



# SURVEY RESULTS

## Authors:

Teplov, R., Pynnönen, M., Ghoreishi, M., Immonen, M.

LUT-University (Finland)

**Abstract:**

The following report presents the results of the survey conducted under WP T2 (Creating Hydrogen Utilization Business Models) activity AT 2.1 Stakeholder analysis. The survey objective was to capture the attitude of general public towards renewable energy solution and hence to complement the actual stakeholders value mapping and analysis activities and better understand the background (i.e. public opinion in the region). The survey covered the majority of countries participating in the NPA programme. The data was collected during summer 2020 with additional round of data collection from Faroe Islands conducted during November-December 2020. The data was analyzed through variety of methods including ANOVA, cluster analysis and conjoint analysis. The results revealed the significant differences in environmental attitudes as well as factors affecting large home purchases between various countries of NPA region, specifically between Nordic countries and Scotland, Ireland and Northern Ireland. The conjoint analysis also revealed

The results of the survey were used in the developing the regional case studies (deliverable DT 2.5.1) where the findings for specific regions/countries were discussed in greater details.

## Contents

Introduction .....	4
Environmental attitudes .....	5
Objectives and Method.....	5
Results.....	6
Subsidies and economic factors.....	7
Objectives and Method.....	7
Results.....	8
Conjoint analysis of energy source concepts for housing.....	10
Objectives and method.....	10
Results.....	10
Conclusion.....	12

## Introduction

Survey conducted by LUT University in the HUGE project targeted to probe life-context of inhabitants in the Northern periphery areas of EU. The survey questionnaire included themes related to daily activities, consumption choice, and environmental attitudes with specific focus on value of green supply chains, price sensitivity regarding green product or service concepts, and expectation related to carbon neutral fuels. The themes were tied with activity area of energy sources of housing. The geographical regions included into sample were selected by the NPA programme area (See Figure 1). The selected areas were later extracted to NUTS (Nomenclature of Territorial Units for Statistics) statistical regions (Level 2) which provided grounds for sample specification. The NUTS level 2 equals to provinces of the countries in most of the cases.

