White goods appliances: electricity loads and residential curtailment contracts

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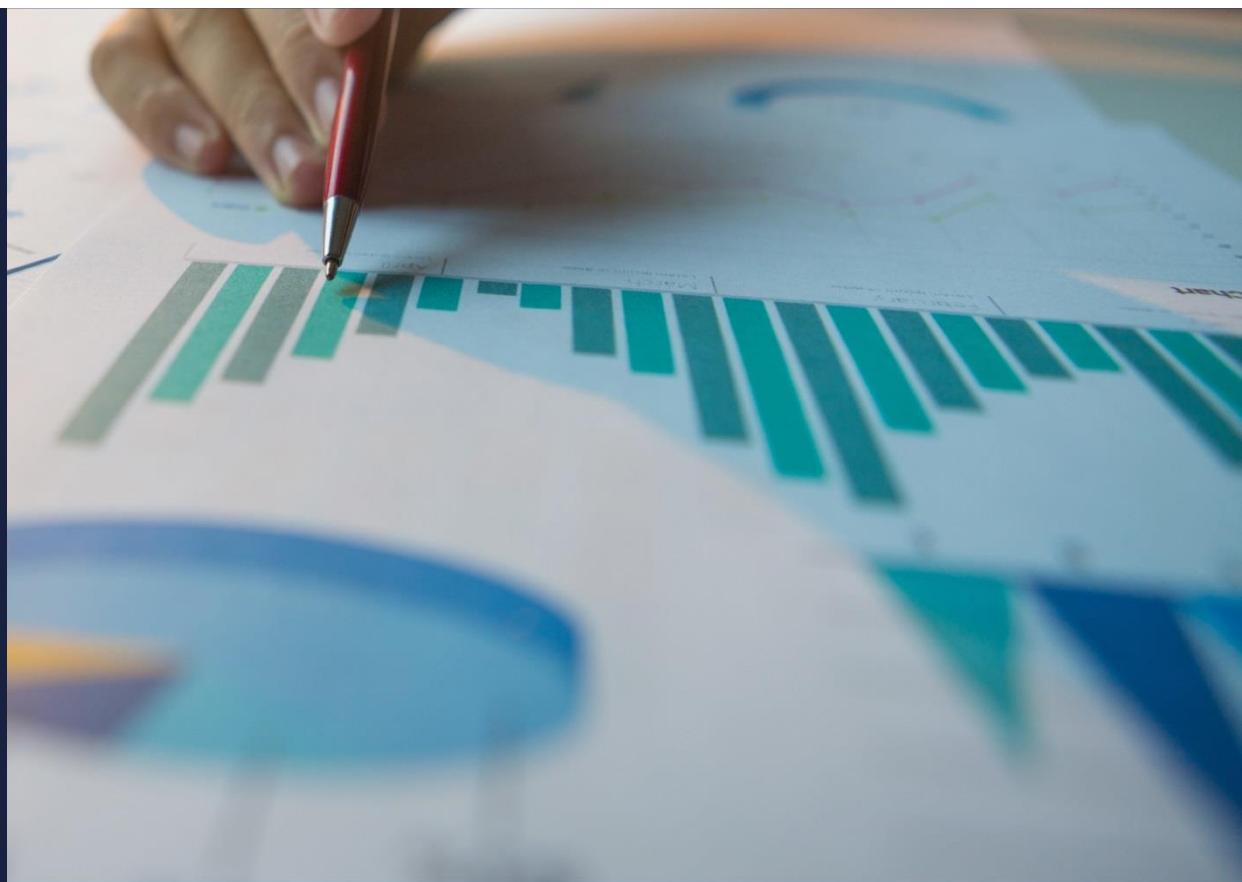
Acknowledgements

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Overview

Part 1: Appliance Use Patterns

- 'White goods' appliances, who uses them, when, and how often

Part 2: Appliance Curtailment Contracts

- Investigating potential for appliance curtailment contracts to shift peak electricity load

