical analysis highlights four particular contingencies of demand management that constrain the scope of interventions pursued. These are industry expectations and ideals; modes of collaboration; processes of evidencing action; and hydrosocial disturbances. We discuss the implications of these findings, making suggestions as to how innovation in the practices of demand management might be facilitated, and the role of academic research in this process.

KEYWORDS: Water, demand management, governance, behaviour change, intervention, social change

INTRODUCTION

As populations grow and climate change compromises water resources, demand becomes an ever more important aspect of water management. This is particularly the case in countries where a large proportion of water abstracted is used to supply domestic consumption, as is the case in the UK (Lawson et al., 2018) and many other industrialised nations. There have been considerable developments in research intended to support demand management, with a noteworthy contribution being the shift "from people to practices" (Browne, 2015), which – in sustainability studies – is most commonly associated with social practice theories. This shift has arisen as a response to technical and behavioural demand management approaches and is intended to support the reconfiguration of lifestyles and routines in order to reduce domestic resource use.

In fields such as food, energy, water and transport, social practice theorists have demonstrated how everyday activity co-evolves with changes in the socio-material worlds in which activity occurs. In their efforts to inform demand management, researchers using social practice theories have provided clarity

on the relationships between service acquisition (such as cleanliness, comfort and convenience (Shove, 2003)); socio-cultural conventions (Evans, 2011); the spatial and temporal choreography of routines (Southerton, 2012); the material environment in which practices are situated, including technologies, infrastructures and the built environment (Hand et al., 2005, Van Vliet et al., 2005); and the mundane material conditions that effect resource use such as home design (Kuijer and de Jong, 2012) and hairstyles (Hielscher et al., 2007). Practice-based inquiry has also demonstrated the heterogeneity of resource use, within and between different social groups (Pullinger et al., 2013) and throughout an individual's life course (Gram-Hanssen, 2007, Burningham et al., 2014). These findings support calls for more ambitious forms of intervention, which engage in the social and material landscape of consumption, and celebrate the diversity of people's everyday routines.

However, practice theorists' depictions of everyday life as collective, distributed and contingent contrasts with the individualised, technocratic accounts of demand ordinarily enacted in water demand management (Sharp et al., 2011). Water demand management delineates activities ranging from leakage reduction, and other interventions, to reduce upstream water demand, to activities designed to reduce water use in homes and businesses, typically referred to as water efficiency (Parker and Wilby, 2013). Though water efficiency itself is a broad term, it has become synonymous with retrofitting and water-saving advice programmes (Orr et al., 2018). In recent years, both retrofitting and advice programmes have proliferated and increased in scale (Orr et al., 2018), with an emerging trend towards whole-town approaches (e.g. H2Eco and Save Water Swindon). Their delivery has been enabled by, and supported the development of, a multitude of water-saving devices, refined water efficiency messages, plumber certification schemes (Waterwise, 2018), and efforts to combine water efficiency with other sustainability interventions (notably energy efficiency). Yet uncertainties around the reality and retention of estimated savings, as well as potential rebound effects, mean that there remains a substantial challenge to reduce demand in line with industrial strategy (e.g. Defra, 2011). Moreover, these forms of intervention are limited in their capacity to bring about patterns of water use that are different from todays, focusing instead on increasing the efficiency of domestic technologies (e.g. toilets, taps, and showers).

There are other activities undertaken by water companies under the banner of water efficiency (see Waterwise, 2015 for a review); however, in a recent review, Orr et al. (2018) concluded that few are designed to bring about different patterns of water use, with rainwater harvesting being "the only widely known initiative for using water differently" (Orr *et al.,* 2018). Orr and colleagues call for strategies for using water differently is echoed in both industrial strategy (Defra, 2011: 80), and social practice research (cf. Browne et al., 2014). However, though harvesting rainwater is one potential avenue for demand management, social practice theories propose a much broader remit for intervention, one which includes recognition of the objects, technologies and infrastructures that mediate access to water services; the socio-cultural conventions that shape domestic practices; and the hydrosocial relations that background ordinary activity (Pullinger et al., 2013; Hoolohan and Browne, 2019). There are few examples of practice-based interventions to water use (though imaginative examples exist e.g. Davies et al., 2013; Hoolohan, 2016). Thus, a nascent body of researchers are calling for water demand managers and policy makers to develop further interventions that engage with the socio-material context of everyday action, so as to propagate less water-intensive routines (cf. Davies et al., 2013; Hoolohan and Browne, 2016).

The limited evidence of practice-based approaches being implemented is symptomatic of a continued reliance on individualised approaches, both within the water industry and in other resource sectors (Fam and Sofoulis, 2015; Strengers and Maller, 2015). This continuity is intriguing, raising questions as to how and why certain modes of policy and intervention prevail whilst investigation and investment into alternatives, that might address the factors that shape the pace and direction of innovation in demand management, is limited. Responding to this intrigue, we propose that demand management itself may be usefully interpreted through a practice lens, revealing that the professional

practices of demand managers are organised and directed by the social, political, semiotic and material features of the water sector as well as the broader context in which water governance is situated. Subsequently, the current situation of demand management in the UK renders individualised and technocratic water efficiency programmes an inevitable mode of governance that is embedded and affirmed within the daily routines of water professionals.

To contribute to further understanding demand management, this paper presents findings from a mixed-method inquiry that explores water demand management through a practice lens. This enquiry is undertaken not only to critique the ways in which privatised water sectors create governable, predictable water subjects (cf. Loftus and Nash, 2016), nor to suggest that responsibility for these outcomes lies solely with demand managers. Indeed, the latter would be disingenuous of practice theories, which ascribe responsibility to distributed socio-material collectives (Browne et al., 2014; Evans et al., 2017), and the former has been valuably examined elsewhere (e.g. Page and Bakker, 2005; Trentmann and Taylor, 2005). However, the regulatory duties of water companies in England and Wales position them as actively, deliberately and strategically effecting changes that may influence domestic water use. Furthermore, demand managers within water companies are not only working – often extremely hard – to find innovative means of reducing domestic demand, but also support practice-based research, providing funding and insight to projects designed to reimagine water management. Thus, our paper is situated at the juncture between a critical, interpretative social science critique of 'what is' and a hopeful exploration of 'what could be', if we were to reconfigure the practices in which water professionals are enmeshed. We do not fully elucidate the former, nor fully realise the latter. Instead, the significance of our analysis is in its interrogation of possible ways to create space within institutions for alternative modes of resource governance, supposing that the limited empirical research into professional practices of demand management obscures potential pathways towards alternative modes of intervention.

