Transitioning towards Urban Water Security in Asia-Pacific
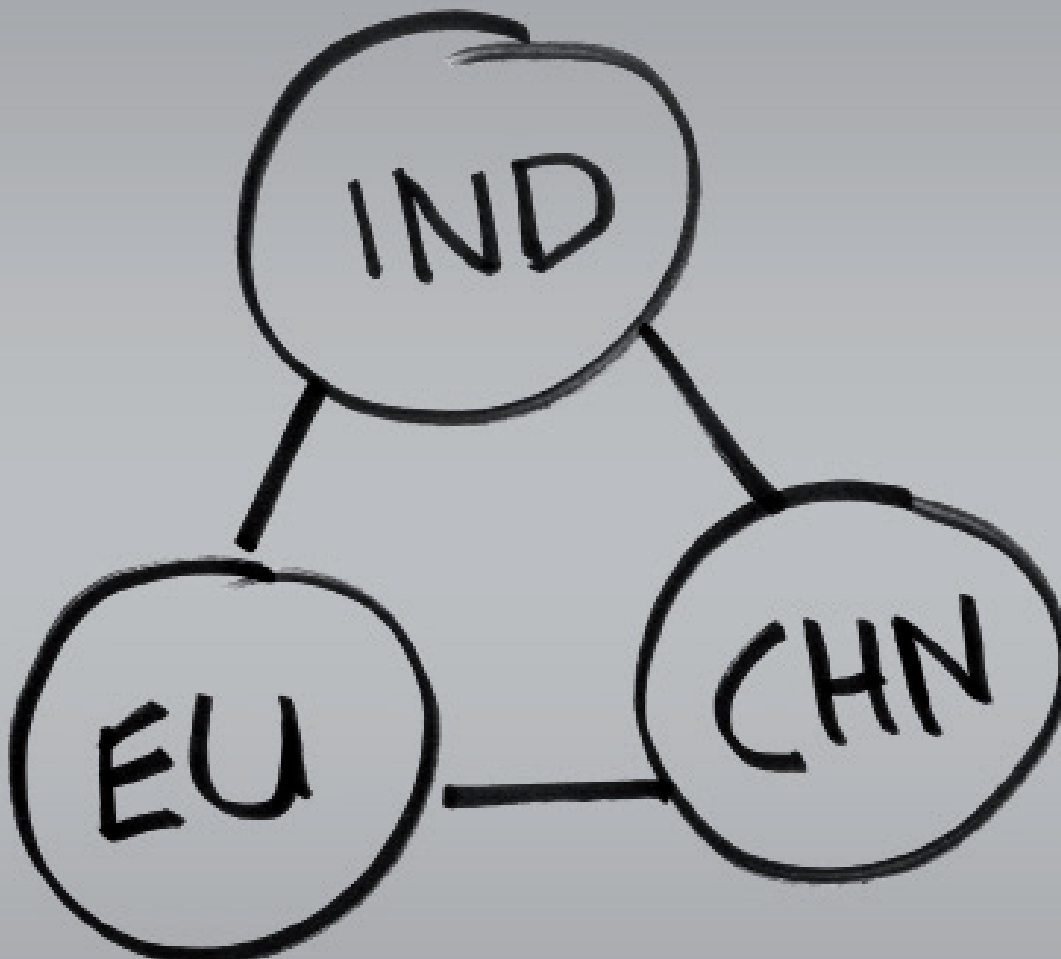
Robert Brears

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Transitioning towards Urban Water Security in Asia-Pacific

Robert Brears

Abstract

To achieve urban water security in the Asia-Pacific region, urban water managers can use a variety of demand management tools to alter the attitudes and behaviours of individuals and society towards water resources. The challenge of managing urban water resources sustainably involves variations to, and increased demand for, water resources as a result of climate change and urbanisation, respectively. Traditionally, water managers mitigate the impacts of water insecurity by increasing supply. However, these supply-side solutions have become too costly, both economically and environmentally. This paper argues that urban water managers in the region need to transition towards actions that attempt to alter the norms and values of individuals and society regarding scarce water resources. Using the framework of diffusion, water managers can use a variety of demand management tools to radically change people's culture, attitudes and practices towards water resources and reduce consumption patterns. However, this process is not free of barriers; instead, there are multiple barriers, both external and internal, to managing water resources sustainably.

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Keywords

Transitions, diffusion, natural resource management, urban water resource management, water security, demand management

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1.   Introduction[1]

In the 21st century, the world will see an unprecedented migration of people moving from rural to urban areas: In 2012 alone, human civilisation reached a milestone with 50% of the world's population living in urban settings. This is projected to reach 80% by 2050. The Asia-Pacific region in particular is one of the fastest urbanising regions in the world: Currently, seven of the world's mega-cities (with populations of 10 million or more) are located in Asia-Pacific; however, by 2025 there will be 21 mega-cities in the region. With global demand for water expected to exceed supply by 40% in 2030, and three out of four Asia-Pacific countries already experiencing water scarcity, urban centres in the region will face water insecurity as a result of climate change and urbanisation.

Traditionally, urban water managers have relied on large-scale, supply-side infrastructural projects such as dams and reservoirs, but also aqueducts or pumping non-renewable groundwater to meet increased demand for water (supply-side management). However, these projects are costly both economically and environmentally, and compete with other key water uses such as irrigation and industrial demand. In addition, with the vast majority of water resources in Asia-Pacific being transboundary, supply-side projects can create political tensions as they rely on water crossing both intra- and inter-state administrative and political boundaries. Therefore, there is a need to transition towards managing actual demand for water (demand management), as ultimately it is people's attitudes and behaviour towards water that determines the amount of water needed.

With multiple levels of cooperation between Europe and Asia-Pacific, be it EU-ASEAN; EU Member State to Asia-Pacific State or even European City to Asia-Pacific City-level cooperation, there is potential for the transfer of best practices in demand management from Europe to Asia-Pacific.

This paper explores how the still-developing theoretical framework of transitions (Loorbach, 2010) can be merged with the theoretical framework of diffusion to achieve urban water security. The combined framework will be empirically tested as part of a wider study of how various European cities of differing climates, incomes, lifestyles, etc. utilise demand management tools to achieve urban water security, and how best practices and lessons learned in Europe can be transferred to the Asia-Pacific region.

In Part One, this paper discusses what a transition is and what it involves (drivers and forces). In Part Two, the paper discusses transitions in natural resource management. In Part Three, the paper addresses transitions in urban water resource management. The paper then discusses the tools involved in balancing demand for water with its supply (Part Four) and the numerous barriers to doing so (Part Five). Finally, in Part Six the paper briefly describes existing partnerships between Europe and Asia-Pacific that can be enhanced to provide water security.

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2.   What is a transition?

A transition is a well-planned, coordinated, transformative shift from one socio-technological system to another over a long period of time (usually one or two generations) (Geels and Schot, 2007).where, a socio-technological system is a stable configuration of infrastructure, institutions, markets, networks, regulations and technology along with the norms and values of the system's social users. In daily life, socio-technological systems serve societal functions such as supplying water, energy, transportation and other services (Smith et al., 2005, Rogers, 2003, Geels, 2005, Rogers and Hall, 2003, Rotmans et al., 2001, Van der Brugge et al., 2005). In particular, a transition is a structural change in the way society operates and which occurs through a combination of behavioural, cultural, ecological, economic, institutional and technological developments that positively reinforce one another to create a new socio-technological system (Geels and Schot, 2007, Elzen and Wieczorek, 2005, Van der Brugge et al., 2005, Kemp and Loorbach, 2003, Seyfang and Smith, 2007, Pelling, 2011, Rotmans et al., 2001). In transitions, the role of institutions is to create a futuristic vision of what this new socio-technological system looks like and coordinate the appropriate resources (economic, financial, knowledge etc.) to achieve it (Geels and Schot, 2007).

