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Evaluation report
Consumer survey on smart appliances

D 5.2 of WP 5.2 report from the Smart-A project

A report prepared as part of the EIE project
„Smart Domestic Appliances in Sustainable Energy Systems (Smart-A)"

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1 Introduction

1.1 The Smart-A project

The project „Smart Domestic Appliances in Sustainable Energy Systems (Smart-A)" aims at developing strategies how smart domestic appliances can contribute to load management in future energy systems. In order to do this, the project assesses the options for load-shifting by a variety of appliances across Europe and compares these with the requirements from energy systems both on the supra-regional and the local level. It is expected that these systems will have to integrate larger shares of renewable energy in the future, which are partly intermittent, and therefore will require a smarter management of generation, network capacities and demand.

The technical aspects of the assessment include an analysis of potential changes to appliances operation, of characteristics of local energy generation (from renewable energies and also cogeneration) and of load management requirements in the larger electricity networks. The project also features a detailed assessment of the acceptance of smart appliances operation by users, and an evaluation of the usability of available control technologies and communication standards. The overall potential of smart appliances is assessed based on a model which takes into account the variations of appliance use and the framework conditions in energy systems.

The project is conducted in cooperation with manufacturers of appliances and electric utilities. The findings from the analysis are being tested with experts in regional case studies in selected European countries.

1.2 This report

To learn more about the consumer opinions about smart domestic appliances surveys were performed in Austria, Germany, Great Britain, Italy and Slovenia.

In Great Britain the interviews were done with an online-questionnaire, 232 questionnaires were filled in. In Slovenia and Italy face-to-face-interviews were performed, 200 interviews were obtained. In Germany and Austria the questionnaires were distributed by using client databases of two energy suppliers. In Germany 1332 questionnaires, in Austria 943 questionnaires were returned. All together 2907 interviews were included in the analysis.

The aim of the survey was to get information regarding the perception of smart appliances as well as to estimate the willingness of people to change their usual behaviour or to accept higher costs to be able to use smart appliances.

In chapters two to seven we present the survey results of Great Britain, Slovenia, Germany, Austria and Italy and an overview over all countries, in chapter eight some hypotheses and results are presented and in chapter nine conclusions are drawn.

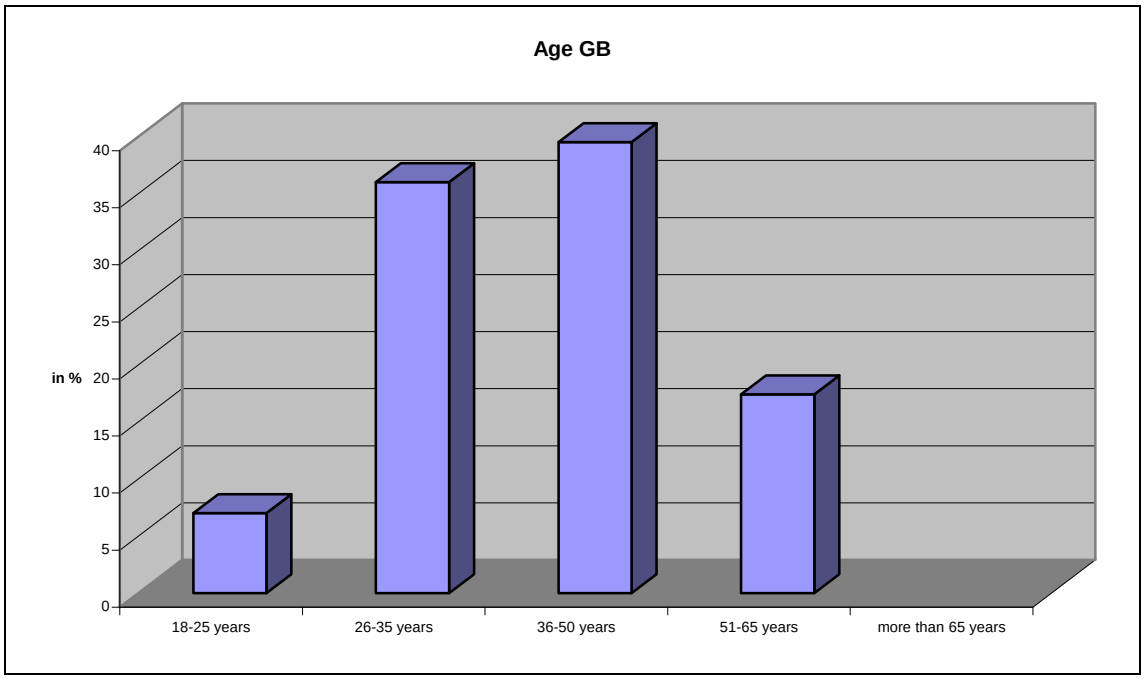
2 Great Britain

2.1 Socio-economic data

In Great Britain 232 questionnaires were filled in. 30% of the respondents are male, 70% are female.

Regarding the age three quarters of all respondents are between 26 to 50 years old, about 15% are older than 50 years (see figure 2-1-1).

Figure 2-1-1 Age GB



Nearly 90% of the respondents in Great Britain are academics, 11% have A-Level (see figure 2-1-2).

In Great Britain almost all respondents are employed (see figure 2-1-3).

45% work or have worked in a technical field.

In 45% of all households two persons are living, in 20% three or four persons live in one household and 15% are one persons households (see figure 2-1-4).

In Great Britain we have about 60% of the households with no child, 17 percent have one child or two children each (see figure 2-1-5).

More than half of the respondents live in a larger city (more than 100 000 habitants), about 15% are living in a smaller city (less than 100 habitants) or in a small town in a rural area (less than 10 000 habitants), about 10% are living in a small town in a municipal area (less than 10 000 habitants) (see figure 2-1-6).

Figure 2-1-2 Highest education level GB

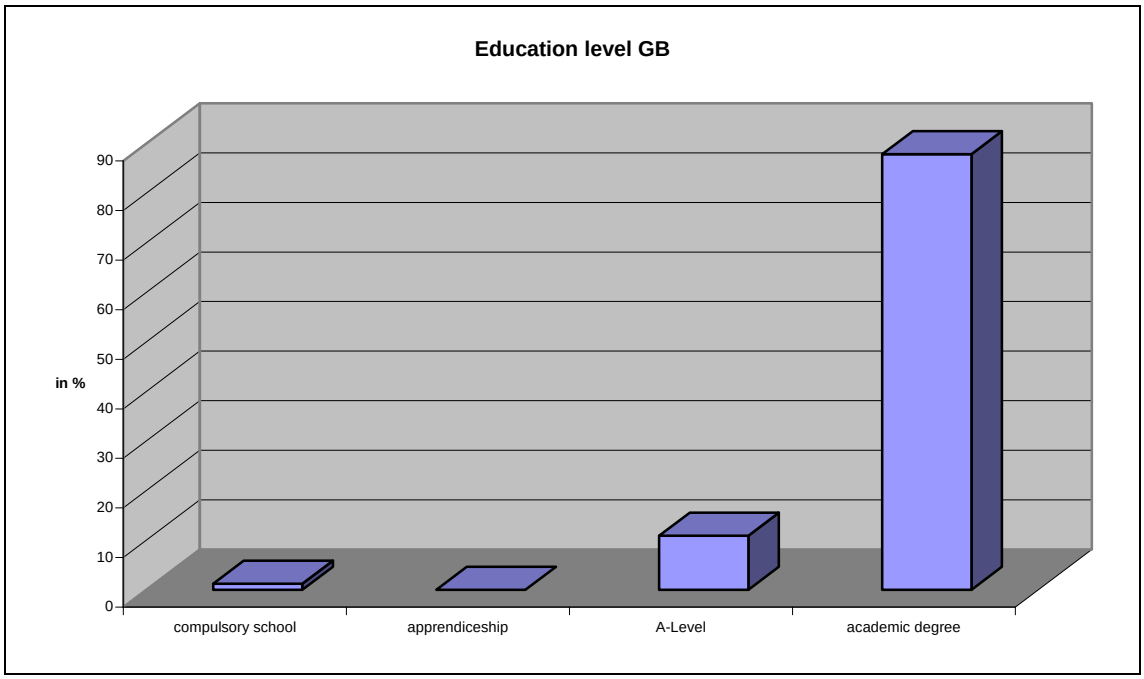


Figure 2-1-3 Employment status GB

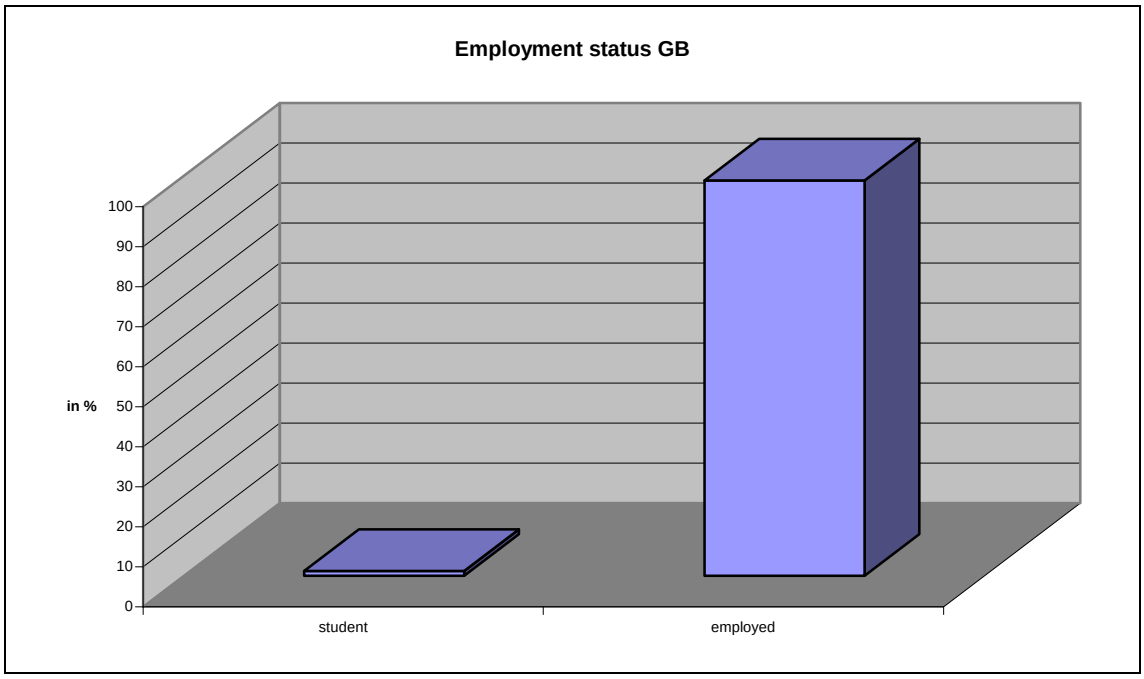


Figure 2-1-4 Number of people living in the household GB

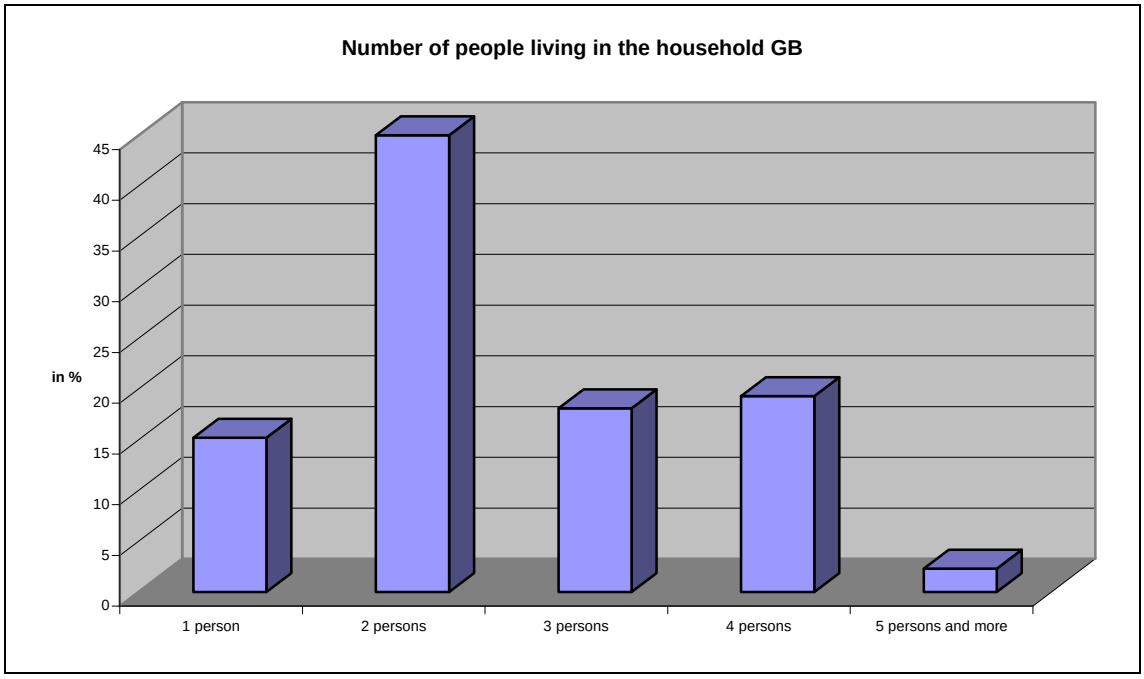
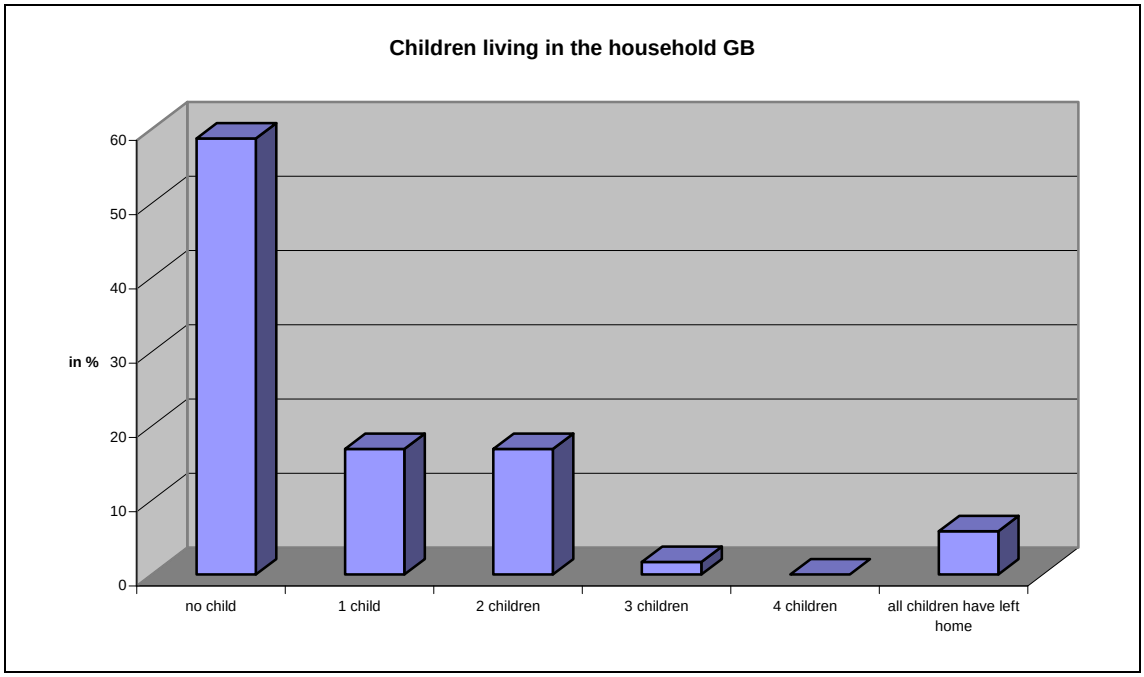


Figure 2-1-5 Number of children living in the household GB



In total in nearly 80% of the households several have an income.

More than 25% of the households have a monthly net income between 3000 and 4000 Euro, 19% earn 4000-5000 Euro, 17% 5000 to 6000 Euro or 2000 to 3000 Euro. 13% earn more than 6000 Euro (see figure 2-1-7).

Figure 2-1-6 Living in area GB

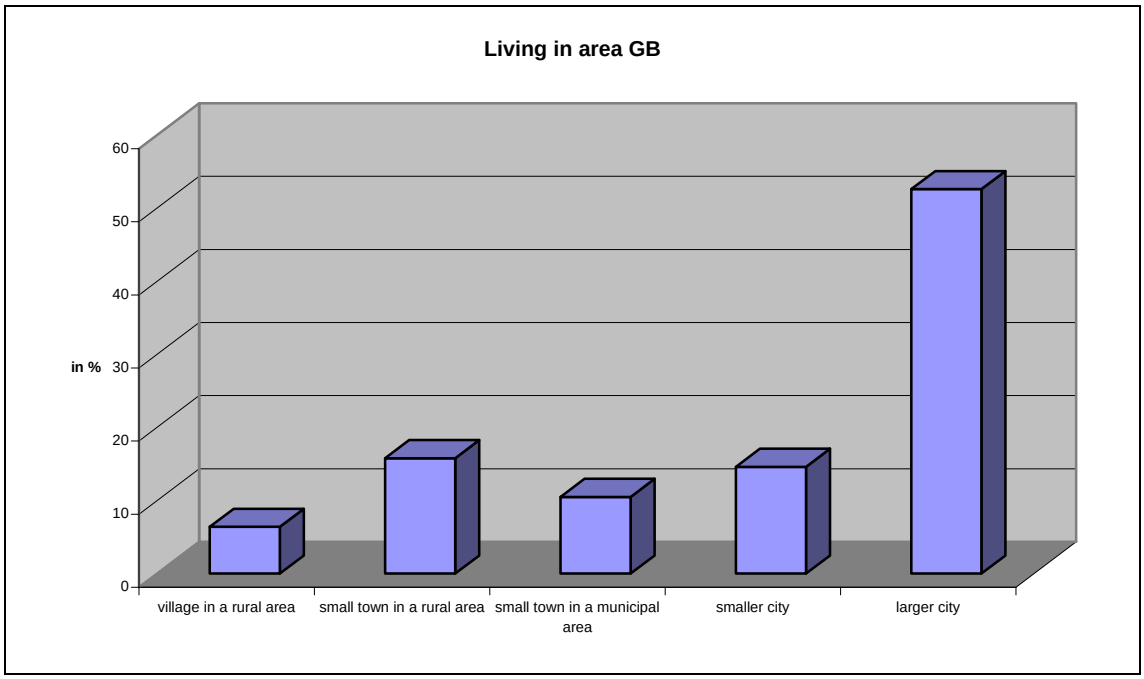
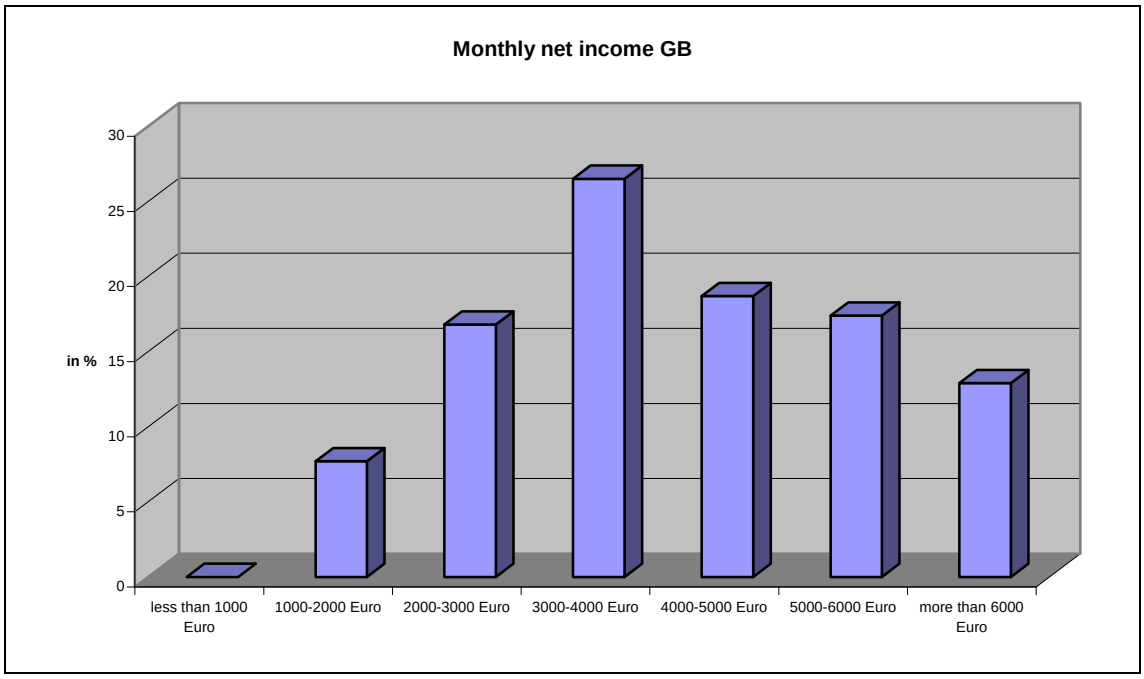


Figure 2-1-7 Monthly net income GB



More than 60% of the respondents live in single or two-family or terraced houses, about 13% are living in a flat and about 25% living in other forms of housing. Only 2% of the respondents live in houses with solar collectors or photovoltaic panels.

