



Environment Center
Charles University
in Prague

PREFERENCES FOR MICROGENERATION TECHNOLOGIES: ARE CZECHS READY TO PAY?

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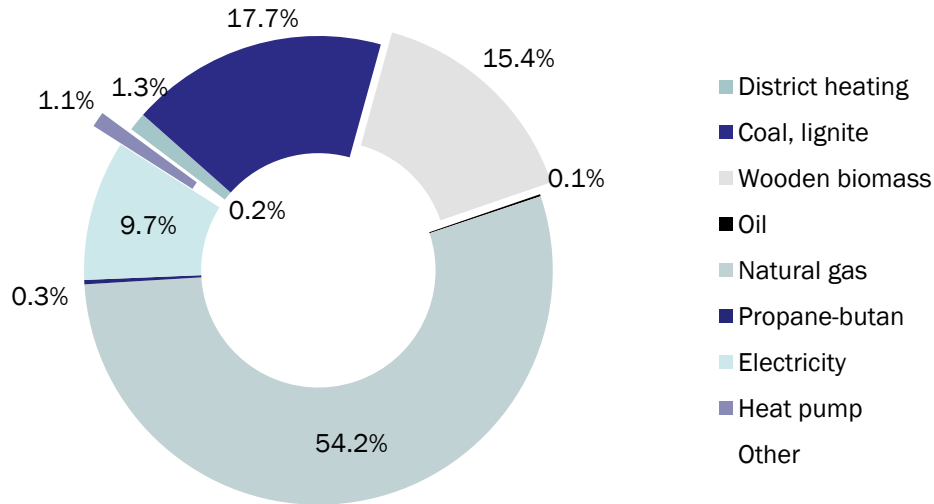
Future Options for EU Climate Policies and their Public Acceptability
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Outline

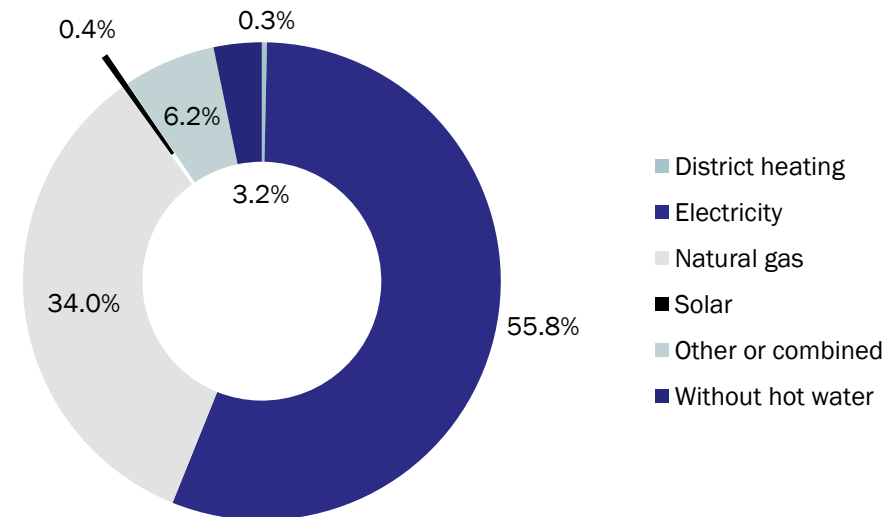
1. Status quo of microgeneration technologies (MGT) in Czech residential sector
2. Household survey on willingness to pay (WTP) for microgeneration technologies
3. What influences the adoption of microgeneration technologies and estimates of willingness to pay

