Residential demand under Water Wise Rules in Sydney

Sydney Water and Dr Vasilis Sarafidis

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Outline

- Background
- Key features of the residential models
- Findings on water use

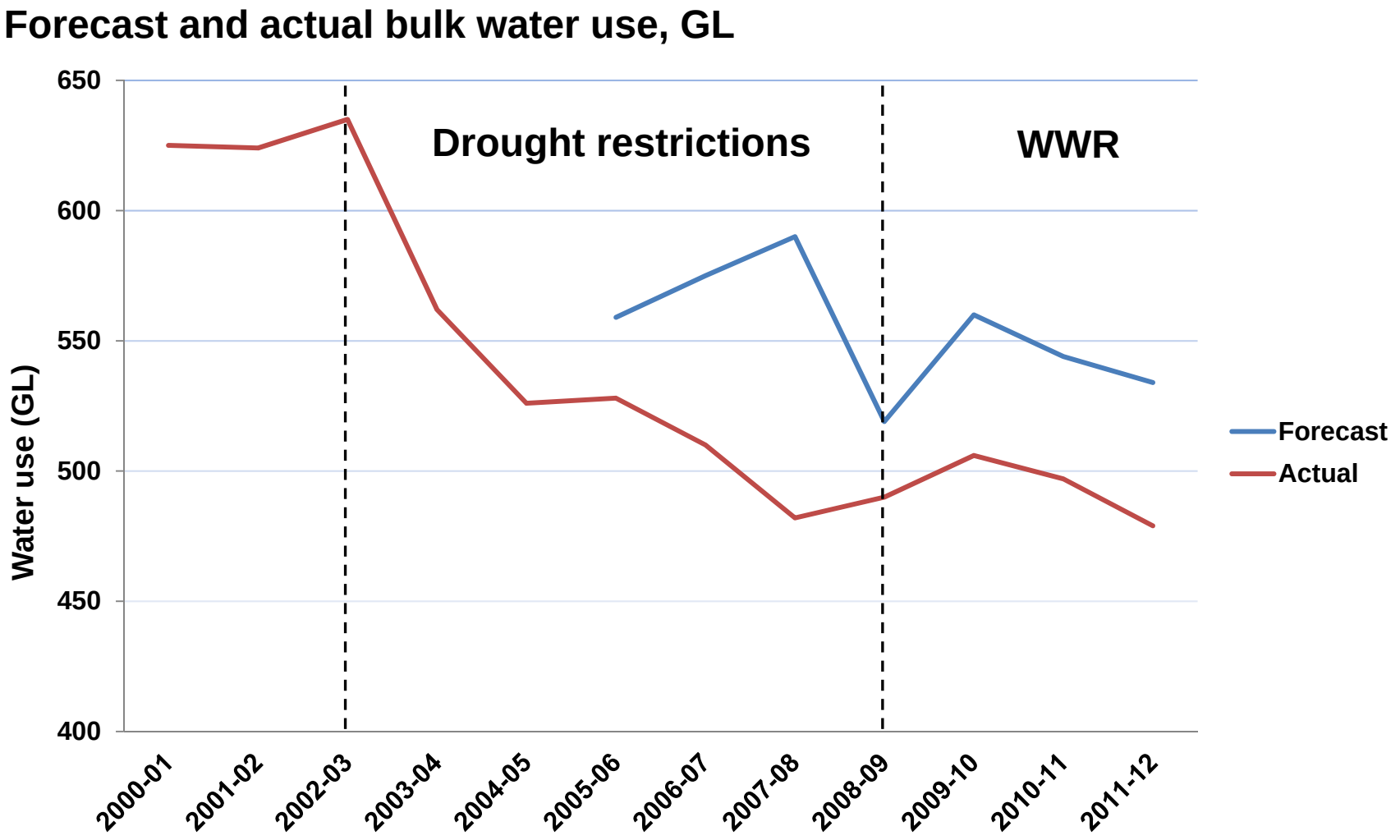
Background

Sydney Water Corporation

Sydney Water is a state-owned corporation

- Water and wastewater services to about 5 million people
- 1.8 million connected properties
- Annual water use: about 500GL
- Drought restrictions: Oct 2003 to June 2009
- Water Wise Rules (WWR): June 2009