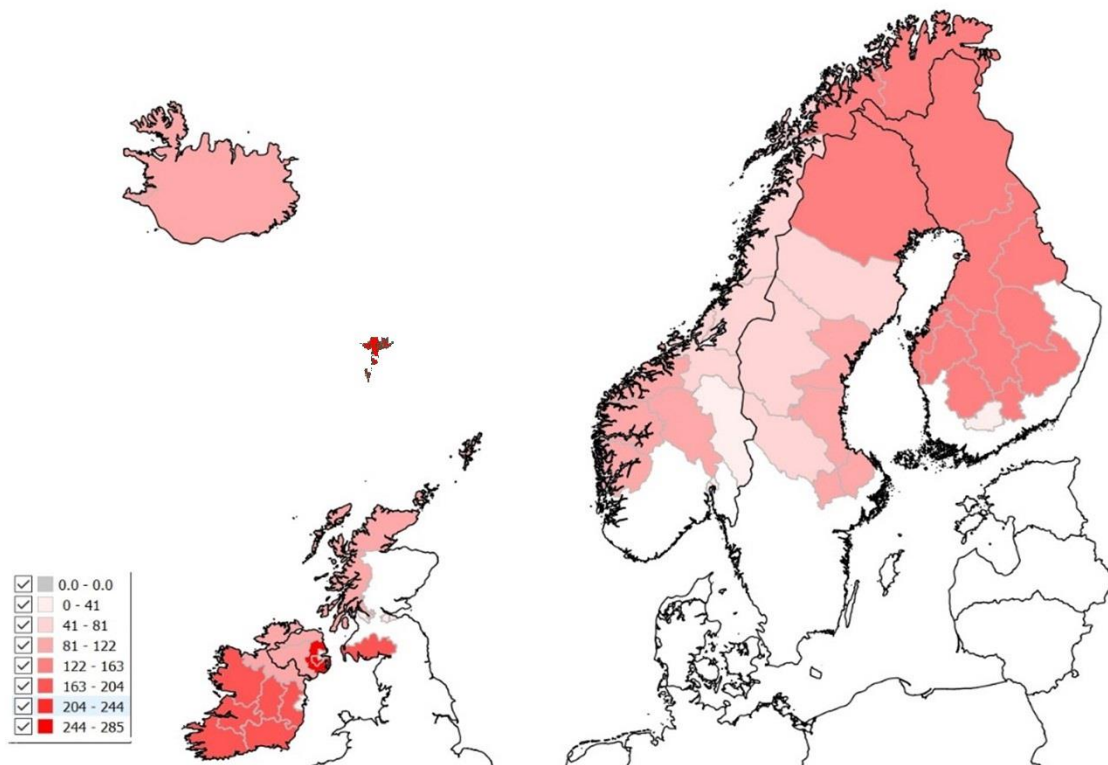


Figure 1 Regions of the survey (coloring by sample from NUTS Level2 regions)

The random sample was drawn to provide approximately equal size sub-samples from each country which were weighted by age and gender distributions of target regions. The data was gathered by online survey for which respondents were selected from participant panel. The final data includes approximately 2000 responses which were divided to countries and demographic features as follows (Table 1 and Table 2). The data was collected during summer 2020. Due to the difficulties with obtaining the data the separate survey was conducted on Faroes Islands during November-December 2020. The Faroes sample consists of 500 responses. However, the survey adopted the shortened questionnaire which limits the opportunities for comparison of Faroe Islands data with the rest of countries (therefore Faroes Islands are omitted in some countries comparison panels).

Table 1 Distribution by country

Area	Count	Percent
Finland	320	16,0 %
Ireland	320	16,0 %
Northern Ireland	319	16,0 %
Scotland	322	16,1 %
Sweden	323	16,2 %
Iceland	94	4,7 %
Norway	301	15,1 %
Faroe Islands*	500	

\*Faroe Islands figures are provided separately

Table 2 Distribution by demographic features

	Count	Percent
<b>Age (10 yrs groups)</b>		
<= 30,00	323	12,95 %
31,00 - 40,00	700	28,01 %
41,00 - 50,00	707	28,29 %
51,00 - 60,00	520	20,81 %
61,00 - 70,00	238	9,52 %
71,00+	5	0,20 %
n/a	6	0,24 %
<b>Gender</b>		
Female	1267	50,70 %
Male	1223	48,93 %
n/a	9	0,37 %
<b>Education</b>		
Lower	1017	40,70 %
Higher	1419	56,78 %
n/a	63	2,52 %
<b>Management of housing</b>		
Owned house/apartment	1541	61,66 %
Rental or part-ownership apartment	850	34,01 %
n/a	108	4,32 %

Figures for the overall sample (including Faroe islands)

## Environmental attitudes

### Objectives and Method

The analysis of respondents' views on environmental protection targets to probe information which can be used for suggestion for policy guidelines creating incentives for citizens. The observed perspectives in the analysis were perceived environmental knowledge, level of environmental concern, and general environmental attitudes. The analysis provides country comparison for the listed themes and segmentation to reveal groups amongst respondents. The occurrence of the recognized segments in survey regions were also assessed. The differences between countries were analyzed by ANOVA and clustering was accomplished by the Two-Step clustering of SPSS software.

## Results

In general, the results show that the environmental attitudes are somehow positive in the analyzed regions where overall rank of the respondents to all dimensions was near to five of maximum of seven (see Figure 2). The statistical test also reveals that there are variations in environmental attitudes between countries which differences are not large but they are statistically significant however. Closer look into differences between countries reveal the differences exists between Nordic countries and, Scotland, Ireland and Northern Ireland. Due to the absence of data Faroe Islands were not included in the analysis.