PROFESSIONAL PRACTICES AND WATER DEMAND MANAGEMENT

Facilitating sustainable consumption requires deeper interrogation of the roles of actors within systems of production and consumption that accelerate and impede transitions. Yet few studies have examined how demand management itself – as a set of professional practices – evolves, or how it shapes and restricts sustainability interventions (exceptions include: Strengers, 2012; Sofoulis, 2014, 2015). Indeed, within the literature on sustainable consumption, empirical studies of the professional practices involved in demand management are in a small minority, with enquiry focusing primarily on understanding domestic practices (Geels, 2010), complemented by a small but valuable body of literature on the role of intermediary actors (e.g. Janda and Parag, 2013; Macrorie et al., 2014; Grandclément et al., 2015; Wade et al., 2016). This section examines how practice-based approaches in other fields might aid our conceptualisation of demand management as professional practice.

In organisation and policy studies, practice-based approaches have been used to unravel the relationship between scientific research, policy and professional activity (for example in medicine (Mol, 2002; Nicolini, 2010, 2011), agriculture (Law, 2006; Hinchliffe and Bingham, 2008) and urban planning (Wagenaar and Wilkinson, 2013)). Analyses illustrate how the actions and understandings of professionals arise in response to an ongoing feedback process between social, temporal, artefactual, and natural agency (Nicolini, 2011; Wagenaar and Wilkinson, 2013). In a study of telemedicine, Nicolini demonstrates how procedural knowledge transpires through "the sayings and doings, the tempo and rhythm of the practice, the objects used in the course of the activity, the interactional order and accountability regime, and how deviations and innovations are taken into account and dealt with" (2011: 609). Consequently, professional practices are neither a rational implementation of formalised training, nor an outcome determined by practitioners themselves, but a collective endeavour; an emergent and situated co-product of the world in which they take place (Bourdieu, 1990; Latour, 2005).

Other bodies of research provide further insight into the configuration of professional practice. The communities of practice literature refers to the symbiotic evolution of practice and community around collaborative exchange (Lave and Wenger, 1991; Wenger, 2010). Communities of practice are neither geographically defined nor necessarily formal (Bradbury and Middlemiss, 2015). But in sharing experiences within a mutual domain of interest, communities of practice provide a site to develop competencies and tools, as well as the conventions that guide their application. Subsequently, communities of practices are frequently proposed as a strategy to promote change in professional practices (Koliba and Gajda, 2009) as they are seen to benefit the development of knowledge within organisations (Zorn and Taylor, 2004; Wenger, 2010), and increase reflexivity and learning (Pahl-Wostl et al., 2007). However, Brown and Duguid (2002: 26) argue that communities of practice "can easily be blinkered by limitations of their own world view" as tacit assumptions blind practitioners to outsider perspectives. In sustainability studies this outcome has been described as 'mini-me-ism', wherein the capacity of experts and decision makers to apprehend and respond to the experiences of resource users is reduced, as it is assumed that resource users think and act as resource managers do (Sofoulis, 2011; Porter and Dessai, 2017). These insights therefore suggest that innovation in professional practice is also shaped by the dynamics of inclusion and exclusion in demand management.

To complement these discussions, researchers in a variety of fields have elaborated on the artefacts of managerial practice, such as the tools and devices that enable project planning and those enrolled in evidencing action. Apparatus, documents, accounting tools and planning frameworks have all been shown to shape and stymie ways of knowing and doing in such fields as research methods (Law, 2009), resource management (Li, 2007; Verran, 2011) and urban planning (Larsen and Hansen, 2008). Examining forest management, Li (2007) uses Deleuze and Guattari's concept of assemblage to demonstrate how scientific knowledge and procedures are employed to simplify and rationalise the complexity of forests and forest communities, rendering them technical so as to enable technocratic modes of management. Verran (2011), attending to river management and also following Deleuze, illustrates how so-called 'enumerated entities' shape discourse in planning processes, showing the partiality of the measures and values involved in evaluating intervention. These analyses reveal how the measures, methods and approaches enrolled in planning and evidencing action grant authority to specific modes of management over others, thereby enabling the validation and consolidation of evidence-making practices. These discussions are particularly pertinent in the context of the drive towards evidence-based policy making occurring in the water sector of many industrialised nations, and the priority given to positivist approaches in these policy processes (Sharp et al., 2011; Verran, 2011).

The boundaries of how materiality is studied in resource management are pushed further in literatures concerning more-than-human or nonhuman geographies. Though rarely are direct connections made between these literatures and studies of resource demand, research highlights how the interactions between water and society shape the practices involved in both living with and managing water (Kaika, 2004; Bakker and Bridge, 2006; Whatmore , 2006). For example, the vitality of water, its physical properties and its contribution to material systems has been noted in studies of urban infrastructure and governance (Page and Bakker, 2005; Bakker, 2012), the role of environmental disturbance in shaping urban political ecologies (Heynen et al., 2006; Swyngedouw, 2009), and of weather and water in effecting social practice (Hitchings, 2011; de Vet, 2013, Maller and Strengers, 2013). A small but growing body of literature illustrates how water management is embedded in the lived experience of socio-natural systems. For example, Hinchliffe (2003) describes how encounters with nonhumans in the city enhance convivial relations for publics and planners, while Whatmore (2013) illustrates how floods expose the assumptions embedded in decision making. The capacity of more-than-human elements to alter social imaginaries and water-related practices (Woelfle-Erskine, 2015) renders them pertinent to any investigation of change, particularly given the likely consequences of climate change for the water sector (Bates et al., 2008). However, how hydrosocial relations shape demand management practices have yet to be thoroughly investigated.