2.2 Appliances in the households

The following appliances are used in the households:

Almost all households have washing machines and refrigerators, more than 70% of them have deep freezers. About 60% of the households have electric cookers and central heating pumps, dishwashers and tumble dryers can be found in about 40% of the households (see table 2-2-1).

Table 2-2-1 Use of household appliances

Household Appliance	**Great Britain (in %)**
Washing machine	98
Refrigerator	98
Deep freezer	71
Electric cooker	65
Central heating pump	61
Tumble dryer	42
Dishwasher	40
Electric heated boiler (more than 80 litres)	17
Electric water heater (up to 10 litres)	14
Electric space heating	13
Air conditioner	1

Which of these appliances have special features like start time delay or energy saving programs or use cheaper tariff options?

As can be seen in the following table, energy saving program are available for the washing machine (65% of all households). Energy saving programs are also used for dishwashers (about 25%) and for refrigerators (8%).

18% of the washing machines have start time delay, also 11% of the electric cookers and 10% of the dishwashers. Only 2% of the washing machines and 3% of the electric space heating are operated with cheaper tariff options (see table 2-2-2).

Table 2-2-2 Special features of household appliances

1 = start time delay (timer)

2 = energy saving program

3 = cheaper tariff option

Household Appliance	**Great Britain (in %)**		
	1	**2**	**3**
Washing machine	16	57	2
Refrigerator	-	-	1
Deep freezer	-	-	0.5
Electric cooker	10	-	1
Central heating pump	-	-	2
Dishwasher	9	22	0.5
Tumble dryer	3	5	1
Electric heated boiler (more than 80 litres)	4	-	2
Electric water heater (up to 10 litres)	2	-	0.5
Electric space heating	4	-	3
Air conditioner	0	-	0

2.3 Use scenarios for smart appliances

In the questionnaires different scenarios were described regarding the usage of appliances in a smarter way. The respondents were asked whether they would accept such a scenario or not.

Scenario A: The washing machine starts after it receives a signal from the energy supplier that cheap and renewable energy is available. It is guaranteed that the process is finished at the desired time. Would people accept this for different appliances? And for financial or ecological or both reasons? (see figure 2-3-1).

Most of the residents would accept this utilisation, if both financial and ecological reasons are given:

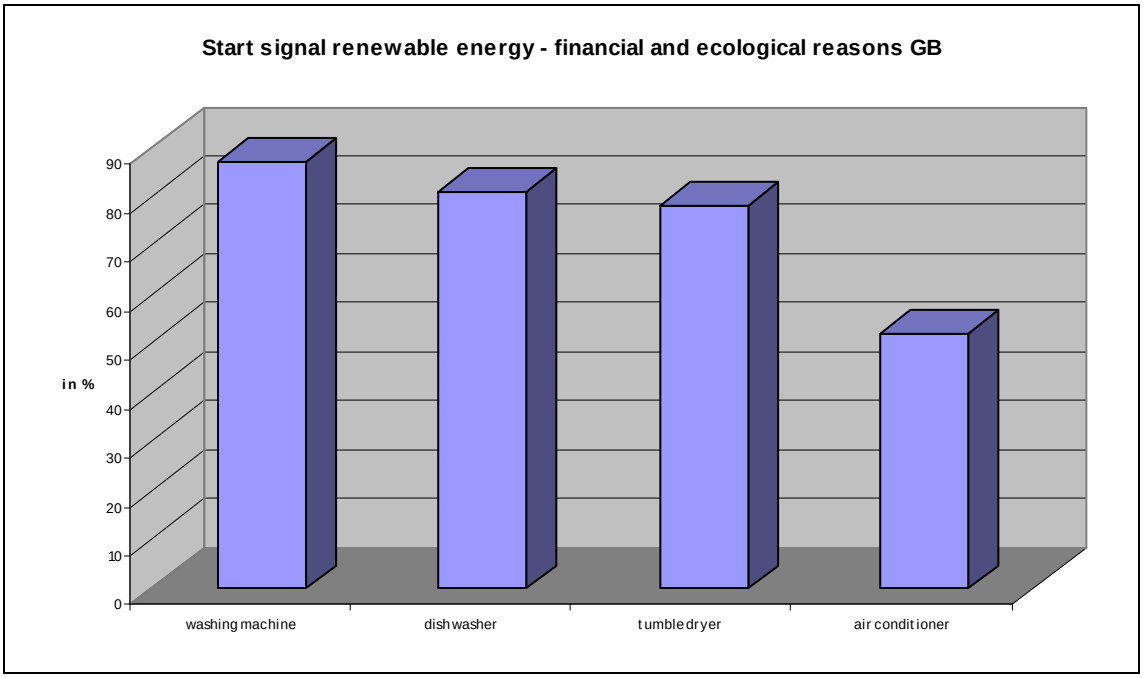
Washing machine: 87%. 5% would not accept it because of problems with noise when the washing machine is running in the night (when cheaper tariffs are available) or because of safety reasons.

Dishwasher: 81%. 8% would not accept it mostly because they have no dishwasher or they don't use it.

Tumble dryer: 78%. 13% wouldn't accept it because they don't have one or they don't want to leave wet clothes for a long time in the tumble dryer.

Air conditioner: 52%. 41% wouldn't accept it because they don't have one, they think it's unnecessary or they need the air conditioner on demand.

Figure 2-3-1 Start because of signal for cheap and renewable energy GB



Scenario B: You are about to start the dishwasher when you receive the information that for financial and ecological reasons it would be better to start it at a specific time later that day. Would you postpone the start? (see figure 2-3-2).

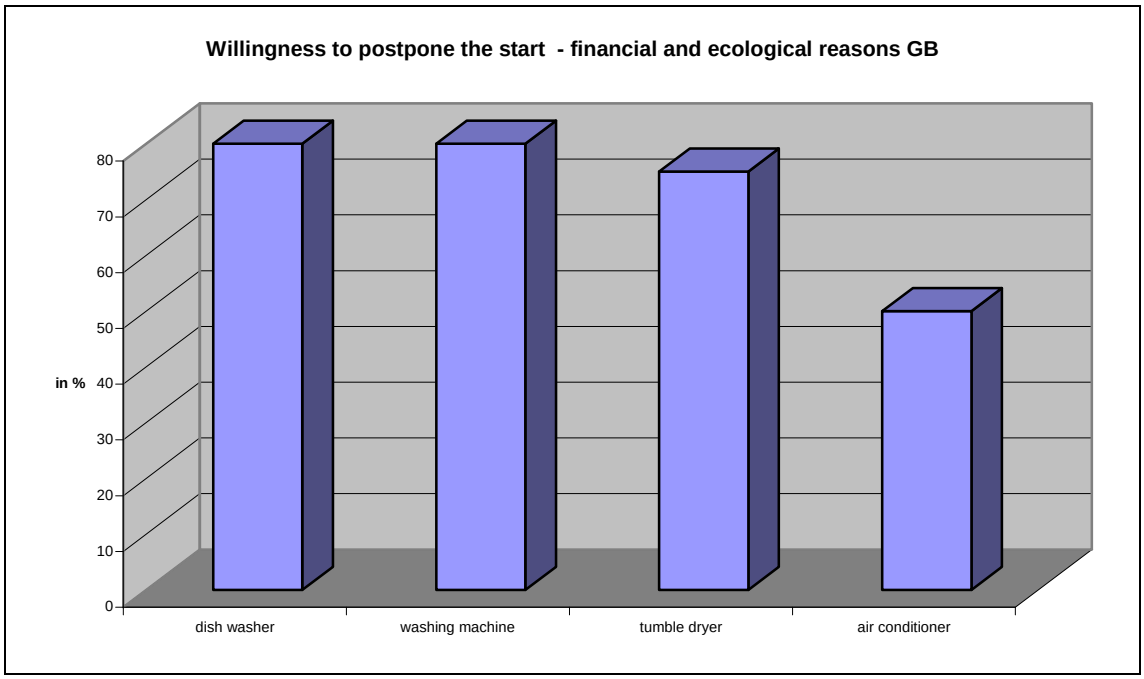
80% of all respondents would postpone the start for financial and ecological reasons. If people don't want to do it (these are about 9%), it's mostly because they need clean dishes right away.

Washing machine: 81% would postpone the start because of financial and ecological reasons. About five percent would not do it mostly because they don't want to leave wet laundry for too long in the machine.

Tumble dryer: 76% would postpone the start because of financial and ecological reasons. 14% wouldn't do it mostly because they don't want to have wet clothes in the dryer waiting to be dried.

Air conditioner: About half of all respondents would postpone the start for financial and ecological reasons. 43% wouldn't do it because they need the air conditioner on demand.

Figure 2-3-2 Willingness to postpone the start of household appliances GB



If yes, up to how long would the shift be acceptable?

Dishwasher: In total 40% of the respondents would find it acceptable to postpone the start for any time if it is not longer than 24 hours, for 9% it should not be longer than two hours (see table 2-3-1).

Table 2-3-1 Dishwasher – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
GB	2	4	14	9	9	8	8	14	93
(n=161)	1,2%	2,5%	8,7%	3,9%	3,9%	3,4%	3,4%	6%	40,1%

Washing machine: Half of the respondents would accept a shift anytime, if not longer than 24 hours, 14% would accept a shift of two hours (see table 2-3-2).

Table 2-3-2 Washing machine – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
GB	2	5	25	12	15	7	4	17	87
(n=174)	1,1%	2,9%	14,4%	6,9%	8,6%	4%	2,3%	9,8%	50%

Tumble dryer: 47% would accept a shift anytime, if not longer than 24 hours, 16% would accept a shift of hours (see table 2-3-3).

Table 2-3-3 Tumble dryer – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
GB	5	7	23	13	10	6	2	10	66
(n=142)	3,5%	4,9%	16,2%	9,2%	7%	4,2%	1,4%	7%	46,5%

Air conditioner: 40% would accept a shift anytime, if not longer than 24 hours, 24% only would accept half an hour, 10% would accept one hour, 17% would accept two hours (see table 2-3-4).

Table 2-3-4 Air conditioner – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
GB	21	9	15	3	2	0	1	1	36
(n=88)	23,9%	10,2%	17%	3,4%	2,3%	0%	1,1%	1,1%	40,9%

Scenario C: Imagine it is possible to set your freezer or fridge in a "smart operation mode" by pressing a button on it. This would cause breaks of two minutes maximum in its operation that you might not even notice. The food quality would definitely stay the same. Would you accept this? (see figure 2-3-3).

84% of all respondents would accept this for financial and ecological reasons, only 2% would not accept it because mostly they don't understand how this should work or they fear the freezer or fridge could get damaged.

Dishwasher: Almost 80% of the respondents would accept this for financial and ecological reasons. Eight percent would not want it mostly because they don't use one, because they think this would not work economically or the breaks in the power would reduce the lifetime of the equipment.

Tumbler dryer: 80% of the respondents would accept this for financial and ecological reasons. About eight percent would not want it mostly because they don't have one or because they think this would not work economically (breaks would only prolong the cycle).

Air conditioner: About three quarters of the respondents would accept this for financial and ecological reasons. 14% would not want it mostly because they think an air conditioner is unnecessary, they don't have one or they need the air conditioner on demand.

Washing machine: 82% of the respondents would accept this for financial and ecological reasons. About five percent would not want it mostly because they think this would not work economically or the breaks in the power would reduce the lifetime of the equipment.

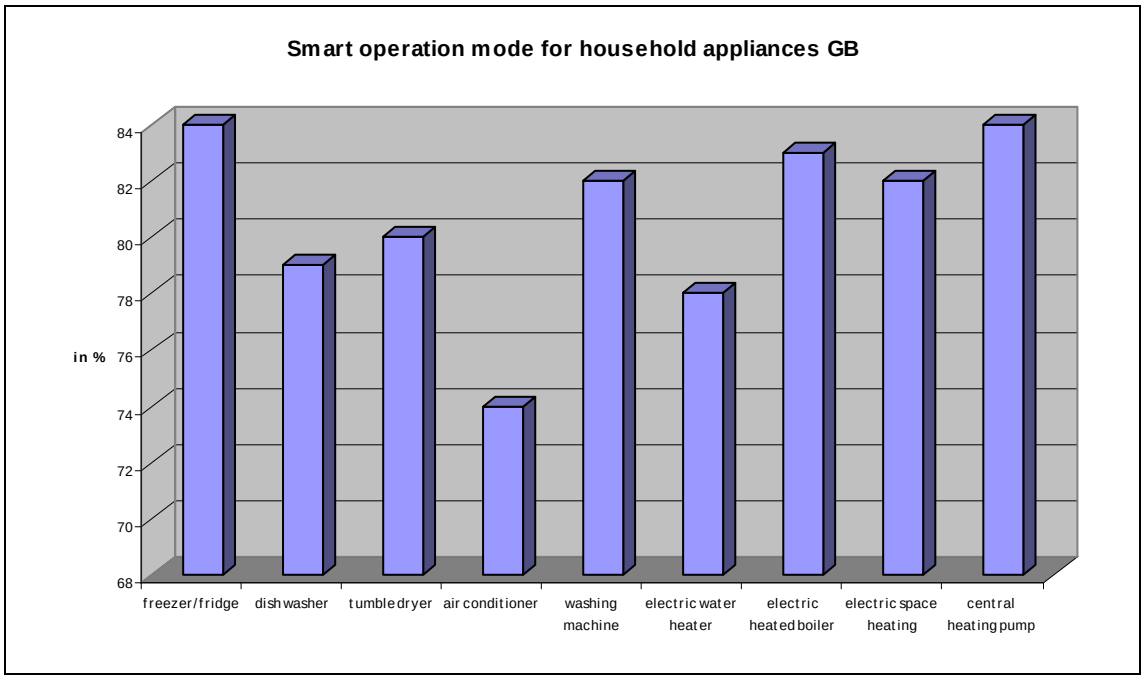
Electric water heater: About 80% of the respondents would accept this for financial and ecological reasons. Eight percent would not want it mostly because the breaks in the power would reduce the lifetime of the equipment, hot water is needed on demand or they don't have one.

Electric heated boiler: 83% of the respondents would accept this for financial and ecological reasons. Five percent would not want it mostly because they need hot water on demand or they don't have one.

Electric space heating: 82% of the respondents would accept this for financial and ecological reasons. Six percent would not want it mostly because they need constant heating or they don't have one.

Central heating pump: 84% of the respondents would accept this for financial and ecological reasons. Four percent would not want it mostly because they need constant heating or use thermostats and timers already.

Figure 2-3-3 Smart operation mode for household appliances GB



2.4 Willingness to pay extra for smart appliances

Would the respondents be willing to pay extra for a freezer which uses stored electricity from a photovoltaic system and uses the stored cool during the night (by compensation via reduced electricity costs within 5 years) (see table 2-4-1).

About half of the respondents would pay 50 to 100 Euro more. Only about a quarter would pay 100 to 200 Euro, about 12% would pay not more than 50 Euro.

If people are not willing to pay extra, this is because of the following reasons: They don't want to rely on solar energy, some people don't have a freezer or they cannot use solar power.

Would people be willing to pay extra for washing machines or dishwashers which use hot instead of cold water (water heated by a solar collector)? Costs are saved for heating the water up. These types cost more than others but this is compensated via the energy savings within five years (see table 2-4-2).

About half of the respondents would pay 50 to 100 Euro extra for such a washing machine or dishwasher. About a quarter would pay 100 to 200 Euro extra, about 10% would pay not more than 50 Euro extra.

Some people are not willing to pay extra for such an appliance because refunding period is too long, it's too expensive, they can't imagine how this should work, they think, there is not enough sun in Great Britain.

Table 2-4-1 Willingness to pay extra for a freezer with stored electricity

	0-50€	**50-100€**	**100-200€**	**I would not be willing to pay extra**
GB	21	95	43	17
(n=176)	11,9%	54%	24,4%	9,7%

Table 2-4-2 Willingness to pay extra for a washing machine/dish washer with stored electricity

	0-50€	**50-100€**	**100-200€**	**I would not be willing to pay extra**
GB	19	94	46	16
(n=175)	10,9%	53,7%	26,3%	9,1%

2.5 Acceptance of monitoring and information

For providing the appliances with cheap and renewable energy the energy supplier might have to monitor the energy consumption of his clients constantly. The information would be treated confidential and deleted after some time. Would the respondents accept this? (see table 2-5-1).

90% of the respondents would accept this (definitely or probably), but only 27% say definitely yes.

If people don't like such a monitoring it's mostly because they want to keep their privacy.

Table 2-5-1 Acceptance of monitoring

	definitely yes	**yes, probably**	**probably not**	**definitely not**
GB	46	101	14	6
(n=167)	27,5%	60,5%	8,4%	3,6%

How would people prefer to be informed about the price and the availability of cheap and renewable energy from the energy supplier? (see table 2-5-2).

55% in total would like to get the information via internet/e-mail, 47% on the display of the appliance, 33% would prefer an information on display unit in their flat, only 6% want to get it by SMS and 15% prefer an automatic regulation.

Table 2-5-2 Information about price and availability (multiple responses)

	via internet/ e-mail	by SMS	on display unit in my flat	on display of the appliance	prefer automatic regulation
GB	107	11	65	91	30
(n=194)	55,2%	5,7%	33,5%	46,9%	15,5%

2.6 Attitudes towards smart appliances

Questions regarding the attitude towards smart appliances were asked in the questionnaire. The following section summarizes the answers to these questions (see figure 2-6-1).

“Smart appliances will play a bigger role in the next ten years.” About 58% agree completely or mostly with this statement.

“Smart appliances will be too expensive for the average household.” 90% agree completely or mostly with this statement.

“Smart appliances are complex to operate.” Only 25% agree completely or mostly.