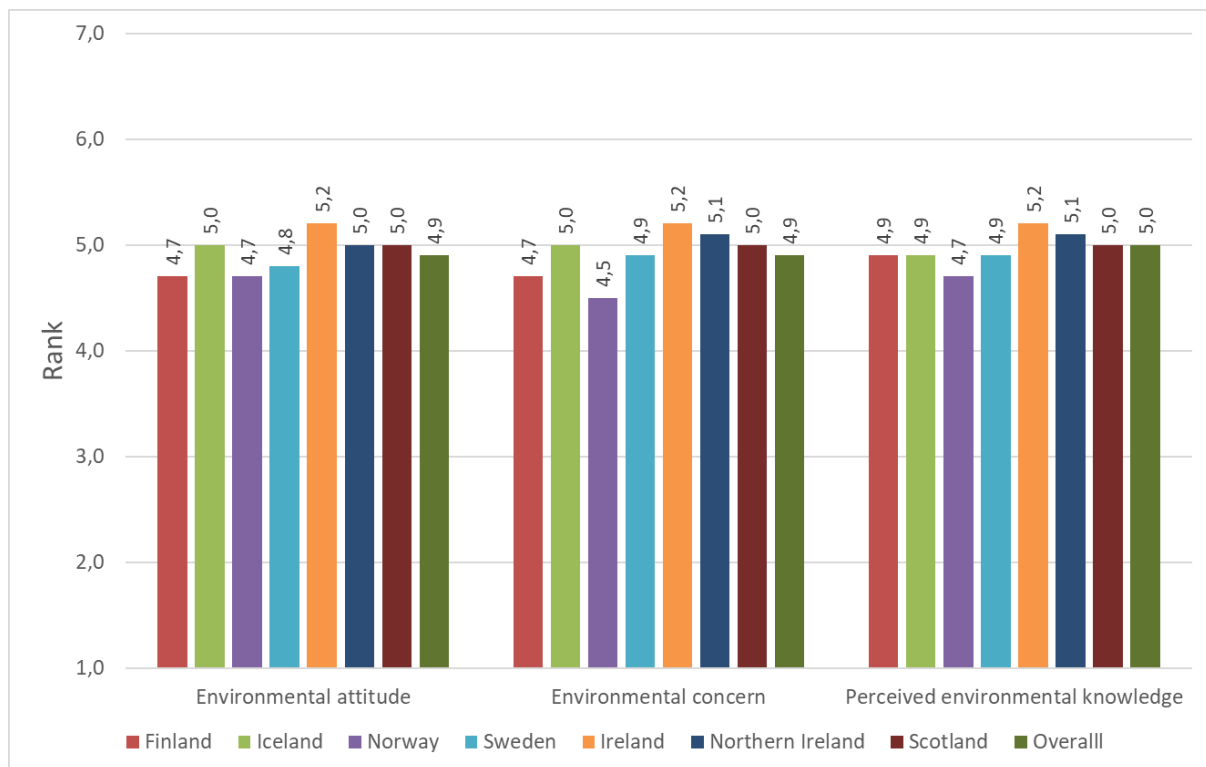


Figure 2 Environmental attitudes in the HUGE region

For further analysis, the respondents were segmented by environmental attitudes into two groups using Two-Step cluster analysis which requires fixed number of cluster and clustering variables as an input. The dividing the sample into two groups leads good clustering quality where the groups also have statistically significant differences in the input variables. The attitude segments represented low or neutral, and high environmental orientation in their thinking (see Table 3). Low or neutral (later 'Low') segment indicated moderate interest on sustainable consumption, neutral attitudes on environmental concern, and average self-rated awareness on environmental issues. In opposite, the high environmental attitude segment (later 'High') showed relatively high interest on sustainable consumption, high concerns on current state of environment, and assessed their self-rated awareness on environmental issues higher than average of population. The segments forms approximately equal size groups in the whole sample where segment has following shares; Low 48 % and High 52 %.