In summary, not only are there significant opportunities to use the insights emerging from practice theories to inform water demand programmes, particularly as a means of challenging individualised and positivist ways of knowing consumers, but there is also value in examining the professional practices of demand management. As a collective, critical researchers are attuned to the limited response of demand management policy and practice to the insights from practice-based research (Shove, 2010). A growing body of research demonstrates various failures, such as the limited capacity to innovate new ways of understanding diverse water users (Sofoulis, 2011), and how water demand programmes reinforce neoliberal rationalities (Loftus and Nash, 2016). However, the combined insights of empirical studies of professional practices described in this section support us in cautioning against the use of tropes, such as that of the homogenous, rational demand manager. Instead, we seek a deeper understanding of the distributed, contingent qualities of water demand management. We propose to explore the complex socio-material-legal-political contexts in which demand management takes place and identify where there are restrictions on, and opportunities for, change within existing professional practices.

CASE STUDY AND RESEARCH DESIGN

Water demand in the UK

Despite the UK's temperate climate, water stress is an increasing challenge. There are areas of southern England, for instance, that are among the most 'water stressed' in Europe; meaning that the majority of available rainfall is already in use and the opportunity to develop new supplies is minimal (Environment Agency and Natural Resources Wales, 2013). As well as investing in aging infrastructures (Bates et al., 2008; Committee on Climate Change, 2012), part of the challenge of securing water supplies in the face of climate change is to reduce demand (Brooks et al., 2009; Defra, 2011). Domestic water use, the single largest component of mains water use (Kowalski et al., 2011), is the focus of much demand management activity, particularly in densely populated and water-stressed areas. Estimates of average per capita consumption range from 126.4 to 150.9 litres per person per day (CCW, 2015), with all but two of England's nine water companies reporting in excess of the 130 litres per day to which the industry aspires (Defra, 2008). Though predicting future water demand is difficult (Walker, 2013), recent estimates suggest that even if per capita consumption remains at around 140 litres per day, population growth alone will result in approximately 15% rise in demand by 2065 (Lawson et al., 2018). It is of therefore paramount importance that future patterns of use are different, and less-water intensive, than today.

The professional practices of those employed in demand management – including the planning, implementation, evaluation and monitoring of demand management activities – are intended to expedite the transition to less-intensive patterns of use. Though in theory demand management may take a variety of forms, to date it has primarily focussed on retrofitting domestic supply technologies and offering water saving advice. This paper presents the findings of a mixed method study to understand the practices of water demand management as enacted in English water companies. We focus on English companies as differences in supply-demand conditions; regulatory context and historical legacies mean that it is pertinent to avoid overgeneralising even between the English water companies, Dwr Cymru (Welsh Water) and Scottish Water. However, both the trends in water demand management observed in previous sections, and the findings that emerge from this study, resonate with proceedings throughout the UK and in several other industrialised nations.

Research methods

The fieldwork reported in this paper was carried out between 2014 and 2015. Thus, this period was a particularly dynamic time for water demand management, as it bridged the end of the water industry's

2010-14 asset management period and the planning and commencement of the 2015-2019 asset management period (AMP5/PR09 and AMP6/PR14. respectively). AMP5/PR09 was the first to follow *Water for Life*, a white paper that translated the aspirations for water demand management presented in *Future Water* into regulatory guidance. Connected to this was the instatement of the first targets for water efficiency (Ofwat, 2009), which were subsequently removed for AMP6/PR14. The targets formalised the reporting of water efficiency, and provided guidance on the level and nature of activities expected of water companies. It was also during this time that *The Evidence Base for Large-scale Water Efficiency in Homes* (Waterwise, 2008, 2010a) was expanded. Thus, this period also saw a rapid consolidation of water efficiency, as it became a core component of water company plans.

An initial review of the regulatory guidance for water management and water efficiency, along with the water company plans, was used to establish a broad understanding of the framing of water efficiency, and the range of interventions planned and ultimately enacted. Twenty-one semi-structured interviews were then conducted to gather individual reflections on the factors that shape and direct professional practices. Participants included representatives of six of the nine regional water and wastewater companies and each regulatory body along with academics, consultants and organisations working alongside the water industry to manage demand. Though practices are shared and collectively formed, individual reflections have proven valuable in unravelling the context of domestic practices and are extensively used in practice-based accounts of professional practice (e.g. Nicolini, 2011; Sofoulis, 2014).

The individual accounts of water demand management obtained in the interviews were complemented by observation of conferences, workshops, and planning meetings; spaces in which water industry professionals gather to articulate and discuss current practice, and explore future courses of action. With regard to conferences and workshops, observation focused on industry-academic events (e.g. WatEf Network Conferences, Waterwise Annual Conferences and other Waterwise events, a Water Efficiency Network meeting). These spaces provide an opportunity to witness the translation, contestation and affirmation of demand management practices (Nicolini, 2011). In addition, participation in these events, as a presenter and as an audience member, allowed a dialogue with those working in demand management to be maintained throughout the fieldwork, enabling emerging themes to be explored and interrogated as they developed.

These data were supplemented with analysis of publicly available documents and those made available by interviewees. These materials include consultation reports, planning documents, and project evaluations all of which provide reflections and critical accounts of water demand management, from the perspective of those working within (or in proximity to) the water industry. Each document affords an opportunity to substantiate and further understand narrative details obtained through interview and observation, and to situate these within wider water industry proceedings.

The analysis used Atlas.ti, a qualitative data analysis software, to identify common themes and was coded to reflect aspects that demand managers felt influenced the trajectory of demand management interventions. Throughout the data collection, respondents shared reflections and experiences that had not otherwise been widely communicated within the water sector, and were sometimes critical of proceedings within the water sector. Thus, in order to preserve the anonymity of respondents, we present data as anonymised quotes and vignettes (composite quotes that convey the opinions of multiple respondents where such opinions were broadly shared), or alternatively use excerpts from publicly available material written by demand managers (e.g. conference proceedings and public records), or where they have been quoted (e.g. blogs and reports). We also refer to documents and other materials that participants referred to during the interview (e.g. reports and websites) and make personal reflections on the data collection to make connections, acknowledge common themes and disparate viewpoints.

RESULTS

The following discussion positions demand management interventions as the observable outcomes of professional practices. The routines of demand managers thus become a space in which the nature of intervention is determined and the onward trajectory of managerial practice is orchestrated. In the following sections we examine how demand management transpires in the context of industry expectations and ideals; in partnerships and collaboration; utilising specific tools for evidencing action; and in the wake of environmental disturbance. In each case we examine how demand management interventions are shaped, stabilised or unsettled by these components of professional practice.