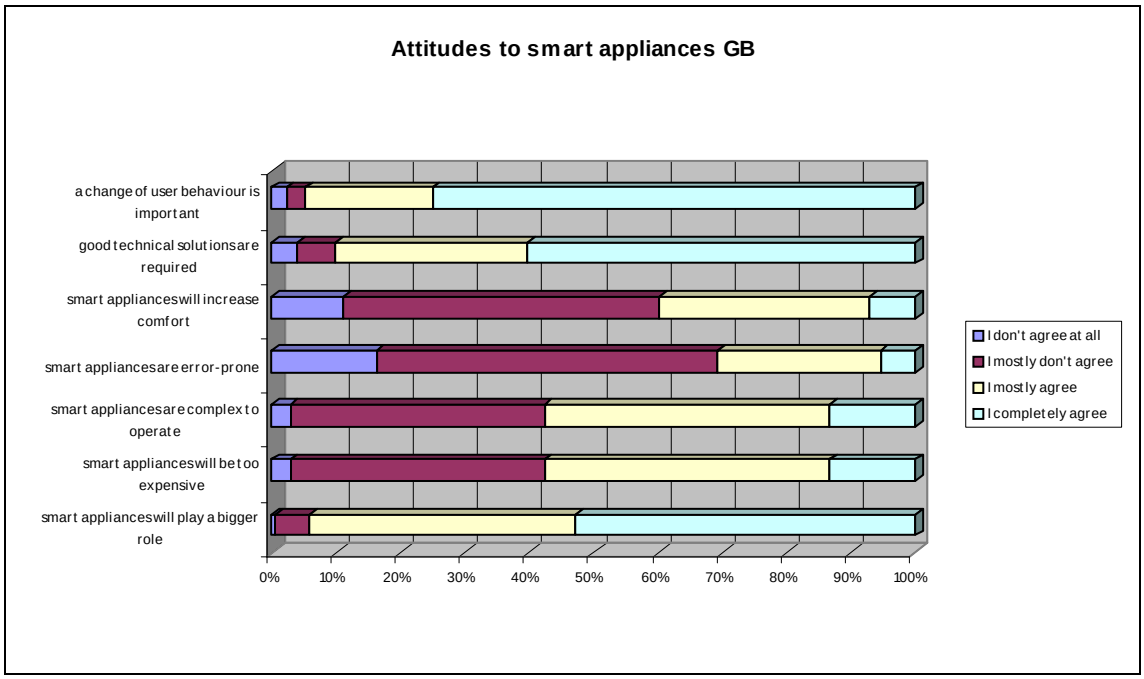
“Smart appliances are error-prone.” Only 30% agree completely or mostly.

“Smart appliances will increase comfort.” 40% in total agree completely or mostly.

“To reduce energy consumption in households good technical solutions are required.” 90% agree completely or mostly.

“To reduce energy consumption in households a change of user behaviour is important.” 97% agree completely or mostly.

Figure 2-6-1 Attitudes to smart appliances GB



2.7 Ecological awareness and engagement of the respondents

There were a few questions in the questionnaire to check the ecological awareness and engagement of the respondents.

60% know roughly the total of their electricity bill without looking it up, about 11% knows it exactly and about 30% do not know it without looking it up (see figure 2-7-1).

Only 12% purchase green energy in their households (see figure 2-7-2).

90% of the respondents use energy saving bulbs often.

Almost 100% of all respondents let dishes cool down, before they put them in the refrigerator.

About three quarters of all respondents are aware of energy labels and often buy appliances with A, A+ or A++.

About 95% of the people often operate the washing machine or the dishwasher only when they are full.

95% of all respondents turn heating control down when leaving home for a longer period.

70% of the respondents often use public transport, bicycle or walking for daily routine travels (see figure 2-7-3).

Figure 2-7-1 Knowledge about energy bill without looking it up GB

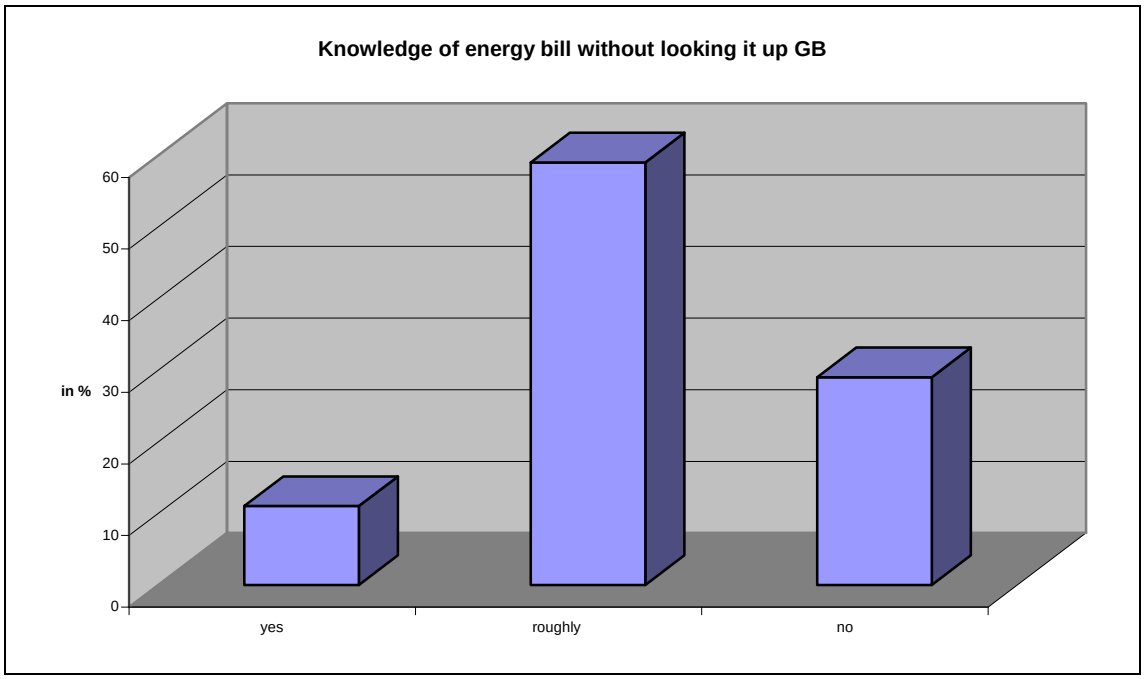


Figure 2-7-2 Purchase of green energy GB

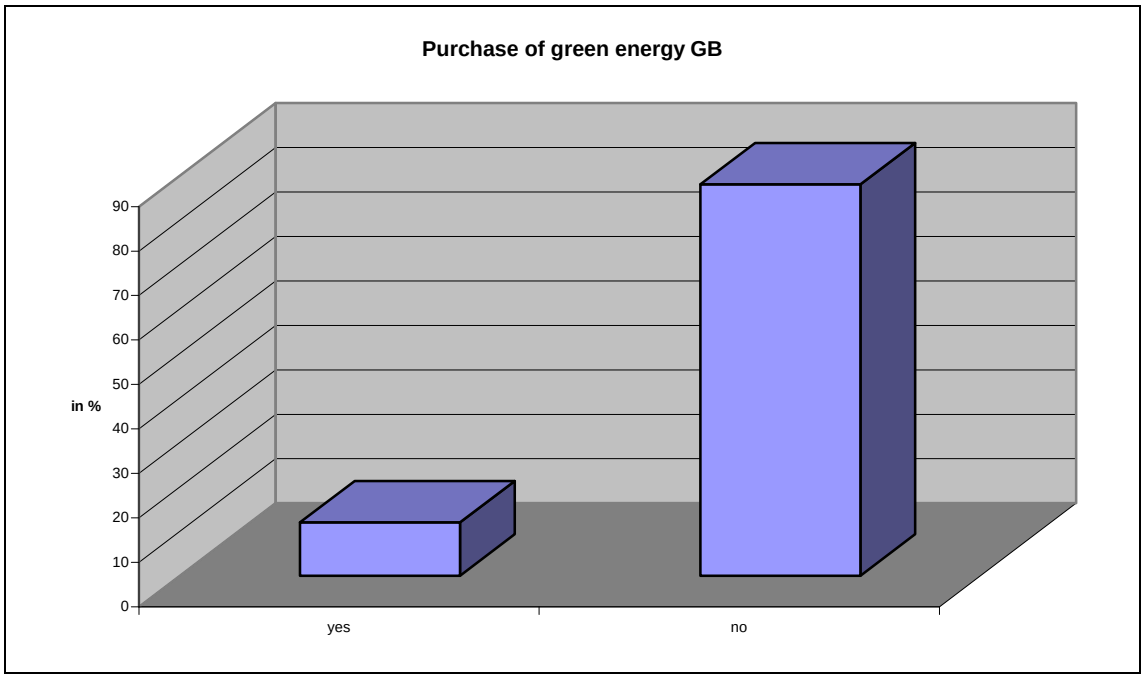
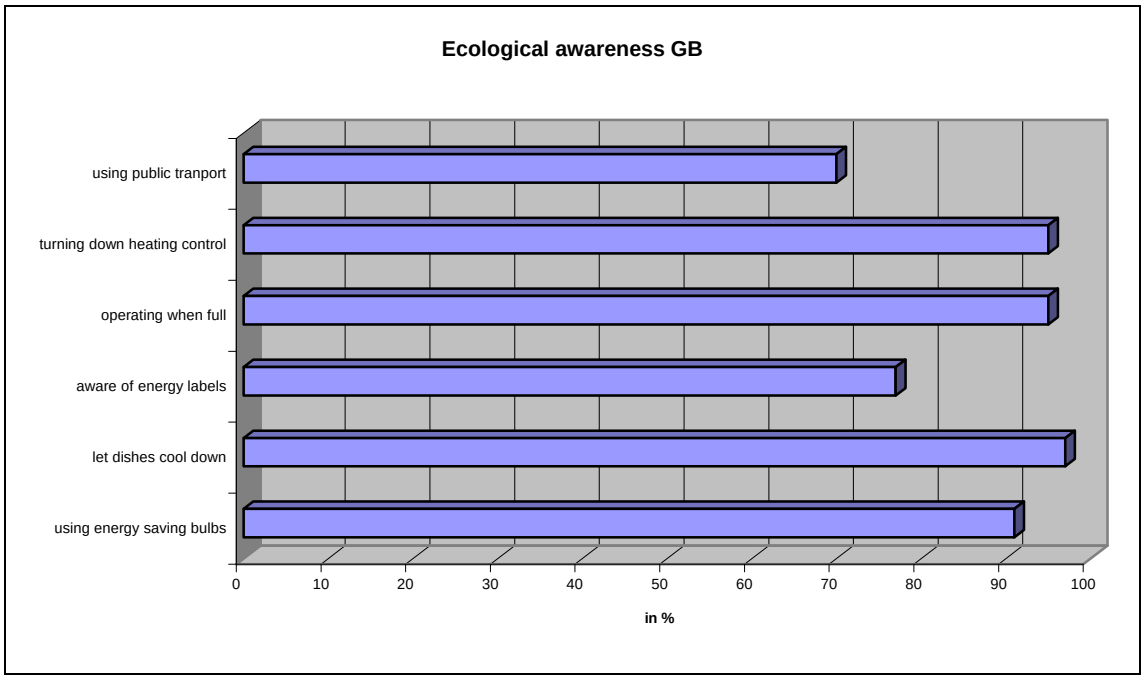


Figure 2-7-3 Ecological awareness GB

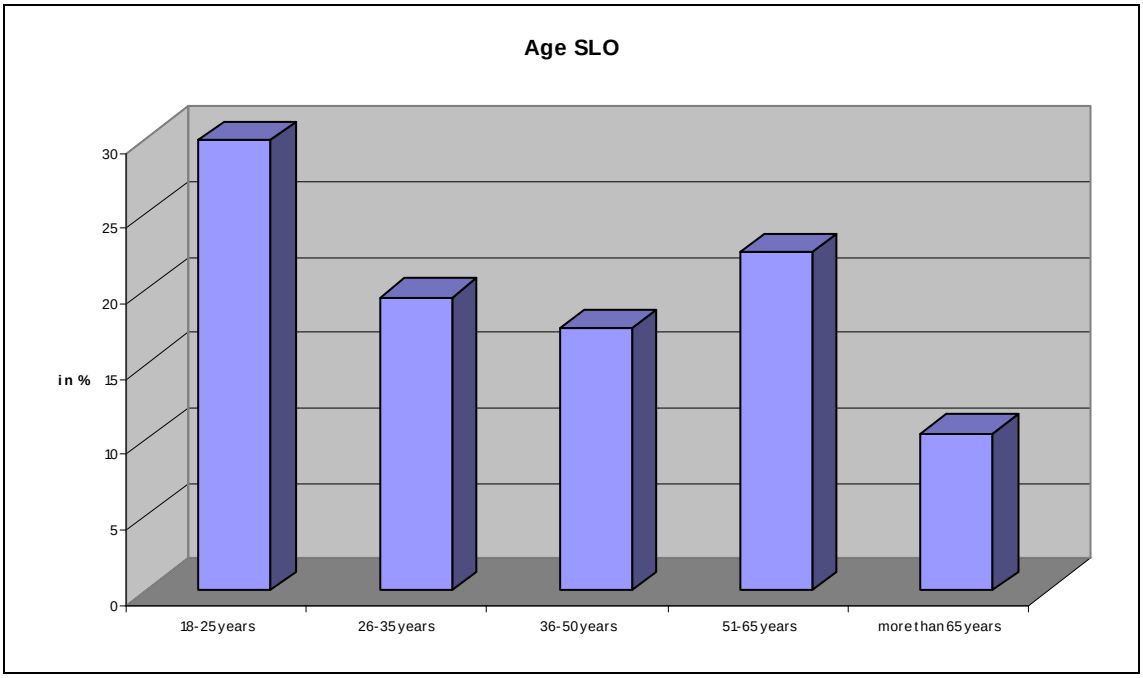


3 Slovenia

3.1 Socio-economic data

The majority of the respondents is female (about 70%), only about 30% are male. Regarding the age, in Slovenia we have 30% of the respondents between 18 to 25 years old, 37% are between 26 to 50 years old and more than 30% are older than fifty years (see figure 3-1-1).

Figure 3-1-1 Age SLO



80% of the respondents have A-level or another post 18 qualification, about a quarter are academics. There are about 10% with apprenticeship and six percent with compulsory school (see figure 3-1-2).

About a third of the respondents is employed, nearly 30% are students and 27% are pensioners (see figure 3-1-3).

About 20% have worked in a technical field, 80% didn't.

In almost 30% of all households two persons are living, in about 25% live three or four persons, 12% are one person households or households with five persons and more (see figure 3-1-4).

In more than 30% of the households lives no child, in about 20% one child, in about 30% two children, in 6% three children (see figure 3-1-5).