Transitions occur over multiple levels: Specifically, transitions occur in the system at the macro-level (landscape), meso-level (regime) and micro-level (individuals) (Elzen and Wieczorek, 2005): The macro-level, or 'landscape', is the exogenous environment in which the system operates and is beyond the direct influence of the meso- and micro-levels (Geels and Schot, 2007). It is relatively static, or hard, and includes the institution's goals and visions that guide transitions at the meso-level (Kemp and Loorbach, 2003, McKenzie-Mohr, 2000). Changes at the macro-level are initiated by exogenous changes in the macro-cultural, economic, environmental and political aspects of society (Frantzeskaki and de Haan, 2009). The meso-level comprises the socio-technological system's regime, which is a constellation of behavioural patterns, cultures, practices, rules and structures of the system's social users (individual users, societal groups, public authorities, research networks and financial institutions, etc.) (Frantzeskaki and de Haan, 2009, Geels, 2005, Rogers, 2003). While each of the system's social users are relatively autonomous of one another, they are at the same time interdependent. This interdependence occurs because the activities at the societal level are coordinated and aligned with each other in the running of the socio-technological system (Geels, 2005): As such, regimes are stable and durable. If a transition is to be successful, institutions must change, in a coordinated way, the norms and values of the regime's social users (Hoffman, 2010). At the micro-level, niches, or innovations (unusual applications, demonstrations, programmes and social improvements, etc.), are tested against one another (Geels, 2005, Seyfang and Smith, 2007). If these innovations, which are essentially variations to the regime's status quo and deviations away from it, become successful (i.e. are deemed to be robust), they will branch out and attract mainstream audiences (Seyfang and Smith, 2007). If they are successful at this stage, the innovation will move from being 'innovative' to becoming a social norm (Lyndhurst, 2008).

2.1 Drivers of transitions

Before a transition can occur, however, there first needs to be a misfit or 'gap' between individuals and society's deeply-held values and the current conditions they face

(Wendt, 1999, Börzel and Risse, 2011, Pike et al., 2010). In the multi-level perspective of transitions, institutions create gaps at both the macro- and micro-levels. At the macro-level, institutions can create tension with the meso-level (regime) by creating a gap between the new strategic vision of the future and the current regime's outdated practices. At the micro-level, institutions can place pressure on the meso-level through innovations that attempt to create a gap between a new alternative regime and the current, outdated regime (Frantzeskaki and de Haan, 2009, Geels and Schot, 2007, Pike et al., 2010). Transitions can also be triggered by changes in the system's external environment, leading to it become inefficient, ineffective or inadequate in fulfilling its societal function. As such, external triggers can throw the current practices of the regime into discredit, creating a gap between the regime's values and the current conditions the system faces (Lenz, 2012, Frantzeskaki and de Haan, 2009). In practice, drivers of transitions can be classified as social, technological, economic, environmental or political (STEEP) (Table 1.)

Table 1: STEEP drivers of transitions

Drivers	
Social	Population Growth, urbanization, demand for cleaner environments
Technological	New technologies/ technological innovations that help or hinder society's efforts
Economic	Economic growth, economic shocks, infrastructure growth, economic competition
Environmental	Climate change, environmental degradation, change in land cover and land use, disasters
Political	International commitments (Rio 1992, Agenda 21, etc.), environmental laws and regulations, the trans-boundary nature of environmental problems

Sources: European Environmental Agency, 2013, American Psychological Association, 2009, Kotler and Lee, 2008, OECD, 2012, Smith, 2005, Voora and Venema, 2008, Engel, 2011, Seyfang and Smith, 2007, Gifford et al., 2011, Pelling, 2011, Schultz, 2011, Dürrschmidt, 2002

2.2 Forces in transitions

For a transition to occur – for the gaps to be closed – force needs to be applied (Kotler and Zaltman, 1971). There are two types of forces that direct transitions: supportive and formative. Supportive forces are top-down (macro-level) forces that create tension with the regime by standardising practices or routines through standards and directives. This ensures practices or routines enjoy universal status by enabling the provision of services (subsidies, capital, investments etc.) to empower and scale up innovations at the micro-level so that they become alternatives to the current regime (Frantzeskaki and de Haan, 2009). Formative forces are bottom-up (micro-level) forces that create pressure on the regime through innovations or groups of actors adopting innovative practices, routines, services or technology. These innovations have the potential to scale up and challenge the existing regime. Formative forces can emerge naturally or be artificially created by institutions (Frantzeskaki and de Haan, 2009).

2.3 Operationalisation of forces in transitions: Diffusion

In transitions, the application of supportive forces at the macro-level can take the form of alternative visions of the future, while at the micro-level formative forces can be in the form of diffusion, which is a process in which ideas, norms and innovations are communicated over time among members of a social system (Rogers, 2003, Börzel and Risse, 2011). The aim of diffusion is to initiate social change, in particular change in the structure and functions of society (Rogers, 2003). This can be achieved through changes in the norms and values of society, where norms are defined as the range of tolerable behaviour (effectively serving as a guide or standard for the behaviour of members of a particular social system), while values are defined as important and enduring beliefs shared by members of a particular community, and therefore underpin people's decisions and actions (BIO Intelligence Service, 2012, Rogers, 2003, Spence and Pidgeon, 2009).

In diffusion, there are two approaches from which people make decisions: the rationalist approach and the constructivist approach. In the rationalist approach, individuals are assumed to be rational and goal-orientated. When rationalists make their decisions, they aim to maximise their utility by weighing up the costs and benefits of different options before 'actioning' a decision (the logic of consequentialism). In the constructivist approach, individuals are not always rational in their decision-making processes. Instead, their decisions are guided by beliefs and judgments, which themselves are guided by collectively shared understandings of what is considered proper and socially-acceptable behaviour (logic of appropriateness) (Börzel and Risse, 2000).

In diffusion, there are two types of diffusion mechanisms that can induce social change: direct and indirect mechanisms. In direct diffusion mechanisms, institutions can actively promote ideas, norms and innovations (vertical diffusion) (Table 2.), while indirect diffusion mechanisms involve actors, independently emulating best practices and solutions that serve their needs (horizontal diffusion) (Table 3.) (Börzel and Risse, 2011).

Table 2: Direct diffusion mechanisms

Direct diffusion mechanisms	
Legal or physical coercion	Laws, directives and regulations, etc.
Manipulation of utility calculations	Use of market-based instruments to induce social change
Socialisation	Institutions promote rules, norms, ideas and practices by providing authoritative models, from which actors internalize them into their domestic structures
Persuasion	Institutions influence individual's attitudes and behaviours through reasoning

Sources: Geels and Schot, 2007, Steg and Vlek, 2009, Checkel, 2005, Börzel and Risse, 2011, Patchen, 2010, Jackson, 2005

Table 3: Indirect diffusion mechanisms

Indirect diffusion mechanisms	
Competition	Individuals independently adjust their behavior towards 'best practices', which in turn promotes competition between individuals
Lesson-drawing	Individuals look to others for rules that effectively solved similar problems elsewhere and that are transferable to their own domestic context
Emulation and mimicry	Individuals emulate others in order to be seen as a legitimate member of a particular community, while mimicry involves a less active process and resembles more the automatic downloading of 'institutional software' without modification simply because it's 'what everyone else is doing'

Source: Börzel and Risse, 2011

2.4 Barriers to diffusion

In diffusion, it is not assumed that actors at the receiving end are passive recipients of innovations. Instead, the process of diffusion involves the active interpretation and in-corporation of new norms into existing structures, as well as resistance or barriers that slow down the process of diffusion (Börzel and Risse, 2011, Stumbaum, 2012). There is rarely only one barrier to diffusion; instead, there are multiple barriers that inhibit the introduction and diffusion of innovations. These multiple barriers interact and reinforce each other, leading to inertia and a lack of uptake and application of innovations (Kemp et al., 1998, Spence and Pidgeon, 2009). Barriers to diffusion can be both external and internal. In particular, external barriers inhibit change by contributing to existing prob-lems or constraining the effectiveness of diffusion mechanisms, while internal barriers are factors within actors that inhibit them from changing their behaviours and attitudes (Kaplan, 2000, Wendt, 1999).