The situated practices of demand management: Implications of industry visions, expectations and ideals

The first apparent influence on demand management is the multiple, converging expectations of the water industry. Though high-level policy and planning documents do not directly specify the terms of demand management, they nevertheless institutionalise specific expectations and visions regarding what water *is* and what water is *for.* While poorly defined, a trio of principles permeate throughout water industry planning and policy documents; safety, reliability and customer service (for examples see: Ofwat, 2010; Defra, 2011; Environment Agency et al., 2012). Each principle frames the services that water companies offer in a different way, reaffirming a set of expectations that arise within the different political and historical legacies with implications for how water demand management activities are directed.

For example, safety standards are ensured by the Wholesomeness Regulation, which guarantees the quality of water used for drinking, food preparation and washing. The Wholesomeness Regulation dates back to the nineteenth century Public Health Acts, and aligns with European and global water quality strategies (e.g. WHO, 2012; UN, 2015), to situate water management within the public health agenda. Subsequently, water companies are required to participate in the protection and promotion of public health by providing high-quality water and effectively removing waste. This assurance of water *for* the public, and a legacy of structural engineering involved in its achievement, was seen by more than one participant as a reason that social aspects water use have remained marginal within demand management:

> Water companies have very much been utility companies and their way of working has been a) make sure there's supply, b) make sure it's wholesome, c) make sure we don't kill anyone and, you know, engineer what we need to achieve those outcomes. This means, bizarrely, that they haven't thought about who uses the water, or how until relatively recently. So now, this sort of thinking has, essentially, to be retrofitted to an engineering system (Quote, Consultant).

In contrast the Guaranteed Standards of Service (GSS) and Service Incentive Mechanism (SIM) provide means of enforcing reliability and customer service, respectively. Both mechanisms emerge from early permutations of the Water Act (1973), which was produced in the early stages of commercialisation of the water sector.[1] These mechanisms provide the basis for the complaints and compensation procedure water companies are obligated to adhere to, and the principles of reliability and customer service are deeply normalised in the routine practices of demand managers. This is evidenced in repeated remarks from interviewees on the role of water efficiency in providing a high-value service to water company customers:

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[1] For a detailed account of the transformation of the water sector in England and Wales see Page and Bakker, 2005.

> [Water efficiency] is good customer service. We supply water and we charge people for it, so let's help them save water and save money. It's an added value thing isn't it? (Vignette from interviews with demand managers)

Furthermore, with all three principles codified in incentive and penalty mechanisms, indicators such as water quality standards and complaints become indicators against which all water company activities are monitored, including demand management:

> Customer complaints are a key indicator [for water efficiency]. It's something companies are monitored on that results in real fines very quickly. As long as an initiative didn't cause complaints, they would think everything was fine. But complaints are not a particularly effective measure of water efficiency (Quote, water demand manager).

On reflection, water managers described how certain modes of intervention were justified not only in terms of water saving, but also by their ability to sustain these ideals. For example, contrasting water managers' justification of greywater and rainwater harvesting against those for retrofitting and advice programmes is revealing:

> It would be wonderful to see greywater or rainwater harvesting included in new-builds as a matter of course and more research into how to retrofit these technologies. But there are issues of potential cross-connection and, maybe contamination, and then they're not 100% reliable. And you've also got a whole load of questions about who is responsible for on-going maintenance and things. So, while both come up regularly as great ideas, it's just not that straightforward (Vignette from interviews with demand managers).

Demand managers descriptions of the risks and ambiguities associated with rainwater or greywater is indicative of how interventions designed to more deeply engage with the socio-material configuration of homes are rendered problematic, as they fail to conform to the definitions of success outlined by industry expectations. In contrast, retrofitting and advice programmes offer benefits; to consumers, as a means of counteracting the rising price of water; and to water companies as a means of easing complaints, signalling corporate social responsibility and enhancing their relationships with their customers:

> We're providing these products [water efficient devices] for free and we're providing the information for free, so that we're seen to be more than a service provider with a bill. Also, I think there's a need for companies to look socially and environmentally responsible, and these initiatives [retrofitting] add to that (Quote, water demand manager).

These findings reveal how, within this arena of expectations, demand management becomes not only an attempt to reduce water use but also to mitigate risks to safety and reliability, and enhance customer service. Our findings demonstrate how sectoral expectations are creative of conditions that simultaneously support certain modes of demand management and undermine others. Furthermore, these ideals are deeply normalised in demand management such that, though demand managers were critical of the remit of demand management activities during these interviews, on a day-to-day level these ideals obscure certain avenues for water efficiency. Subsequently, the risks associated with known alternatives are underexplored and there is limited space to consider other, potentially transformative, approaches to intervention.

The water industry's aims are constantly shifting, sometimes quite rapidly. However, changes in high-level narratives have neither immediate nor equivalent effects on water demand management practices. This was the case when changes to the Water Act were announced in 2015, coinciding with Ofwat's *Water 2020*. These strategic documents sought to action the ambitions of *Water for Life* (Defra, 2011), by creating space for deeper experimentation with water service provision and encouraging water companies to engage with water users in creative new ways (Ofwat, 2015). However,

commentators observed a lag in demand managers' response to these changes. Addressing the audience at Ofwat's launch of *Water 2020* Tompkins, founder of Waterwise, likened regulatory changes to the throwing open of 'prison doors', granting freedom to water companies to experiment by removing barriers to water efficiency. However, reflecting on the options and possibilities for intervention detailed within water company plans for AMP6/PR14 (for their review see Waterwise, 2015), Tompkins also described most water companies as remaining "in the prison waiting to be told what to do" (quoted in Utility Week, 2015). This lag indicates that factors other than policy expectations influence intervention, a selection of which are explored in the following sections.

Networked water efficiency: Partnerships and collaboration in practices of water demand management

The second theme identified in this study revolves around how the participants and procedures involved in collaborative projects have implications for the trajectory of demand management. Water companies are increasingly encouraged to collaborate – with each other and with private partners, research partners, NGOs and government organisations – to deliver demand management initiatives. Collaborative, multi-party processes can benefit social, or higher order, learning and increase the potential for transformation in management practices if they are appropriately inclusive and reflexive (Pahl-Wostl et al., 2012). However, in this case interviewees' experiences of partnership suggest the opportunity for learning varies depending on who is involved in collaboration, and the nature of their involvement. Table 1 and the paragraphs that follow reflect on three collaborations observed during the fieldwork. Contrasting the processes and outcomes of these three examples illustrates how the inclusion of different partner organisation(s), the different relationships between partners, and the division of responsibility within the collaboration have implications for the practices of demand management.