Table 3 Mean values of clustering variables in the attitude clusters

	Cluster	Mean
EvnAtt_EAT	Low	4,0351
	High	5,9021
EvnAtt_EC	Low	4,0469
	High	5,912
EvnAtt_PEK	Low	4,1713
	High	5,8776

Comparison of the countries by occurrence of the segments shows that the segment high has greater share in Scotland, Ireland and Northern Ireland whereas the Nordic countries are biased by the Lower attitude segment (see Table 4). The result was expected by the ANOVA results. However, the analysis of the segment highlights differences in population wide environmental attitudes. In Scotland, Ireland and Northern Ireland, where the attitudes to environmental protection have slightly higher importance compared to rest of the sample it can be recognized significant difference between Ireland, and Scotland and Northern Ireland. Similarly, the differences occur between the Nordic countries. Finland, Sweden, and Iceland are rather neutral to environmental protection related questions whereas results from Norway may indicate slightly lower interest.

Table 4 Occurrence of the segments in country of the HUGE regions.

	Attitude segment	
	Low	High
Finland	55,2 %	44,8 %
Iceland	52,7 %	47,3 %
Ireland	41,1 %	58,9 %
Norway	60,5 %	39,5 %
Sweden	53,8 %	46,2 %
Scotland and Northern Ireland	48,3 %	51,7 %

## Subsidies and economic factors

### Objectives and Method

The analysis of respondents' views on factors affecting the choice of environmentally friendly alternatives in large home purchases (e.g. cars, or expensive home equipment) to probe information which can be used for suggestion for policy guidelines creating incentives for citizens. The observed factors in the analysis included purchase costs, relative advantage (comparing to conventional, non-green alternative), and contextual factors such as subsidies and taxes, perceived risks (both economic and technical) and attitude towards ownership (leasing instead of buying). The analysis provides country comparison for the listed themes and segmentation to reveal groups amongst respondents. The occurrence of the recognized segments in survey regions were also assessed. The differences between countries were analyzed by ANOVA and clustering was accomplished by the Two-Step clustering of SPSS software.

## Results

The results demonstrate that on average such factors as total costs (comparing to the traditional products) and relative advantage (over traditional products) perceived as important by respondents and therefore are expected to effect on decision-making process in large home purchases. In respect to contextual factors (such as subsidies and taxes provided by the government and perceived risks) they also considered as important by all countries respondents with certain exceptions. On the other hand, attitudes towards leasing are less positive with all countries scoring below the average. Figure 3 reveals also clear differences between countries which is also supported by the ANOVA test confirming the presence of significant differences between countries for all factors.

On average it appears that respondents in Nordic countries place less importance on relative advantage of the greener products and less concerned with governmental incentives. They also seem to be less interested in leasing comparing to respondents from Scotland, Ireland and Northern Ireland.