3. Transitions towards sustainable natural resource management

In transitions towards sustainable natural resource management, there are two types of drivers: climatic and non-climatic drivers. Regarding climate change drivers, there are two approaches society can take in adapting to the pressures of climate change: miti-gation and adaptation. Traditionally, it is common for local authorities to mitigate the impacts of climate and environmental change by taking actions that prevent the impact of an event, for example the construction of dams and reservoirs to protect communities from variability in precipitation as a result of climate change. However, these 'hard' in-infrastructural solutions are typically both economically and environmentally costly to im-plement (Australian Government Productivity Commission, 2012). Adaptation towards

climate change aims first to increase the capacity of a system in order to successfully respond to climate and environmental change through behavioural, resource and technological adjustments. Second, it aims to reduce the risks associated with the impacts of climate and environmental change (Adger et al., 2007, Kolikow et al., 2012). Adaptations occur over multiple dimensions, including spatial (local, regional, national) ones, across many sectors (water, etc.) and involve numerous actions (physical and technological actions, investments, regulations and markets) and actors (local authorities, government, public and private sectors, communities and individuals) (Adger et al., 2007).

There are two main types of adaptations in climate change: green actions and soft actions. Green actions ensure that ecosystem health is maintained in order to reduce society's vulnerability to risks; this can be achieved by ensuring natural resources are used as efficiently as possible. An example of this is the maintainance of healthy riparian wetlands and forests to reduce the impacts of floods (European Environmental Agency, 2013). Green actions are usually less resource-intensive than mitigation (hard actions) in terms of financial and technological capacity, as green actions do not usually require the development and maintenance of high-tech, innovative solutions (European Environmental Agency, 2013). In addition, green actions are also less environmentally costly to implement compared to mitigation, as they focus on preserving the health of ecosystems (Australian Government Productivity Commission, 2012). Nonetheless, green actions frequently overlook the social dimensions of climate and environmental change: Instead, they focus on economic and technological solutions to the problems (Hoffman, 2010). In soft actions, the focus is on using management, legal and policy approaches to alter human behaviour as a way of reducing the vulnerability towards climate change risk (European Environmental Agency, 2013).

In natural resource management, institutions seek to reduce the vulnerability of society from environmental degradation and resource scarcity as a result of urbanisation and population growth, by transitioning from a first-order scarcity socio-technological system to eventually a third-order scarcity socio-technological system. In first-order scarcity, institutions rely on mitigation as a way of meeting actual or perceived supply inadequacies. In particular, natural resource managers address resource scarcity by constructing large-scale infrastructural projects to increase supply. Because of the large economic and environmental costs associated with supply-side projects, natural resource managers have turned to second-order scarcity policies, which focus on improving economic and technological efficiency in managing the demand and supply of natural resources (Wolfe and Brooks, 2003).

In second-order scarcity, adaptations involve the use of economic and technological measures to manage natural resources more efficiently. However, while economic instruments and technological developments may appear to provide solutions to resource scarcity, individual beliefs, norms and values drive environmental change (Hoffman,

2010, Lieberherr-Gardiol, 2008). As such, in order to properly address environmental degradation and resource scarcity there needs to be a transition in societal values, in particular changes in behavioural patterns, thinking and value structures regarding the environment, so that society recognises that environmental degradation is not only a scientific fact, but a social fact too (Milbrath, 1995, Wolfe and Brooks, 2003, Hoffman, 2010).

In third-order scarcity, the focus is on behavioural change as a way of decreasing demand for resources, which in turn lowers environmental degradation (Williams and Millington, 2004, Wolfe and Brooks, 2003). Specifically, in third-order scarcity natural resource managers recognise that a transition to a sustainable society is not only a technological matter but a social matter too, requiring deep and broad social relearning of thinking, value structures, behavioural patterns and institutional arrangements concerning scarce resources (Milbrath, 1995).

Combined, natural resources can be managed in a way that adapts to both climate change and increased demand (Table 4.):

Table 4:
Managing the impacts of climate change and scarcity in natural resource management

Adaption type	Order	Description
Mitigation	1st order	Hard infrastructural projects
Green adaption	2nd order	Economic/technological solutions
Soft adaptation	3rd order	**Managing demand for resources through alteration of behaviour**

4. Transitions in urban water resource management

A transition in water resource management is a well-planned, coordinated transformative shift from one water system to another over a long period of time (usually one or two generations), where a water system is comprised of physical and technological infrastructure, cultural/political meanings and societal users (Table 5) (Pahl-Wostl, 2007, Najjar and Collier, 2011). In a water system, society is both a component of the water system and a significant agent of change in the system, both physically (changing processes of the hydrological cycle) and biologically (changing the sum of all aquatic and riparian organisms and their associated ecosystems) (Pahl-Wostl, 2007). More specifically, a transition from one water system to another involves a structural change in the way society manages its scarce water resources and occurs through a combination of behavioural, cultural, ecological, economic, institutional and technological developments that positively reinforce

each other to create a new water system

Table 5: Components of a water system

Socio-technological system for water supply	
Regulations and policies	Managing the quality and quantity of water resources
Infrastructure	Drinking, storm and wastewater network
Treatment	Drinking and wastewater
Markets and users	Domestic and non-domestic user habits, expectations and practices
Drinking water	Quality of supply
Culture	Cultural and symbolic meanings (social and cultural values of water, the use of water and water technologies)

4.1 What does water security look like?

Water security is about ensuring that populations can access adequate quantities of acceptable quality water for the following purposes: sustaining livelihoods, human well-being and socio-economic development; ensuring protection against water-borne pollution and water-related disasters; and for preserving ecosystems in a climate of peace and political stability (United Nations, 2013). Specifically, the core elements necessary for achieving and maintaining water security for both nature and humans ensures

- Access to safe and sufficient drinking water, at an affordable cost, to meet basic needs• Protection of livelihoods and cultural and recreational values

- Preservation and protection of ecosystems in allocating water resources to ensure their ability to deliver and sustain the functioning of ecosystem services

- Water supplies for socio-economic development and activities (agriculture, energy, food, transportation, etc.)

- Collection and treatment of wastewater to protect the environment and human health from pollution

- Collaborative approaches to transboundary water resource management within and between countries

- The ability to cope with uncertainties and risks of water-related hazards including droughts, floods and pollution

- Good governance and accountability of water resources including appropriate legal regimes, transparent and accountable institutions and adequate infrastructure (United Nations, 2013).

4.2 Drivers of transitions in water resource management

In urban water resource management, transitions to new water systems are triggered

by changes in the external environment of the system, leading to it become inefficient, ineffective or inadequate in fulfilling its societal function, in this case ensuring the sustainable access of water resources for all users. The main drivers in transitions to new socio-technological systems in water are climate change and urbanisation (Table 6).

Table 6: External drivers of transitions in urban water resource management

Climate	
Precipitation and storm events	Storm events (flooding) wash pollutants from urban areas into surface water bodies, as well as contaminate ground water supplies. As urban populations encroach into river basins they are increased risk of contaminated water supplies during flooding events
Heat-island effects	Built environments, including buildings and roads, absorb sunlight and re-radiate heat. This, combined with less vegetative cover which provides shade and cool moisture in the air, means air temperatures of urban areas are 3.5 to 4 degrees Celsius higher than surrounding rural areas. The result is an increase in demand for water for cooling and drinking.
Heat waves and droughts	During heat waves and droughts, demand for water increases (drinking water and water for cooling). In addition, with increased temperatures, oxygen levels in water will decrease while algal levels increase, degrading the quality of water resources, leading to increased treatment costs and energy use in the treatment process
Sea-level rise and coastal flooding	Globally, cities are mainly concentrated in coastal zones, resulting in a large portion of the world's urban population exposed to the risk of sea-level rise and intensifying storm-surges, which contaminate groundwater supplies and damage water infrastructure
Urbanisation	
Increase in population	Rapid population growth has increased for water for both domestic and non-domestic use, frequently leading to over-exploitation of water resources. This results in excessive withdrawals and water scarcity
Land-use change	Urbanisation (urban sprawl or encroachment into river basin catchment areas) lowers the availability of good quality water of sufficient quantity through point source pollution (industrial, domestic wastewater) and non-point source pollution (pathogens, organics and inorganics)
Degradation of ecosystems	Over exploitation of ground and surface water degrades ecosystems and their services (e.g. reduced ability to purify water, etc.)
Competition	Over-exploitation can lead to inter-sectoral, inter-regional and even international competition over scarce water resources

Sources: Policy Research Institute, 2005, Engel, 2011, Arnell, 1999, Offermans et al., 2011, Darrel Jenerette and Larsen, 2006, Global Water Partnership, 2012, Bank, 2012, Corfee-Morlot et al., 2009, Smith et al., 2006, Bithas, 2008

4.3 Transitioning from first to third-orders in urban water resources management

In urban water resource management, water managers must contend with variability of supply as a result of climate change and increased demand from urbanisation. In transitions towards managing scarcity, urban water managers move from first- to third-order scarcity.