Table 1. Summary of three partnerships, from interview and observational data.

Example	Partnership model	Purpose
Collaborative Fund	A network of water companies and research partners (e.g. consultants, market researchers, and academics).	Designed to address knowledge gaps, research novel interventions and evaluate progress in water efficiency cost-effectively.
Save Water Swindon (SWS)	A large-scale water company led initiative partnered with multiple public (e.g. housing associations) and private organisations (e.g. plumbers and a renewable energy company).	To maximise participation and enable effective and efficient delivery by disseminating information, recruiting households and installing devices.
Care for the Kennet	A water company collaboration with a charity that campaigns for local ecological issues with support from several NGOs and connections to SWS, but with limited direct involvement.	To develop relationship between partner organisations and to enhance the legitimacy of water efficiency activities in the local area.

Though the partners involved in the *Collaborative Fund*[2] and *Save Water Swindon* vary, the purpose of partnership in each was to deliver demand management initiatives more effectively. The *Collaborative Fund* invites research partners and consultants, to provide support to address various knowledge gaps identified by the water companies, reducing the costs of research and development activities to enhance the performance of water efficiency across the sector:

> Water companies collect data and direct the project, but the delivery and analysis are led by contractors, saving a considerable amount of time and expense. Interviewer: How were the projects selected? Respondent: By the steering group, which consisted of all the water companies, and the decision was made, basically, on what the water companies wanted results on (Extract from interview with demand manager).

Similarly, *Save Water Swindon* employs public and private partners to implement the initiative. For example, organisations with pre-existing relationships with water users, such as housing associations, were employed to increase public participation and reduce the cost and reach of retrofitting activities:

> Housing associations are great partners because we can just provide them with the kit [water-saving devices] and a small percentage of their costs and then don't have to pay a plumber ourselves. We also get a higher level of take-up because they [the housing association] can make it an opt-out sort of thing (Vignette from interviews with demand managers).

The observed outcomes of *Save Water Swindon* and the *Collaborative Fund* projects suggest that these instrumental modes of partnership contribute to reinforcing and refining established practices of demand management rather than contributing to innovation. In neither case are partners extensively involved in defining problems or designing intervention strategies, which is where research suggests there is greatest potential to unsettle existing problem frames (Pahl-Wostl et al., 2007). Instead collaborators are employed to address specific challenges that water companies have encountered, either in the form of knowledge gaps or barriers to implementation.

In contrast, *Care for the Kennet* evolved from an extended dialogue between Thames Water and a local ecological action group Action for the River Kennet (ARK). ARK had a long history of campaigning for environmental protection within the Kennet catchment, and both prior to and throughout *Care for the Kennet*, and were vocal in their criticism of Thames Water's approach to abstraction and pollution within the catchment (examples of which emerged in the interviews and were also identified in consultation reports (e.g. RSPB, 2009) and the media (BBC, 2011).

Care for the Kennet provided a platform for ARK and Thames Water to collaborate on a shared interest; reducing abstraction on the Kennet. Both parties were involved in designing the initiative, Thames Water provided funding and experience in delivering water efficiency initiatives, and ARK provided experience of working with local communities and connections to a network of conservation charities. The outcomes of this project suggest this collaboration supported a shift in the problem framing and nature of intervention as demand management became connected to a broader discussion of local ecological sustainability. Interviewees described how emphasis moved away from water efficient devices and behaviour change, though both remained features, to focus on reaffirming connections between people and the river. Under the *Care for the Kennet* banner, ARK and Thames Water developed participatory activities including interactive river models, school projects revolving around the rearing and release of ecologically significant local species, and community events. Both parties reflected on the success of the partnership, not only in terms of the project itself which

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[2] Introduced in 2012, the Collaborative Fund was initially supplemented by the Water Companies, who were then able to claim a credit towards their base-level water efficiency targets, equivalent to 3% of the 2010-15 base volumetric targets at the assumed cost of £170,000 per Mega litre.

contributed to changing local discourse and social imaginary regarding the role of water in society (Hoolohan, 2016; Hoolohan and Browne, 2019), but also in establishing a dialogue between ARK and Thames Water around water management in the local area.

The findings in this section illustrate the capacity of partnerships to reinforce, shape and alter demand management practices in various ways. Though these three examples are by no means representative of collaborations across the water industry, there are noteworthy commonalities in who is, and is not, typically enrolled to participate strategically in water demand management. For example, it remains unusual to see water users directly involved in developing and prototyping initiatives despite often being involved in their evaluation. Similarly, actors such as home designers, the fashion industry, and hair stylists are also uncommon collaborators in water company initiatives, yet important contributors to the broader coalition of actors that influence domestic practices (Hoolohan, 2016). It is also relatively uncommon that social scientists are involved in designing and developing interventions, instead of typically taking a more evaluative role in water industry research (Browne et al., 2014). Though there are exceptions to all of these, reflecting on the experiences of collaboration in the initiatives described here suggests a need for more inclusive partnerships and deeper forms of collaborative exchange to facilitate innovation.

Technologies of demand management: Evidencing action

> Initiatives that might actually drive down consumption and change how people use water in their home are a massive challenge for water companies because they are so difficult to measure. All water companies try, but often don't really know what they're getting for their efforts (Quote, Consultant).

The third theme apparent throughout the fieldwork was the role of evidence in legitimising certain management pathways while creating friction for others. As the quote above alludes, this section examines the ways in which techniques involved in measuring and evidencing water demand management grant priority to retrofitting and water-saving advice programmes (Orr et al., 2018), whilst problematising interventions that might bring about different patterns of water use. We focus our analysis around two core findings, first regarding *what evidence is* (or what qualifies as evidence), and *what evidence is used for* and demonstrate how the qualities and functions of the evidence-making process have implications for the nature and trajectory of innovation.