Forecast and actual water use



Actuals on average 10% below forecast for the last 7 years

Forecasting water use

Key forecasting issues:

- Some 70% real increase in water usage prices
- An extensive water efficiency program (subsidised water efficient appliances)
- Weather – variability in outcomes
- Short- and long-run response by residents to Water Wise Rules
- Time period over which residents fully adjust to Water Wise Rules

Key features of the residential models

Summary of approach

Panel data analysis of large subsets of residential households:

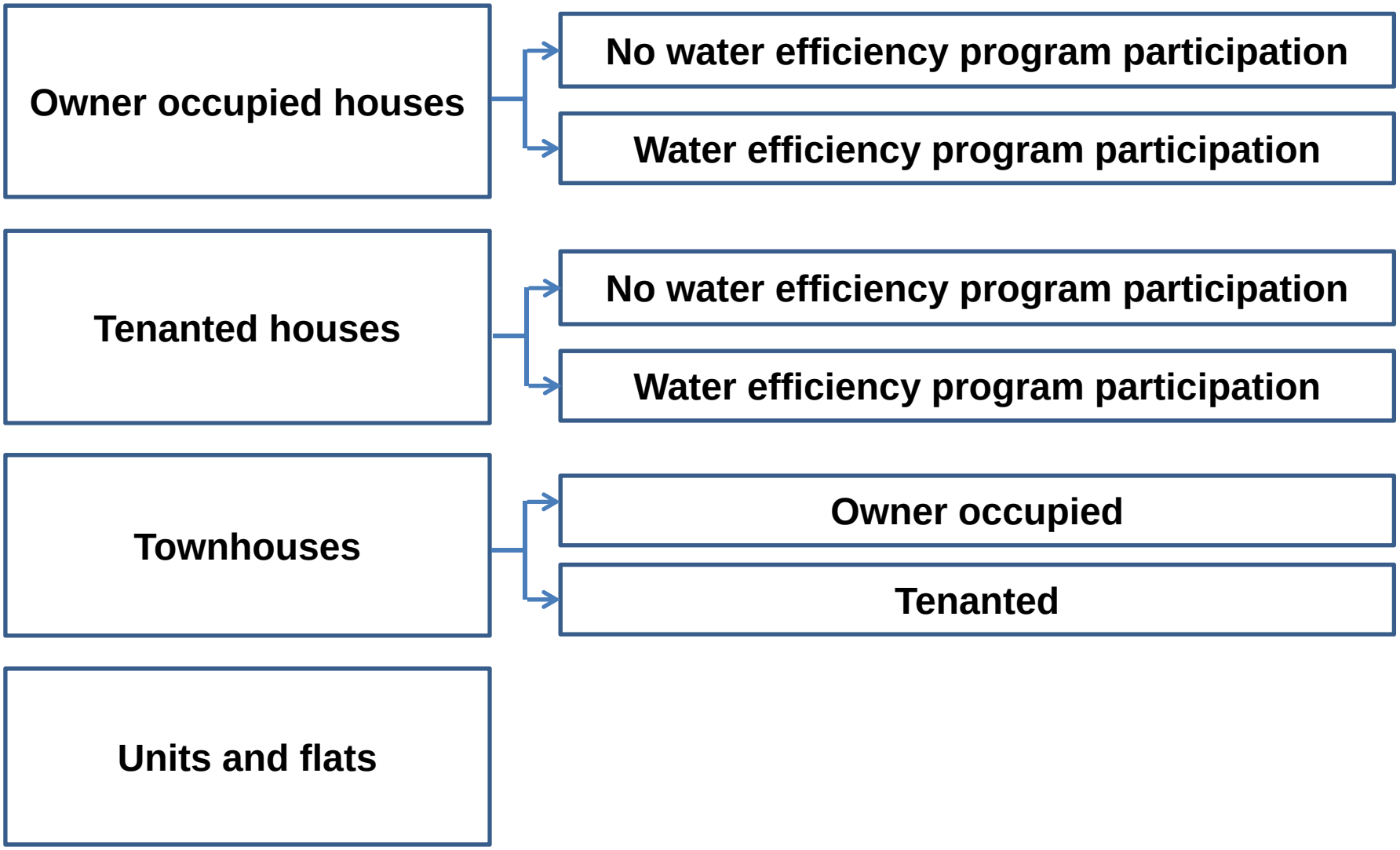
- About 140,000 households selected for analysis
- Segmented by ownership and participation in a water efficiency program
- Clustering analysis of houses based on property size (m^2)
- Dynamic model specification
- Generalised method of moments estimation