Figure 3-1-2 Highest education level SLO

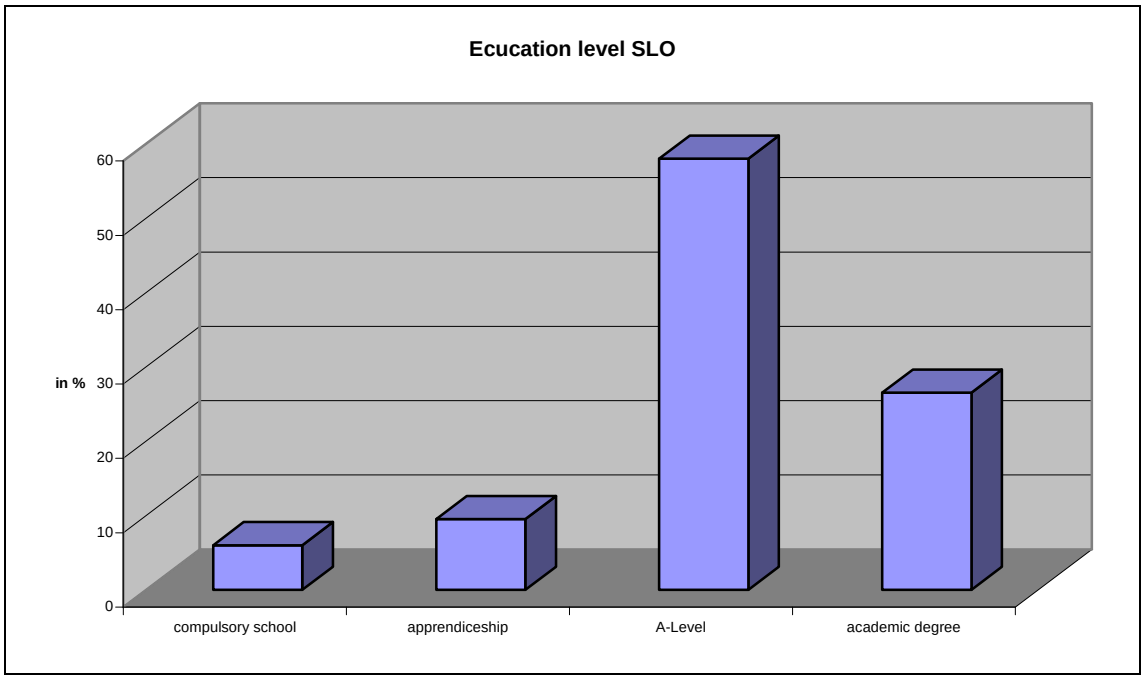


Figure 3-1-3 Employment status SLO

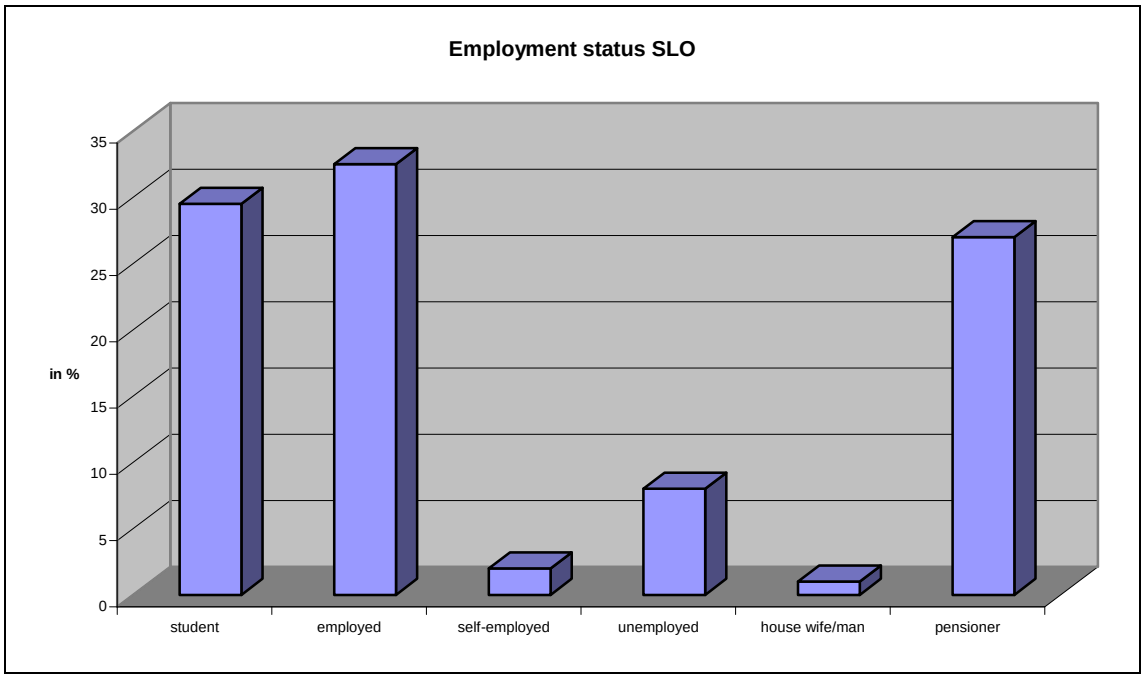


Figure 3-1-4 Number of people living in the household SLO

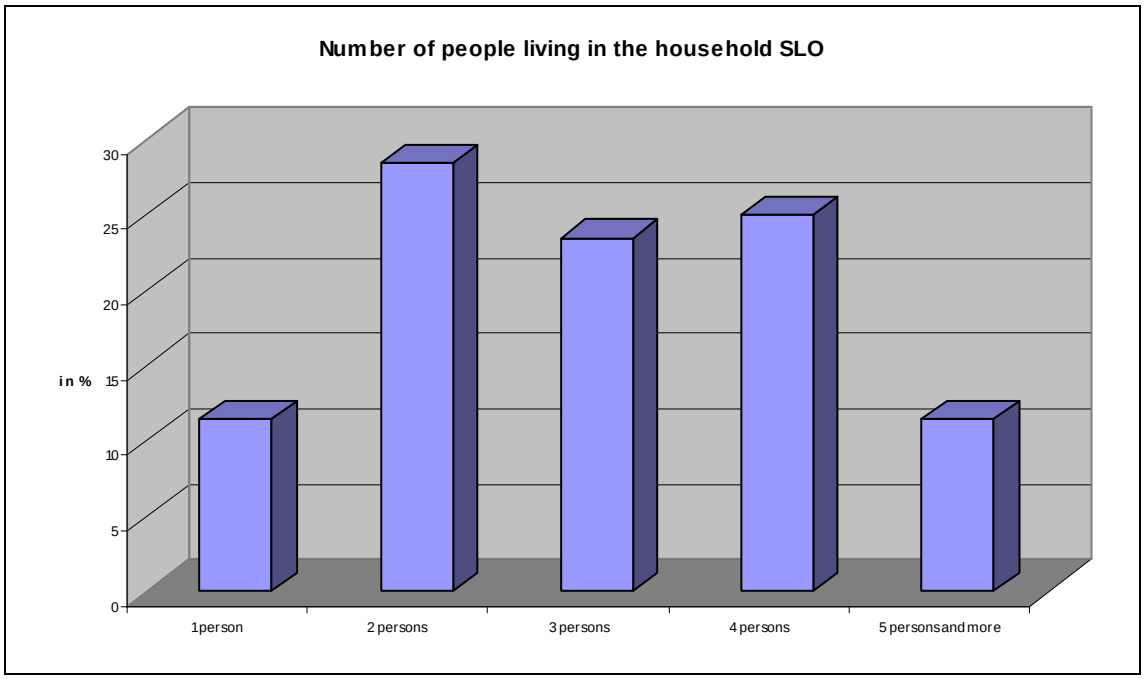
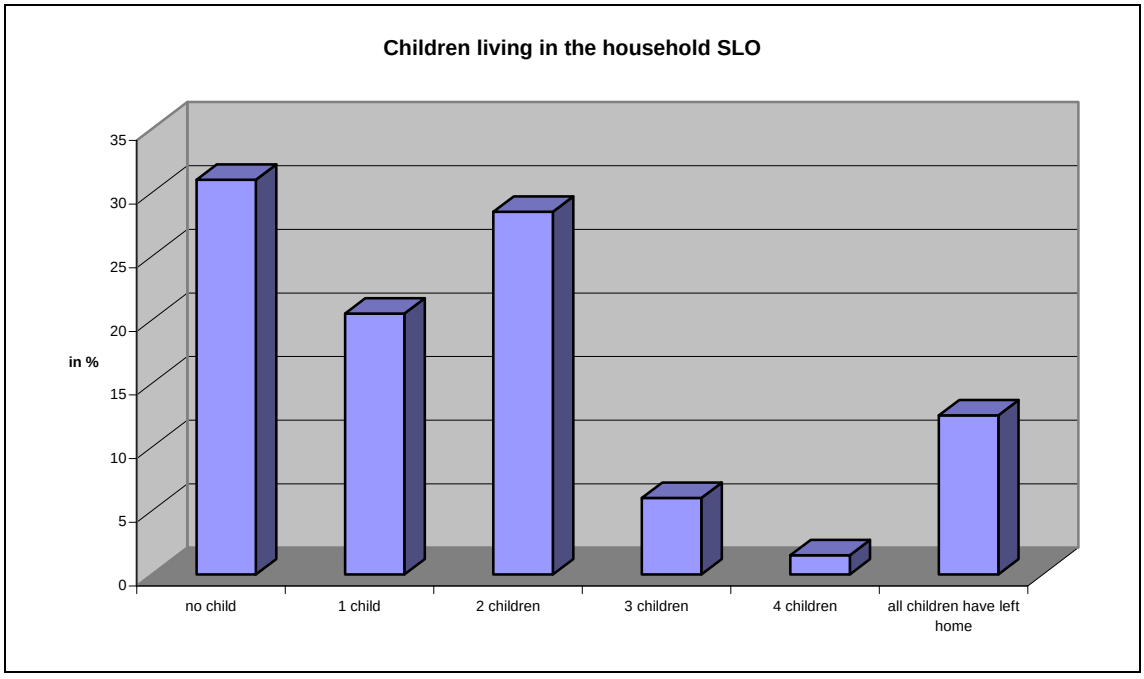
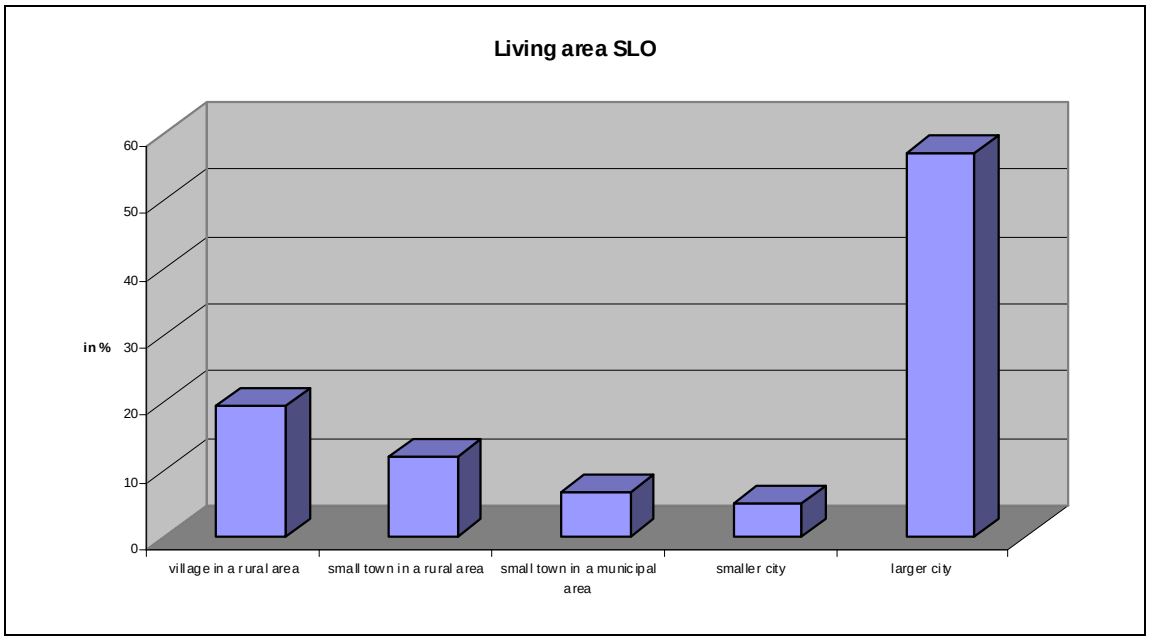


Figure 3-1-5 Number of children living in the household SLO



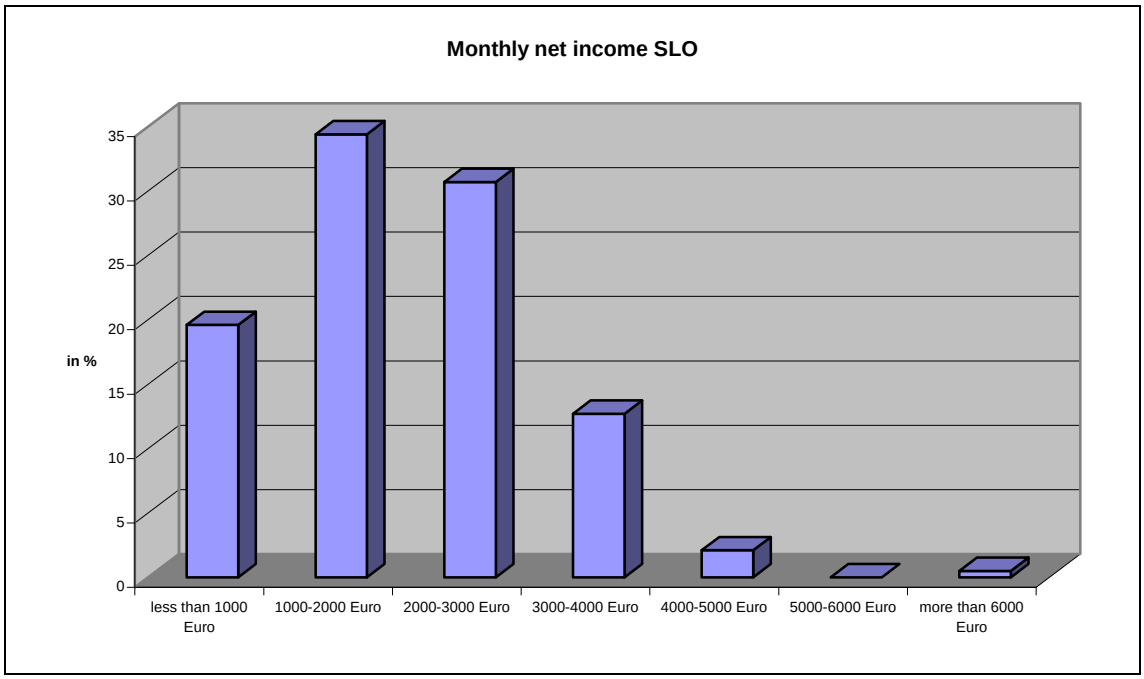
Concerning the living area in total more than the half of the respondents are living in a larger city (more than 100 000 habitants), about 20% are living in a village in a rural area (less than 100 habitants), 12% in a small town in a rural area (less than 10 000 habitants) (see figure 3-1-6).

Figure 3-1-6 Living area SLO



In more than 80% of the households several people have an income. About 35% of the households have a monthly net income between 1000 and 2000 Euro, about 30% between 2000 and 3000 Euro, about 20% have less than 1000 Euro, about 13% earn between 3000 and 4000 Euro (see figure 3-1-7).

Figure 3-1-7 Monthly net income SLO



In total half of the respondents live in single or two-family or terraced houses, the other half lives in a flat. Only about 4% of the respondents live in houses with solar collectors or photovoltaic panels.

3.2 Appliances in the households

The following appliances are used in the households:

Almost all households in Slovenia have washing machines and refrigerators, many of them deep freezers. Half of the households have electric cookers, dishwashers can be found in almost half of the households. Also central heating pumps and tumble dryers can be found in 50% of the households (see table 3-2-1).

Table 3-2-1 Using of household appliances

Household Appliance	**Slovenia (in %)**
Washing machine	100
Refrigerator	99
Deep freezer	77
Dishwasher	61
Central heating pump	44
Electric cooker	43
Electric heated boiler (more than 80 litres)	37
Tumble dryer	34
Electric water heater (up to 10 litres)	20
Electric space heating	15
Air conditioner	18

Which of these appliances have special features like start time delay, energy saving programs or cheaper tariff options?

As you can see in the following table, the most common feature is an energy saving program for the washing machine (about a quarter of all households). Also the dish-washers have in about 14% of the cases energy saving programs.

22% of the washing machines have start time delay and 14% of the dish washers. Only 11% of the washing machines use a cheaper tariff option (see table 3-2-2).

1 = start time delay (timer)

2 = energy saving program

3 = cheaper tariff option

Household Appliance	**Slovenia (in%)**		
	1	**2**	**3**
Washing machine	22	24	11
Refrigerator	-	-	3
Deep freezer	-	-	2
Electric cooker	5	-	0
Central heating pump	-	-	0.5
Dishwasher	15	14	3
Tumble dryer	7	6	3
Electric heated boiler (more than 80 litres)	3	-	1
Electric water heater (up to 10 litres)	1	-	0
Electric space heating	2	-	0.5
Air conditioner	4	-	1

3.3 Use scenarios for smart appliances

In the questionnaires different scenarios were described regarding the usage of appliances in a smarter way. The respondents were asked, whether they would accept such a scenario or not.

Scenario A: The washing machine starts after it receives a signal from the energy supplier that cheap and renewable energy is available. It is guaranteed that the process is finished at the desired time. Would people accept this for different appliances? And for financial or ecological or both reasons? (see figure 3-3-1).

Most of the residents would accept this utilisation, if financial and ecological reasons are given:

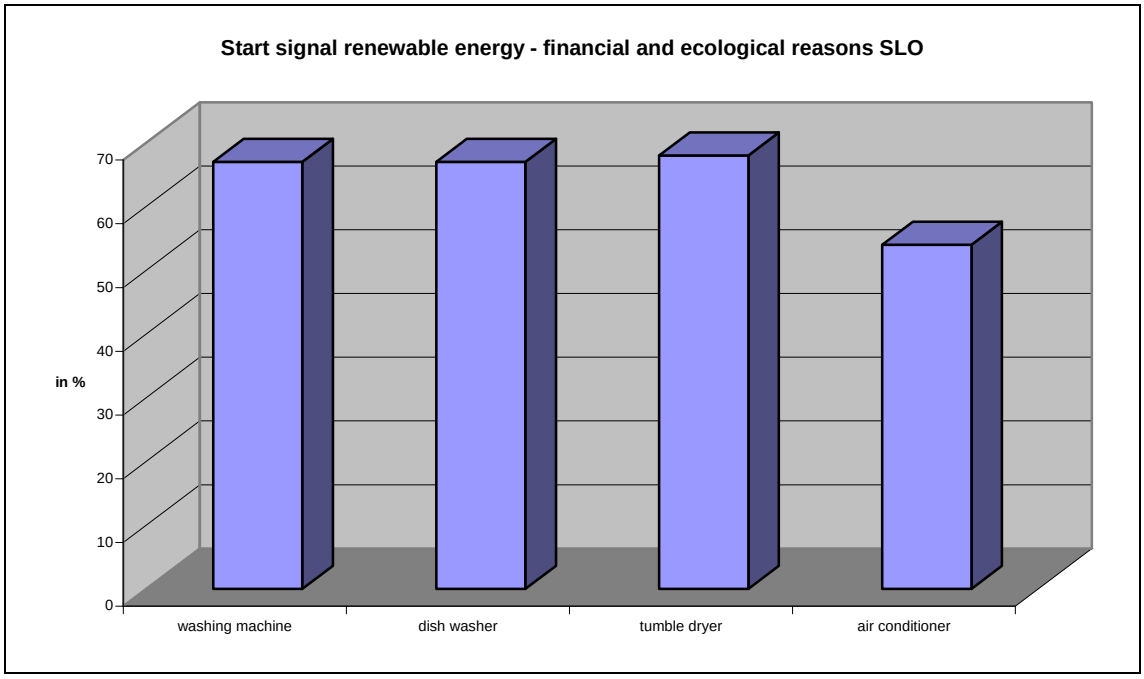
Washing machine: 67%. 7% would not accept it because they like to keep control or turn the washing machine on when electricity is cheaper.

Dishwasher: 67%. 6% would not accept it mostly because they don’t use it.

Tumble dryer: 68%. 5% wouldn't accept it because they don't need such a feature or they like to maintain control.

Air conditioner: 55%. 13% wouldn't accept it because they don't have one or they need the air conditioner on demand.

Figure 3-3-1 Start because of signal for cheap and renewable energy SLO



Scenario B: You are about to start the dishwasher when you receive the information that for financial and ecological reasons it would be better to start it at a specific time later that day. Would you postpone the start? (see figure 3-3-2).

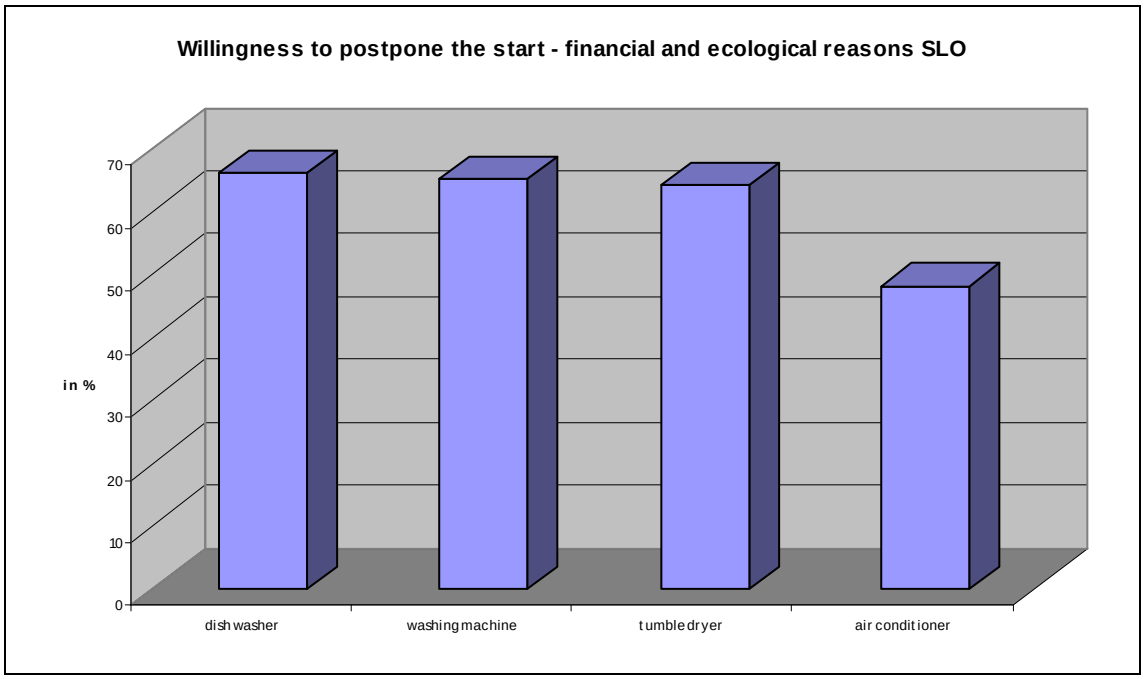
66% of all respondents would postpone the start for financial and ecological reasons. If people don't want to do it (these are about 9%), it's mostly because they need clean dishes right away.

Washing machine: 65% would postpone the start because of financial and ecological reasons. About six percent would not postpone the start because they want to do the washing when they need it.

Tumble dryer: 64% would postpone the start because of financial and ecological reasons. Five percent wouldn't do it mostly because they need the clothes right away.

Air conditioner: About half of all respondents would postpone the start for financial and ecological reasons. About a quarter wouldn't do it because they need the air conditioner on demand.

Figure 3-3-2 Willingness to postpone the start of household appliances SLO



If yes, up to how long would the shift be acceptable?

Dishwasher: About half of the respondents would find it acceptable to postpone the start for any time if it is not longer than 24 hours, for 12% it should not be longer than one hour or two hours (see table 3-3-1).

Table 3-3-1 Dishwasher – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
SLO	4	22	23	13	13	11	4	7	85
(n=182)	2,2%	12,1%	12,6%	7,1%	7,1%	6%	2,2%	3,8%	46,7%

Washing machine: Almost half of the respondents would accept a shift any time if not longer than 24 hours, 13% would accept two hours, 11% one hour (see table 3-3-2).

Table 3-3-2 Washing machine – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
SLO	5	20	24	15	10	13	2	7	93
(n=189)	2,6%	10,6%	12,7%	7,9%	5,3%	6,9%	1,1%	3,7%	49,2%

Tumble dryer: 47% would accept a shift any time if not longer than 24 hours, 13% would accept two hours, 12% one hour (see table 3-3-3).

Table 3-3-3 Tumble dryer – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
SLO	9	23	24	11	12	12	2	7	90
(n=190)	4,7%	12,1%	12,6%	5,8%	6,3%	6,3%	1,1%	3,7%	47,4%

Air conditioner: 23% would accept a shift any time if not longer than 24 hours, 26% only would accept half an hour, 23% would accept one hour, 13% would accept two hours (see table 3-3-4).

Table 3-3-4 Air conditioner – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
SLO	39	35	20	6	5	6	0	5	35
(n=151)	25,8%	23,2%	13,2%	4%	3,3%	4%	0%	3,5%	23,2%

Scenario C: Imagine it is possible to set your freezer or fridge in a "smart operation mode" by pressing a button on it. This would cause breaks of two minutes maximum in its operation that you might not even notice. The food quality would definitely stay the same. Would you accept this? (see figure 3-3-3).

About 70% of all respondents would accept this for financial and ecological reasons, only 3% would not accept it mostly because they fear that the quality of the food is damaged.

Dishwasher: Almost 70% of the respondents would accept this for financial and ecological reasons. Four percent would not want it mostly because they think each cycle of the dishwasher would take too long.

