Household preferences for characteristics of space and water heating systems

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Organization of the presentation

1. Some background information to set the context of the study
2. A description of the survey software
3. A description of the sample
4. Results and implications

The New Zealand context

Space heating in NZ is typically energy inefficient

- Modest insulation requirements first imposed in 1978
  - Insulation retro fits usually limited to ceiling insulation
- Efficient heating systems rarely installed at construction
  - Un-ducted electric heat pumps and more efficient wood burners becoming more common

Water heating is also relatively energy inefficient

- Standard resistive electric heating dominates

Concerns about insufficient space heating in the context of constraints on energy supply have encouraged some government intervention

- Equipment subsidies and social marketing
  - Market response has been modest

Context of this study

Part of a larger multi-disciplinary study

Aim

- To identify “barriers” to adoption of energy efficient technologies or behaviours
- Recommend policies and/or commercial practices that lower those barriers

Key concept: energy “cultures”

- Households vary in their preferences/practices with respect to energy
- Identify groups with similar preferences/practices
- Target interventions to these various groups

This study

Two-part survey

- ‘Conjoint’ (stated preference) survey
  - Participants asked to make a series of hypothetical choices that each require a trade off between attributes of:
    - water heating systems
    - or space heating systems
- Standard tic-the-box survey
  - House and household characteristics
  - Energy technologies and practices
  - A series of ‘values’ questions

Unique survey software

1000Minds

- Web-based multi-attribute decision software
- Key unique characteristic
  - Practically complete ranking of all pairwise comparisons for each respondent
  - With each choice made, all other choices implied by transitivity are eliminated

'Partworth' utilities estimated using a linear program

- Complete set of relative utilities for each respondent

Utilities for each respondent allows use of 'cluster analysis'

- Distinguish groups of respondents with similar patterns of preferences with respect to the attributes of space or water heating systems

Attribute/	Raw utilities		Scaled utilities		
level	True	Estimated	True	Estimated	Difference
a1 =	904,230,422	0	0.00	0.00	
a2 =	1,150,254,494	12	2.67	2.60	0.08
a3 =	1,495,892,988	29	6.43	6.28	0.15
a4 =	1,788,956,205	44	9.62	9.52	0.09
b1 =	55,645,646	0	0.00	0.00	
b2 =	889,812,010	42	9.07	9.09	-0.02
b3 =	1,099,792,614	53	11.35	11.47	-0.12
b4 =	2,127,666,586	106	22.52	22.94	-0.42
c1 =	1,374,830,808	0	0.00	0.00	
c2 =	1,521,235,223	7	1.59	1.52	0.08
c3 =	1,768,266,343	20	4.28	4.33	-0.05
c4 =	1,779,443,831	21	4.40	4.55	-0.15
d1 =	606,481,081	0	0.00	0.00	
d2 =	906,422,939	16	3.26	3.46	-0.20
d3 =	1,448,663,716	43	9.15	9.31	-0.15
d4 =	1,587,755,931	49	10.67	10.61	0.06

Sample recruitment

Started with a small sample

- Drawn from telephone directory
- Conducted structured interviews

Market research firm

- Recruits participants through a loyalty program
  - Survey respondents earn “reward points”
- Database consists of about 90,000 email addresses
  - We targeted home owners (with or without mortgage)
  - 28% space and 21% water heating response rates

Electricity retailer email database

- ~ 10% response rate

Sample characteristics

Geographic distribution is closely representative

Household characteristics	Sample	Population
1 person	9.2%	22.6%
2 person	38.5%	25.2%
3 – 5 person	47.4%	27.0%
Age > 65	17.0%	16.4%
Age 30 – 64	74.5%	56.9%
Med HH income	70 – 80k	60 – 70k
Paying mortgage	67.9%	54.9%
House built before 1978	52.6%	

Attributes of hypothetical water heating improvement

Upfront $ cost (purchase and installation)

Running cost ($)

Reliability of water supply

Confidence that the system will perform as advertised

Fit with house

Impact on neighbours

Dependent on energy from the local grid

Upgradable

Attributes of hypothetical space heating improvement

Upfront $ cost (purchase and installation)

Running cost ($)