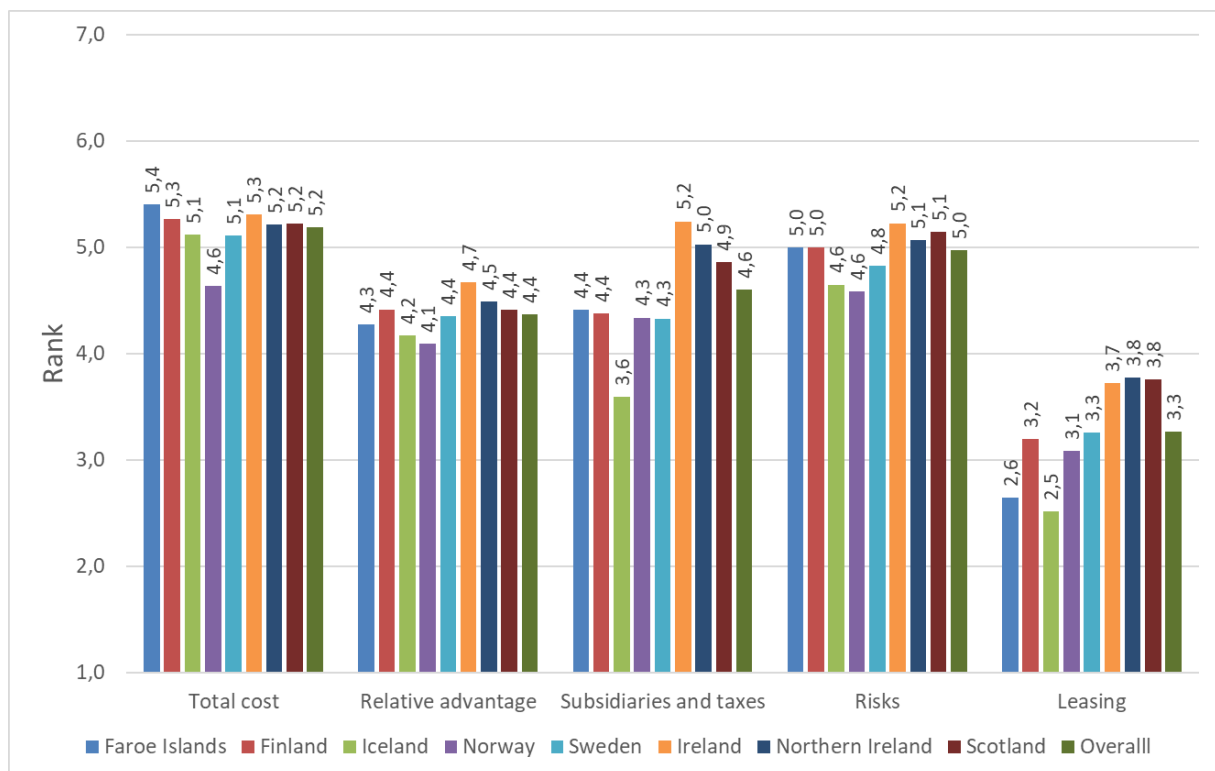


Figure 3 Subsidies and economic factor relative importance in the HUGE region

Next, the extend the analysis the Two-Step clustering procedure was employed. In contrast to prior analysis of Environmental attitudes the number of clusters was increased from two to three. That allowed capturing more subtle differences between clusters and thus account for higher number of more diverse clustering variables. All three clusters demonstrate statistically significant differences in input variables.

In respect to the average perceived importance of factors affecting large home purchases the resulting clusters can be marked as High, Medium and Low (Table5). The first cluster (24.7 % of total share) represents the respondents placing the high importance on both costs and relative advantage factors as well as the governmental incentives. They also very concerned with possible risks and express positive attitude towards leasing. The second and the largest (60.7% of the total share) cluster contains respondents' similar attitudes (although somehow lower) to majority of factors except for



leasing. This cluster respondents on average seem not to consider leasing as a viable option. The third cluster (14.7 % of the total share) consists of respondents considering all factors as quite unimportant

*Table 5 Mean values of clustering variables in the attitude clusters*

	Cluster	Mean
Total costs	Low	3.224
	Medium	5.206
	High	6.195
Relative advantage	Low	3.046
	Medium	4.188
	High	5.597
Subsidies and taxes	Low	3.031
	Medium	4.372
	High	6.065
Risks	Low	2.966
	Medium	4.935
	High	6.078
Leasing	Low	2.149
	Medium	2.942
	High	4.876

Analyzing the occurrence of countries in clusters (Table 6) we can conclude that while the countries in general follow the common the common distribution there are also some differences which supports the results of prior ANOVA test. Thus, we can observe minority of respondents from Scotland, Ireland and Northern Ireland belonging to cluster with low attitudes towards factors affecting decision-making. On the other hand, more respondents from Iceland, Norway and to some extent from Sweden tend to be less concerned with these factors in large home purchases.

*Table 6 Occurrence of the segments in country of the HUGE regions.*

	Attitude segment		
	Low	Medium	High
Faroe Islands	16.4%	62.3%	21.3%
Finland	12.1%	67.2%	20.7%
Iceland	28.9%	56.6%	14.5%
Ireland	6.8%	54.9%	38.2%
Norway	21.1%	59.7%	17.2%
Sweden	10.1%	59.6%	30.3%
Scotland	18.1%	63.7%	18.1%
Northern Ireland	10.6%	58.2%	31.2%

To summarize, for the majority of respondents such factors as product costs, performance, incentives and possible risks play an important role in the decision making. While these results might seem trivial it worth noting that still for the respondents from the third cluster these factors do not seem to play decisive role. Also noticeable, that for only relatively small share of the respondents (cluster 1) express positive attitudes towards leasing option. These results in general are valid for all survey countries although there are some differences in particular between respondents from Scotland, Ireland and

Norther Ireland and from Nordic countries who appears to be slightly less concerned with product characteristics and available incentives in large home purchases decision-making.

