Examining energy efficiency retrofit depth in Ireland

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ESRI-UCD Energy Research Workshop, 16 March 2016

Motivation

- Space heating accounts for 40% of residential energy consumption (EU Energy Efficiency Plan 2011)
- December 2015: 50% of homes in Ireland possess a BER between D1 and G (CSO Domestic BER Release)
- The Better Energy Homes scheme provides grant aid to home owners to undertake energy efficient retrofit
- By engaging homes in deeper retrofits, greater reductions in residential energy consumption can be achieved

Research Questions

1. Which households are most likely to engage in deeper retrofits?
2. Has the introduction of a bonus payment for multiple measures led to deeper retrofits?
3. Has the role of Obligated Parties affected retrofit depth?

Measuring Retrofit Depth

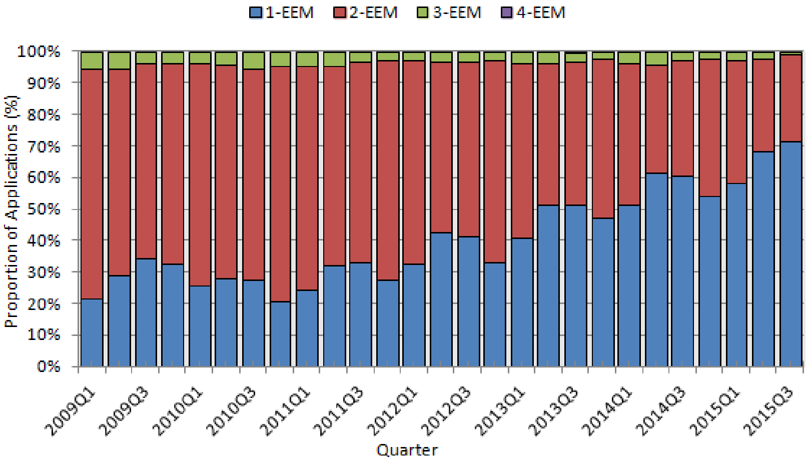
Two measures of retrofit depth:

- Number of retrofit measures undertaken
- More Comprehensive Retrofits: The propensity of a household to undertake a ‘more comprehensive’ retrofit
  - 88% of successful applications are made for ‘less comprehensive’ retrofits