Methodology

Based on domestic appliance usage survey - Summer 2018

- Survey: N=972
- Large domestic appliance use information
- Stated preference survey on curtailment scenarios
- Data analysis: N=810

Sample Composition

	Total	Percent	National*
18-24 years	82	10.12%	10.99%
25-34 years	137	16.91%	18.47%
35-44 years	171	21.11%	20.91%
45-54 years	152	18.77%	17.53%
55-64 years	133	16.42%	14.25%
65+ years	135	16.67%	17.85%
Male	364	44.94%	48.88%
Female	446	55.06%	51.12%
Rural	295	36.42%	39.91%
Urban	515	63.58%	60.09%
One or Two Members	417	51.48%	52.07%
Three Members	153	18.89%	17.48%
Four Members	153	18.89%	16.94%
Five Plus Members	87	10.74%	13.51%
Secondary	209	25.83%	48.65%
Tertiary	285	35.23%	29.13%
Honours Degree/Post Graduate	315	38.94%	22.23%
Full Time Employed	487	60.12%	53.43%
Other	323	39.88%	46.57%

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Appliance Uses per Week

Specific attention paid to large domestic washing and drying appliances with discrete user initiated cycles

- Oven
- Dishwasher
- Washing Machine
- Tumble Dryer

Presence of deferrable peak period load identified

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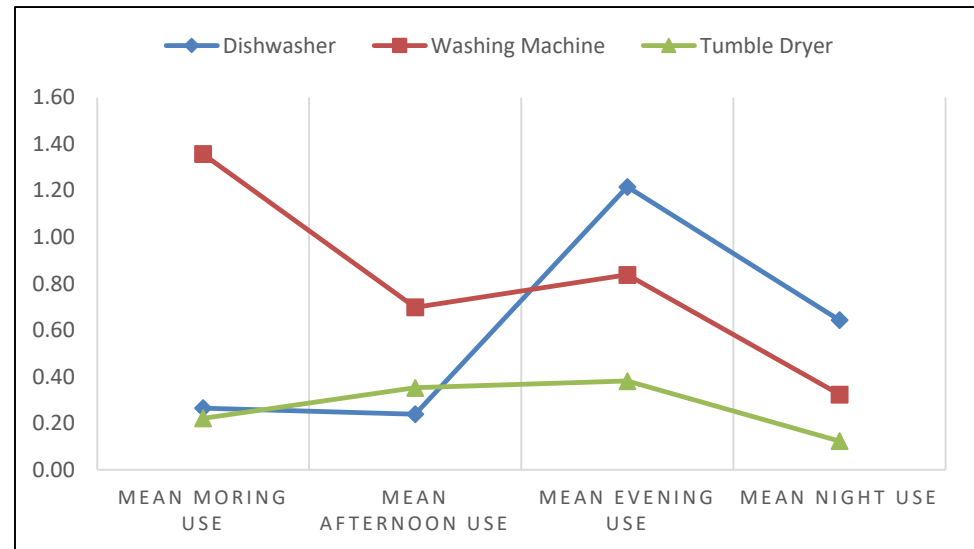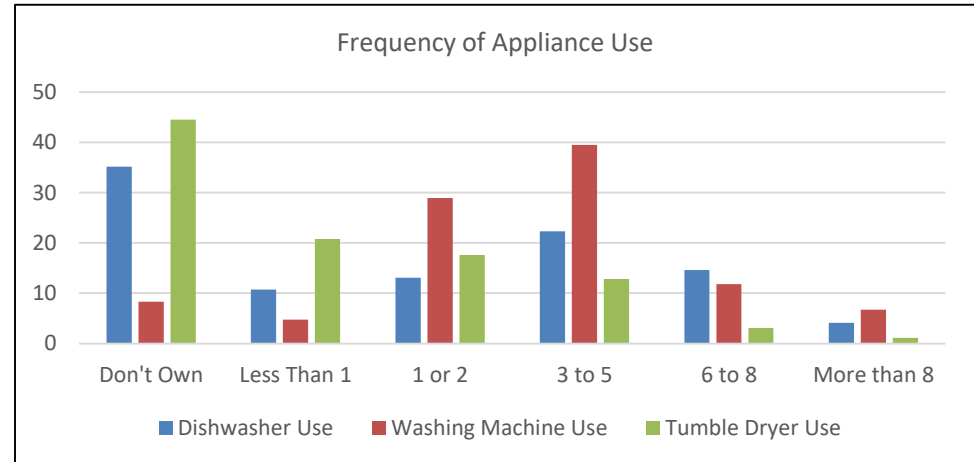
Appliance Use Conclusions