## Conjoint analysis of energy source concepts for housing

### Objectives and method

The conjoint analysis section examines the respondents' interest in upgrading their homes with new energy sources. The analysis targets to explain attributes of technology adoption, and to test markets' sensitivity against certain features of housing energy concept which in future may be provided as energy source upgrades. The results are applicable for exploring frameworks to build policy guidelines in the target regions.

The analysis frame for testing alternative energy source concepts is not fixed to any specific technology, but it focusses to find out difference between product and service provision concepts. In this study, the new energy systems for housing are defined as a concept which may include the property's energy production equipment, fuel storage, and equipment to be installed in apartments. The respondents were also notified that the systems can be installed on all types of properties (detached houses, terraced houses and apartment buildings). In the future, low-emission energy sources for housing can be offered to the buyer in alternative ways. To assess potential of the concepts, the analysis compares alternatives which include a variety of technical systems, service contracts (fuel and maintenance), forms of subsidies, and intelligent control and monitoring services. The provided alternatives have also different effects on CO<sub>2</sub> emissions. Different financing options for acquisition of energy concepts were tested where loan financing for customer's direct ownership, and long-term leasing contracts were alternatives. The listed features of the concept were extracted into randomized features for experiments for which concept cards were generated by orthogonal design.

### Results

The conjoint model in the final survey was based seven factors of which had two factor levels. The model selection grounds on balance between sensitivity of the tool and complexity of the questionnaire because count of factors and levels influence on required randomized concept cards. Influences of the different service and product features assessed by two stages. In the first stage, importance of the product features is analyzed which also includes comparison between countries, buyer segments and genders. The second stage targets assess preference between provided feature alternatives.

Average importance scores show preferences of features for respondents when making ratings for interest toward alternative concepts. Comparison of average importance scores between countries shows that balance between features of the tested concept are rather similar in overall (see Figure 4). Purchase price compared to other alternative in markets is the most important feature in overall and in each country. In this study, provided government subsidies and expected impact on CO<sub>2</sub> -emission are at the second important features where some variation exists between countries. Financing options and level of operating expenses are the third important features which also indicate some differences between regions. The least important features of the provided energy system were service subscription and monitoring services as additional features where ability to follow energy consumption seems to indicate large variation between countries.