Tumbler dryer: Almost 70% of the respondents would accept this for financial and ecological reasons. About four percent would not want it mostly because they think breaks in the power are not good for the appliance and you should let it work normally.

Air conditioner: About 67% of the respondents would accept this for financial and ecological reasons. Five percent would not want it mostly because they think an air conditioner is unnecessary, they don't have one, they need the air conditioner on demand or because they think this would reduce the lifetime of the equipment.

Washing machine: About 70% of the respondents would accept this for financial and ecological reasons. Four percent would not want it mostly because they think this would damage the appliance or the cycle would take longer.

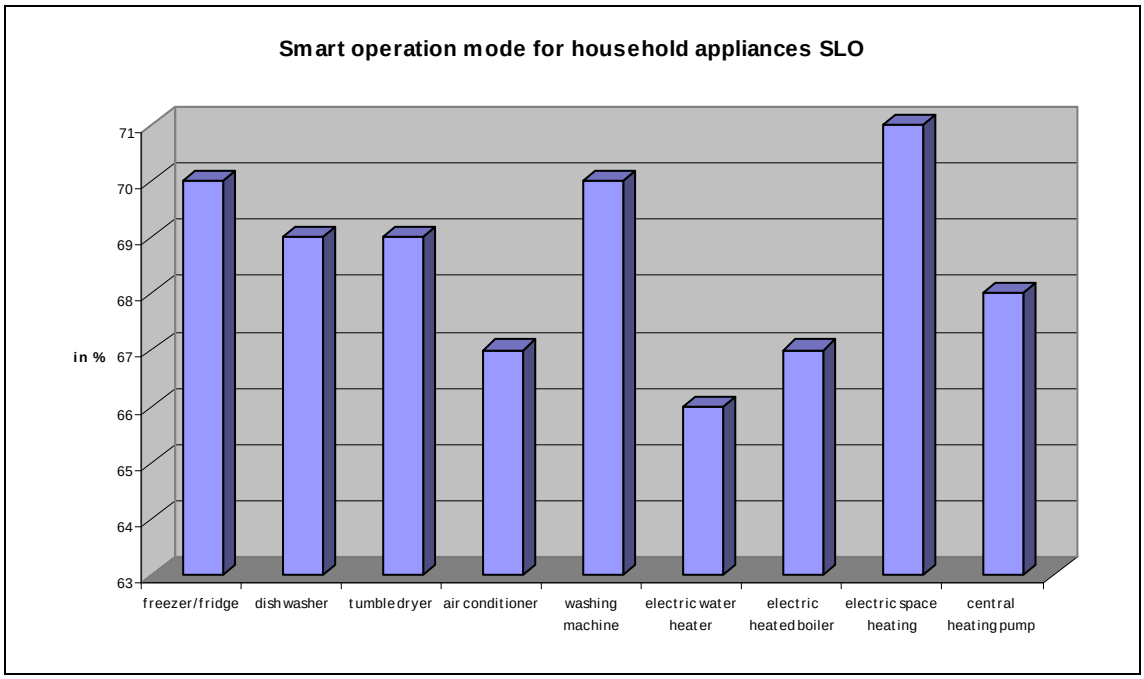
Electric water heater: Two thirds of the respondents would accept this for financial and ecological reasons. Six percent would not want it mostly because they need hot water on demand.

Electric heated boiler: About two thirds of the respondents would accept this for financial and ecological reasons. Four percent would not want it mostly because they need hot water on demand.

Electric space heating: About 70% of the respondents would accept this for financial and ecological reasons. Four percent would not want it mostly because they think this would take too long.

Central heating pump: 68% of the respondents would accept this for financial and ecological reasons. Five percent would not want it mostly because they need constant heating.

Figure 3-3-3 Smart operation mode for household appliances SLO



3.4 Willingness to pay extra for smart appliances

Would the respondents be willing to pay extra for a freezer which uses stored electricity from a photovoltaic system and uses the stored cool during the night (by compensation via reduced electricity costs within 5 years) (see table 3-4-1).

In Slovenia about half of the respondents would pay 50 to 100 Euro more. Only about 20% would pay 100 to 200 Euro, about a quarter would pay not more than 50 Euro.

If people are not willing to pay extra, this is because they think they do not need such an appliance or the refunding period is too long.

Would people be willing to pay extra for washing machines or dishwashers which use hot instead of cold water (water heated by a solar collector)? Costs are saved for heating the water up. These types cost more than others but this is compensated via the energy savings within five years (see table 3-4-2).

Half of the respondents would pay 50 to 100 Euro extra for such a washing machine or dishwasher. About a quarter would pay 100 to 200 Euro extra, about another quarter would pay not more than 50 Euro extra.

Some people are not willing to pay extra for such an appliance because they don't need it or they think it's too expensive.

Table 3-4-1 Willingness to pay extra for a freezer with stored electricity

	0-50€	**50-100€**	**100-200€**	**I would not be willing to pay extra**
SLO	48	101	41	9
(n=199)	24,1%	50,8%	20,6%	4,5%

Table 3-4-2 Willingness to pay extra for a washing machine/dish washer with stored electricity

	0-50€	**50-100€**	**100-200€**	**I would not be willing to pay extra**
SLO	47	101	47	5
(n=200)	23,5%	50,5%	23,5%	2,5%

3.5 Acceptance of monitoring and information

For providing the appliances with cheap and renewable energy the energy supplier might have to monitor the energy consumption of his clients constantly. The information would be treated confidential and deleted after some time. Would the respondents accept this? (see table 3-5-1).

More than 90% of the respondents would accept this (definitely or probably), nearly 50% say definitely yes.

If people don't like such a monitoring it's mostly because they want to keep their privacy.

Table 3-5-1 Acceptance of monitoring

	definitely yes	**yes, probably**	**probably not**	**definitely not**
SLO	97	86	7	9
(n=199)	48,7%	43,2%	3,5%	4,5%

How would people prefer to be informed about the price and the availability of cheap and renewable energy from the energy supplier? (see table 3-5-2).

In Slovenia 50% in total would like to get the information on a display of the appliance, 44% via internet/e-mail, 18% in total would prefer an information on a display unit in their flat, 30% want to get it by SMS and only 10% prefer an automatic regulation.

Table 3-5-2 Information about price and availability (multiple responses)

	via internet/ e-mail	**by SMS**	**on display unit in my flat**	**on display of the appliance**	**prefer automatic regulation**
SLO	88	58	35	101	21
(n=198)	44%	29%	17,5%	50,5%	10,5%

3.6 Attitudes to smart appliances

Questions regarding the attitude towards smart appliances were asked in the questionnaire. The following section summarizes the answers to these questions (see figure 3-6-1).

“Smart appliances will play a bigger role in the next ten years.” In Slovenia nearly 100% in total agree completely or mostly with this statement.

“Smart appliances will be too expensive for the average household.” 78% agree completely or mostly with this statement.

“Smart appliances are complex to operate.” Only 20% of the respondents agree completely or mostly.

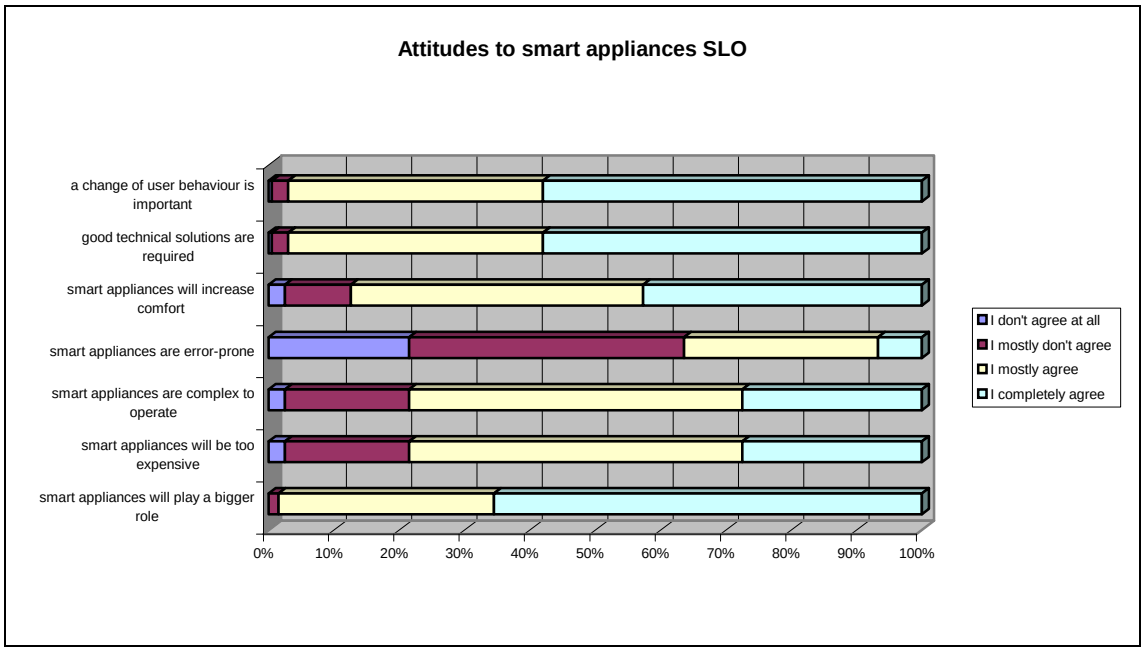
“Smart appliances are error-prone.” Only 37% agree completely or mostly.

“Smart appliances will increase comfort.” 87% agree completely or mostly.

“To reduce energy consumption in households good technical solutions are required.” 97% agree completely or mostly.

“To reduce energy consumption in households a change of user behaviour is important.” 98% agree completely or mostly.

Figure 3-6-1 Attitudes to smart appliances SLO



3.7 Ecological awareness and engagement of the respondents

There were a few questions in the questionnaire to check the ecological awareness and engagement of the respondents in Slovenia.

About 40% know roughly the total of their electricity bill without looking it up, about a third knows it exactly and about a quarter does not know it without looking it up (see figure3-7-1).

Only 4% purchase green energy (see figure 3-7-2).

About 60% of the respondents use energy saving bulbs often.

86% of all respondents let dishes cool down, before they put them in the refrigerator.

More than half of all respondents are aware of energy labels and often buy appliances with A, A+ or A++.

About 90% of the people often operate the washing machine or the dishwasher only when they are full.

83% of all respondents turn down heating control when leaving home for a longer period.

About 60% of the respondents often use public transport, bicycle or walking for daily routine travels (see figure 3-7-3).

Figure 3-7-1 Knowledge about energy bill without looking it up SLO

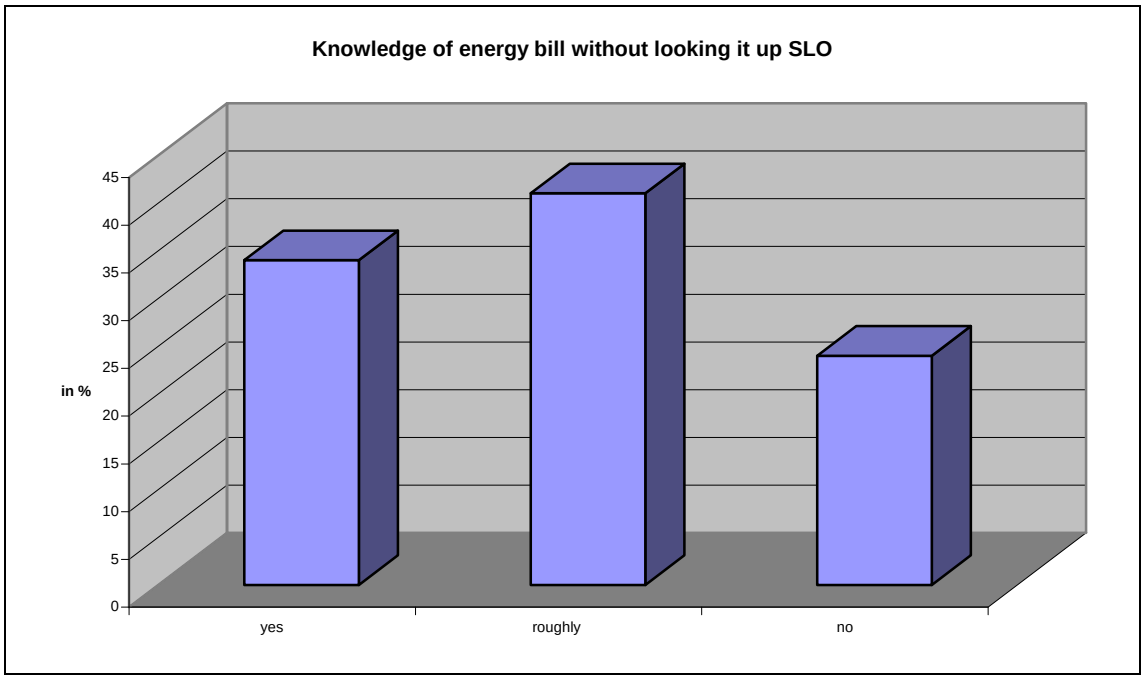


Figure 3-7-2 Purchase of green energy SLO

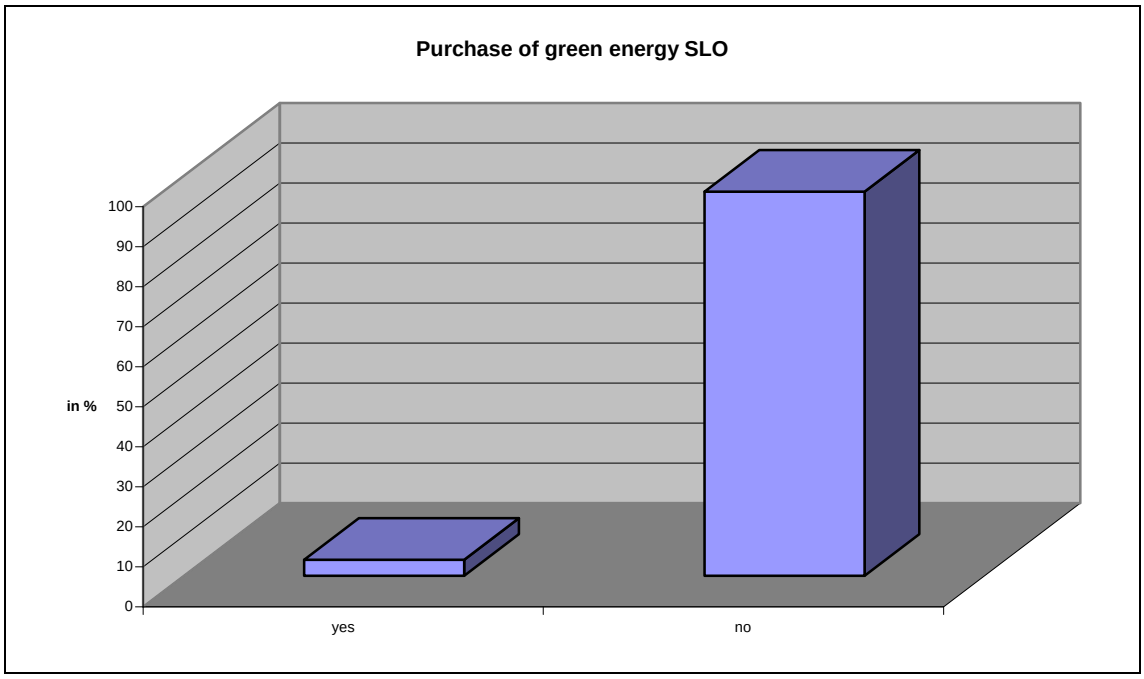
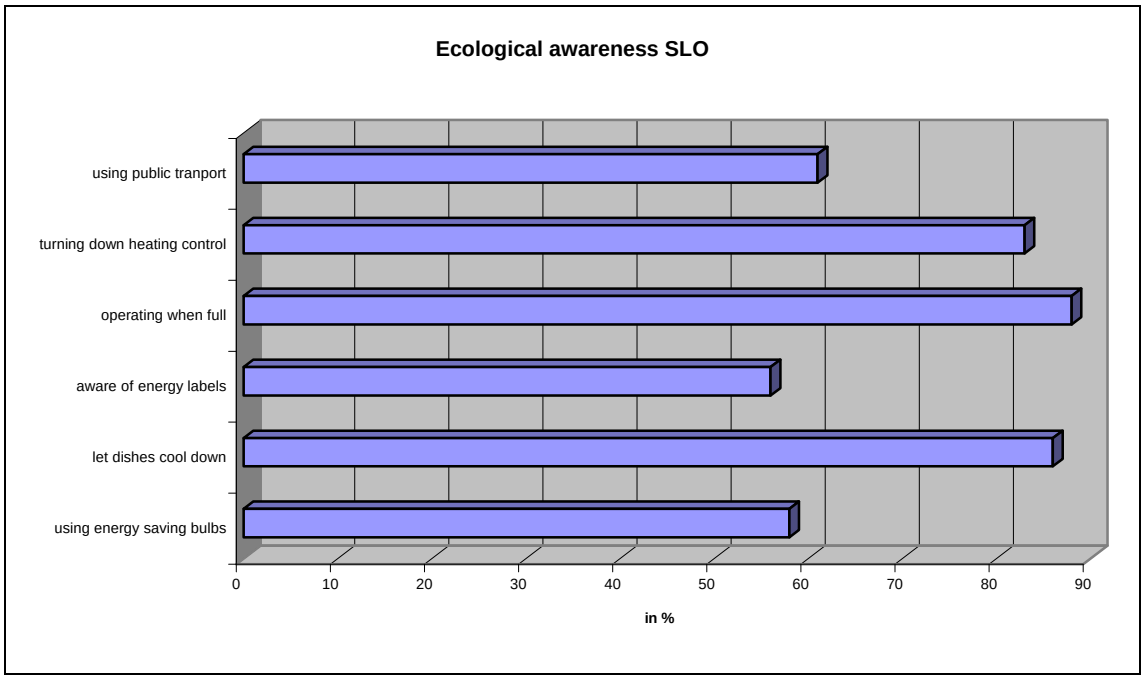


Figure 3-7-3 Ecological awareness SLO



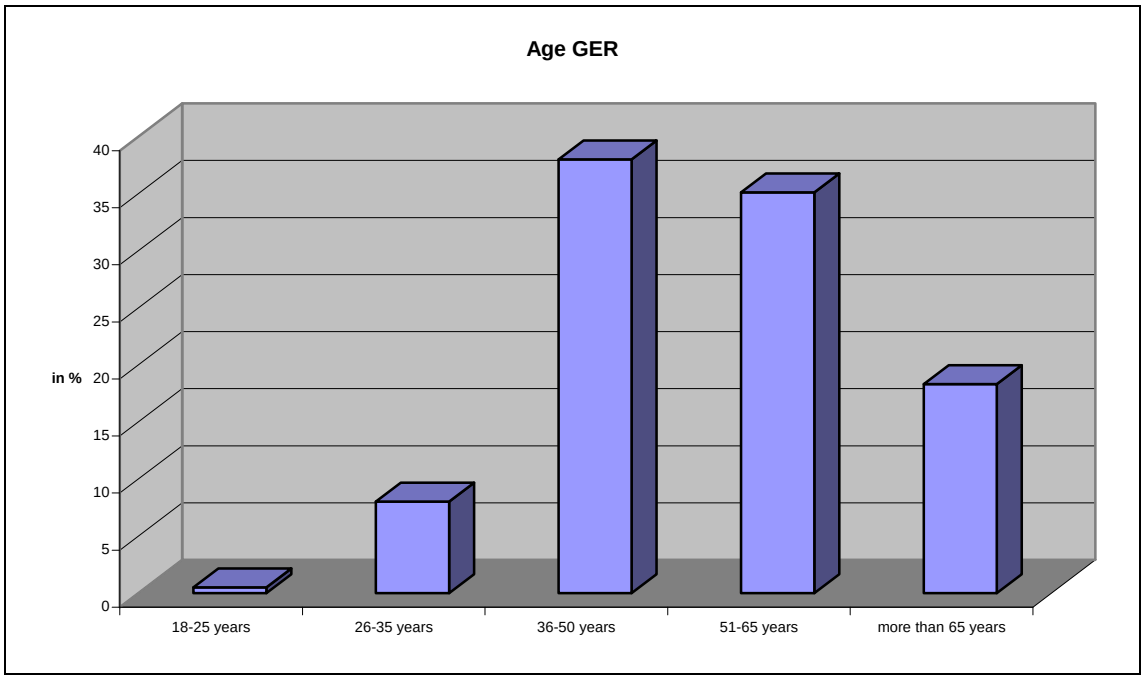
4 Germany

4.1 Socio-economic data

1332 questionnaires were included in the analysis. The majority of the respondents is male (about 83%), only about 17% are female.