Sample

Stratified random sample:

- Over 132,000 households and 6,800 blocks of housing units
  - About 10% of total residential households
- July 2004 to December 2010 (27 meter readings)
  - 18 months of Water Wise Rules
  - About 3.6 million observations
- Explanatory variables created to match the meter reading periods of individual households

User groups - segments



Clustering analysis

Clustering analysis of houses based on property size (m^2)

- Find ‘natural’ groupings of households
- Allows each cluster its own response to changes in the explanatory variables
- Partitional approach to developing clusters
- Generated 65 subsets of households for analysis

Dynamic model specification

Auto regressive distributed lag model (ARDL)

$$\ln c_{it} = \alpha \cdot \ln c_{it-1} + \sum_{j=0}^{5} \beta_j \cdot price_{it-j} + \gamma_1 \cdot raindev_{it} + \gamma_2 \cdot evapdev_{it} +$$

$$\sum_{j=0}^{1} \lambda_j \cdot waterfix_{it-j} + \sum_{j=0}^{1} \phi_j \cdot wmr_{it-j} + \sum_{j=0}^{1} \theta_j \cdot diy_{it-j}$$

$$+ \gamma_3 \cdot L2R_{it} + \sum_{j=1}^{4} \delta_j \cdot season_{itj} + \sum_{j=1}^{4} \rho_j \cdot WWRseason_{itj} + u_{it},$$

$$u_{it} = \eta_i + \varepsilon_{it}, \quad |\alpha| < 1,$$

- 'ρ_j': short-run impact of replacing drought restrictions with Water Wise Rules by season
- $\rho_j / (1-\alpha)$: long-run impact of replacing drought restrictions with Water Wise Rules by season
- α: rate of adjustment parameter

