

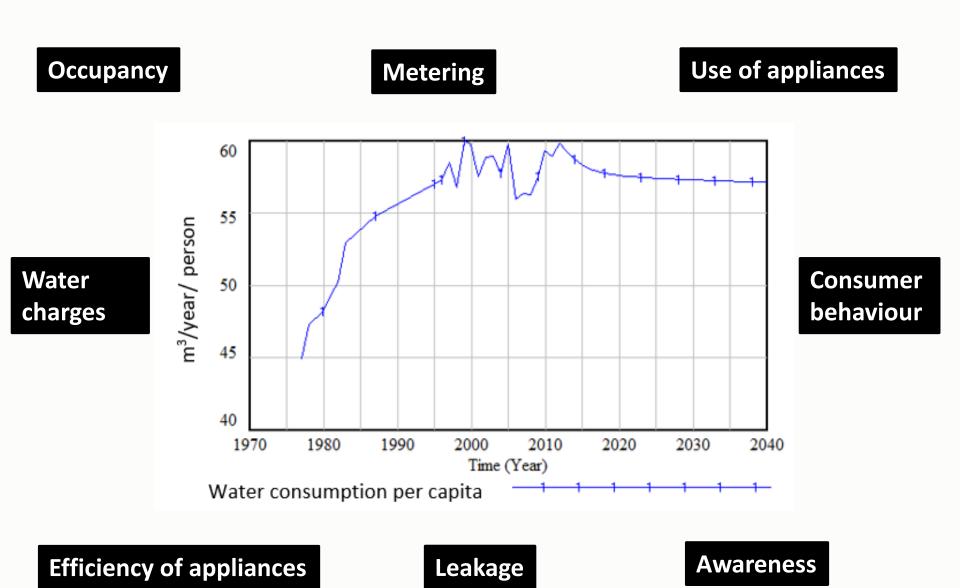


Background

- ❖37% of areas in England and Wales classified as seriously water stressed
- Households use 52% of water
- ❖Objective to reduce water consumption to 0.15–0.16 to 0.12–0.13 m³ per person per day by 2030
- Water management is a complex system

Background

- Reaching water efficiency targets can be difficult and counterintuitive.
- System dynamics approach
- London Case Study



Metering

	Unmetered households		Percentage of metered
Year	(000s)	(000s)	households
2012	1924.19	630.47	24.68
2015	1790.17	825.37	31.56
2020	1671.23	1082.38	39.31
2025	1573.50	1316.38	45.55
2030	1475.79	1557.06	51.34
2035	1378.08	1805.29	56.71
2040	1280.26	2061.01	61.68

Table 1. Number of customers of Thames Water in London that are metered and unmetered Source: Thames Water, 2014

Metering

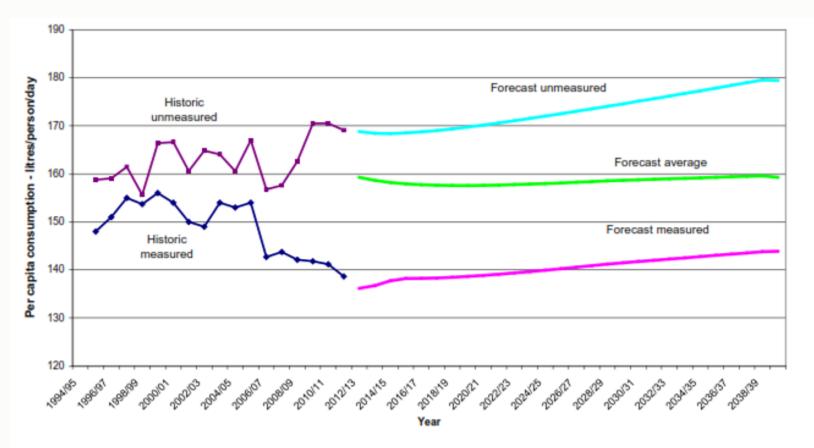


Figure 1. Historic and projected water consumption for households with and without water meters Source: Thames Water, 2014

Occupancy

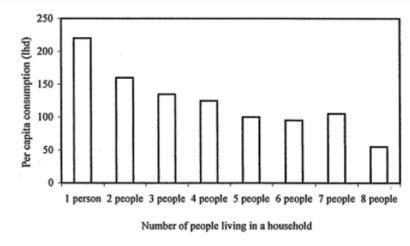


Figure 2. Impact of occupancy on WCPC Source: Edward & Martin, 1995

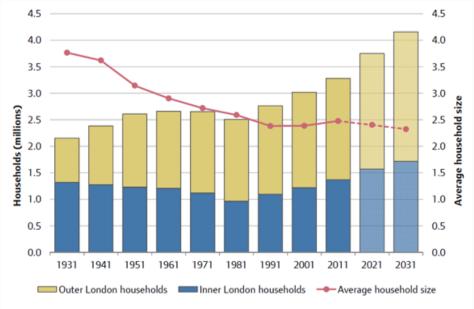


Figure 3. Average occupancy in households in London Source: Greater London Authority, 2015