Regarding the age, 38% are between 36 to 50 years old, 35% are between 50 to 65 years old, 18% are older than 65 years, only 8% are under 25 years (see figure 4-1-1).

Figure 4-1-1 Age GER



More than 40% of the respondents are academics, about 30% have apprenticeship, 17% compulsory school and seven percent A-level (see figure 4-1-2).

About the half of the respondents is employed, 20% are pensioners, 10% are self-employed (see figure 4-1-3).

60% work or have worked in a technical field, 40% didn't.

In almost 40% of all households two persons are living, in about 20% three or four persons live, 12% are households with five persons or more (see figure 4-1-4).

In more than 60% of the households lives no child, in about 15% one child, in about 18% two children, in 5% three children (see figure 4-1-5).

Figure 4-1-2 Highest education level GER

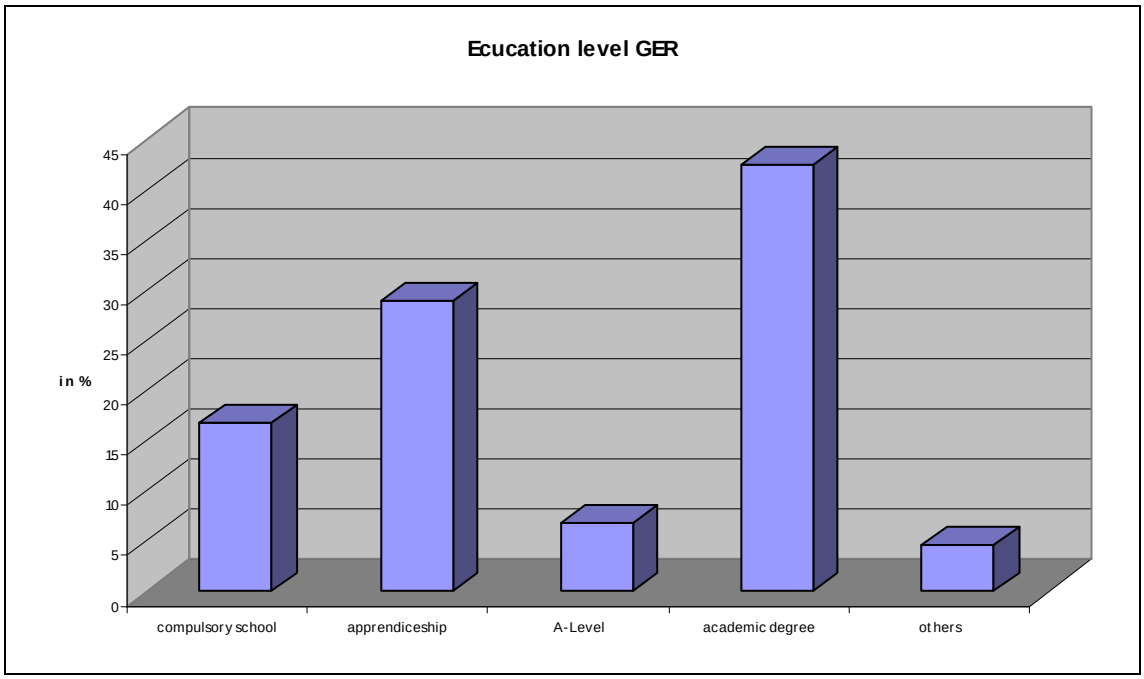


Figure 4-1-3 Employment status GER

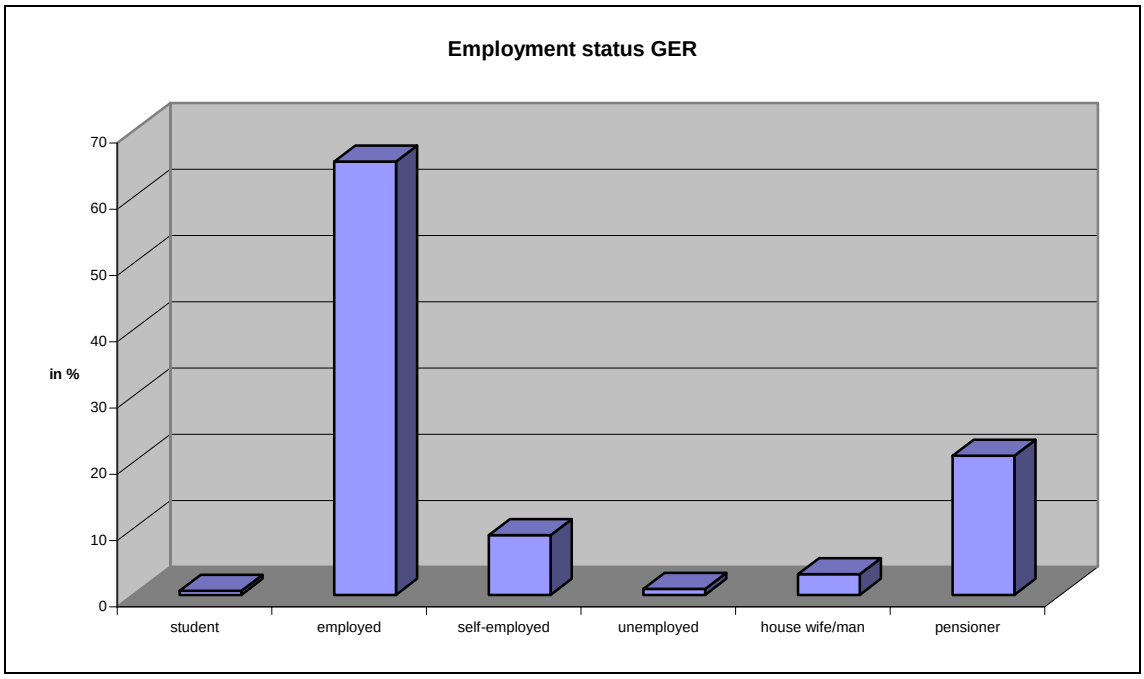


Figure 4-1-4 Number of people living in the household GER

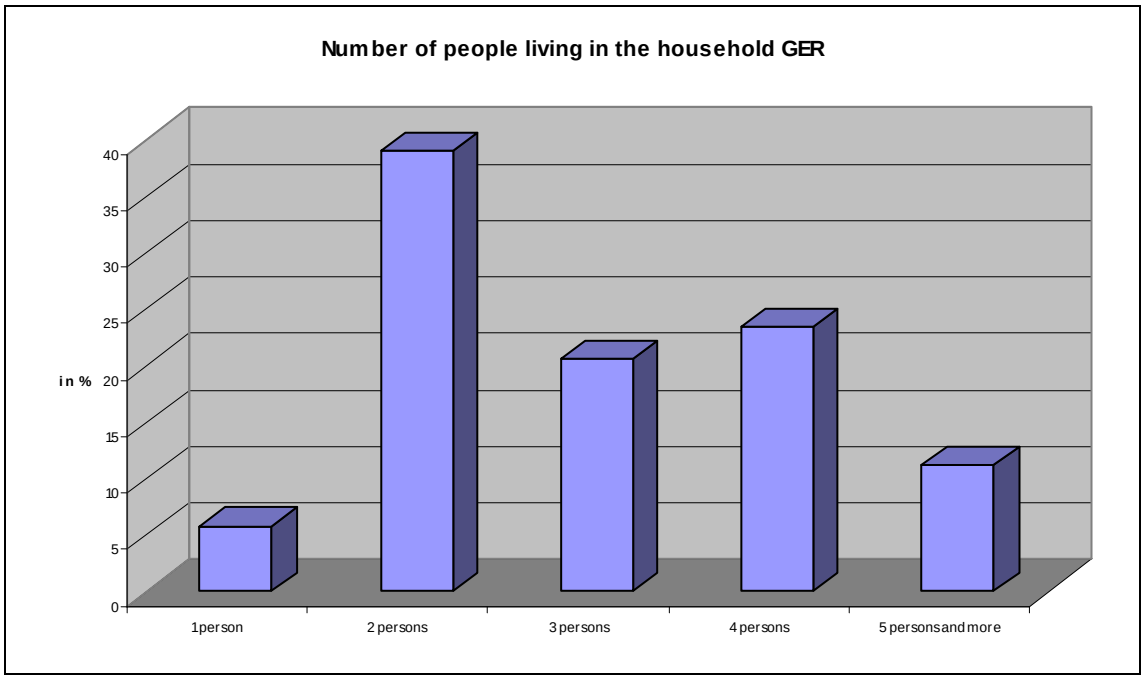
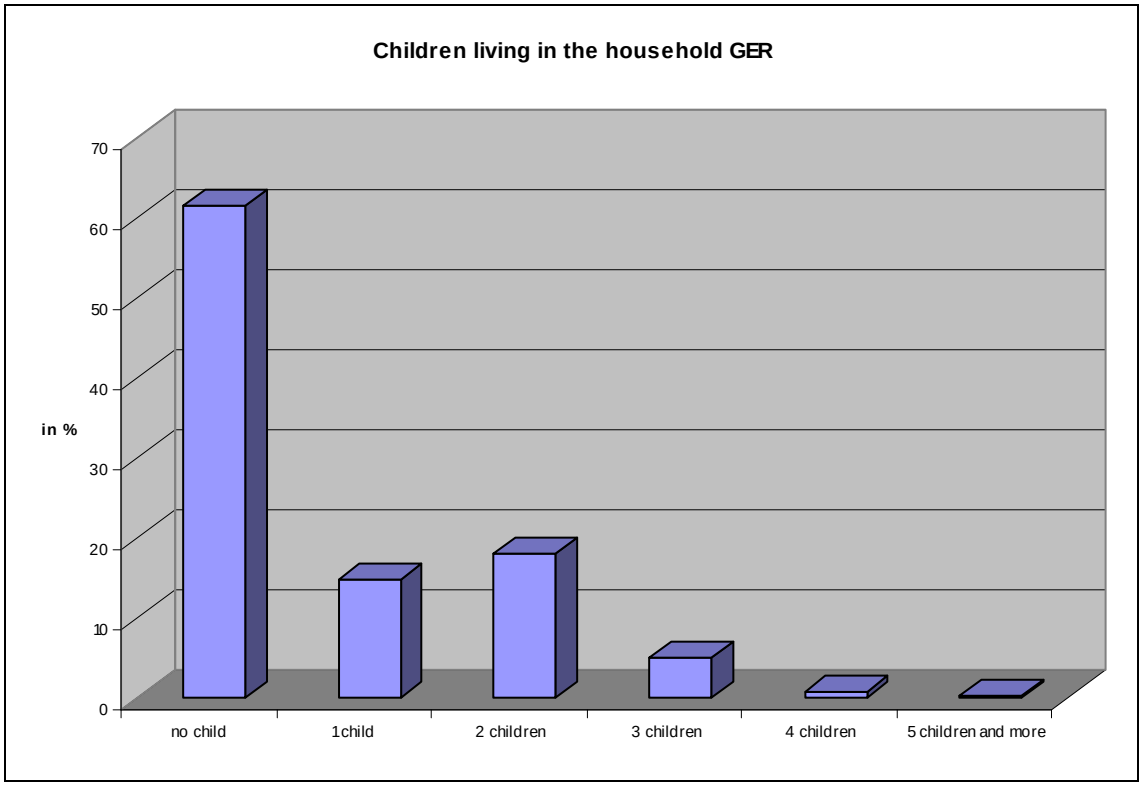
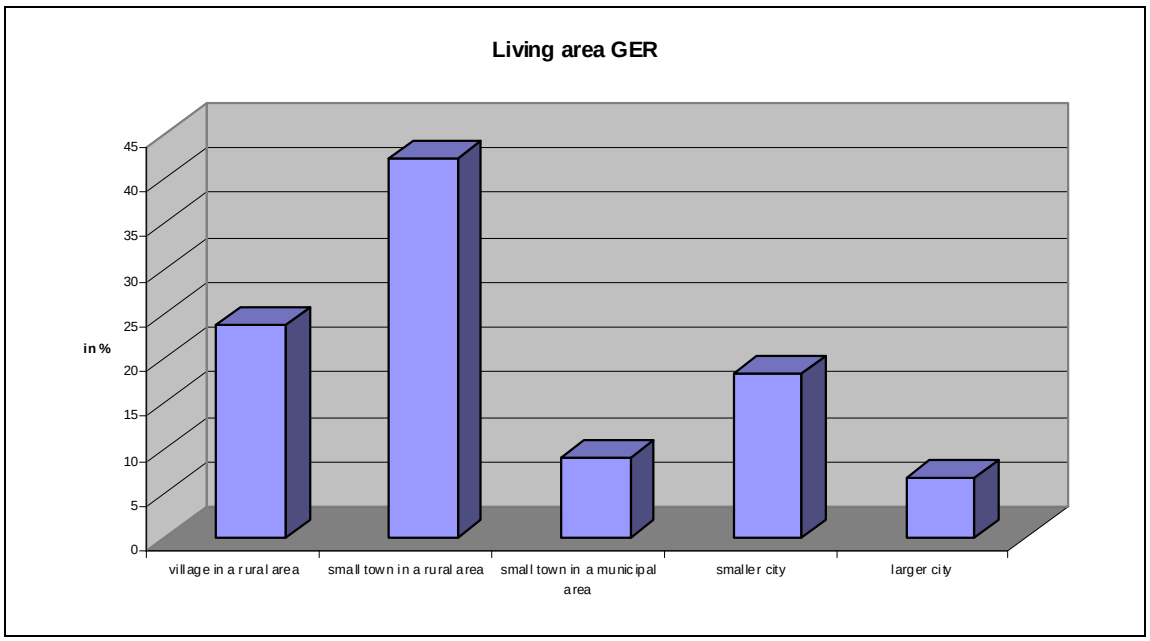


Figure 4-1-5 Number of children living in the household GER



Concerning the living area there are more than 40% living in a small town in a rural area (less than 10 000 habitants), about a quarter is living in a village in a rural area (less than 1 000 habitants), 18% in a smaller city (less than 100 000 habitants) (see figure 4-1-6).

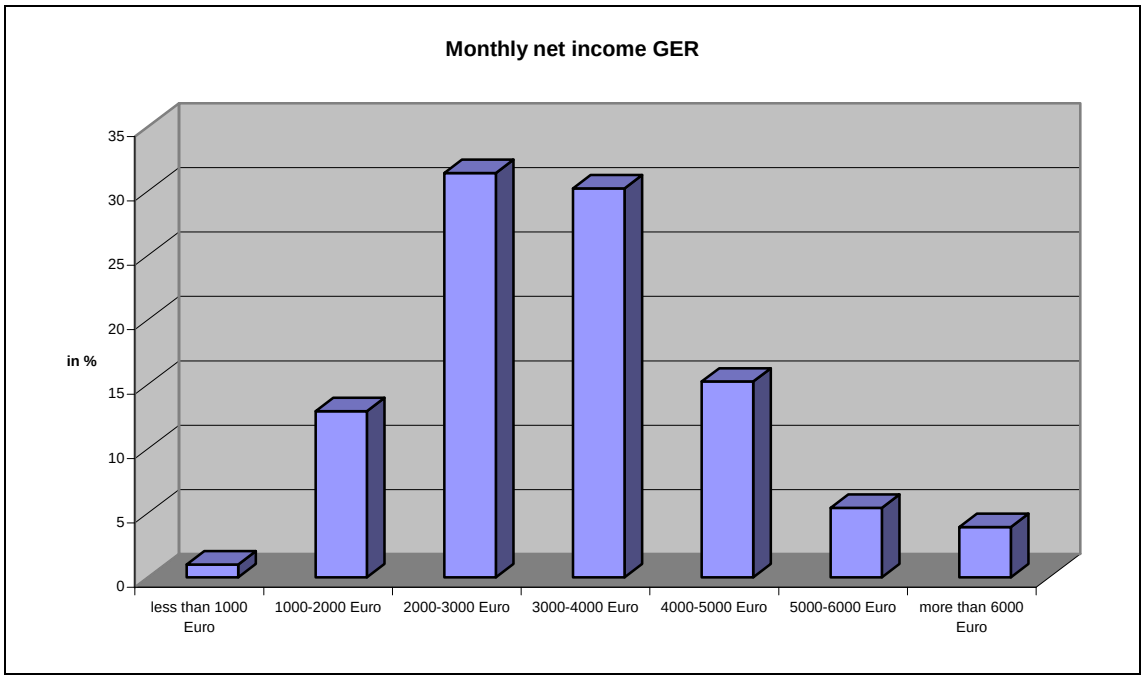
Figure 4-1-6 Living area GER



In two thirds of the households several people have an income.

More than 30% of the households have a monthly net income between 2000 and 3000 Euro, about 30% between 3000 and 4000 Euro, about 15% 4000 to 5000 Euro, about 13% have 1000 to 2000 Euro (see figure 4-1-7).

Figure 4-1-7 Monthly net income GER



84% of the of the respondents live in single or two-family or terraced houses, 15% live in a flat. About 30% of the respondents live in houses with solar collectors or photo-voltaic panels.

4.2 Appliances in the households

The following appliances are used in the households:

All households in Germany have washing machines and refrigerators, many of them electric cookers, dishwashers and deep freezers. Tumble dryers have three quarters of the households (see table 4-2-1).

Table 4-2-1 Using of household appliances

Household Appliance	**Germany (in %)**
Washing machine	100
Refrigerator	100
Electric cooker	98
Dishwasher	95
Deep freezer	91
Tumble dryer	76
Electric heated boiler (more than 80 litres)	22
Electric space heating	20
Central heating pump	16
Electric water heater (up to 10 litres)	10
Air conditioner	5

Which of these appliances have special features like start time delay, energy saving programs or use cheaper tariff options?

As you can see in the following table, the most common feature is an energy saving program for the washing machine (85%). Also 63% of the dishwashers have energy saving programs.

About 62% of the washing machines have start time delay, also 41% of the dish washers and 32% of the tumble dryers.

44% of the washing machines are operated on a cheaper tariff option, also about 40% of the electric space heating, and about 30% of the dish washers, tumble dryers and electric heating boilers (see table 4-2-2).

Table 4-2-2 Special features of household appliances

1 = start time delay

2 = energy saving program

3 = cheaper tariff option

Household Appliance	**Germany (in%)**		
	1	**2**	**3**
Washing machine	62	84	44
Dishwasher	41	63	33
Refrigerator	-	-	15
Deep freezer	-	-	15
Electric cooker	24	-	8
Central heating pump	-	-	19
Tumble dryer	32	37	31
Electric heated boiler (more than 80 litres)	4	-	36
Electric water heater (up to 10 litres)	1	-	3
Electric space heating	5	-	40
Air conditioner	2	-	1

4.3 Use scenarios for smart appliances

In the questionnaires different scenarios were described regarding the usage of appliances in a smarter way. The respondents were asked whether they would accept such a scenario or not.

Scenario A: The washing machine starts after it receives a signal from the energy supplier that cheap and renewable energy is available. It is guaranteed that the process is finished at the desired time. Would people accept this for different appliances? And for financial or ecological or both reasons? (see figure 4-3-1).