On what evidence *is*, interviewees frequently referred to *The Evidence Base for Large-scale Water Efficiency in Homes* (the *Evidence Base*) (Waterwise, 2008, 2010a) and the *Water Efficiency Targets* (Ofwat, 2009) as providing guidance for the evidence generation process. These documents share an approach to evidence that not only privileges quantitative data, but specific forms of quantification. Bottom-up analyses are evident throughout water companies' plans and evaluations, used to predict the potential saving arising from a planned initiative and to report on the outcomes of those implemented (e.g. Box 1):

Box 1: formula to estimate benefits of water efficient devices (adapted from Waterwise, 2011)

$$\text{£ / Ml day}^{-1} = \left(\frac{N \times I \times S}{1000}\right) / \text{£ cost}$$

Where: N = properties targeted; I = installation rate (%) and S = Saving (litres/property/day)

Such calculations are quick to conduct, relatively straightforward and allow gaps in data to be filled with assumptions and secondary calculations. Thus, they require minimal data and analytical capacity; qualities that resonate with interviewees need to find analysis techniques that fit project timelines and budgets:

> It has to be simple, and easy to monitor as it's all very well doing the projects but you've got to then spend the time and or the money to analyse it and get something out of it. We don't always have those luxuries (Vignette from interviews with demand managers).

However, they also restrict demand management, framing domestic demand as a function of domestic technologies and their use, rather than the result of the ordinary acts of water users involved in accessing the services that water provides (e.g. cleanliness or comfort). Consequently, these positivist modes of evidence making address certain elements of demand and neglect others, accentuating taps and showers, rather than the social meanings, routines and bathroom designs that influence bathing practices. In so doing they foreclose the broader reflection on how water services might otherwise be fulfilled that theories of social practice call for.

With regard to what evidence is *used for*, there were two core functions of evidence apparent in our data. First is to qualify water demand management as a valid resource management strategy, alongside supply-side initiatives. Second is to support the up-scaling of management activities. During the fieldwork, these two objectives resonated throughout documents and planning processes, and in the narratives of presentations, events and conference themes.

In order that the first might be achieved, any beneficial effects must be directly attributed to an intervention. This enables the benefit of investment in water efficiency to be discernible from other management options such as network management, leakage reduction and metering. The financialisation of impact, whereby the benefit is translated into £/Ml day^{-1} for example (see Box 1) is the most common strategy through which this is achieved. In Water Resource Management Plans the cost-benefit ratio of different water management strategies are calculated, allowing demand management, and the options therein, to be compared alongside other management options:

> The water resources management plan outlines all the options and their respective costs and benefits. A lot of work goes in to working out every option, even those that are discounted, so you can see why it's discounted. That way the best options sort of just fall out of the model. You go from the ridiculous – installing grey water harvesting, rainwater harvesting and things like that – to more realistic things, retrofitting dual flush cisterns, tap inserts, showers and all that sort of thing (Vignette from interviews with demand managers).

As the quote above demonstrates, by simplifying and aligning demand management activities these criteria grant authority to interventions whose impacts are direct and immediately observable. Both retrofitting and water-saving advice programmes are rendered 'realistic' as they have a discrete, measurable intervention with a quantifiable impact; either in the form of devices installed or messages delivered (whether in the form of tips and information provided on bills and other mail-outs or in terms of 'clicks and hits' on online materials (quote, demand manager). Conversely, options such as greywater harvesting, rainwater harvesting and water sensitive urban design are rendered 'ridiculous' as the financial costs are relatively high, and their benefits to water demand are complex and nonlinear. Furthermore, this process leaves little room for the consideration of initiatives with unproven (or unquantifiable) impacts. Referring again to *Care for the Kennet*, though the initiative was perceived to be successful in various regards, its benefits in terms of reconfiguring local hydrosocial relationships proved difficult to account for, beyond measuring participation in associated retrofitting programmes (for further discussion see Hoolohan, 2016; Hoolohan and Browne, 2019).

The second function of the evidence-making process is to support the scaling and streamlining of management activities:

> Words and terms like bigger, better, streamlined, creative, and innovative and 'let's aim big and get on with it', are becoming engrained throughout all our plans (Extract from 'Supersize my WEFF [Water Efficiency]!' in proceedings from WatEfCon2014: 199).

Supersizing depends on designing and scaling generic interventions; encouraging a focus on ubiquitous technological elements such as taps, toilets and showers that are easily replicable. The scalability of these programmes relies on generating evidence of impact in defined spheres of action. These programmes are often initiated with particular partner organisations, such as those who operate in multiple locales (e.g. local authorities, schools and housing associations) or have broad geographic reach (e.g. NGOs and charities). These partners are well placed to replicate sustainability interventions in other socio-geographic situations, however their capacity to foster different patterns of water use is limited compared to, for example, urban planners and the construction industry, or fashion, beauty and interior design sectors. The limitations of existing partnerships, including those that attempt to upscale programmes, to effect deep changes in water use manifest as a sensation of working against the flow of institutions that shape the socio-material conditions of everyday life. As several interviewees reported:

> Sometimes you feel that water companies are the only people trying to do anything about the amount of water people use. It would be the dream to see water efficiency embedded in everything, construction and planning for example, or in the media. But at the moment – I don't think I'm being unfair in saying this – water efficiency comes from the water companies only (Vignette from interviews with demand managers).

Fundamentally, the positivist methods that form the primary tools in the water industry's quest for evidence-based action are seductive in their simplicity. They allow demand management to be compared against other water management options and for these programmes to be scaled-up with ever-greater benefit. Ultimately, the priority given to discrete, quantifiable impact reaffirms a focus on domestic supply technologies such as taps, toilets and showerheads, thereby endorsing retrofitting and water-saving advice programmes. In turn, while water companies are increasingly working within multiparty collaborations, priority is given to partnerships that facilitate the generation of evidence or scalable action. In contrast, interventions and partnerships that might bring about different patterns of water use and deeper changes to domestic demand are marginalised by restrictive forms of evidence making.

Demand management in the wake of hydrosocial disturbances

The fourth and final theme apparent in the findings is the influence of extreme events, such as drought or flood on water demand management. These often-unanticipated events trigger plans that are disconnected from ordinary water demand management action, yet have implications for the ongoing practices of water demand management. This section examines the observed implications of two droughts that occurred in the years prior to the fieldwork (summarised in Table 2), and their enduring consequences for demand management evident in 2014-2015. Droughts have previously shown to create opportunities for rapid reconfiguration of policy and practice by sparking critical discussion around water governance (Chappells et al., 2011). Less attention has been paid to how the legacies of drought shape the onwards trajectory of water demand management. Contrasting the experiences of the 2005/6 and 2011/12 droughts (see Table 2 for a summary of key facts) demonstrates the co-evolution of drought and drought management; the paragraphs that follow explore how the experiences of drought shape water resource planning and management.