*Improvement capitalizes into house sale price

Confidence that the system will perform as advertised

*Control over the system

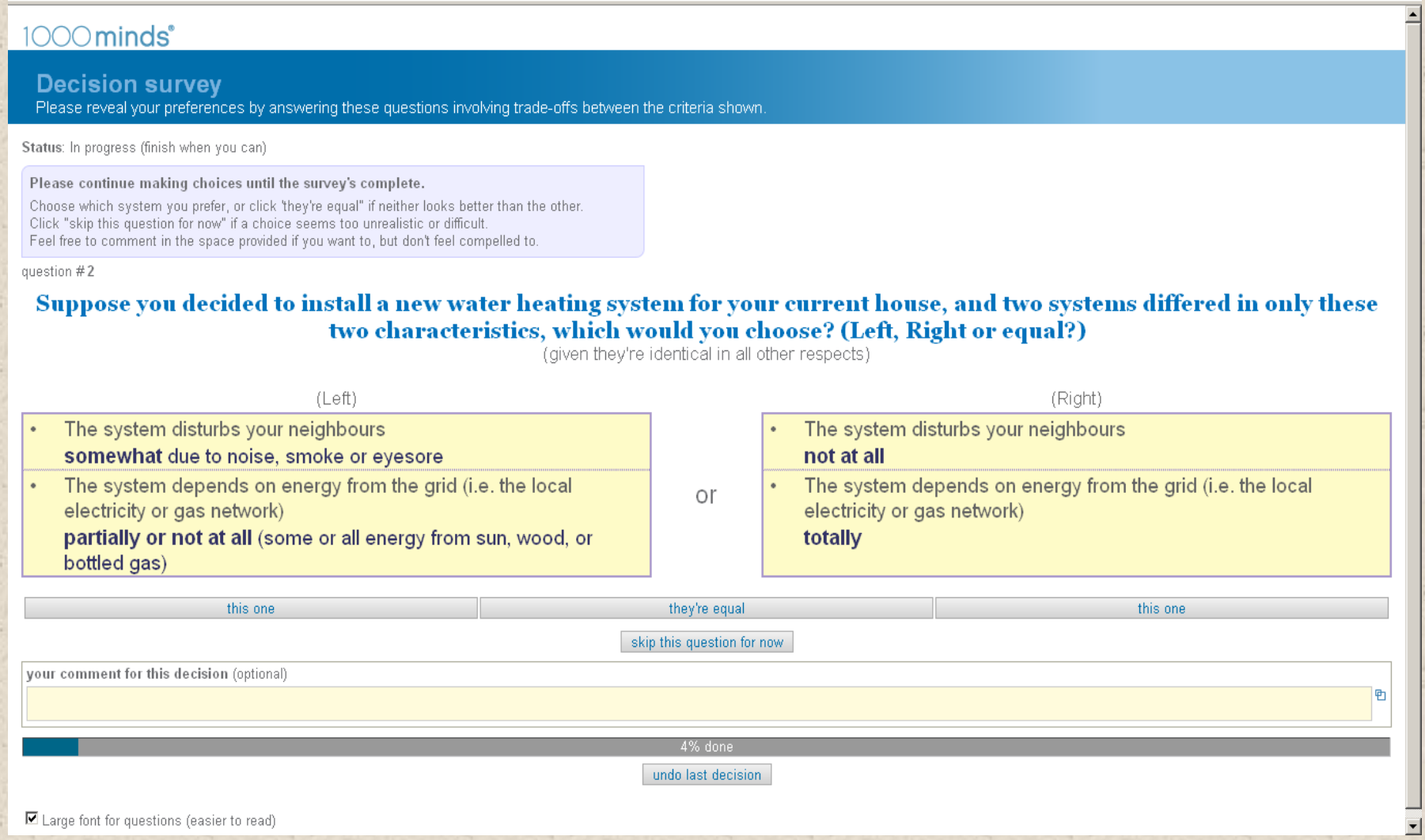
Fit with house

Impact on neighbours

*Impact on householders

Dependent on energy from the local grid

Screenshot of conjoint survey choice pair



Estimated utilities: space heating

		Cluster				
	Mean	**1**	**2**	**3**	**4**	**5**
Upfront cost	17.4%	**33.5%**	16.5%	10.0%	18.0%	15.0%
Running cost	14.3%	15.5%	**19.2%**	17.2%	9.8%	12.0%
Improves sale price	8.1%	3.4%	**14.7%**	6.8%	7.6%	8.0%
Confident in tech	10.7%	9.8%	11.8%	**12.5%**	10.5%	9.3%
Control over system	7.5%	7.3%	5.6%	**13.2%**	6.9%	5.0%
Fits with house	13.1%	12.5%	10.0%	**16.0%**	13.7%	12.5%
Not disturb neighbours	9.9%	5.3%	6.1%	8.8%	**14.5%**	11.4%
Not disturb you	10.8%	7.2%	8.9%	9.2%	**15.0%**	11.5%
Off grid	8.2%	5.5%	7.0%	6.4%	4.1%	**15.3%**
Size	810	111	134	170	185	210
	100%	**14%**	**17%**	**21%**	**23%**	**26%**

Differences across groups: space heating

	Cheap	Efficient	Reliable	Aesthete	Independent
House					
House age	older	newer	newer		
Bedrooms	fewer				more
No mortgage		fewer		more	
Years plan to stay	more	fewer		more	
Demographics					
Age		younger		older	
European descent	fewer				more
Heating method					
Heat pump	more		fewer		fewer
Wood burner	fewer		fewer		more

More differences: space heating

	Cheap	Efficient	Reliable	Aesthete	Independent
Behaviours					
Use delay function			more	fewer	fewer
Keep heat low	more		fewer		
Reduce heat	more	fewer	fewer	more	
Energy spend	less	less			more
Personal values					
Technology solves				yes	
Protect environ	less				yes
Being helpful	less				
Respect tradition				yes	
Policy preferences					
Energy use labels		less		yes	
Customised advice		less		yes	
Ban inefficient tech			yes		less

Estimated utilities: water heating

		Clusters			
	Mean	**1**	**2**	**3**	**4**
Upfront cost	14.6%	**22.8%**	15.1%	12.4%	12.1%
Running cost	16.4%	**25.5%**	16.7%	13.8%	14.1%
Reliable supply	17.7%	11.0%	**26.0%**	19.1%	12.8%
Confident in technology	12.4%	9.9%	**14.3%**	12.0%	12.7%
Fits with house	12.2%	7.9%	10.6%	**14.9%**	12.8%
Not disturb neighbours	13.8%	8.4%	7.9%	**20.0%**	14.0%