In traditional water resource management (first-order scarcity), urban water managers forecast population growth and economic development to determine future levels of demand. If there is a projected supply deficit (demand outstripping supply), traditional water management relies on large-scale water supply projects consisting of dams, reservoirs, and pipelines to transport water over large distances to bridge that gap (Gleick, 1998, Sofoulis, 2005, Richter et al., 2013, Molle, 2009). Over time, however, these supply-side solutions have become unfavourable due to their environmental costs; for instance, supply-side solutions such as dams and reservoirs impact the quantity and quality of water available for ecosystems, adversely impacting the numerous services on which both nature and humans rely (Molle, 2009). There are also large economic costs involved in wide supply-side solutions; in particular, the reliance on more distant water, often of inferior quality, to meet rising demand has not only increased the costs of transportation (energy costs) but treatment costs as well (chemical costs) (Van Roon, 2007, Bithas, 2008). In addition, traditional water resource management fails to account for uncertainty in supply from climate change extremes (floods and droughts) and changing weather patterns (spatial and temporal changes in precipitation levels) (Molle, 2009, Van der Brugge and Van Raak, 2007). As such, with increased demand for water (urbanisation) and variability of supply (climate change), traditional water management practices have become outdated (Bahri, 2012).

In second-order scarcity, urban water managers explore demand-side options in the management of scarce water resources. Specifically, rather than projecting current demand trends forward and then trying to find the water to meet those needs, water managers deconstruct demand to determine actual needs and the most efficient ways of meeting those needs (Gleick, 1998). To ensure water is used in the most efficient way, second-order policies focus on increasing economic and technological efficiency in water use. In particular, attention is paid to the economic value of water, which encourages the introduction of pricing water to end users and the subsequent need to meter water consumption (Wolfe and Brooks, 2003). However, while second-order scarcity policies may be sufficient for a few years, at some point they have to give way to third-order policies as a result of water scarcity from climate change and urbanisation (Wolfe and Brooks, 2003, Farrelly and Brown, 2011).

Third-order scarcity policies are directed at shifting the emphasis away from economic and technological efficiency towards addressing the actual driver of water demand: human behaviour. Specifically, third-order scarcity policies combine second-order scarcity

of economic and technological efficiency with policies that focus on changing people's norms and values towards the environment in general and water in particular (Loucks, 2000, Global Water Partnership, 2012). To decrease demand for water through social change in third-order scarcity, urban water managers first examine how identities (behaviours, norms and values) are formed, maintained and modified. Second, they define a future ideal level of water consumption and work backwards to find a feasible and desired pathway to change people's attitudes and behaviours towards water to achieve that vision (Sofoulis, 2005, Wolfe and Brooks, 2003). The eventual goal of third-order scarcity in water resource management is to decouple water consumption from economic and population growth (Næss and Høyer, 2009).

4.4 Forces of transition to third-order scarcity in water management

In a transition towards third-order scarcity, the application of supportive forces at the macro-level by urban water managers can be in the form of targeted levels of water consumption (per capita litres/day for example), with the baseline for comparison being current levels of (unsustainable) water consumption. At the micro-level, on the other hand, using the definition of diffusion, the application of formative forces by urban water managers can take the form of demand management tools (water pricing, education, public awareness campaigns, etc.) that modify human behaviour to achieve the targeted level of water consumption (Wolfe and Brooks, 2003).

5.   Demand management in third-order scarcity

In third-order scarcity, water managers use demand management to radically change people's culture, attitudes and practices towards water and reduce consumption patterns (Global Water Partnership, 2012, Muller, 2007). Using the rationalist/constructivist approach to diffusion, water managers can use two types of demand management strategies to modify attitudes and behaviour towards water: antecedent and consequential strategies (Maheepala et al., 2010, Molle and Berkoff, 2009, Gifford et al., 2011). Antecedent strategies attempt to influence the determinants of target behaviour prior to the performance of the behaviour. Consequential strategies attempt to influence the determinants of target behaviour after the performance of the behaviour. Specifically, antecedent strategies attempt to influence the determinants of target behaviour through activities such as increasing individuals' knowledge or awareness of problems through information campaigns, behavioural commitments and prompting, the assumption being that it is assumed that these strategies can influence the determinants of behaviour prior to its performance. Consequential strategies (feedback, rewards, and punishments) are all assumed to influence the determinants of target behaviour after the performance of the behaviour. The latter strategy assumes that feedback, both positive and negative,

from the consequences of that behaviour influence the likelihood of that behaviour being performed in the future (Gifford et al., 2011).

5.1 Demand management tools

Using the framework of diffusion, there are two types of demand management tools water managers can use to promote water conservation: direct and indirect demand management tools. Direct demand management tools attempt to modify individuals' and communities' attitudes and behaviour towards water resources through legal or physical coercion, manipulation of utility calculations, socialisation and persuasion.

5.1.1 Legal or physical coercion

Legal or physical coercion tools in water management generally come in the form of temporary and permanent ordinances and regulations. Temporary ordinances and regulations for water conservation restrict certain types of water use during specified times and/or restrict the level of water use to a specified amount. These programmes are usually enacted during times of severe water shortages and cease once the shortage has passed (Michelsen et al., 1999, Canada West Foundation, 2004). Examples of water-use regulations include restrictions on non-essential water uses, e.g. watering lawns, washing cars, filling swimming pools, washing driveways; restrictions on commercial use, e.g. car washes, hotels and other large consumers of water; and bans on using water of drinking quality for cooling purposes. Meanwhile, permanent ordinances and regulations for water conservation include amendments to building codes and ordinances requiring the installation of water-saving devices, e.g. low-flow toilets, showerheads and faucets in all newly constructed or renovated homes and offices (Michelsen et al., 1999, OECD, 2011, Pennsylvania State University, 2010). For example, plumbing codes can be used to ensure new homes and offices have maximum water use standards for plumbing fixtures such as toilets, urinals, faucets and showers.

5.1.2 Manipulation of utility calculations – water pricing

In water resource management, the manipulation of utility calculations is conducted through the pricing of water, as economic theory suggests that demand for water should behave like any other goods – as price increases, water use decreases. In using price as a mechanism to promote water conservation, water managers can use a variety of different price structures, all of which send different conservation signals to individuals and communities. A flat rate is essentially a fixed charge for water usage regardless of the volume used, where typically the size of the charge is related to the customer's property value (Sibly, 2006, Policy Research Institute, 2005). While fixed prices enable water utilities to raise sufficient revenue for the operation and maintenance of the water supply network, it does not provide any incentive for individuals and households to conserve

water (CAP-NET, 2008, Olmstead and Stavins, 2007). A volumetric rate is a charge based on the volume used at a constant rate, e.g. $1 per cubic metre of water used. Therefore, the amount users pay for water is strictly based on the amount of water consumed (Policy Research Institute, 2005). An increasing block tariff contains different prices for two or more pre-specified quantities (blocks) of water, with prices increasing with each successive block. Water managers must therefore decide first on the number of blocks, second, on the volume of water use associated with each block, and third, on the price charged for each block. The pricing of water can include a two-part tariff system: a fixed and a variable component. In the fixed component, water users pay one amount independent of consumption and this covers the infrastructural and administrative costs of supplying water. Meanwhile, the variable amount is based on the quantity of water consumed and covers the costs of providing water as well as encouraging conservation.