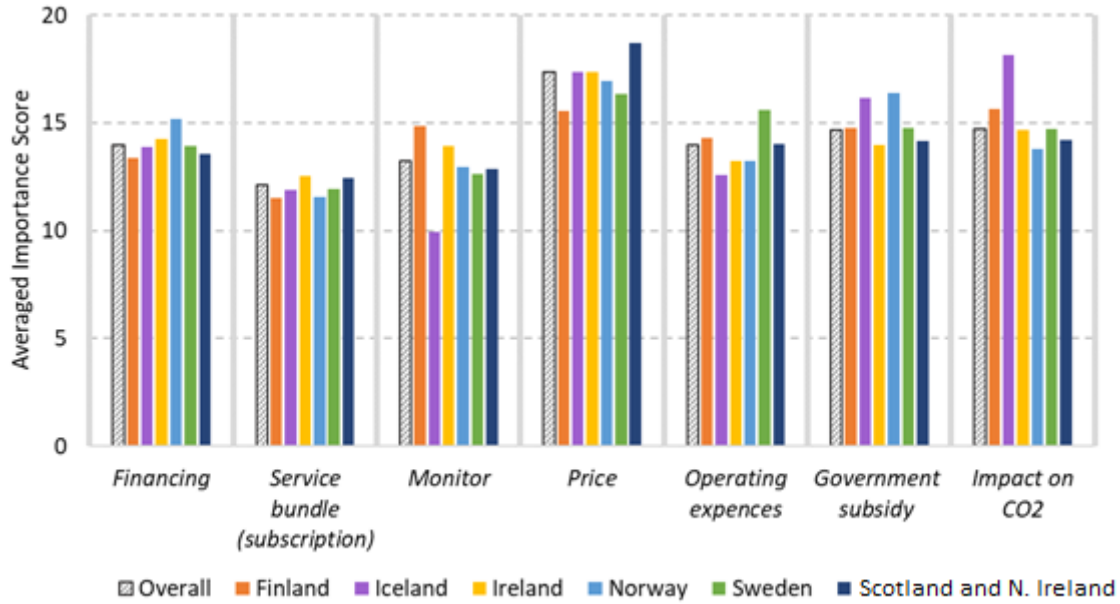


Figure 4 Overall importances of the system feature

Comparison of the importance scores between respondent groups reveals that the balance between features follows similar pattern to general case but showing rather clear contrast between groups, however (see Figure 5). The price is the most important for each individual group where attitude segments do show any variation. In this, males seem to bias the price more than females however. Similar pattern of differences can also find related to financing options, available service subscriptions and monitoring where males differ from other groups by the lowest importance scores. The differences between attitude segments finds in their perceptions to the level of operating expenses, provided subsidies, and the systems impact on CO<sub>2</sub>-emission. In these cases, 'high -attitude' segment has higher importance to the expenses and the emission impacts whereas subsidies are more important for 'low -attitude' segment.

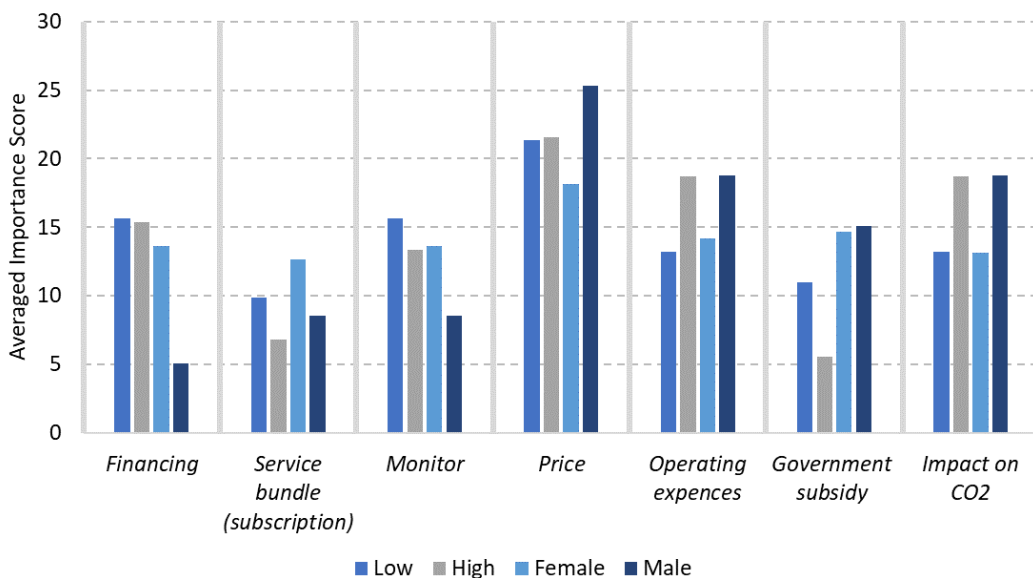


Figure 5 Importances of the system features amongst environmental attitude segments and genders

The utility estimate of factor levels describes preferences between alternatives (see Table 7). Results by whole sample shows that respondents prefer options where the purchase price is same as competing products and they are not willing to pay extra for operating expenses for use of novel low carbon emission energy concept. Furthermore, the respondents prefer plans where government subsidies are provided. The additional services also increase willingness to buy the energy service concepts where long-term leasing options, service subscriptions, and monitoring services are preferred features.