MGTs in Czech residential sector – heating and hot water

Heating – family houses



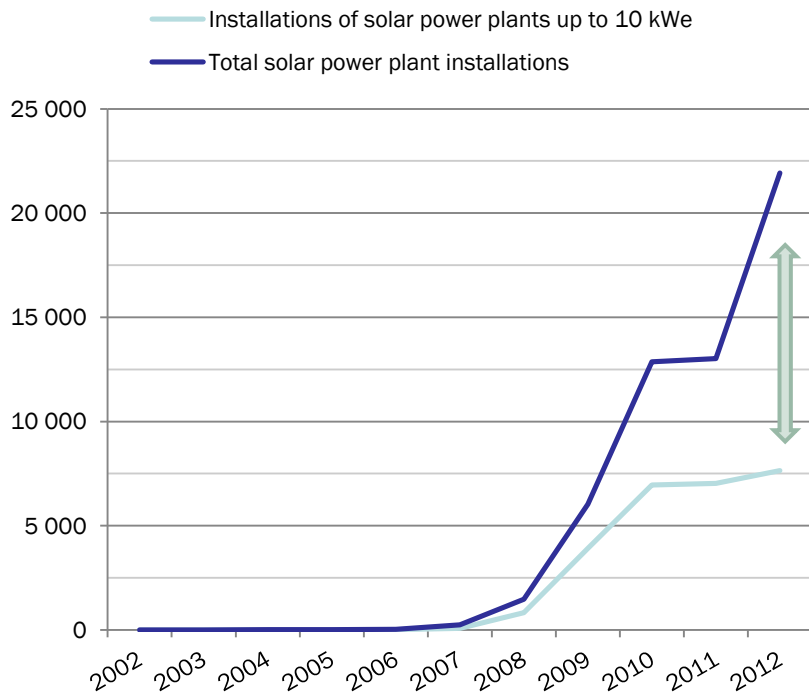
Hot water – family houses



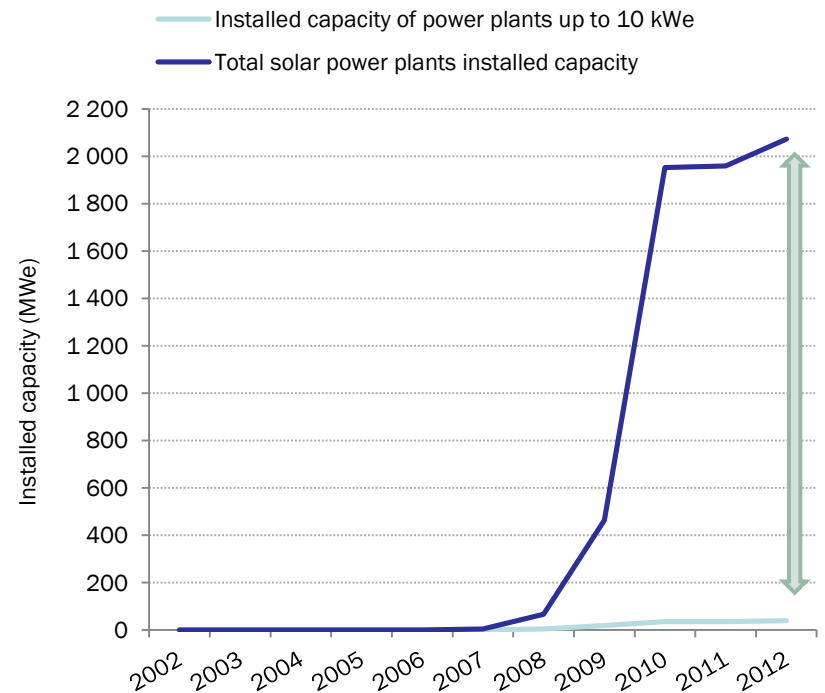
Source: Census 2011

MGTs in Czech residential sector – electricity

Comparison of number of solar power plants installations of up to 10 kWe and number of total solar power plants installations



Comparison of installed capacity of solar power plants installations of up to 10 kWe and total solar power plants installed capacity



Source: own calculations (Škopková, 2013b), data on business licenses in energy sector provided by Czech Energy Regulatory Office

Household survey – objectives

1. Identify major barriers and motivations of MGTs adoption for Czech households
2. Estimate the willingness to pay for 8 MGTs:
 - photovoltaic system
 - micro-wind turbines
 - solar thermal system
 - hybrid solar thermal-photovoltaic systems
 - heat pump
 - micro CHP on natural gas
 - micro co-generation boiler on biomass
 - hydrogen fuel cell
3. Reveal perceptions of specific technology attributes (Diffusion of innovations theory, Rogers 1962)

Household survey – characteristics

Target population

- 18+ owners of family houses, max. 3 flats
- Basic knowledge about the hh energy consumption and costs

Sampling

- Stratified random selection (quotas on region and size of town)
- Recruited via telephone by random generation of telephone numbers

Survey implementation

- May-June 2014
- CASI/CAWI – online self administered web interview
- N=3280 households in main data collection (N=208 in pilot survey)

The concept of willingness to pay (WTP)

- Economic valuation with stated preference techniques
 - *economic techniques for the valuation of non-market goods and services*
 - *the value is estimated in monetary terms*
 - *hypothetical market situation created in a survey where the respondents are asked to state their willingness to pay (WTP)*

Why estimate WTP for MGT?