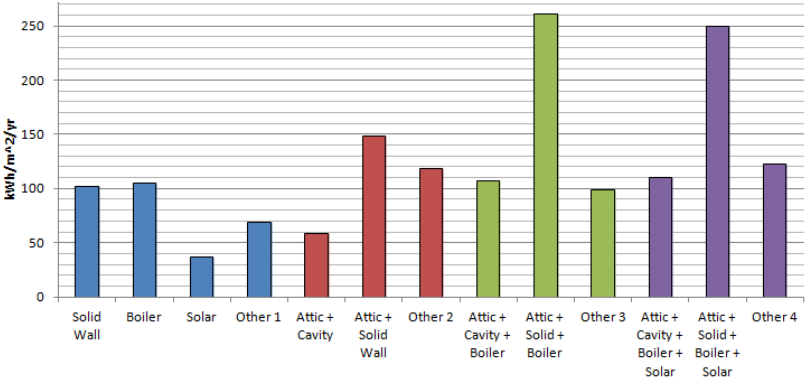
Data - BEH Scheme

Measure	Category	Sub-Category	Scheme 1 Mar-09 €	Scheme 2 Jun-10 €	Scheme 3 May-11 €	Scheme 4 Dec-11 €	Scheme 5 Mar-15 €
Roof	Roof/Attic Insulation		250	250	200	200	300
Wall	Cavity Wall Insulation		400	400	320	250	300
	Internal Dry-Lining		2500	2500	2000	.	.
		Apartment or Mid-terrace House	.	.	.	900	1200
		Semi-detached or End of Terrace	.	.	.	1350	1800
		Detached House	.	.	.	1800	2400
	External Wall Insulation		4000	4000	4000	.	.
		Apartment or Mid-terrace House	.	.	.	1800	2250
		Semi-detached or End of Terrace	.	.	.	2700	3400
		Detached House	.	.	.	3600	4500
Boiler	High efficiency boiler (oil or gas) upgrade with heating controls		700	700	560	560	700
	Heating Controls upgrade only		500	500	400	400	600
Solar	Solar Heating		.	.	800	800	1200
BER	Before & After Building Energy Rating		100	.	.	.	.
	Mandatory Before & After Building Energy Rating		.	100	80	50	50
Bonus	Bonus for 3rd measure		.	.	.	.	300
	Bonus for 4th measure		.	.	.	.	100

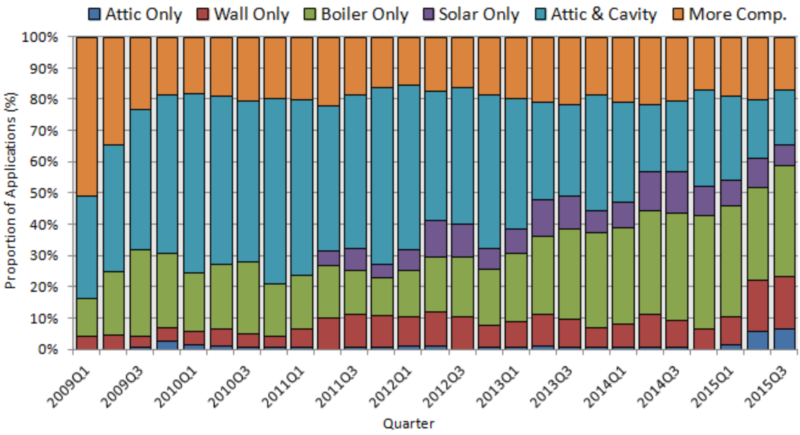
Data - Number of Measures over Time



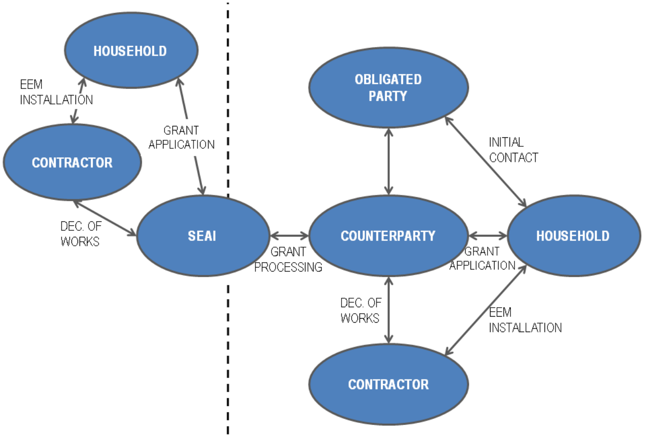
Average BER improvements across retrofit combinations