*Table 7 Con-joint model and impact of features*

Factor	Levels	Utility Estimate (Impact)
<i>Financing</i>	ownership	-0,041
	leasing	0,041
<i>Service bundle</i>	no service	-0,056
	service bundle	0,056
<i>Monitor</i>	no	-0,052
	yes	0,052
<i>Price</i>	+0%	0
	+15%	-0,697
<i>Operating expences</i>	+0%	0
	+15%	-0,397
<i>Government subsidy</i>	0%	0
	20%	0,219
<i>Impact on CO2</i>	-20%	0,006
	-0%	0

## Conclusion

The survey was conducted under WP T2 (Creating Hydrogen Utilization Business Models) activity AT 2.1 Stakeholder analysis. The survey objective was to capture the attitude of general public towards renewable energy solution and hence to complement the actual stakeholders value mapping and analysis activities and better understand the background (i.e. public opinion in the region). The survey covered the majority of countries participating in the NPA programme.

Overall environmental attitudes are positive (i.e. above average) which suggests of high level of awareness of environmental issues among NPA programme regions population. While the ANOVA test found significant differences between all countries it can be also noticed higher level grouping which was also revealed by cluster analysis. Hence our sample can be divided into two groups – the first group contains Nordic countries while the second represent Scotland, Ireland and Northern Ireland. In general Nordic countries (with the exception of Iceland) show somehow lower environmental attitudes than second group. They demonstrate also slightly lower level of environmental concern and environmental knowledge. However, it should be noted that even being slightly lower (in comparison with Scotland, Ireland and Northern Ireland) these attitudes are still stay at a quite high level.

Subsidies and economic factors affecting the large home purchases demonstrate even greater variability between countries. On average total costs and associated risks are the most important

factors while the relative advantage and governmental initiatives in form of subsidies and taxation incentives receive less attention (although being still above average). The difference between Nordic countries and Scotland, Ireland and Northern Ireland is especially pronounced in the attitudes towards governmental subsidies. The respondents from Scotland, Ireland and Northern Ireland consider them noticeably more important than respondents from Nordic countries. The leasing option does not seem to be popular among the majority of respondents, again with the exception of Scotland, Ireland and Northern Ireland respondents.

The findings of conjoint analysis provide more granular observations on features affecting respondents' decision in upgrading their housing energy solution. The results accord quite well with the prior analysis of economics and environmental factors demonstrating the price as the most important factor. Second important factor is the provision of governmental subsidies which also aligns well with previous results. Interestingly, however, the between-countries variation is different, thus Nordic countries appear to be more concerned with subsidies than Scotland, Ireland and Northern Ireland which is opposite to prior results. These findings can be explained by different methodology of analysis (thus in conjoint analysis the respondents were supplied with the more specific options and thus could relate their choices more precisely). Moreover, it should be noted that in any case the importance of governmental subsidies is above average which makes it an important factor for any country in both analyses.

To summarize, the results of the conducted survey revealed that in spite of certain differences between countries, on average all respondents demonstrated the high level of environmental awareness and positive attitude towards green energy options providing their competitive price and/or governmental subsidies to buy.

This study as any other inevitably has limitations. Thus, the survey method of data collection limits the richness and details of obtained data comparing to in-depth interviews. However, this method enables capturing the large, structured datasets (comparing to qualitative face-to-face) allowing variety of statistical analysis methods and generalization of results to the whole region in focus. Being coupled with interviews and discussion conducted during the preparation of case studies that enabled multiperspective approach to the issue of hydrogen utilization.

The scope of the survey might also be considered as a limitation. Indeed, since the survey was targeted to the general public, the specific hydrogen focus was missing from the questions which instead addressed more general concepts of environmentally friendly solutions. Furthermore, the conjoint analysis was addressing the housing energy concept which was considered appropriate for the target audience. That might limit the direct applicability of survey results to specific business aspects of hydrogen utilization (such as development of hydrogen ecosystem, finding appropriate techno-economical solution, etc.). However, the attitudes of general public towards environment and factors affecting their decisions in making large home purchases still provides value for both, business actors aiming to introduce novel product/service and for policy-makers aiming to design new policies aiming to promote green-energy transition. Therefore, the survey focus makes the results applicable for the broad categories extending the list of potential beneficiaries beyond the solely hydrogen-focused solutions.