Droughts offer substantial learning opportunities for demand managers, as they provide a space in which to trial novel management approaches. 2005/6 saw the implementation of the first co-ordinated drought management initiative, *Beat the Drought*. *Beat the Drought* aimed to establish a consistent approach to communications and temporary use bans (TUBs) across the southern regions of the UK. Though generally heralded as a success, as water companies worked effectively together to deliver consistent information to water users, the initiative was also criticised for causing confusion in areas less-effected by drought. The collective learning of managing the 2005/6 drought were formalised with the introduction of the *Code of Practice and Guidance on Water Use restrictions* (UKWIR Report 09/WR/33/2, hereby referred to as *the Code*), initially through four principles to guide water company

response (see Table 2). These principles sought to ensure a consistent approach to drought management which tried to ensure that water users shared similar experiences of water restrictions:

> [The code] sets out really clearly what the messages should be, what the regulatory requirements are – the temporary use bans, non-essential use bans, exemptions etc.; etc. – and how water companies manage drought so that customers' experience is similar throughout the country (Quote, demand manager).

The evolution of drought management planning tools throughout successive droughts (Table 2) illustrates how droughts provide opportunities to develop and refine strategies for future management. This precedence for cooperation was tested during the 2011/12 drought in which water companies sought to implement the code while also addressing criticisms that arose during 2005/6. Subsequent revisions to *the Code* in 2013 sought to reinforce the coordinated approach to drought management, establishing five actions that translated the principles introduced in 2006 into a common drought management response strategy (see Table 2). In this instance the experience of managing the 2005/6 and 2011/12 droughts established "a new benchmark for cooperation between companies and the [regulators]" (Waterwise, 2010b) that went on to inform subsequent strategies for demand management outside of periods of drought.

Table 2. Analysis of two drought events.

	Key features of drought	Management response	Implications for future drought management
2005-2006	Localised to southern regions but some areas of the southeast were largely unaffected. Long period of lower than average rainfall, two consecutive dry winters. Average rainfall resumed August 2006 with most regions replenished by December.	*Beat the Drought* implemented; a collaborative project between eight water companies and the Environment Agency that streamlined drought management and introduced a year-round public engagement programme. TUBs were implemented in all southern regions.	The Code (UKWIR, 2009) was established, centred on 4 key principles: • Ensure consistency and transparency; • Ensure restrictions are proportionate; • Ensure clear and early communications with water users; • Consider objections and representations in a fair way.
2011-2012	Extensive, affecting much of the UK but concentrated in areas of existing water stress. 24 months of below-average rainfall, two consecutive dry winters. April-June 2012 brought the highest rainfall on record, resulting in extensive flooding.	Locally sensitive initiatives. Coordinated drought communications activities, but TUBs and other activities implemented to suit local conditions and fit water companies' plans. Most companies implemented at least partial restrictions by April 2012.	5 actions added to the Code (UKWIR, 2014): • Companies, regulators and government to work together; • Coordinate communications; • Adopt a common phased approach, considering socio-economic factors; • Adopt a common approach to exceptions; • Promote understanding and good practice.

Sources: Interview data and secondary analysis of drought reporting (Marsh and Wilby, 2007; Kendon et al., 2013).

The timing, extent and duration of extreme events also effect demand management. This is well illustrated by experiences from the 2011/12 drought:

> In the early months of 2012, water companies placed restrictions on customers in many regions. There was lower than average precipitation that winter – a time when water reserves are usually replenished. By the end of 2012, the UK had experienced its second wettest year on record (Extract from At Home With Water, EST, 2013).

The timing of the 2011/2012 drought was important. While companies across the UK were preparing substantial demand management strategies for the summer months, in London, the coincidence of the drought with planning for the 2012 Olympic Games was cause for particular concern.

> It could have been horrendous. Projections were that if it hadn't started raining in April, London would have run out of water just as the Olympics started, with all the extra visitors in London and the whole world about to tune in (Quote, water professional).

In order to manage demand in this context, Thames Water, Greater London Authority and several intermediaries developed plans to distribute water efficient devices to 200,000 homes in Thames Water's region (for details see the Mayor's Water Strategy, 2011). Several interviewees described the difficulties of carrying our demand management activities in the heavy rain and flooding that ended the drought:

> You have to abandon [the demand management activity]. Wait for it to stop raining, sort the flooding out, and try again. You can't speak to someone about drought two weeks after a flood because they just don't want to hear it, it's insensitive. You'd just be told to go away (Vignette from interviews with demand managers).

With activities being abandoned, the water efficient devices that had been purchased remained uninstalled. The physical conditions of the drought and the circumstances coinciding with its duration resulted in a material legacy that shaped future demand management activities.

These examples illustrate the provocative and creative character of extreme events, which stimulate and shape practices of demand management. The socio-material context of demand management observed during the fieldwork was shaped by the legacies of these events, despite drought management and water demand management being separate features of water company plans. In this instance, drought management activities established precedence for co-ordinated multiparty activity and an abundance of water efficient devices, thereby providing elements – both social and material – for demand management beyond the duration of the drought.

DISCUSSION

We began this paper by suggesting there to be value in examining professional activities involved in demand management through a practice lens. Our argument was that detailed empirical research was needed to understand how certain modes of intervention recruit and retain support at the expense of others, with a view to identifying avenues through which innovation in management practice might be facilitated. In this section we reflect on the findings of this research, and examine the possibilities of supporting innovation in demand management practices.

The findings presented in this paper illustrate the collective and contingent properties of water demand management. We show demand management to be situated in industry expectations and ideals, processes of collaboration, systems of evidencing action, and hydrosocial disturbances. This is a partial study, by no means accounting for all of the influences at work on demand management, though highlight some vital components. Each of these dynamics provides context to professional practice, legitimising certain modes of intervention while undermining others. Throughout the subsections above

we have discussed a tendency for the current nature and configuration of these elements to support retrofitting and water-saving advice programmes, rather than interventions that might bring about different patterns of water use that policymakers, water companies and researchers increasingly seek.