5.1.3 Manipulation of utility calculations – subsidies and rebates

Economic instruments such as subsidies (incentives) and rebates are used to modify individuals' behaviour in a predictable, cost-effective way, i.e. reduce wastage and lower water consumption (Global Water Partnership, 2012, Policy Research Institute, 2005, Savenije and van der Zaag, 2002, OECD, 2012). In particular, incentives are commonly used to encourage the uptake of water-efficient appliances, as positive incentives are found to be more effective then disincentives in promoting water conservation. In addition, incentives have been found to reduce the gap between the time the incentive is presented and behavioural change as compared to disincentives (Policy Research Institute, 2005). In order to accelerate the replacement of old water-using fixtures, water managers also commonly offer rebates to customers who purchase water-efficient toilets, taps and showerheads.

5.1.4 Socialisation

Water managers can promote water conservation through the use of authoritative schemes such as product labelling schemes, as well as managing retrofits of water-using devices such as taps, showers and toilets.

The labelling of household appliances according to water efficiency is important in reducing household water consumption by eliminating unsustainable products from the market: however, this is provided the labelling scheme is clear and comprehensible and identifies both the private and public benefits of conserving water. Nonetheless, people are more likely to respond to eco-labels if the environmental benefits match closely with personal benefits such as reduced water bills.

Retrofit programmes involve the distribution and installation of replacement devices to physically reduce water use in homes and offices. The most common retrofits are toilet retrofits, where customers have their older toilets replaced with newer low/dual flush toilets, and the distributing of showerheads and faucet aerators (devices that when inserted into taps reduce the flow of water) to households and offices (Georgia Environmental Protection Division Watershed Protection Branch, 2007, Canada West Foundation, 2004, Michelsen et al., 1999, Pennsylvania State University, 2010).

Water-saving devices can be distributed by water managers in numerous ways, including door-to-door delivery of water-saving kits to households, direct installation by trained technicians or plumbers, mass-mailings with water saving devices, depot pick-up with customers calling in to pick up devices, or water-saving device requests where customers request devices for installation (Pennsylvania State University, 2010).

5.1.5 Persuasion

Education of the public is crucial for generating an understanding of water scarcity and creating acceptance of the need to implement water conservation programmes. For a water conservation programme to be robust, it must target both young people and adults (Georgia Environmental Protection Division Watershed Protection Branch, 2007). Water managers can promote water conservation in schools to increase young people's knowledge of the water cycle and encourage the sustainable use of scarce water resources. To do so, water managers can use a variety of strategies, including school presentations, distribution of water conservation information and materials that can be used in school curriculum. Meanwhile, water managers can use public education to persuade individuals and communities to conserve water resources. In particular, water managers can influence individuals' attitudes and behaviours towards water resources by increasing their knowledge and awareness of environmental problems associated with water scarcity (Steg and Vlek, 2009, Najjar and Collier, 2011, Policy Research Institute, 2005). There are multiple tools and formats water managers can use to increase environmental awareness and water conservation:

- Public information: printed literature distributed or available for the general public, public service announcements and billboard advertisements, public transportation, television commercials, newspaper articles and advertisements, internet and social media campaigns

- Public events such as conservation workshops: Customers can receive information on both water conservation tips and the various types of water-saving devices available

- Information in water bills: Water bills should be understandable, enabling customers to easily identify the usage volume, rates and charges, etc. The water bill should also be informative, enabling customers to compare their current bill with previous bills (EPA, 1998, Michelsen et al., 1999, Pennsylvania State University, 2010, The State of Israel Ministry of National Infrastructures Planning Department Water Authority, 2011, Georgia Environmental Protection Division Watershed Protection Branch, 2007, Keramitsoglou and Tsagarakis, 2011).

Water managers can also play a critical role in social learning by providing leadership in conservation. There are several reasons why water managers should lead by example to achieve pro-environmental behaviour: First, a failure to exemplify the behavioural changes water managers wish to see will undermine any information or persuasion campaigns water managers attempt to engage in at a future date. Second, successful internal water conservation programmes send a strong signal to individuals and businesses about what is possible, and that water managers are serious about water conservation. Third, these initiatives allow water managers to learn invaluable lessons

first-hand on the difficulties of achieving water conservation goals (Jackson, 2005).

Overall, direct-demand management tools attempt to modify individuals' and communities' attitudes and behaviours towards water resources through coercion, pricing of water resources, promoting authoritative models of water conservation, and persuading people of the need to conserve scarce water resources. Specifically, Table 7 provides a brief summary of direct-demand management tools available to water managers for promoting water conservation.

Table 7. Direct-demand management tools

Direct-demand management tools	
Legal or physical coercion	Water bans or water restrictions, rules and regulations in homes and commercial buildings for water-efficiency
Manipulation of utility calculations	Water pricing can be used as an incentive to increase water efficiency and promote water conservation. In particular, water pricing internalises the environmental and social costs of water use (in addition to raising revenue for the operation and maintenance of water supply infrastructure)
Socialisation	Water managers can promote water conservation through the use of authoritative schemes such as labelling, accreditation and certification of water efficiency in appliances, building designs, etc.
Persuasion	Water managers can use public education to persuade individuals to conserve water. This can be conducted through various multi-media formats (TV, radio, newspapers, internet, etc.) Education programmes in schools can also be used to persuade young people to conserve water resources

Sources: Policy Research Institute, 2005, Checkel, 2005, Van Roon, 2007, Gifford et al., 2011, OECD, 2012, Keramitsoglou and Tsagarakis, 2011, American Psychological Association, 2009, Bank, 2012, Global Water Partnership, 2012, Sofoulis, 2005

5.2 Indirect-demand management tools

Water managers can utilise indirect-demand management tools of competition, lesson-drawing, and emulation and mimicry in an attempt to modify individuals' and communities' attitudes and behaviours towards water resources.

5.2.1 Competition

Water managers can increase participation rates in water conservation programmes by promoting competition among individuals and communities to achieve specific water consumption targets. Examples of competitions include eliciting commitments to water savings targets and promoting competition through the water bill. In eliciting commitments, water managers can obtain verbal or written commitments from individuals and communities to achieve specific water-saving targets. Competitions can then be formed to compare individuals' or communities' water savings with one another and offer winners' recognition or prizes for their water-saving achievements (Georgia Environmental Protection Division Watershed Protection Branch, 2007, Patchen,

2010). The water bill can also be used as a tool for competition between water users; for example, water bills can show a household's water consumption compared to the average household in the neighbourhood, city, province or state (Georgia Environmental Protection Division Watershed Protection Branch, 2007, Patchen, 2010).

5.2.2 Lesson-drawing

As norms can be made 'salient'/prominent by viewing the behaviour of another person or inferring the actions of others, water managers can provide examples of how individuals and communities successfully conserved water (Georgia Environmental Protection Division Watershed Protection Branch, 2007). This enables individuals and communities to draw lessons from successful water conservation efforts, helping establish behaviour change in individuals.

5.2.3 Emulation and mimicry

Water managers can 'reference' other communitys' water savings as an ideal model for communities to emulate or mimic. Alternatively, water managers can use water-saving role models such as community leaders or winners of water-saving competitions as reference points for ideal behaviour that can be emulated or mimicked by others. Overall, Table 8 provides a brief summary of indirect-demand management tools available for water managers to promote water conservation.

Table 8: Indirect-demand management tools

Indirect-demand management tools	
Competition	Water managers can promote competition between water users by enabling the comparison of one's own water consumption or savings with the average water consumption or savings of others.
Lesson-drawing	Water managers can provide individuals and communities with information on water conservation practices that have worked elsewhere and are easily transferable to the local context
Emulation and mimicry	Water managers can promote communities that have made considerable water savings as a standard for other communities to emulate. Similarly, water managers can provide tips on how to mimic another community's water savings

Source: BIO Intelligence Service, 2012

6.   Barriers to demand management

Similar to diffusion, none of the demand management tools used to promote water conservation assumes that individuals and communities at the receiving end are passive recipients of innovations. Instead, demand management involves the active interpretation and incorporation of new norms for water conservation into existing structures, as well as barriers to particular ideas. Like diffusion, there are multiple barriers to water conservation which are both external and internal: External barriers inhibit change towards water conservation by contributing to existing problems or constraining the effectiveness of demand management tools (Table 9) (Wendt, 1999, Kemp et al., 1998).