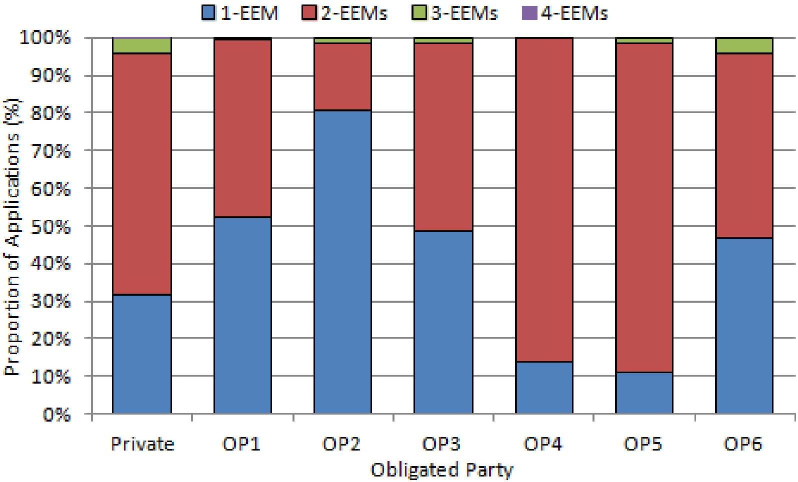
Data - Comprehensiveness over Time



Data - Obligated Parties



Data - Number of Measures by Obligated Party



Descriptive Statistics

	Observations	Proportion		Observations	Proportion
Measures			*Dwelling Type*		
1	54,172	0.3274	House	162,199	0.9804
2	103,603	0.6262	Apartment	3,245	0.0196
3	7,457	0.0451		165,444	
4	212	0.0013	*Island Status*		
	165,444		Mainland	165,276	0.9990
Type of Retrofit			Island	168	0.0010
Simple	145,459	0.8792		165,444	
More Comprehensive	19,985	0.1208	*Season*		
	165444		Spring	44,620	0.2697
Year of Construction			Summer	39,884	0.2411
-1950	20,573	0.1244	Autumn	36,405	0.2200
1951 - 1970	25,271	0.1527	Winter	44,535	0.2692
1971 - 1980	33,042	0.1997		165,444	
1981 - 1990	25,718	0.1554	*Obligated Party Status*		
1991 - 2000	37,020	0.2238	Private	151,560	0.9161
2001 -	23,820	0.1440	OP 1	1,432	0.0087
	165,444		OP 2	582	0.0035
Location			OP 3	9,600	0.0580
GDA	41,635	0.2517	OP 4	1,676	0.0101
County with City	55,080	0.3329	OP 5	298	0.0018
Border Midlands West	35,623	0.2153	OP 6	296	0.0018
South & East (ex. GDA)	33,106	0.2001		165,444	
	165,444				

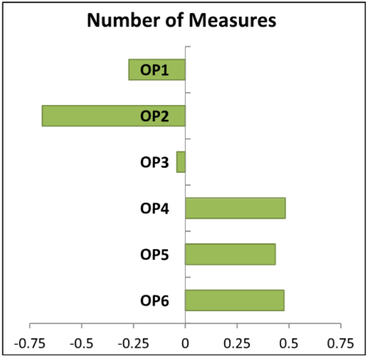
Methodology: Number of Measures

- Ordered Logistic Regression
  - *P(Intensity* $=$ *n)* $=$ *f(grant aid, household characteristics, contracting type)* $+ \epsilon$
  - $1 \leq n \leq 4$
- Count Data Model: Double-Truncated Poisson Regression
  - *Number of measures* $=$ *f(grant aid, household characteristics, contracting type)* $+ \epsilon$

Methodology: Retrofit Comprehensiveness

- Logistic Regression
  - *P(More Comprehensive)* $=$ *f(grant aid, household characteristics, contracting type)* $+ \epsilon$

Results: Obligated Parties



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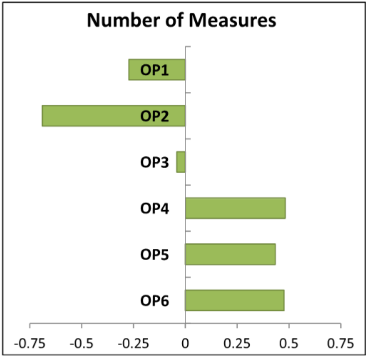
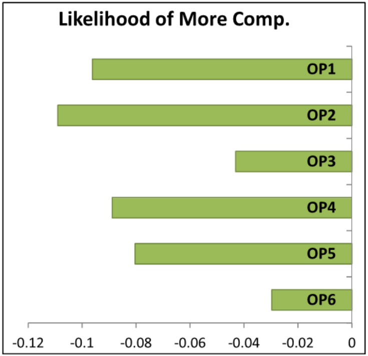
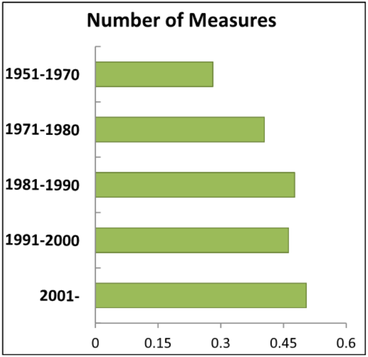