- Low penetration of MGTs in the population
- Some of the valued technologies not yet on the market
- Possible way, how to assess at what price people would be willing to purchase the technology
- Achtnicht, 2011 (Germany); Baskaran, Managi, & Bendig, 2013 (New Zealand); Claudy et al., 2011 (Ireland); Ida et al., 2012 (Japan); Rouvinen & Matero, 2012 (Finland); Scarpa & Willis, 2010 (Great Britain)

Questionnaire structure

1. House and household characteristics
 - *hh energy sources for different purposes, current heating technologies*
 - *already installed electricity producing MGT*
 - *energy expenditures*
2. Contingent valuation – WTP estimates
3. Perception of technology attributes according to the Diffusion of innovations theory
4. Specific attitudes, proenvironmental attitudes (GEB) scale, energy consumption behaviour
5. Socio-demographic characteristics

Hypothetical scenarios

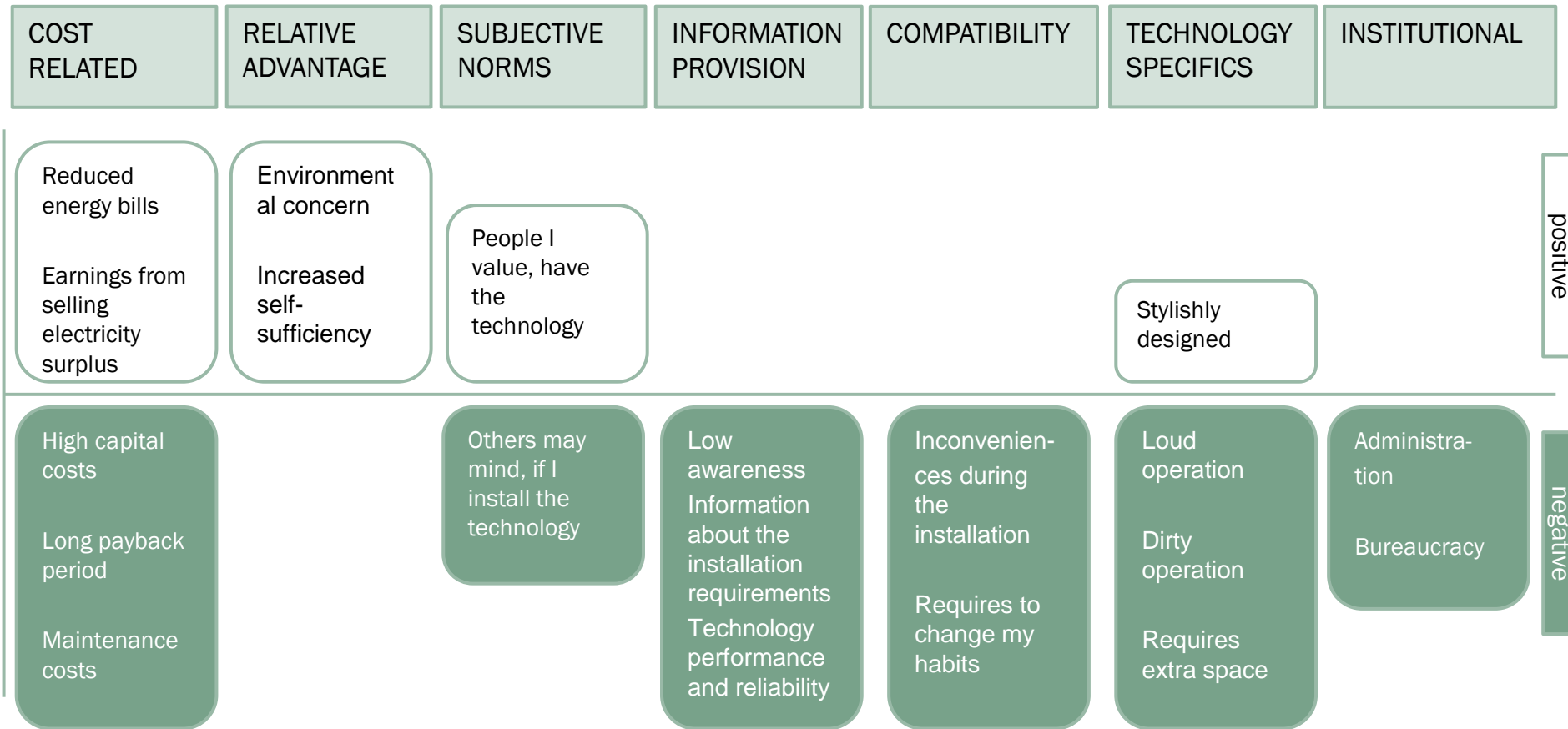
1. Technologies complementary to current heating system:
 - photovoltaic system, micro-wind turbines, solar thermal system and hybrid solar thermal-photovoltaic systems
2. Technologies replacing the current heating system:
 - heat pump, micro CHP on natural gas , micro CHP boiler on biomass and hydrogen fuel cell