Table 9: External barriers to demand management tools

External barriers in demand management	
Economic	New innovative practices and technologies often lack economies of scale and therefore cannot compete on price
Infrastructural	Often current infrastructure cannot support alternative technologies or practices
Political/institutional	Institutions often lack political will in implementing projects due to lack of clear authority, capacity or coordination across sectors
Regulatory	Existing regulations often support current practices rather than the implementation of more efficient or optimal choices that violate those regulations
Technological	Often, new innovations require complimentary technology which could be expensive to develop or culturally undesirable to implement

Sources: Geels, 2005, Seyfang and Smith, 2007, Adger et al., 2007, Kemp et al., 1998, Frantz and Mayer, 2009, Sofoulis, 2005, Barbier, 2011, Moser and Ekstrom, 2010, Vallance et al., 2011, Elzen and Wieczorek, 2005, Hoffman, 2010, Kolikow et al., 2012, Pelling, 2011

Internal barriers are factors within actors that inhibit them from changing their behaviours and attitudes towards water resources (Table 10) (Wendt, 1999, Kemp et al., 1998).

Table 10: Internal barriers to demand management tools

Internal barriers in demand management	
Information/knowledge/ awareness barriers	The majority of people do not understand the basic water cycle and therefore do not recognise the importance of water conservation
Lack of connection with nature	With the cast majority of people living in urban centres, people lack a basic connection with nature and therefore are not aware of the impacts of humans on the environment in general and on water resources in particular
Uncertainty or scepticism towards climate change	Many people are uncertain of the actual impacts of climate change or are sceptical as to whether it is human-driven or even exists
Fear framing	Framing conservation messages with guilt often results in lack of action because people feel helpless
Over-optimistic belief in technology	It is common to believe that technology can solve climate change and environmental degradation
Climate change as a distant problem in time and space	Climate change is often seen as something happening far in the future, in the remotest locations, e.g. Arctic sea ice melting. This means people believe climate change will not impact them locally now or later
Reluctance to change lifestyles	Sustainability is often related to a loss in lifestyle from consuming less
Feeling of helplessness	People need to know their conservation efforts do have an impact
Lack of action by Big Business and Government	It is common for people to believe that businesses and governments should solve climate change and environmental degradation instead of individuals
Free-rider effect	People fail to act environmentally if they perceive others are not doing their part too
Demographic	Each society has a variety of demographic groups, each having differing beliefs and worldviews. Some groups may associate sustainability with left-wing political groups, others may not believe in climate change, etc.

Sources: American Psychological Association, 2009, Gero et al., 2012, Milbrath, 1995, Patchen, 2010, Pike et al., 2010, Schultz, 2011, Balmford and Cowling, 2006, Frantz and Mayer, 2009, Australian Government Productivity Commission, 2012, Kollmuss and Agyeman, 2002, Pacala and Socolow, 2004, Spence and Pidgeon, 2009, Brechin and Bhandari, 2011, Hoffman, 2010, Kemp et al., 1998, Kaplan, 2000, Smith et al., 2005, Adger et al., 2007

7. Cooperation between Europe and Asia-Pacific on demand management

Under the EU's "Europe 2020" strategy for smart, sustainable and inclusive growth, the Flagship Initiative for achieving a resource-efficient Europe aims to create a framework for policies that support Europe's shift towards a resource-efficient and low-carbon economy. This will help Europe fight climate change and limit the environmental impacts of resource use. To achieve this shift, the Flagship Initiative calls for a change in consumer behaviour towards resources. The Flagship Initiative calls for a water policy that makes water-saving measures and increasing water efficiency a priority in order

to ensure that water is available in sufficient quantities, is of appropriate quality, is used sustainably and with minimum resource input, and is ultimately returned to the environment with an acceptable quality.

Building on growing international awareness of the strategic importance of avoiding risks to the supply of resources, including water, the Europe 2020 Flagship Initiative identifies cooperation with key partners as a key priority for addressing resource efficiency issues internationally. The strategy highlights how concerted action on a global level can help mitigate the rise in global demand for resources, and calls for international cooperation to promote the exchange of skills, technology and best practices.

As part of this Flagship Initiative, the EU can transfer to the Asia-Pacific region best practices and lessons learnt concerning how European cities have used demand management instruments to implement the Communication paper's policy options to achieve urban water security: pricing water, allocating water-related funding more efficiently, fostering water-efficient technologies and practices, and fostering the emergence of a water-saving culture to achieve urban water security. In particular, by utilising Europe-wide initiatives, the EU can transfer to the Asia-Pacific region best practices and lessons learnt regarding demand management through numerous existing institutional frameworks for cooperation between the two regions, at the EU, EU member state and EU member state city levels.

- EU-ASEAN Partnership: The Bandar Seri Begawan Plan for Action to Strengthen the ASEAN-EU Enhanced Partnership (2013-2017) serves as a vehicle to strengthen the ASEAN-EU Partnership on addressing regional and global challenges of shared concern. With regard to water resource management, the Plan of Action calls for promoting public awareness and partnership to enhance integrated water resource management.

- State-to-State: At the State-to-State level, the project funded by the German Federal Ministry for Education and Research and executed by the UFZ, TU Dresden and Dresden Sewerage and Drainage Company IWAS (Internationale Wasserforschungs-Allianz Sachsen, Water Research Alliance Saxony) has been initiated in partnership with Vietnam with the aim of modernising the country's water sector.

- State-to-State and City: At the State-to-City level, the German Federal Ministry for Economic Cooperation and Development (BMZ) has commissioned the 'Integrated Resources Management in Asia Cities: The Urban Nexus' project with 10 Asian cities in China, Indonesia, Mongolia, Philippines, Thailand and Vietnam.
- City-to-City: At the city level, Berlin's water utility (Berliner Wasserbetriebe) has a management contract with Kathmandu's water utility (Kathmandu Upatyaka Khanepaini Limited) to enhance the capacity of Kathmandu's water managers.

8.   Conclusion

Traditionally, urban water managers, in first-order scarcity, mitigate the impacts of water scarcity by increasing supply. However, with urbanisation and uncertainties of climate change, traditional supply-side solutions consisting of dams, reservoirs, etc. have become too costly, both economically and environmentally. In an attempt to manage supply, urban water managers have implemented economic and technological measures (second-order scarcity) to increase the efficient use of scarce supplies. Nonetheless, this ignores the fact that human behaviour itself is the driver of water scarcity. As such, urban water managers need to transition towards third-order scarcity policies that focus on actions that alter the norms and values of individuals and society towards water resources and achieve water security. In particular, urban water managers, using the theoretical framework of diffusion, can use a variety of demand management tools to radically change people's culture, attitudes and practices towards water resources and reduce consumption patterns. Nevertheless, there are many barriers, both external and internal, to modifying the attitudes and behaviours of individuals and communities towards water resources. Regarding cooperation between Europe and Asia-Pacific in reducing urban water insecurity, cooperation can occur at multiple levels of governance: EU-ASEAN, State-to-State and even City-to-City.

Bibliography

ADGER, W. N., AGRAWALA, S., MIRZA, M. M. Q., CONDE, C., O'BRIEN, K., PULHIN, J., PULWARTY, R., SMIT, B. & TAKAHASHI, K., 2007. *Assessment of adaptation practices, options, constraints and capacity*. Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability. Cambridge University Press.

AMERICAN PSYCHOLOGICAL ASSOCIATION, 2009. *Psychology and Global Climate Change: Addressing a Multi-faceted Phenomenon and Set of Challenges Task Force on the Interface between Psychology and Global Climate Change* [Online]. Available at: http://www.apa.org/science/about/publications/climate-change.aspx.

ARNELL, N. W., 1999. 'Climate change and global water resources'. *Global Environmental Change*, 9, 31-49.

AUSTRALIAN GOVERNMENT PRODUCTIVITY COMMISSION, 2012. *Barriers to Effective Climate Change Adaptation*. Available at: http://www.pc.gov.au/__data/assets/pdf_file/0008/119663/climate-change-adaptation.pdf.