Results: Location and Property Type



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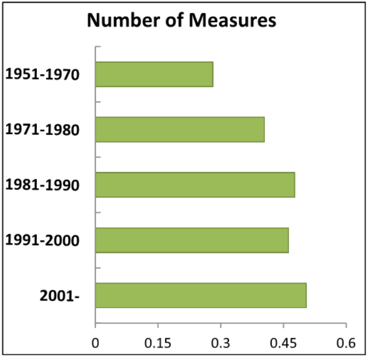

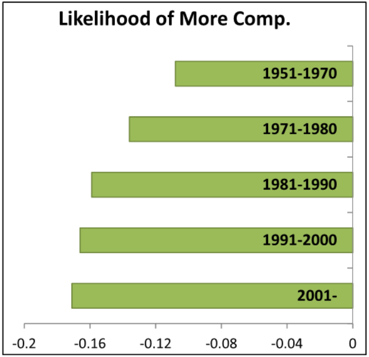

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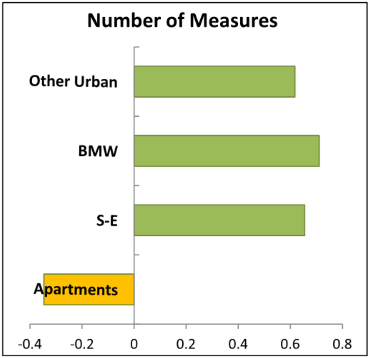

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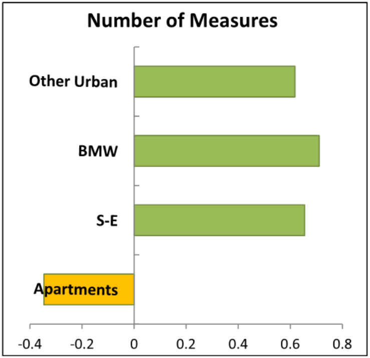

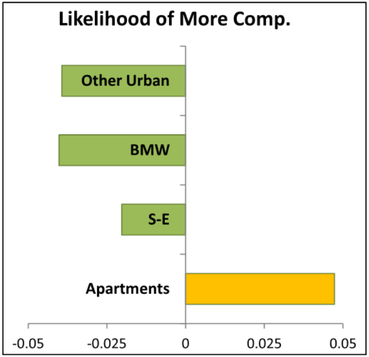

Results: Scheme Rule Changes and Early Adopter Effects

- The introduction of a bonus payment for 3- and 4-measure retrofits has not coincided with any increases in retrofit depth
- An early adopter effect was found for the first 12 months of the scheme

Conclusions

1. Which households are most likely to engage in deeper retrofits?
    - Newer dwellings in rural areas found to engage in more intense retrofits
    - Older dwellings in the Greater Dublin Area more likely to engage in more comprehensive retrofits
    - Conflicting results due to prevalence of attic and cavity retrofits in newer and rural dwellings
2. Has the introduction of a bonus payment for multiple measures led to deeper retrofits?
    - Bonus payments have not led to any increases in intensity of more comprehensive retrofits
3. Has the role of Obligated Parties affected retrofit depth?
    - Some obligated parties are found to provide more intense retrofits, relative to private applications
    - This is due to some parties focusing on attic and cavity retrofits, increasing the number of 2-measure retrofits but not more comprehensive retrofits

Thank You