Most of the residents would accept this utilisation, if both financial and ecological reasons are given:

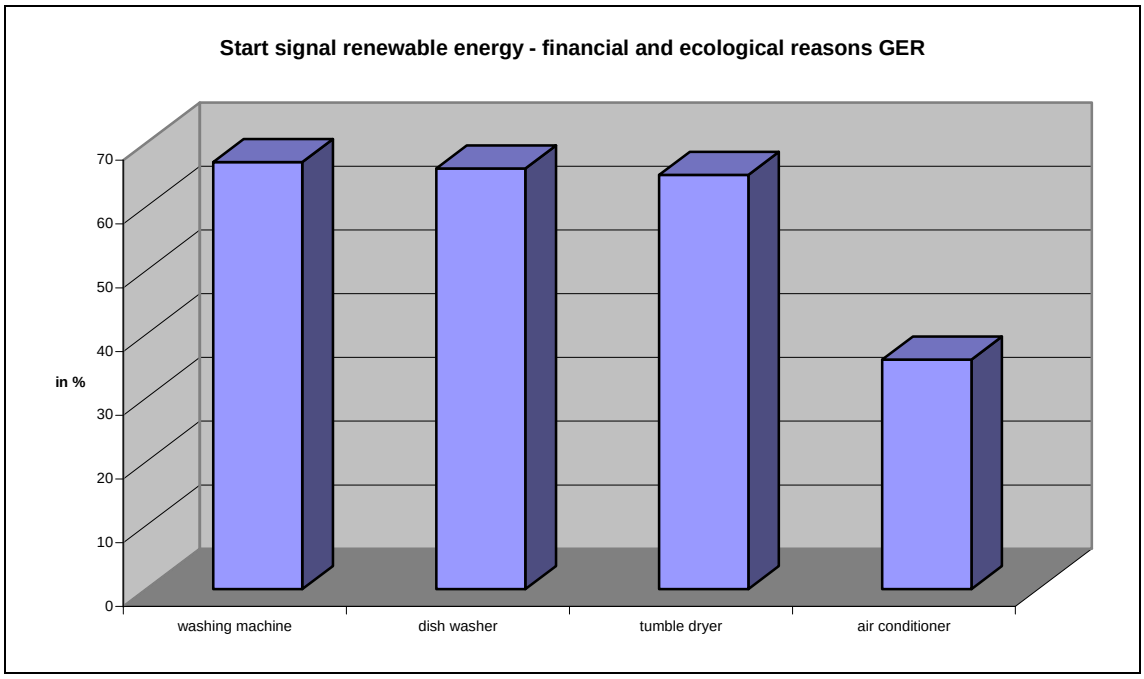
Washing machine: 66%. 6% would not accept it because they want to keep control over the device or they think this system is not flexible or they do not want to leave the washing machine unattended.

Dishwasher: 65%. 8% would not accept it mostly because they want to wash the dishes on demand, they don't like that the dishwasher is unattended or they fear the noise in the night when cheap tariffs are available.

Tumble dryer: 66%. 8% wouldn't accept it because they think the laundry should not stay wet for a longer time or it's not flexible enough or they don't need tumble dryers.

Air conditioner: 36%. 42% wouldn't accept it because they think air conditioning is unnecessary because of financial and ecological reasons, they need the air conditioner on demand or they don't have one.

Figure 4-3-1 Start because of signal for cheap and renewable energy GER



Scenario B: You are about to start the dishwasher when you receive the information that for financial and ecological reasons it would be better to start it at a specific time later that day. Would you postpone the start? (see figure 4-3-2).

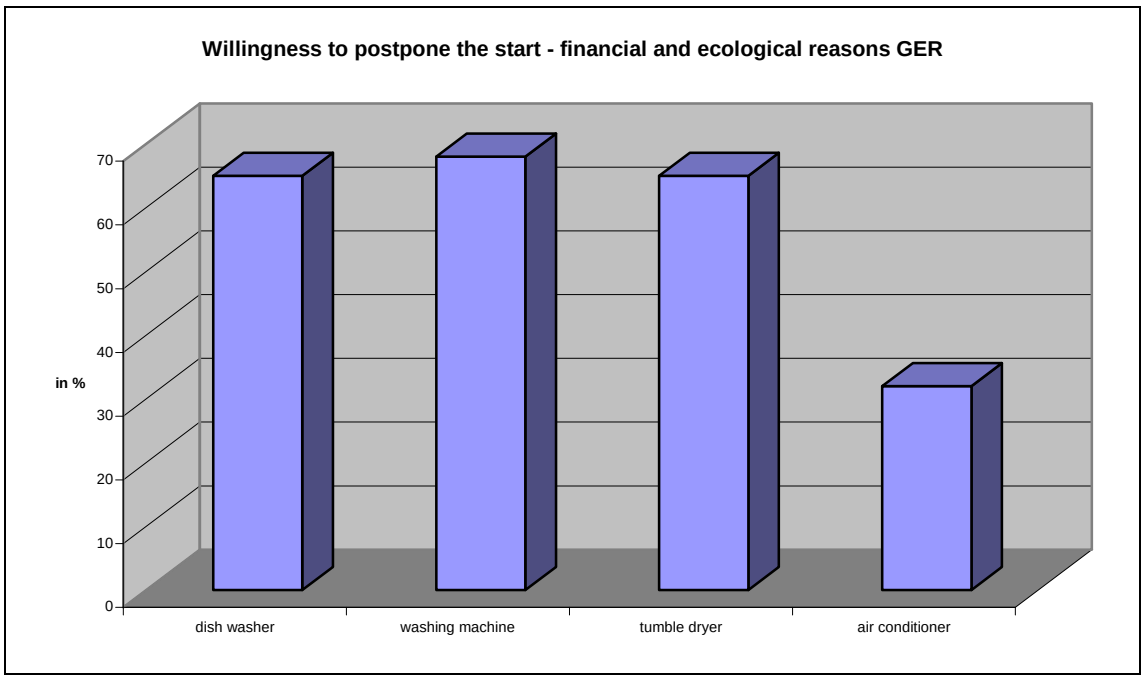
65% of all respondents would postpone the start for financial and ecological reasons. If people don't want to do it (these are about 6%), it's mostly because they need clean dishes right away.

Washing machine: 68% would postpone the start because of financial and ecological reasons. About five percent would not do it mostly because this is not compatible with their daily life routine.

Tumble dryer: 65% would postpone the start because of financial and ecological reasons. Six percent wouldn't do it mostly because this doesn't fit with their daily planning or they don't use one.

Air conditioner: Only 32% of all respondents would postpone the start for financial and ecological reasons. 48% wouldn't do it because they think air conditioning is unnecessary or they need the air conditioner on demand.

Figure 4-3-2 Willingness to postpone the start of household appliances GER



If yes, up to how long would the shift be acceptable?

Dishwasher: About 37% the respondents would find it acceptable to postpone the start for any time if it is not longer than 24 hours, for about 12% it should not be longer than one, two, three or four hours each (see table 4-3-1).

Table 4-3-1 Dishwasher – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
GER (n= 1239)	32 2,6%	76 6,1%	144 11,6%	146 11,8%	143 11,5%	63 5,1%	92 7,4%	83 6,7%	460 37,1%

Washing machine: 40% of the respondents would accept a shift any time if not longer than 24 hours, 13% would accept two hours, 10% would accept three or four hours (see table 4-3-2).

Table 4-3-2 Washing machine – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
GER (n= 1256)	24 1,9%	72 5,7%	153 12,2%	122 9,7%	120 9,6%	74 5,9%	88 7%	90 7,2%	513 40,8%

Tumble dryer: 40% would accept a shift any time if not longer than 24 hours, about 10% would accept two or three hours each, 12% would accept four hours (see table 4-3-3).

Table 4-3-3 Tumble dryer – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
GER (n= 1083)	30 2,8%	72 6,6%	113 10,4%	101 9,3%	126 11,6%	61 5,6%	77 7,1%	71 6,6%	432 39,9%

Air conditioner: 20% would accept a shift any time if not longer than 24 hours, 28% would accept half an hour, 21% would accept one hour, 16% would accept two hours (see table 4-3-4).

Table 4-3-4 Air conditioner – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
GER	111 27,6%	85 21,1%	64 15,9%	22 5,5%	14 3,5%	7 1,7%	8 2%	9 2,2%	82 20,4%

Scenario C: Imagine it is possible to set your freezer or fridge in a "smart operation mode" by pressing a button on it. This would cause breaks of two minutes maximum in its operation that you might not even notice. The food quality would definitely stay the same. Would you accept this? (see figure 4-3-3).

70% of all respondents in Germany would accept this for financial and ecological reasons, only three percent would not accept it mostly because they fear that this feature damages the appliance or the quality of the food. Some of them didn't understand what was meant.

Dishwasher: 65% of the respondents would accept this for financial and ecological reasons. Seven percent would not want it mostly because they think it does not make sense, that the energy saving is too small or this lasts too long.

Tumbler dryer: Almost 65% of the respondents would accept this for financial and ecological reasons. About six percent would not want it mostly because they think breaks in the power are not good for the appliance or it does not make sense.

Air conditioner: 54% of the respondents would accept this for financial and ecological reasons. 15% would not want it mostly because they think an air conditioner is unnecessary, they don't have one, they need the air conditioner on demand and this is less comfortable.

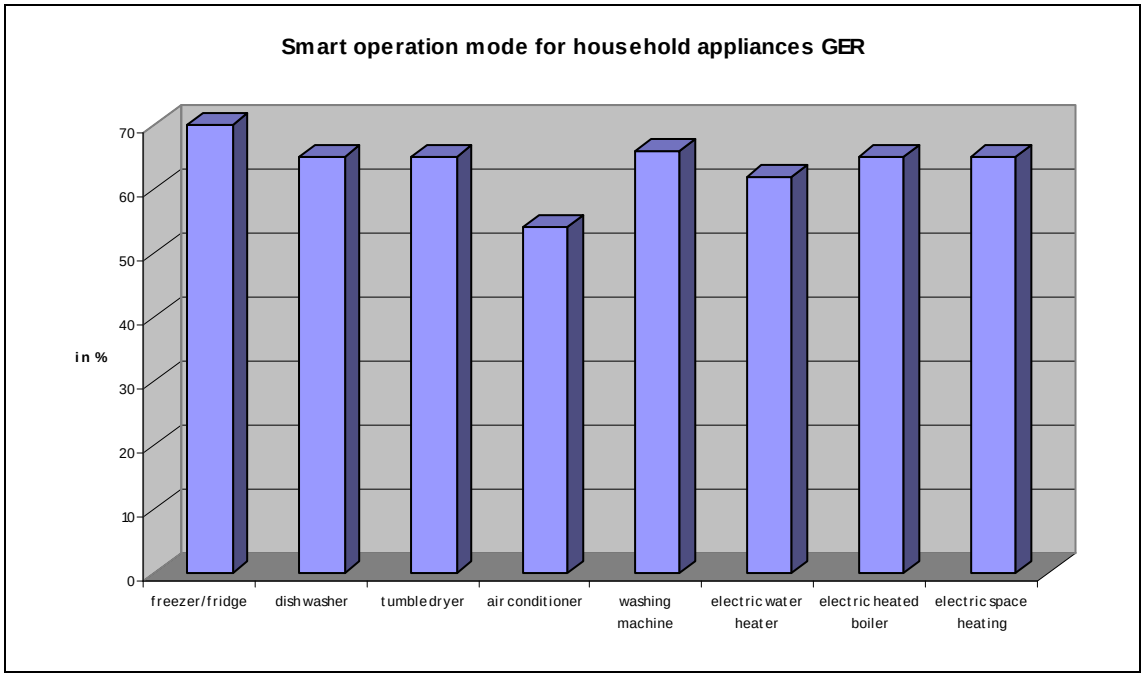
Washing machine: 66% of the respondents would accept this for financial and ecological reasons. Six percent would not want it mostly because they think this does not make sense, this would damage the appliance or the washing cycle lasts too long.

Electric water heater: 62% of the respondents would accept this for financial and ecological reasons. 10% would not want it mostly because they need hot water on demand or they don't have such an appliance.

Electric heated boiler: About two thirds of the respondents would accept this for financial and ecological reasons. Six percent would not want it mostly because they don't have such an appliance or they think that it does not make sense.

Electric space heating: 65% of the respondents would accept this for financial and ecological reasons. Seven percent would not want it mostly because they don't have an electric space heating or they think that it does not make sense.

Figure 4-3-3 Smart operation mode for household appliances GER



4.4 Willingness to pay extra for smart appliances

Would the respondents be willing to pay extra for a freezer which uses stored electricity from a photovoltaic system and uses the stored cool during the night (by compensation via reduced electricity costs within 5 years) (see table 4-4-1).

In Germany more than the half of the respondents would pay 50 to 100 Euro more. About a quarter would pay 100 to 200 Euro, about 15% would pay not more than 50 Euro extra.

If people are not willing to pay extra, this is because they are sceptical towards solar energy or think the refunding period is too long.

Would people be willing to pay extra for washing machines or dishwashers which use hot instead of cold water (water heated by a solar collector)? Costs are saved for heating the water up. These types cost more than others but this is compensated via the energy savings within five years (see table 4-4-2).

Half of the respondents would pay 50 to 100 Euro extra for such a washing machine or dishwasher. About a quarter would pay 100 to 200 Euro extra, about 16% would pay not more than 50 Euro extra.

10% are not willing to pay extra for such an appliance because the installation is too complex, they don't have the hook-ups for such an appliance or they don't possess solar collectors.

Table 4-4-1 Willingness to pay extra for a freezer with stored electricity

	0-50€	**50-100€**	**100-200€**	**I would not be willing to pay extra**
GER (n=1305)	203 15,6%	693 53,1%	337 25,8%	72 5,5%

Table 4-4-2 Willingness to pay extra for a washing machine/dish washer with stored electricity

	0-50€	**50-100€**	**100-200€**	**i would not be willing to pay extra**
GER (n=1304)	213 16,3%	653 50,1%	311 23,8%	127 9,7%

4.5 Acceptance of monitoring and information

For providing the appliances with cheap and renewable energy the energy supplier might have to monitor the energy consumption of his clients constantly. The information would be treated confidential and deleted after some time. Would the respondents accept this? (see table 4-5-1).

More than 90% of the respondents in Germany would accept this (definitely or probably), more than 60% say definitely yes.

Table 4-5-1 Acceptance of monitoring

	definitely yes	yes, probably	probably not	definitely not
GER (n=1321)	826 62,5%	404 30,6%	27 2%	19 1,4%

How would people prefer to be informed about the price and the availability of cheap and renewable energy from the energy supplier? (see table 4-5-2).

Two thirds in total would like to get the information via internet/e-mail, about half would prefer an information on a display unit in their flat, 38% would like to have it on a display of the appliance, about 25% prefer automatic regulation and only 3% want to get it by SMS.

Table 4-5-2 Information about price and availability (multiple responses)

	via internet/ e-mail	by SMS	on display unit in my flat	on display of the appliance	prefer automatic regulation
GER (n=1291)	863 66,3%	44 3,4%	653 50,2%	492 37,8%	317 24,3%

4.6 Attitudes to smart appliances

Questions regarding the attitude towards smart appliances were asked in the questionnaire. The following section summarizes the answers to these questions (see figure 4-6-1).

“Smart appliances will play a bigger role in the next ten years”. In Germany about 77% in total agree completely or mostly with this statement.

“Smart appliances will be too expensive for the average household”. Only 47% agree completely or mostly with this statement.

"Smart appliances are complex to operate." Only 27% of the respondents agree completely or mostly.

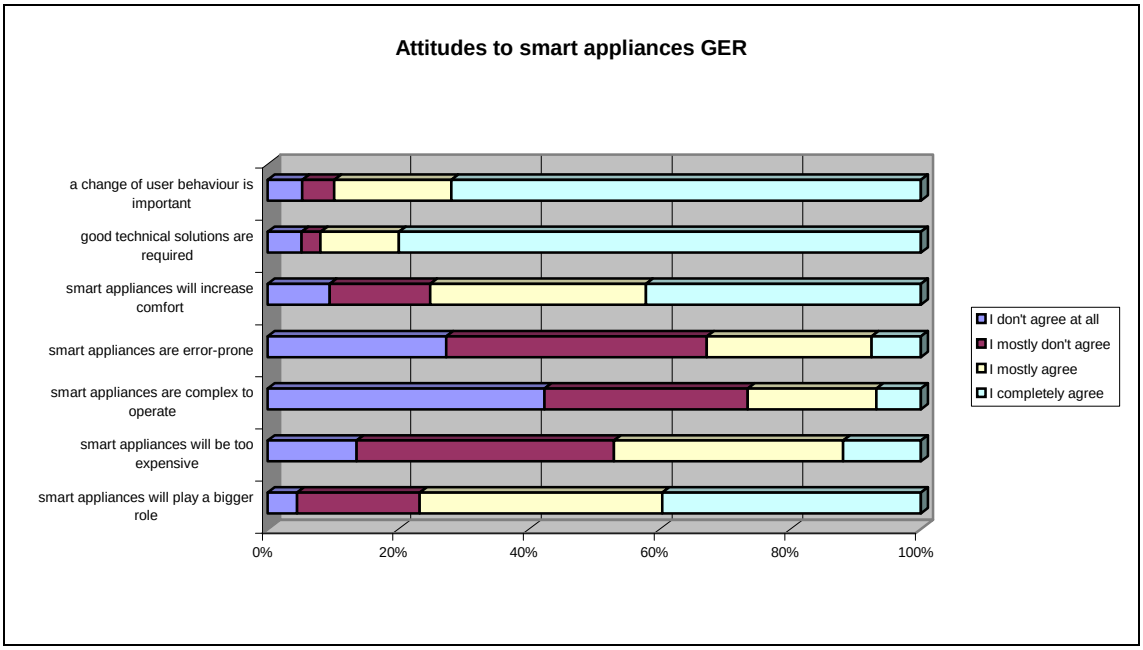
"Smart appliances are error-prone." Only a third of the respondents agrees completely or mostly.

"Smart appliances will increase comfort." 75% agree completely or mostly.

"To reduce energy consumption in households good technical solutions are required." 92% agree completely or mostly.

"To reduce energy consumption in households a change of user behaviour is important." 90% agree completely or mostly.

Figure 4-6-1 Attitudes to smart appliances GER



4.7 Ecological awareness and engagement of the respondents

There were a few questions in the questionnaire to check the ecological awareness and engagement of the respondents in Germany.

57% know exactly the total of their electricity bill without looking it up, 37% know it roughly and only about five percent do not know it without looking it up (see figure 4-7-1).

Only 3% purchase green energy (see figure 4-7-2).

About three quarters of the respondents use energy saving bulbs often.

95% of all respondents let dishes cool down, before they put them in the refrigerator.

94% of all respondents in Germany are aware of energy labels and often buy appliances with A, A+ or A++.

95% of the people often operate the washing machine or the dishwasher only when they are full.

87% of all respondents turn down heating control when leaving home for a longer period.

43% of the respondents often use public transport, bicycle or walking for daily routine travels (see figure 4-7-3).