Estimation technique

Large cross section with 27 meter reading sequences

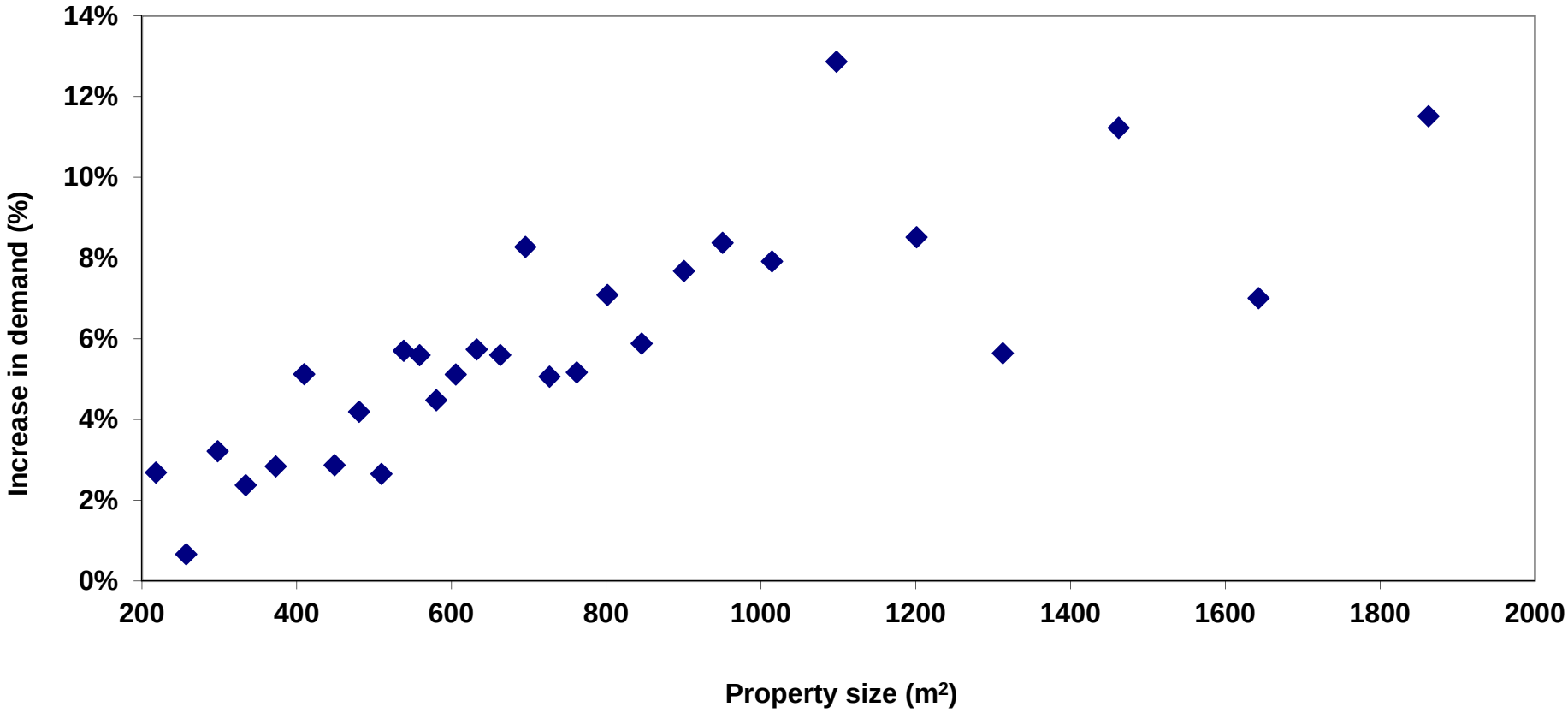
‘Endogenous’ explanatory variables - price and previous consumption

- Ordinary least squares – biased and inconsistent estimators
- Maximum likelihood – sensitive to initial specification
- Preferred approach: ‘Two step’ generalised method of moments