Technology

- Installation of new fittings can reduce the overall water consumption by 25 percent (Sim, et al. 2005)
- Capacity to "adopt and adapt" (Adeyeye, 2013).
- Interaction between customer and water EA (Waterwise, 2010).
- Uptake rate is influenced by the easiness to upgrade the fitting (Robinson, et al., 2014a), the disruption of existing configurations and people's lifestyles (Hoolohan & Browne, 2014).



Technology

- If the price and characteristics of the fittings are similar, 49 percent of the people surveyed prefer to purchase a bathroom product that is more water efficient (Bailey, 2014).
- Retrofit and behaviour change initiatives can reduce water consumption up to 0.041 m³ per day per household and an average of 0.02-0.025 m³ per day per household (Tipper 2015).

Behaviour

- Water shortages are influenced partially by human behaviour (Robinson, et al., 2014a).
- Awareness campaigns fail to change consumer behaviour: quality of campaigns and that people already perceive themselves as water efficient (Robinson, et al., 2014b).

Behaviour

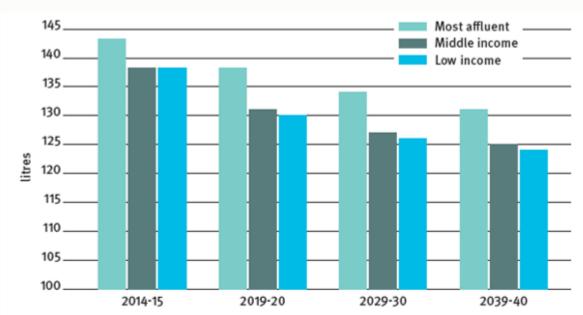
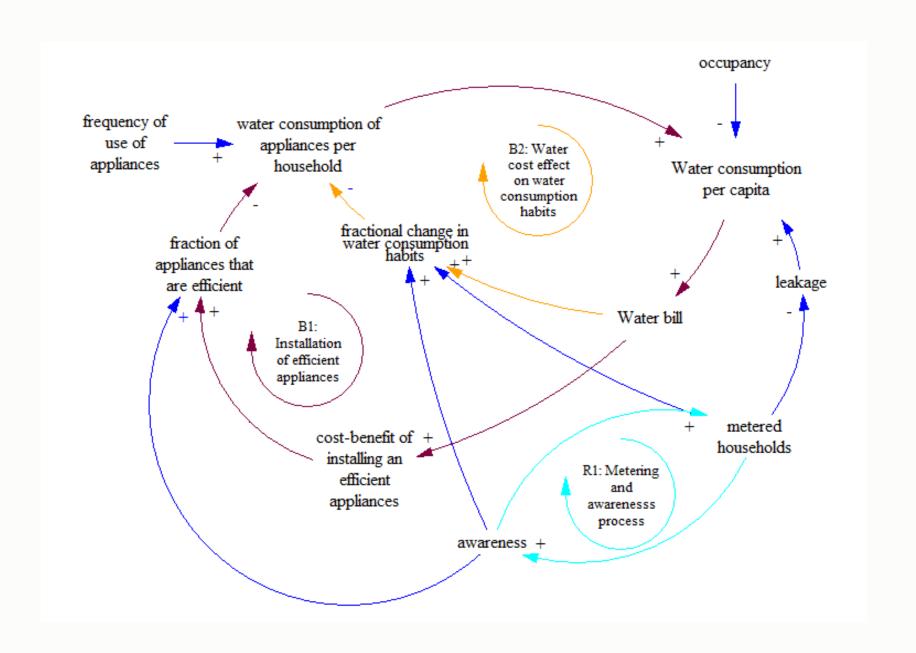


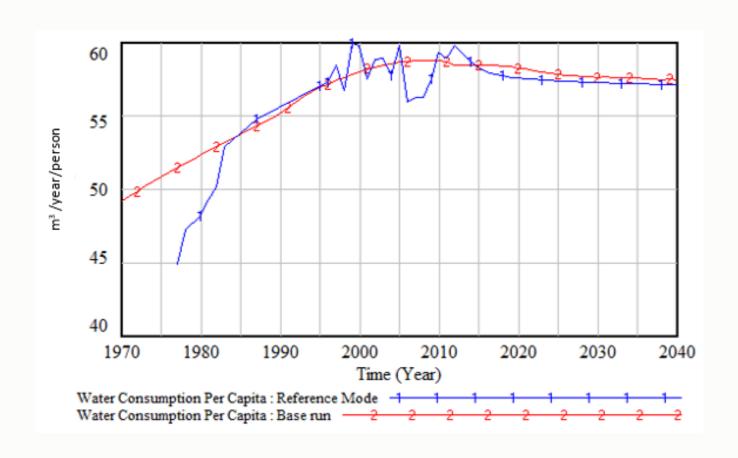
Figure 4. Water consumption in Southern England (per capita)
Source: Elaborated by Tipper 2015 with information of Appendices of the water resources management plan 2015-40 of Southern Water