	FOTO	HYBR	SOLAR	WIND	BIOM	HPUMP	FUEL	CHP	TOTAL
N	944	1097	971	1067	734	751	776	220	6560

WTP estimates

	Mean WTP (nonparametric estimates)		Czech market price		WTP/ market price
	CZK	EUR	CZK	EUR	%
<i>COMPLEMENTARY TECHNOLOGIES</i>					
Wind turbine (3.5 kW)	68 629	2 496	105 000	3 818	65
Solar thermal system (3.5 kW)	74 876	2 722	105 000	3 818	71
Photovoltaic system (3.5 kW)	82 974	3 017	170 000	6 182	49
Hybrid solar system (3.5 kW)	83 391	3 032	? 170 000	6 182	49
<i>REPLACING TECHNOLOGIES</i>					
Co-generating biomass boiler	87 793	3 192	? 300 000	10 909	29
CHP (natural gas)	90 817	3 302	350 000	12 727	26
Fuel cell	105 548	3 838	? 650 000	23 636	16
Heat pump	114 698	4 171	200 000	7 272	57

Major determinants of MGT adoption



positive

negative

How important do you consider following aspects of a new heating system?

N=3 280	Mean score	Std. d.	Min	Max
Low energy expenditures	1.28	0.592	1	5
As little as possible time consuming operation of the heating	1.66	0.794	1	5
Increasing the independency of my household on external suppliers of energy sources	1.80	0.870	1	5
To have the possibility to combine more energy sources in my heating system	1.97	0.932	1	5
To understand in detail, how the heating system works	1.95	0.956	1	5
To have the possibility of using a renewable energy source	2.11	0.993	1	5
As little as possible space demanding heating system	2.16	1.003	1	5
Increasing the air quality in my hometown	2.20	1.041	1	5
Low GHG emissions production from heating	2.41	1.091	1	5

Reasons for (not)purchasing the MGT

	HYBR	FOTO	SOLAR	WIND	HPUMP	FUEL	CHP	BIOM
Stated positive WTP (YY/YN/NY)	71%	70%	64%	55%	61%	59%	46%	40%
MAIN REASON FOR PURCHASING								
I will reduce my energy costs	48%	48%	51%	48%	51%	52%	55%	56%
I will increase the independency of my hh on external energy suppliers	33%	31%	29%	31%	30%	28%	18%	23%
It is a good investment	7%	8%	7%	6%	8%	9%	10%	7%
I will contribute to a better state of the environment	5%	5%	5%	5%	3%	4%	8%	5%
I will reduce the GHG emissions of our household	2%	1%	2%	2%	2%	2%	0%	2%
MAIN REASON FOR NOT PURCHASING								
I do not have enough money for that	13%	16%	13%	7%	17%	17%	7%	11%
The investment would not pay off for me	11%	8%	10%	4%	5%	8%	3%	5%
I have no space for the technology in my home	9%	10%	8%	10%	13%	7%	5%	20%
I do not fancy the technology	8%	6%	8%	17%	4%	13%	11%	9%
I think, it is impossible to install the technology in my home	7%	8%	6%	9%	8%	4%	17%	7%
I do not want any other device that I would have to take care of	6%	5%	5%	8%	5%	6%	4%	10%

What influences the WTP?