BAHRI, A., 2012. *Integrated urban water management*. Available at: http://www.gwp.org/Global/The%20Challenge/Resource%20material/GWP_TEC16.pdf.

BALMFORD, A. & COWLING, R. M., 2006. 'Fusion or Failure? The Future of Conservation Biology'. *Conservation Biology*, 20, 692-695.

BANK, W., 2012. 'Integrated Urban Water Management: A summary note'. *Blue Water Green Cities* [Online]. Available at: http://siteresources.worldbank.org/INTLAC/Resources/257803-1351801841279/1PrincipalIntegratedUrbanWaterManagementENG.pdf.

BARBIER, E., 2011. 'The policy challenges for green economy and sustainable economic development'. *Natural resources forum, 35,* 233-245.

BIO INTELLIGENCE SERVICE, 2012. *Policies to encourage sustainable consumption.* Final report prepared for the European Commission (DG ENV). Available at: http://ec.europa.eu/environment/eussd/pdf/report_22082012.pdf.

BITHAS, K., 2008. 'The sustainable residential water use: Sustainability, efficiency and social equity. The European experience'. *Ecological Economics*, 68, 221-229.

BÖRZEL, T. & RISSE, T., 2000. 'When Europe hits home: Europeanization and domestic change'. *European Integration online Papers (EIoP)*, 4, 1-24.

BÖRZEL, T. & RISSE, T., 2011. 'From Europeanisation to Diffusion: Introduction'. *West European Politics*, 35, 1-19.

BRECHIN, S. R. & BHANDARI, M., 2011. 'Perceptions of climate change worldwide'. *Wiley Interdisciplinary Reviews: Climate Change*, 2, 871-885.

CANADA WEST FOUNDATION. 2004. 'Drop by Drop: Urban Water Conservation Practices in Western Canada'. *Western Cities Project Report* [Online]. Available: http://cwf.ca/publications-1/drop-by-drop-urban-water-conservation-practices-in-western-canada.

CAP-NET, 2008. *Economics in sustainable water management: Training manual and facilitators' guide.* Available at: http://www.euwi.net/files/Cap_net_EUWI_FWG_GWP_Manual_Economics_of_water_FINAL.pdf.

CHECKEL, J. T., 2005. 'International institutions and socialization in Europe: Introduction and framework'. *International Organization*, 59, 801-826.

CORFEE-MORLOT, J., KAMAL-CHAOUI, L., DONOVAN, M., COCHRAN, I., ROBERT, A. & TEASDALE, P.-J., 2009. *Cities, climate change and multilevel governance.* OECD publishing Paris.

DARREL JENERETTE, G. & LARSEN, L., 2006. 'A global perspective on changing sustainable urban water supplies'. *Global and Planetary Change*, 50, 202-211.

DÜRRSCHMIDT, J., 2002. 'Multiple agoras: Local and regional environmental policies between globalization and European pathways of transformation'. *Innovation: The European Journal of Social Science Research*, 15, 193-209.

ELZEN, B. & WIECZOREK, A., 2005. 'Transitions towards sustainability through system innovation'. *Technological forecasting and social change*, 72, 651-661.

ENGEL, K., 2011. *Big Cities. Big Water. Big Challenges: Water in an Urbanizing World.* Available at: http://www.wwf.se/source.php/1390895/Big%20Cities_Big%20Water_Big%20Challenges_2011.pdf.

EPA, 1998. *Water Conservation Plan Guidelines.* Available at: http://www.epa.gov/WaterSense/pubs/guide.html.

EUROPEAN ENVIRONMENTAL AGENCY, 2013. *Adaptation in Europe - Addressing risks and opportunities from climate change in the context of socio-economic developments.* Available at: http://www.eea.europa.eu/publications/adaptation-in-europe.

FARRELLY, M. & BROWN, R., 2011. 'Rethinking urban water management: Experimentation as a way forward?' *Global Environmental Change*, 21, 721-732.

FRANTZ, C. M. & MAYER, F. S., 2009. 'The emergency of climate change: Why are we failing to take action?' *Analyses of Social Issues and Public Policy*, 9, 205-222.

FRANTZESKAKI, N. & DE HAAN, H., 2009. 'Transitions: Two steps from theory to policy'. *Futures*, 41, 593-606.

GEELS, F. W., 2005. 'Processes and patterns in transitions and system innovations: refining the co-evolutionary multi-level perspective'. *Technological forecasting and social change*, 72, 682.

GEELS, F. W. & SCHOT, J., 2007. 'Typology of sociotechnical transition pathways'. *Research policy*, 36, 399-417.

GEORGIA ENVIRONMENTAL PROTECTION DIVISION WATERSHED PROTECTION BRANCH, 2007. *Water conservation education programs EPD Guidance Document.* Available at: http://www1.gadnr.org/cws/Documents/Conservation_Education.pdf.

GERO, A., KURUPPU, N. & MUKHEIBIR, P., 2012. *Cross-Scale Barriers to Climate Change Adaptation in Local Government, Australia.* UTS: Institute for Sustainable Futures, University of Technology Sydney.

GIFFORD, R., KORMOS, C. & MCINTYRE, A., 2011. 'Behavioral dimensions of climate change: drivers, responses, barriers, and interventions'. *Wiley Interdisciplinary Reviews: Climate Change*, 2, 801-827.

GLEICK, P. H., 1998. 'Water in crisis: paths to sustainable water use'. *Ecological applications*, 8, 571-579.

GLOBAL WATER PARTNERSHIP, 2012. 'Water Demand Management (WDM) — The Mediterranean Experience'. *Technical focus paper* [Online]. Available at: http://www.gwp.org/Global/The%20Challenge/Resource%20material/gwp_tech_focus.pdf.

HOFFMAN, A. J., 2010. 'Climate change as a cultural and behavioral issue: Addressing barriers and implementing solutions'. *Organizational Dynamics*, 39, 295-305.

JACKSON, T., 2005. *Motivating sustainable consumption: a review of evidence on consumer behaviour and behavioural change: a report to the Sustainable Development Research Network.* Centre for Environmental Strategy, University of Surrey.

KAPLAN, S., 2000. 'New ways to promote proenvironmental behavior: Human nature and environmentally responsible behavior'. *Journal of social issues*, 56, 491-508.

KEMP, R. & LOORBACH, D., 2003. *Governance for sustainability through transition management.* Open Meeting of Human Dimensions of Global Environmental Change Research Community, Montreal, Canada, 12-30.

KEMP, R., SCHOT, J. & HOOGMA, R., 1998. 'Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management'. *Technology Analysis & Strategic Management,* 10, 175-198.

KERAMITSOGLOU, K. M. & TSAGARAKIS, K. P., 2011. 'Raising effective awareness for domestic water saving: evidence from an environmental educational programme in Greece'. *Water Policy,* 13, 828-844.

KOLIKOW, S., KRAGT, M. E. & MUGERA, A. W., 2012. 'An interdisciplinary framework of limits and barriers to climate change adaptation in agriculture.' *Working Paper.* School of Agricultural and Resource Economics: University of Western Australia.

KOLLMUSS, A. & AGYEMAN, J., 2002. 'Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?' *Environmental education research,* 8, 239-260.

KOTLER, P. & LEE, N., 2008. *Social Marketing: Influencing Behaviors for Good.* London: Sage Publications.

KOTLER, P. & ZALTMAN, G., 1971. 'Social marketing: an approach to planned social change'. *The Journal of Marketing,* 3-12.

LENZ, T., 2012. 'Spurred emulation: the EU and regional integration in Mercosur and SADC'. *West European Politics,* 35, 155-173.

LIEBERHERR-GARDIOL, F., 2008. 'Urban sustainability and governance: issues for the twentyfirst century'. *International Social Science Journal,* 59, 331-342.

LOORBACH, D., 2010. 'Transition management for sustainable development: a prescriptive, complexity-based governance framework'. *Governance,* 23, 161-183.

LOUCKS, D. P., 2000. 'Sustainable water resources management'. *Water International,* 25, 3-10.

LYNDHURST, B., 2008. *The diffusion of environmental behaviours: The role of influential individuals in social networks.* Available at: http://www.brooklyndhurst.co.uk/the-diffusion-of-environmental-behaviours-the-role-of-influential-individuals-in-social-networks-_110. html.