Findings

Sensitivity to weather conditions

Impact of a 1mm increase in average evaporation levels



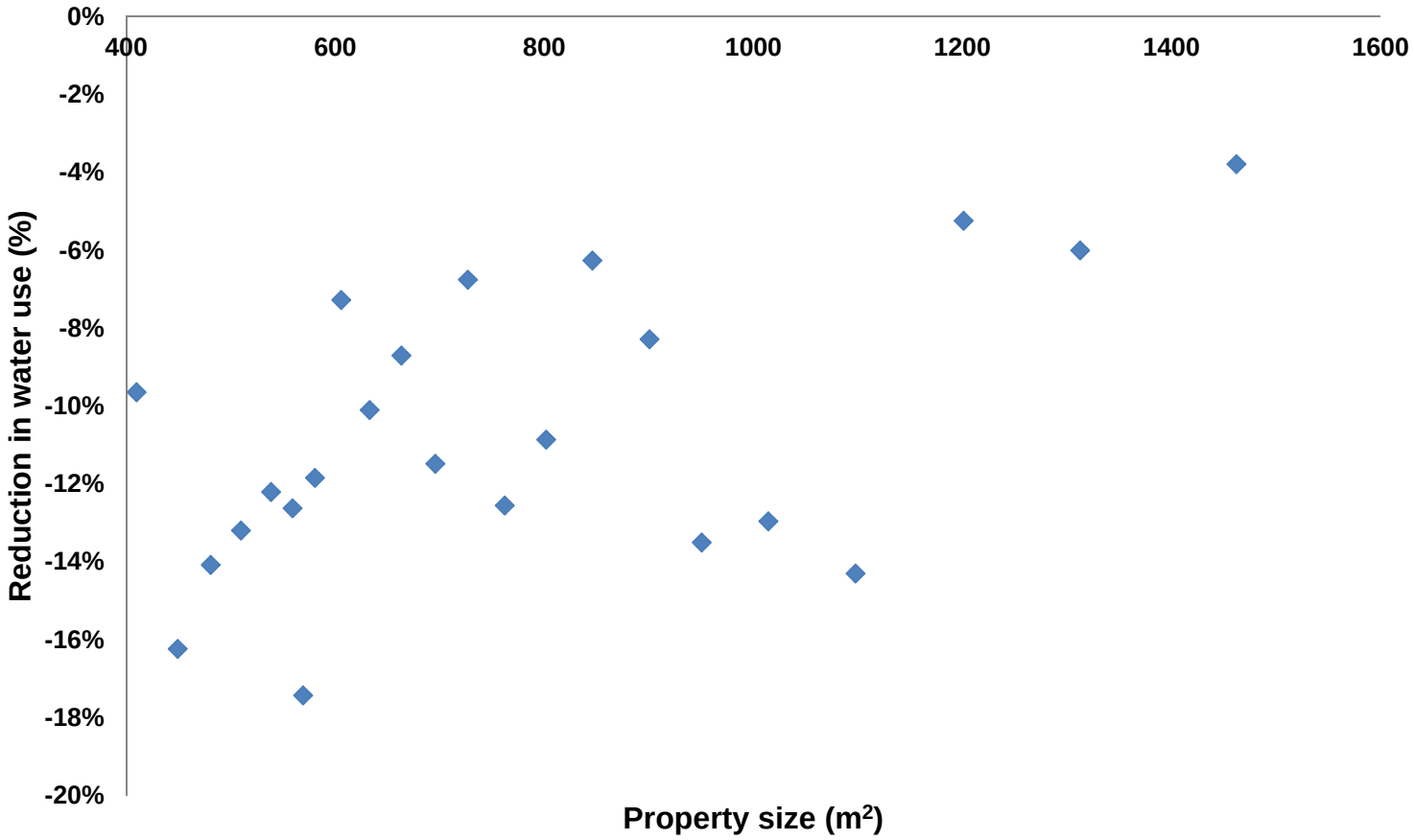
Price elasticity of demand

Real price elasticities

Property type	Long-run price elasticity	
	$1.50 kL	$2.00 kL
Owner occupied houses, no water efficiency program	-0.29	-0.38
Owner occupied houses, water efficiency program	-0.20	-0.26
Tenanted houses, no water efficiency program	-0.16	-0.22
Tenanted houses, water efficiency program	-0.14	-0.19
Units and flats	-0.09	-0.12
Owner occupied townhouses	-0.27	-0.36
Tenanted townhouses	-0.10	-0.13

Water efficiency programs

Estimated impact of WaterFix (%)



Average impact: about 23kL/year per household reduction in water use

Water Wise Rules

Increase in water use with replacing drought restrictions with Water Wise Rules (22 June 2009)

	% increase		kL/year	
Property type	**SR**	**LR**	**SR**	**LR**
Owner occupied houses, no water efficiency program	3.8%	6.0%	8	13
Owner occupied houses, water efficiency program	2.5%	3.3%	5	6
Tenanted houses, no water efficiency program	1.9%	3.4%	4	7
Tenanted houses, water efficiency program	2.1%	3.8%	4	8
Units and flats	2.1%	4.4%	3	6
Owner occupied townhouses	3.3%	5.0%	4	7
Tenanted townhouses	1.2%	2.2%	2	4