1. Socio-demographic variables:
 - gender, age, education, income, urban/rural
2. House characteristics
 - durability of current heating system
3. Perceived knowledge of the technology
4. Pro-environmental attitudes and social norms (people would mind/agree)
5. Perceptions of technology attributes:
 - complexity – requires knowledge
 - compatibility – requires major reconstruction
 - relative advantage – GHG emissions reduction, local environment, increasing independency, lowering energy expenses

Estimates of interval regression model for microgeneration technologies (unstandardized coefficients, std. errors)

	FOTO			SOLAR			WIND			HYBR		
	Coef. Estimate	Std. Error	Sig.	Coef. Estimate	Std. Error	Sig.	Coef. Estimate	Std. Error	Sig.	Coef. Estimate	Std. Error	Sig.
(Intercept)	8.796432	0.621078 ***		9.7502712	0.6296941 ***		9.276707	0.63227 ***		9.7458019	0.5487782 ***	
gender	0.015557	0.050916		-0.0780467	0.0543387		-0.040646	0.056511		0.0399601	0.0488231	
Age	-0.001396	0.001976		-0.0003311	0.0020885		-0.001465	0.002262		-0.0060758	0.0018679 **	
Tertiary_edu	0.053136	0.05159		0.0203811	0.0563022		0.065491	0.055051		-0.0004089	0.0493568	
log(Hincome_c)	0.20272	0.057471 ***		0.101028	0.0583769 .		0.134365	0.056661 *		0.1429758	0.0505302 **	
size_town	-0.013447	0.05062		-0.0261751	0.0532011		0.040723	0.054581		-0.0496979	0.0469784	
heat_reconst	0.135284	0.051669 **		0.1817987	0.053264 ***		0.245484	0.056032 ***		0.1465241	0.0502444 **	
familiar_foto	0.099555	0.054976 .		0.0825938	0.0516387		0.031528	0.054179		0.0562436	0.047582	
theta_inv	0.03728	0.025011		0.0466598	0.0270929 .		0.01414	0.029535		0.0811878	0.0254133 **	
requires_knowledge	0.009512	0.056198		0.0232613	0.0596347		0.111168	0.060693		-0.0270498	0.0517511	
requires_reconst	-0.118551	0.05337 *		-0.1050409	0.0563972 .		-0.139486	0.058248 *		-0.1094383	0.0495535 *	
people_agree	0.160837	0.054207 **		0.173073	0.058149 **		0.183953	0.059619 **		0.1565545	0.0519032 **	
people_mind	-0.087691	0.0584		0.122644	0.0596765		-0.147743	0.054395 **		-0.122526	0.0539591 *	
GHG_decrease	0.028236	0.074924		0.1168509	0.0691538 .		0.080303	0.073194		-0.0838136	0.0654029	
local_env	0.132179	0.072948 .		0.0701618	0.0730838		-0.081717	0.074068		0.0935647	0.0667863	
independency	0.09089	0.067731		0.1421897	0.067076 *		0.238879	0.075661 **		0.0600516	0.0689185	
energy_expenses	0.153401	0.066578 *		0.0473983	0.0695096		0.264356	0.073812 ***		0.25236	0.0690406 ***	
sigma	0.3476	0.01316 ***		0.3733794	0.014458 ***		0.390983	0.016258 ***		0.3675514	0.0132078 ***	
Log-Likelihood:	-1018.184			-1031.388			-1062.25			-1237.106		
df	776			778			823			917		