MAHEEPALA, S., BLACKMORE, J., DIAPER, C., MOGLIA, M., SHARMA, A. & KENWAY, S., 2010. *Towards the Adoption of Integrated Urban Water Management Approach for Planning.* Proceedings of the Water Environment Federation, 6734-6753.

MCKENZIE-MOHR, D., 2000. 'New Ways to Promote Proenvironmental Behavior: Promoting Sustainable Behavior: An Introduction to Community-Based Social Marketing'. *Journal of social issues,* 56, 543-554.

MICHELSEN, A. M., MCGUCKIN, J. T. & STUMPF, D., 1999. 'Nonprice water conservation

programs as a demand management tool'. *JAWRA Journal of the American Water Resources Association*, 35, 593-602.

MILBRATH, L. W., 1995. 'Psychological, cultural, and informational barriers to sustainability'. *Journal of social issues,* 51, 101-120.

MOLLE, F., 2009. 'Water and society: new problems faced, new skills needed'. *Irrigation and drainage*, 58, 205-S211.

MOLLE, F. & BERKOFF, J., 2009. 'Cities vs. agriculture: A review of intersectoral water re-allocation'. *Natural Resources Forum*, 33, 6-18.

MOSER, S. C. & EKSTROM, J. A., 2010. 'A framework to diagnose barriers to climate change adaptation'. *Proceedings of the National Academy of Sciences*, 107, 22026-22031.

MULLER, M., 2007. 'Adapting to climate change water management for urban resilience'. *Environment and Urbanization*, 19, 99-113.

NÆSS, P. & HØYER, K. G., 2009. 'The Emperor's Green Clothes: Growth, Decoupling, and Capitalism'. *Capitalism Nature Socialism*, 20, 74-95.

NAJJAR, K. & COLLIER, C. R., 2011. 'Integrated Water Resources Management: Bringing It All Together'. *Water Resources Impact*, 13, 3-8.

OECD, 2011. *Greening Household Behaviour The Role of Public Policy: The Role of Public Policy*. OECD Publishing.

OECD, 2012. *Environmental Outlook to 2050 The Consequences of Inaction: The Consequences of Inaction*. OECD Publishing.

OFFERMANS, A., HAASNOOT, M. & VALKERING, P., 2011. 'A method to explore social response for sustainable water management strategies under changing conditions'. *Sustainable Development*, 19, 312-324.

OLMSTEAD, S. M. & STAVINS, R. N., 2007. 'Managing Water Demand: Price vs. Non-Price Conservation Programs'. P*ioneer Institute White Paper,* 39.

PACALA, S. & SOCOLOW, R., 2004. 'Stabilization wedges: solving the climate problem for the next 50 years with current technologies'. *Science*, 305, 968-972.

PAHL-WOSTL, C., 2007. 'Transitions towards adaptive management of water facing climate and global change'. *Water resources management*, 21, 49-62.

PATCHEN, M., 2010. 'What shapes public reactions to climate change? Overview of research and policy implications'. *Analyses of Social Issues and Public Policy*, 10, 47-68.

PELLING, M., 2011. *Adaptation to Climate Change: From Resilience to Transformation*. London: Routledge.

PENNSYLVANIA STATE UNIVERSITY, 2010. *Water Conservation for Communities*. Available at: http://pubs.cas.psu.edu/FreePubs/PDFs/AGRS113.pdf.

PIKE, C., DOPPELT, B. & HERR, M., 2010. 'Climate communications and behavior change: A guide for practitioners'. *The Climate Leadership Initiative* [Online]. Available at: http://www.thesocialcapitalproject.org/The-Social-Capital-Project/pubs/climate-communications-and-behavior-change.

POLICY RESEARCH INSTITUTE, 2005. *Economic Instruments for Water Demand Management in an Integrated Water Resources Management Framework: Synthesis Report.* Government of Canada.

RICHTER, B. D., ABELL, D., BACHA, E., BRAUMAN, K., CALOS, S., COHN, A., DISLA, C., O'BRIEN, S. F., HODGES, D. & KAISER, S., 2013. 'Tapped out: how can cities secure their water future?' *Water Policy*, 15, 335-363.

ROGERS, E. M., 2003. *Diffusion of Innovations.* 5th Edition. New York: Free Press.

ROGERS, P. & HALL, A. W., 2003. 'Effective water governance'. *Background Paper, Global Water Partnership Technical Committee*, 7.

ROTMANS, J., KEMP, R. & VAN ASSELT, M., 2001. 'More evolution than revolution: transition management in public policy'. *Foresight*, 3, 15-31.

SAVENIJE, H. & VAN DER ZAAG, P., 2002. 'Water as an economic good and demand management: paradigms with pitfalls'. *Water International*, 27, 98-104.

SCHULTZ, P., 2011. 'Conservation means behavior'. *Conservation Biology,* 25, 1080-1083.

SEYFANG, G. & SMITH, A., 2007. 'Grassroots innovations for sustainable development: Towards a new research and policy agenda'. *Environmental Politics*, 16, 584-603.

SIBLY, H., 2006. 'Efficient urban water pricing'. *Australian Economic Review*, 39, 227-237.

SMITH, A., STIRLING, A. & BERKHOUT, F., 2005. 'The governance of sustainable socio-technical transitions'. *Research policy*, 34, 1491-1510.

SMITH, G., 2005. 'Green Citizenship and the Social Economy'. *Environmental Politics*, 14, 273-289.

SMITH, M., DE GROOT, D. & BERGKAMP, G., 2006. *Pay: Establishing payments for watershed services*, IUCN.

SOFOULIS, Z., 2005. 'Big water, everyday water: a sociotechnical perspective'. *Continuum: Journal of Media & Cultural Studies*, 19, 445-463.

SPENCE, A. & PIDGEON, N., 2009. 'Psychology, Climate Change & Sustainable Bahaviour'. *Environment: Science and Policy for Sustainable Development*, 51, 8-18.

STEG, L. & VLEK, C., 2009. 'Encouraging pro-environmental behaviour: An integrative review and research agenda'. *Journal of Environmental Psychology*, 29, 309-317.

STUMBAUM, M.-B. U., 2012. 'How does Asia view the EU? Security in an interpolar world'. *NFG Working Paper,* 1.

THE STATE OF ISRAEL MINISTRY OF NATIONAL INFRASTRUCTURES PLANNING DEPARTMENT WATER AUTHORITY, 2011. *The State of Israel: National Water Efficiency Report*. Available at: http://www.water.gov.il/Hebrew/ProfessionalInfoAndData/2012/04-The-State-of-Israel-National-Water-Efficiency-Report.pdf.

UNITED NATIONS, 2013. *UN-Water Analytical Brief on Water Security and the Global Water Agenda*. Available at: http://www.unwater.org/TFsecurity.html.

VALLANCE, S., PERKINS, H. C. & DIXON, J. E., 2011. 'What is social sustainability? A clarification of concepts'. *Geoforum*, 42, 342-348.

VAN DER BRUGGE, R., ROTMANS, J. & LOORBACH, D., 2005. 'The transition in Dutch water management'. *Regional Environmental Change*, 5, 164-176.

VAN DER BRUGGE, R. & VAN RAAK, R., 2007. 'Facing the adaptive management challenge: insights from transition management'. *Ecology and Society*, 12, 33.

VAN ROON, M., 2007. 'Water localisation and reclamation: Steps towards low impact urban design and development'. *Journal of environmental management*, 83, 437-447.

VOORA, V. A. & VENEMA, H. D., 2008. *The natural capital approach: a concept paper*. International Institute for Sustainable Development.

WENDT, A., 1999. *Social Theory of International Politics*. Cambridge: Cambridge University Press.

WILLIAMS, C. C. & MILLINGTON, A. C., 2004. 'The diverse and contested meanings of sustainable development'. *The Geographical Journal*, 170, 99-104.

WOLFE, S. & BROOKS, D. B., 2003. 'Water scarcity: An alternative view and its implications for policy and capacity building'. *Natural Resources Forum*, 27, 99-107.