Off grid	7.3%	9.4%	4.3%	3.3%	**14.0%**
Upgradable	5.6%	5.1%	5.2%	4.7%	**7.6%**
Size	586	94	134	203	155
	100%	**16.0%**	**22.9%**	**34.6%**	**26.5%**

Differences across groups: water heating

	Thrifty	Reliable	Aesthetic	Independent
Demographics				
Income	lower	higher		
Immigrant	fewer	more		
European descent	fewer	more		
Energy behaviours				
> 50% eco light bulbs	yes	less		yes
Keep heat low	yes	less		
More clothing first	yes	less	less	
Personal values				
Nature delicate		no		
Modify environment no harm	no	yes		
Technological solutions		yes		
Protect environment		no		yes
Respect tradition		no	yes	
Being obedient		no	yes	

To sum up...

The aim of the study is to explore heterogeneity in household preferences for attributes of space and water heating improvements

- In particular, to distinguish groups of households with similar patterns of preferences
  - As indicated by hypothetical choices

Unique survey software provides respondent-specific estimates of relative utilities for each attribute of a hypothetical improvement

- Standard cluster analysis provides plausible groupings with respect to these estimated preferences
- The groups vary plausibly, though not strongly, with house and household characteristics
- This kind of information could be commercially valuable and has policy implications

A concern is that the sample is probably not as representative as would be desired

Policy implications

Each group has its own policy implications:

- A relatively small cost-constrained group
  - Consistent with limited response to subsidies; subsidies necessary for some but not sufficient for many
- A group willing to invest, but concerned about recovering upfront cost upon sale of house
  - Suggests home energy audit and certification program
- A relatively large group concerned about functional reliability
  - Suggests aggressive independent testing and certification
- Another group concerned about aesthetics
  - Suggests support for customized installations
- A surprisingly large group interested in independence from the grid
  - Support for solar systems?

Thank you!

Suggestions most welcome