We have shown that the often technocratic and restricted activities of demand management cannot be simply attributed to the nefarious, or even reluctantly benign, decisions of demand managers. Rather, the interventions promoted within the water sector are created and maintained through the distributed relations in which water demand managers are enmeshed. The final task that we turn to, therefore, is to reflect on how support for deeper interventions into the social and material fabric of everyday consumption might be built. Our objective here, having previously noted both academic and grey literature that calls for water to be used differently, is to consider how the scope of intervention might be extended by intervening in the practices of demand management. Ideally, this extension would shift the target of intervention beyond domestic supply technologies such as toilets, taps and showers, and ideally beyond the home and its occupants, to engage throughout the web of social and material components involved in shaping domestic demand. We highlight here three spheres of activity that may push us beyond the typical water management programmes of today.

Firstly, the findings suggest that recognising the influences of policies and industrial strategy that may seem unrelated to demand management is vitally important, in order that space is preserved for more ambitious forms of intervention. The role of industry visions and strategies in shaping consumer expectations of 'ordinary use' is well documented (Page and Bakker, 2005; Trentmann and Taylor, 2005). Our analysis adds to these findings, describing how the expectations and ideals that diffuse from high-level strategic action are enacted in the day-to-day practices of industry professionals to influence what is defined as realistic, valuable and possible within demand management. Going forward, policy narratives that reflect the broad, long-term and complex outcomes of water demand management intervention are needed, so as to enable deeper recognition of the potential risks of inaction that accompany existing and demand management programmes and the potential benefits of supporting actions with less immediately observable impacts on water demand. Given these complexities, responsibility for demand management extends beyond those immediately employed as demand managers, to all who are involved in setting water industry policy and strategy, and those outside of the water sector who are nevertheless influential in shaping water industry visions (Browne et al., 2014). In this way, demand management may be better integrated throughout water company business and a broader hydrosocial contract might emerge that is more conducive to sustainable water use (Farrelly and Brown, 2014).

Secondly, in order to extend the palette of possible interventions, the findings point to a need for deeper, more inclusive modes of participation in order to unsettle existing practices of water management and provide the imaginative resources to identify alternative interventions. In practice, this entails initiatives that work with the broad coalition of actors that contribute to the configuration of the socio-material conditions shaping domestic demand (Foden et al., 2018). This might include manufacturers, retailers and service providers shaping expectations, images and meanings that surround everyday water use (including, for example, how people dress and style their hair, homes, and gardens); or those involved in designing, funding and building the material surrounds in which water use arises (from cities and homes, to laundry technologies and clothing). There may also be benefit in the deeper and more sustained inclusion of critical social scientists, others with divergent understandings of water and social practices, and water users, including consideration of those who cannot represent themselves, human or otherwise (Ferguson et al., 2013). In all cases there is an additional requirement to ensure that space is created for deep, reflexive forms of participation, so as to enable social learning that allows unsustainable water use to be understood and the pathways toward a less water-intensive future to be examined. Though some of this work is ongoing outside of water companies, sometimes with demand managers as participants in research or design processes

(e.g. Davies et al., 2013; Hoolohan, 2016) there is a need to consider new modes of governance that better accommodate these wider obligations and responsibilities.

Thirdly, we highlight the importance of cultivating a cultural patience for failure and enthusiasm for genuine experimentation, not only to affect the design of interventions but also in the methodological approaches designed for accounting for, and evidencing, action. The water sector needs to remain alert to what is mobilised and made possible (or foreclosed) in the pursuit of particular forms of evidence of success. In the context of evidence-based action, broadening the scope of intervention requires a corresponding change in evidence-making processes so as to move beyond simplistic measures of success to those that better account for change in complex systems. There is lively debate over whether alternative methods might be employed alongside positivist methodologies, with some highlighting the importance of interdisciplinary work (Sharp et al., 2011) and others arguing such approaches are likely to be "neither cumulative nor complementary" (Evans and Marvin, 2006: 1013). In either case, alternative modes of researching social change are much needed, along with a cultural patience for the inherent uncertainty encountered when engaging in socio-technical systems. These include a wider range of investigative methods to understand the implications of interventions (both planned and implemented), including, for example, historical methods (Kuijer and Watson, 2017) or audio-visual methods (Pink and Leder Mackley, 2012). There is also need for alternative methods for charting progress (e.g. Brown et al., 2018). None of these methods are perfect; however, they better accommodate complex change processes, and in the latter case enable the benchmarking and navigating of sustainable transitions.

None of the suggestions made in this section are simple tasks. Yet they pose rich inter- and trans-disciplinary opportunities that stretch social science research beyond its usual evaluative role in order to support practical action (De Fries et al., 2012). Though there may be a role for policy to support such collaborative efforts, more important perhaps is the creation of a space, physical or otherwise, for potential collaborators to assemble and develop ideas. There are established methods not yet commonly applied in water demand management that might provide such a platform, such as design methods (e.g. Kuijer and de Jong, 2012; Vihalemm et al., 2015), action research (e.g. Jack, 2013), and participatory backcasting (Davies et al., 2012; Ferguson et al., 2013). There are mutual benefits to developing such an agenda. Such methods provide a space for co-development, learning and sharing of expertise that might aid demand managers' defection from existing modes of practice to those with potential to reconfigure the social and material context in which everyday consumption takes place. Further, co-development provides a space in which researchers might deepen their understanding of managerial practices and participate in developing strategies for intervention and evaluation.

CONCLUSION

In this paper we have sought to develop an empirical account of the collectivities and contingencies of demand management in the English water sector. We have demonstrated the effects of industry expectations, processes of partnership working, evidence-making and socio-natural disturbances on the nature and trajectory of demand management. In doing so we illustrate how specific modes of professional practice recruit, support and are sustained at the expense of innovative interventions that might bring about deeper changes to the social and material fabric of domestic water use. We propose a variety of ways in which researchers might support transition in demand management practices, and the changes that may need to occur in the water sector to enable these to take hold. Thus, although this paper is far from exhaustive we hope that it sparks further enquiry into the practices of demand management within and beyond the water sector. Empirical studies such as this can provide a potential bridge through which researchers and those employed in strategic activity might better collaborate to affect change in domestic practice and wider systems of demand management.

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