	BIOM			HPUMP			CHP			FUEL		
	Coef. Estimate	Std. Error	Sig.	Coef. Estimate	Std. Error	Sig.	Coef. Estimate	Std. Error	Sig.	Coef. Estimate	Std. Error	Sig.
(Intercept)	8.258433	0.765442 ***		9.037262	0.687801 ***		7.325465	1.707885 ***		8.638897	0.635268 ***	
gender	-0.007437	0.064951		-0.140796	0.058865 *		0.089444	0.163626		-0.143312	0.053847 **	
Age	0.002089	0.002301		0.004952	0.002355 *		0.00349	0.007171		0.001539	0.001987	
Tertiary_edu	-0.049735	0.064327		0.134646	0.062324 *		-0.209755	0.16273		-0.016376	0.058608	
log(Hincome_c)	0.232815	0.070183 ***		0.221947	0.063739 ***		0.342643	0.147124 *		0.241385	0.057777 ***	
size_town	0.082346	0.060762		-0.018094	0.057711		-0.242483	0.151202		-0.114347	0.052354 *	
heat_reconst	0.122168	0.064648 .		0.245013	0.056693 ***		0.158853	0.147687		0.147083	0.056535 **	
familiar_biom	0.173126	0.061763 **		0.10799	0.063917 .		0.103759	0.171473		-0.073908	0.0694	
theta_inv	0.068689	0.034671 *		0.048327	0.030062		-0.048708	0.078467		0.044836	0.026625 .	
requires_knowledge	-0.085207	0.070743		0.073591	0.069318		-0.155638	0.184759		-0.136661	0.059589 *	
requires_reconst	-0.082823	0.066474		-0.173603	0.060879 **		-0.051718	0.153421		-0.142409	0.059495 *	
people_agree	0.120799	0.075226		0.267866	0.060919 ***		0.255199	0.204913		0.290784	0.065069 ***	
people_mind	-0.044221	0.071343		-0.144024	0.068195 *		-0.09096	0.177054		-0.136427	0.059698 *	
GHG_decrease	-0.029428	0.08304		0.007432	0.082314		-0.167642	0.204213		0.117753	0.076955	
local_env	0.223719	0.084503 **		0.071382	0.07928		0.021421	0.198819		-0.131091	0.081948	
independency	0.226773	0.078098 **		0.06167	0.082797		0.366698	0.173231 *		0.222156	0.075821 **	
energy_expenses	0.283982	0.080962 ***		0.253952	0.085313 **		0.505929	0.189437 **		0.350328	0.081401 ***	
sigma	0.349877	0.019197 ***		0.344253	0.017129 ***		0.378024	0.048815 ***		0.336965	0.016883 ***	
Log-Likelihood:	-612.877			-706.7029			-160.5252			-755.481		
df	532			571			127			629		

Note: "****" 0.1% sig. level; "***"1% sig. level; "**"5% sig. level; "."10% sig. level

DETERMINANTS LOWERING THE WTP

DETERMINANTS INCREASING THE WTP

	DETERMINANTS LOWERING THE WTP					DETERMINANTS INCREASING THE WTP									
FOTO			requires reconstr			income	hsystem reconstr	familiar technol		people agree					energy expenses
SOLAR			requires reconstr	people_ mind		income	hsystem reconstr		proenv attitude	people agree	GHG emission		indep dency		
WIND			requires reconstr	people_ mind		income	hsystem reconstr			people agree			indep dency	energy expenses	
HYBR		higher age	requires reconstr	people_ mind		income	hsystem reconstr		proenv attitude	people agree				energy expenses	
BIOM						income	hsystem reconstr	familiar technol	proenv attitude			local environ	indep dency	energy expenses	
HPUMP	female	higher age	requires reconstr	people_ mind		income	hsystem reconstr	familiar technol		people agree				energy expenses	
CHP						income							indep dency	energy expenses	
FUEL	female		requires knowled	requires reconstr	people_ mind	income	hsystem reconstr		proenv attitude	people agree			indep dency	energy expenses	
	female	higher age	requires knowled	requires reconstr	people_ mind	income	hsystem reconstr	familiar technol	proenv attitude	people agree	GHG emission	local environ	indep dency	energy expenses	

Conclusions

Potential adopters are:

- with higher income
- planning to reconstruct their current heating system in near future
- with strong pro-environmental attitudes
- well informed about the technology

Motivational factors are:

- lowering expenditures on energy
- independency of the hh on external suppliers and increasing its self-sufficiency
- positive social norms (people approve my decision)

Hindering factor are:

- high capital costs, mean WTPs still below market prices
- concerns about incompatibility with the house (major reconstruction needed)
- negative social norms (people would mind, if I have it)

Thank you for your attention!

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