Household characteristics determine both:

- The likelihood of using an appliance during the peak period

- The frequency of such use

Significant associated factors include:

- Income, Age, region (urban/rural), household size

- Engagement in full time employment

- Number of appliances owned

Evening Appliance Use

Key determinant of appliance use:		
Household size	Evening appliance uses	Incidence ratios
one (ref)	-	-
two	+0.8	1.4
three	+1.6	2.1
four	+2.3	2.5
five plus	+3.2	3.0

Households with zero evening appliance use:

- Households with 1-2 people at home in day twice as likely to have zero evening appliance uses (relative to 0 home-in-day)

Appliance curtailment contracts

Discrete choice experiment:

Attributes examined:

- Appliance types
- Frequency of curtailments
- Advance notice (12hr)
- 'Opt Outs' (1 per month)
- Bill discount – a.k.a. fee

Note: The time of curtailment is fixed across all contracts and is between 5pm and 8pm in the evening.

Choice Card 1

	Contract A	Contract B	Contract C
Appliance to be curtailed	Tumble Dryer	Dishwasher	Current contract as it is today
Max frequency of curtailment	9 times per month	3 times per month	
Advance Notice (at least 12 hours)	Yes	No	
Opt Out (once per month)	No	Yes	
Electricity Discount (per bimonthly bill)	€20	€20	

Please select which contract you prefer.

◯ Contract A
◯ Contract B
◯ Contract C

Attribute Levels

Appliance	Maximum Frequency	Opt-Out	Advance Notice	Utility Discount
Dishwasher	3 per month	Yes	Yes	€10
Washing machine	6 per month	No	No	€20
Electric Oven	9 per month			€30
Dryer				

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Choice Modelling Results

- Majority positively disposed to curtailment contracts

- User side agency important, i.e. opt-outs & advance notice

- Curtailment contracts potentially viable option

- Customer preferences highly heterogeneous

- Classified customer preferences into 5 groups/classes

1. **"Cautious Culinarians" – 31%**

    - Most resistant to oven curtailments

2. **"Conservative Curtailers" – 25%**

    - Highest valuation of status quo

3. **"Ambivalent Accountants" – 19%**

    - Only class no monetary compensation

4. **"Compensated Controllers" – 18%**

    - Highest utility for monetary compensation & opt outs & advance notice

5. **"Frequently Fearful" – 7%**

    - Highest disutility associated higher frequency curtailments

WTA Estimates

	Class 1	Class 2	Class 3	Class 4	Class 5
Oven	**€38.09***	**€15.16***	€6.98	€2.73	**€22.54***
Dryer	**€-11.79***	€-4.88	€88.16	**€-3.52***	**€19.6***
Dishwasher	**€-4.65***	**€7.95***	€60.45	€-1.76	€-11.27
Frequency	**€1.04***	**€1.23***	€-2.23	**€0.75***	**€2.84***
Opt Out	€-1	**€-4.57***	€-17.62	**€-2.04***	€-2.90
Advance Notice	€-0.33	**€-6.98***	€-35.63	**€-2.81***	€-3.15
ASC	**€12.35***	**€-29.89***	€93.07	€8.19	€1.76
Class share:	31%	25%	19%	18%	7%

Overall Conclusions

- Excl. ovens considerable evening peak load in domestic washing & drying

- Specific household attributes associated with these load, i.e. systematic

- Curtailment contracts potential role in demand flexibility

- Considerable heterogeneity present w.r.t contract attributes

- Need to consider user-side control features when designing such contracts