13 GL long-run increase in water use (4.3%)

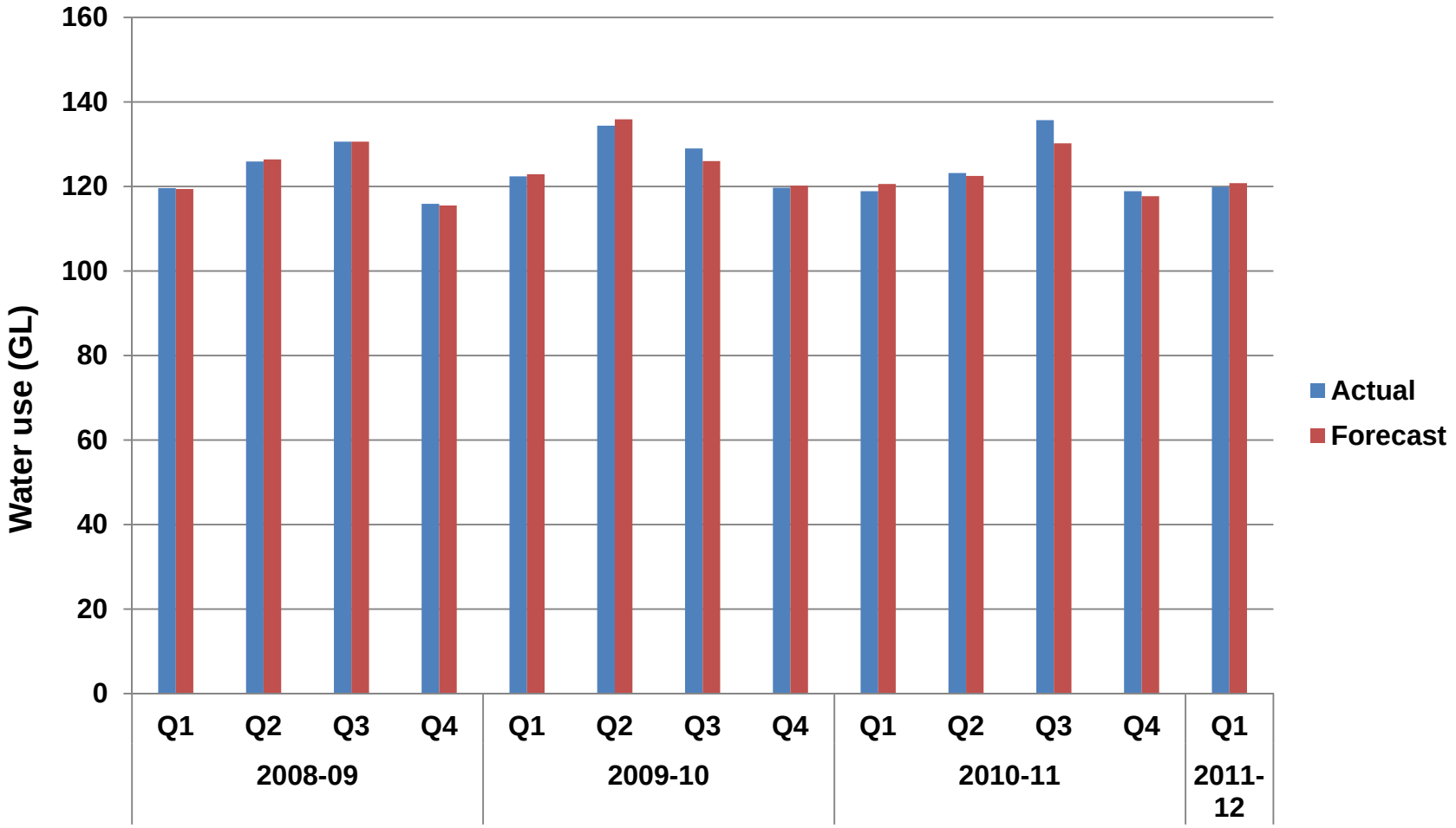
Water Wise Rules

Time taken to adjust >98% to the long-run position

Property type	α	Months	Date*
Owner occupied houses, no water efficiency program	0.35	12	June 2011
Owner occupied houses, water efficiency program	0.23	9	March 2011
Tenanted houses, no water efficiency program	0.42	15	Sept 2011
Tenanted houses, water efficiency program	0.43	15	Sept 2011
Units and flats	0.51	18	Dec 2011
Owner occupied townhouses	0.32	12	June 2011
Tenanted townhouses	0.44	15	Sept 2011

*Measured from July 2010 given seasonal WWRs variables

Forecasts and actuals




Questions?