System Dynamics

- System dynamics: analyse complex systems and to design policies by including social, physical and technical systems during the modelling process (Sterman, 2000).
- One of the main advantages of using a system dynamics approach is that it reduces the risk of policy resistance since it considers unforeseen reactions (Sterman, 2000).



Model Runs



Finding 1

S-shaped growth:

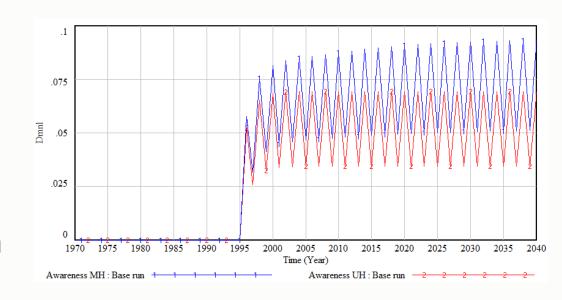
- Water meter installation, awareness, water consumption reduction-> reaches a limit.
- Limits to growth

Finding 2

Awareness in MH is influenced by

- The installation of water meters
- Frequency of campaigns.

Contrary, awareness in UH is only affected by the variable frequency of campaigns.



Finding 3

- Average water consumption decreases as more efficient appliances are in the market
- Water consumption per appliance decreases but on the other hand number of appliances and frequency of use increase
- At the beginning encourages people to use efficient appliances but it becomes weaker when increased efficiency reduces water consumption costs lowering the incentive to move further towards efficient appliances

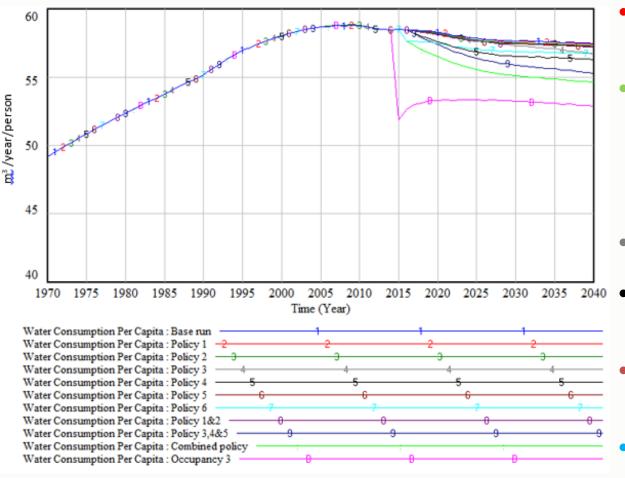
Finding 4

 A variation of occupancy to 2 occupants per household increases water consumption by 13.26 percent in 2040, and a variation of occupancy to 3, reduces water consumption by 13.52 percent

Finding 5

 Water cost to income ratio was always below 1.6, showing that, water cost in London is less than the typical value payed in UK and in other countries, therefore little effect was observed on water consumption

Policies



- Policy 1: Metering for all users and switching to measured tariffs.
- Policy 2: Introduction of informative water bills, targeted awareness campaigns, public education programmes and promotion of water efficient appliances.
- Policy 3: Promote research for new technologies.
- **Policy 4:** Replace waterwasting appliances and fittings and provide retrofit kits.
 - **Policy 5:** Incorporate a waterenergy nexus to increase uptake of efficient appliances.
- **Policy 6:** Increase common water usage areas.

Conclusions

- Metering: useful tool to increase awareness and reduce water consumption
- Awareness was determined to be important for enhancing the effect of other variables in the model.
- This model showed that promoting efficient appliances is a promising sector for reducing water consumption. Effort must be placed in the improvement of efficiency and replacement time of old appliances.
- Stabilization was reached due to balancing feedback loops, where a "limits to growth" behaviour was identified.
- Occupancy is still a major factor influencing water consumption.
- Also, replacement of appliances can have other environmental side effects.
- Most of the policies are based on "good will" and "cost-benefit" motivations and it could be said that consumption tends to stabilize when consumers have reached an "acceptable water consumption".

Thank you for listening!

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