Figure 4-7-1 Knowledge about energy bill without looking it up GER

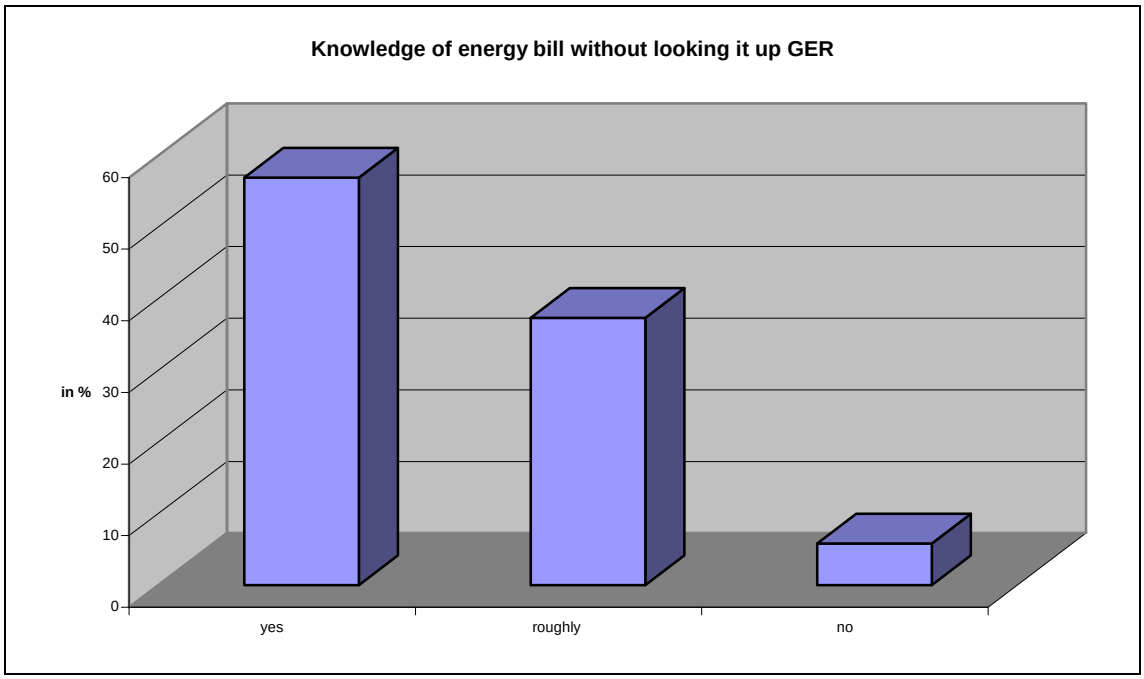


Figure 4-7-2 Purchase of green energy GER

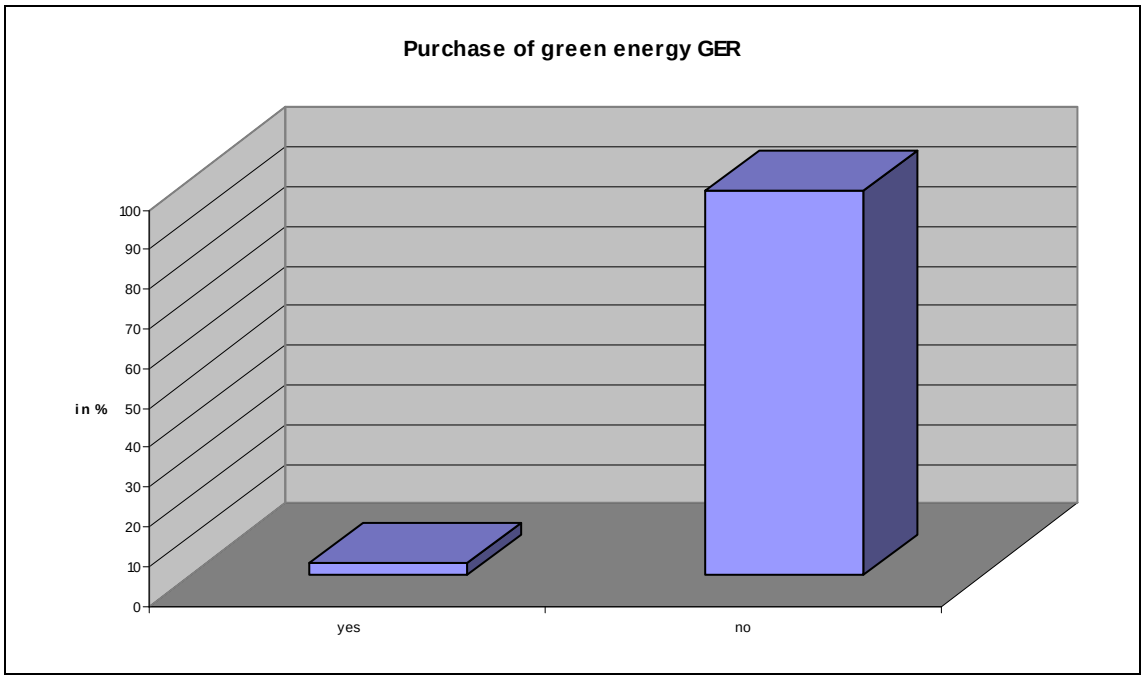
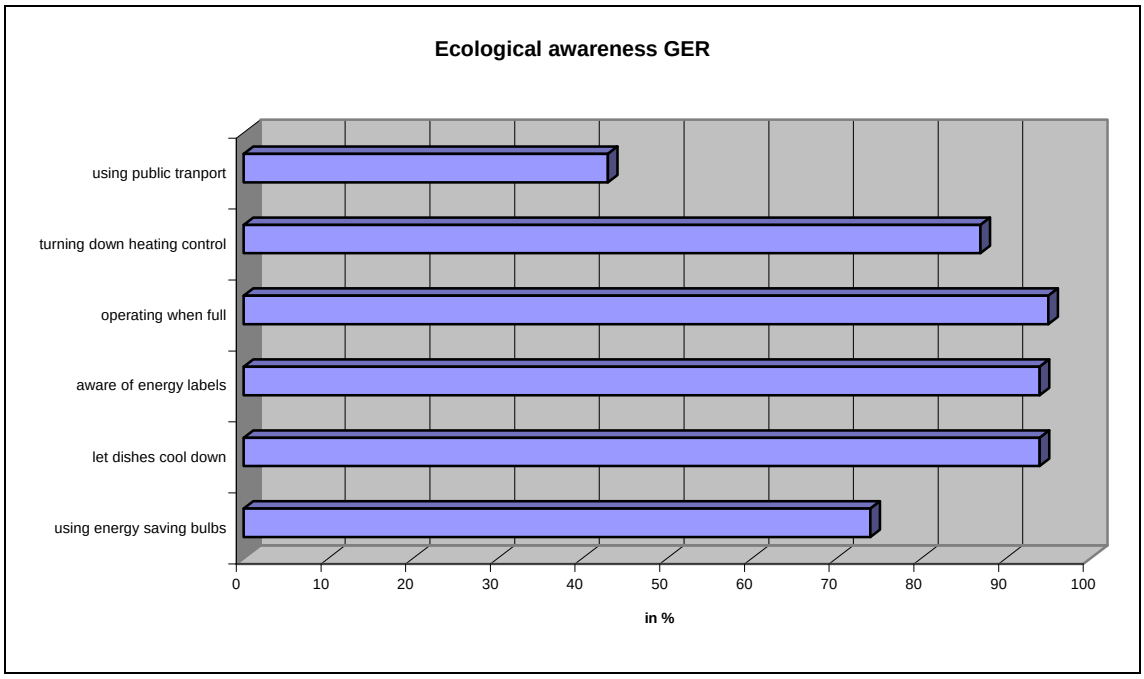


Figure 4-7-3 Ecological awareness GER



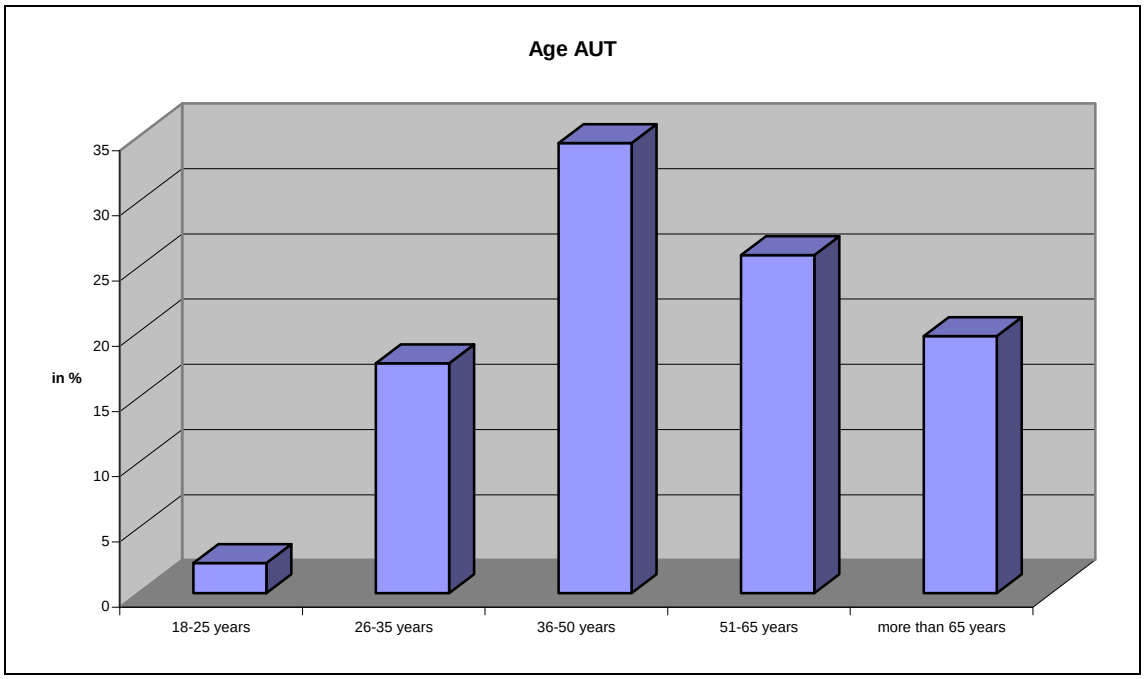
5 Austria

5.1 Socio-economic data

943 questionnaires were included in the analysis. One half of the respondents is male, the other half female.

Regarding the age, in Austria 35% are between 36 to 50 years old, 25% are between 50 to 65 years old, 20% are older than 65 years, 18% are 26 to 35 years old, only 2% are under 25 years (see figure 5-1-1).

Figure 5-1-1 Age AUT



Nearly 40% of the respondents have compulsory school, about 20% are academics, about 15% have apprenticeship, 12% secondary modern school and 15% other school leaving qualifications (see figure 5-1-2).

About 60% of the respondents are employed, about 22% are pensioners, about 8% are self-employed (see figure 5-1-3).

About a third has worked in a technical field, about two thirds didn't.

In 32% of all households two persons are living, in about 20% one person, about 15% are households with three, four or five persons or more (see figure 5-1-4).

In more than 60% of the households lives no child, in about 17% two children, in about 15% one child, in 5% three children (see figure 5-1-5).

Figure 5-1-2 Highest education level AUT

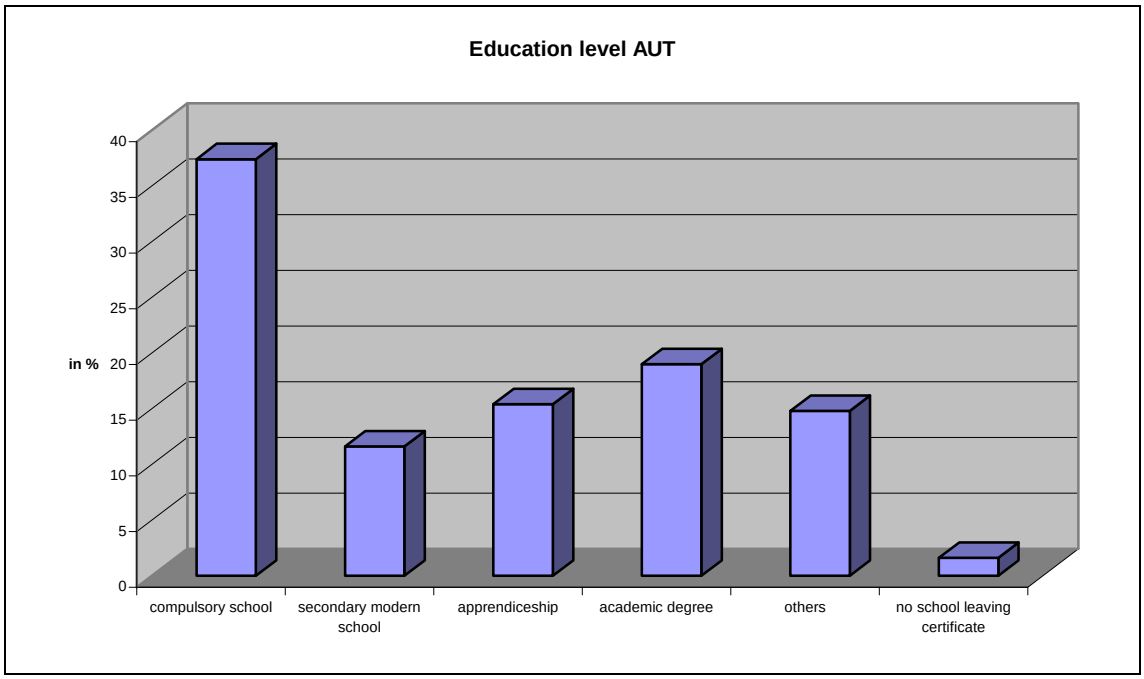


Figure 5-1-3 Employment status AUT

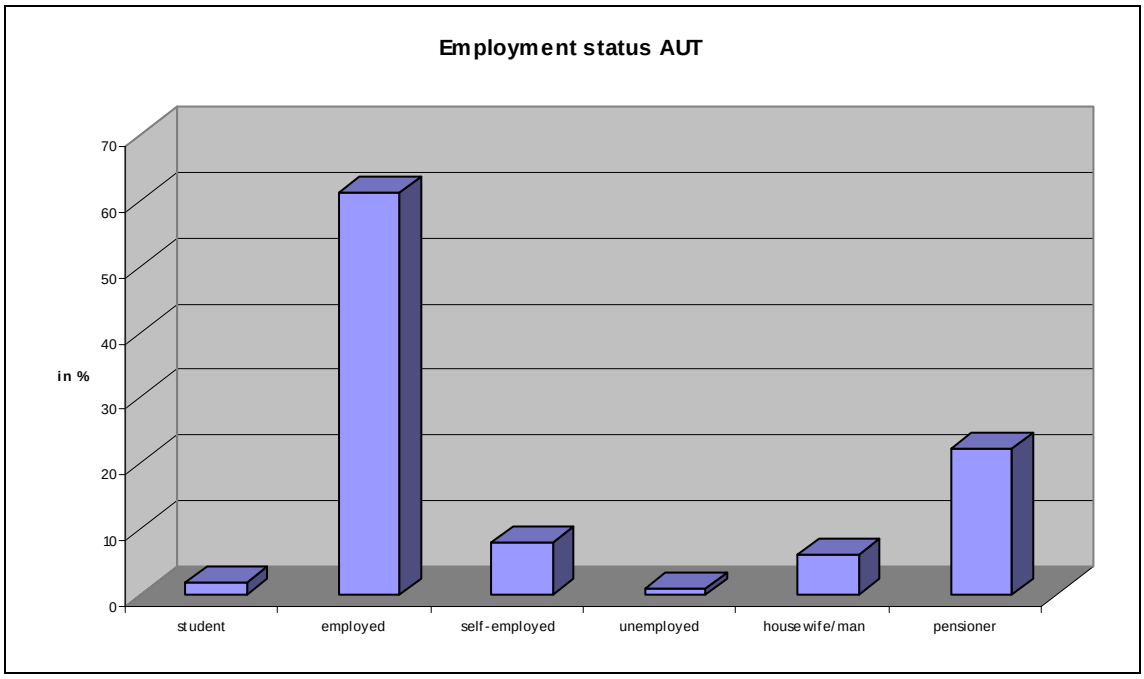


Figure 5-1-4 Number of people living in the household AUT

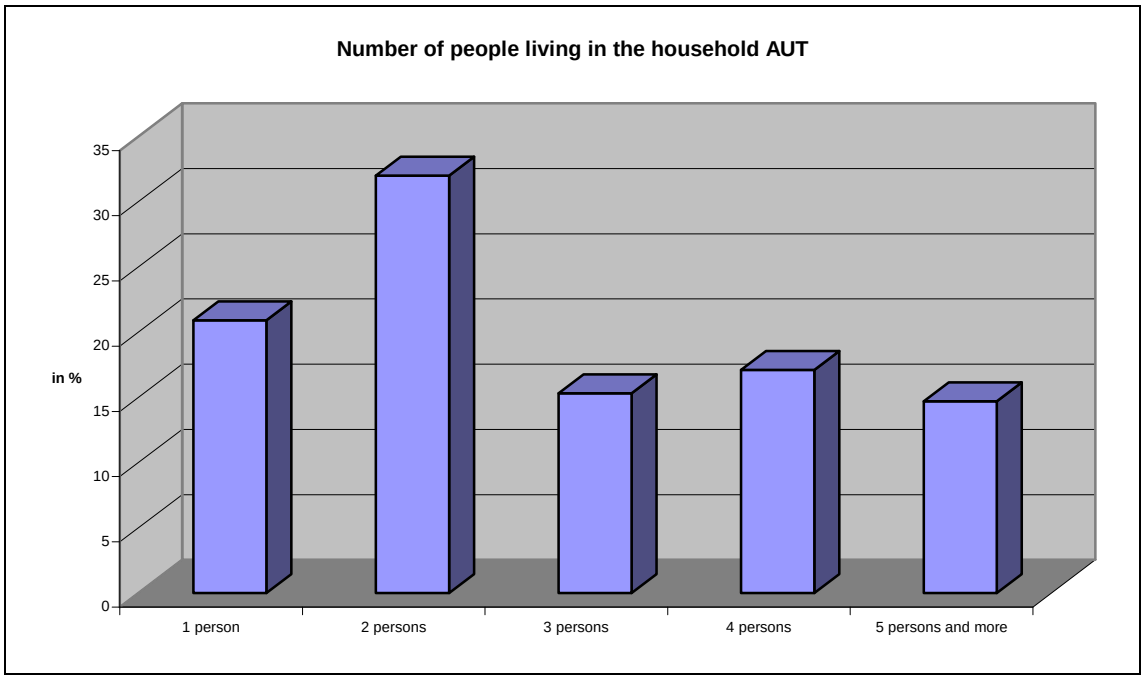
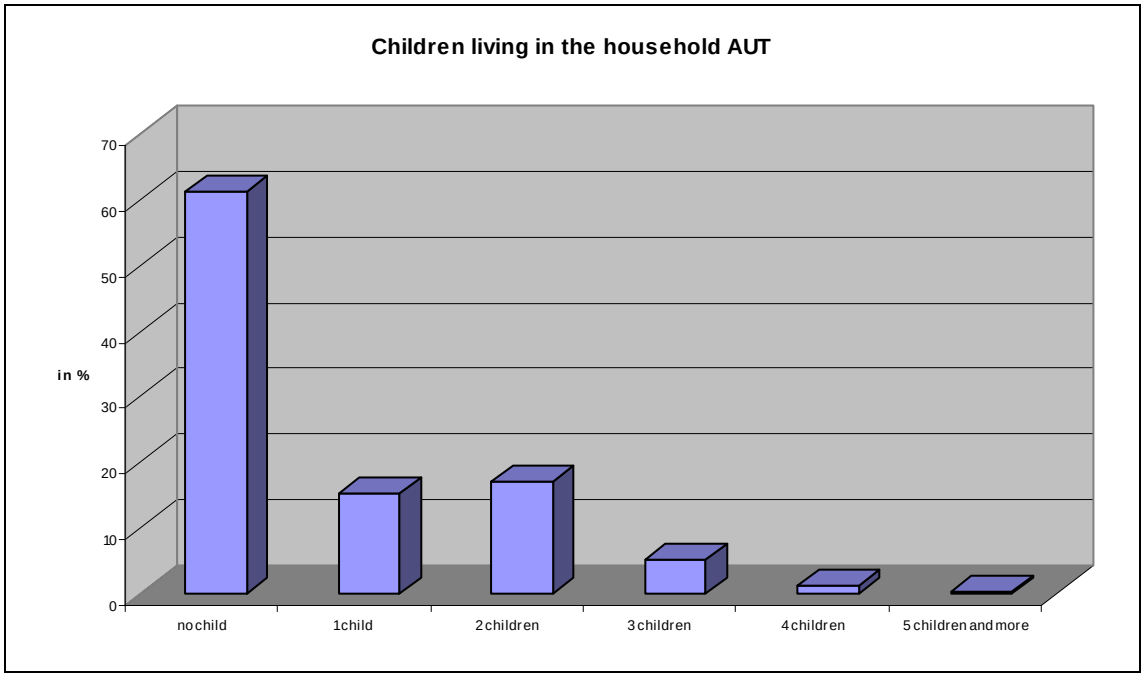
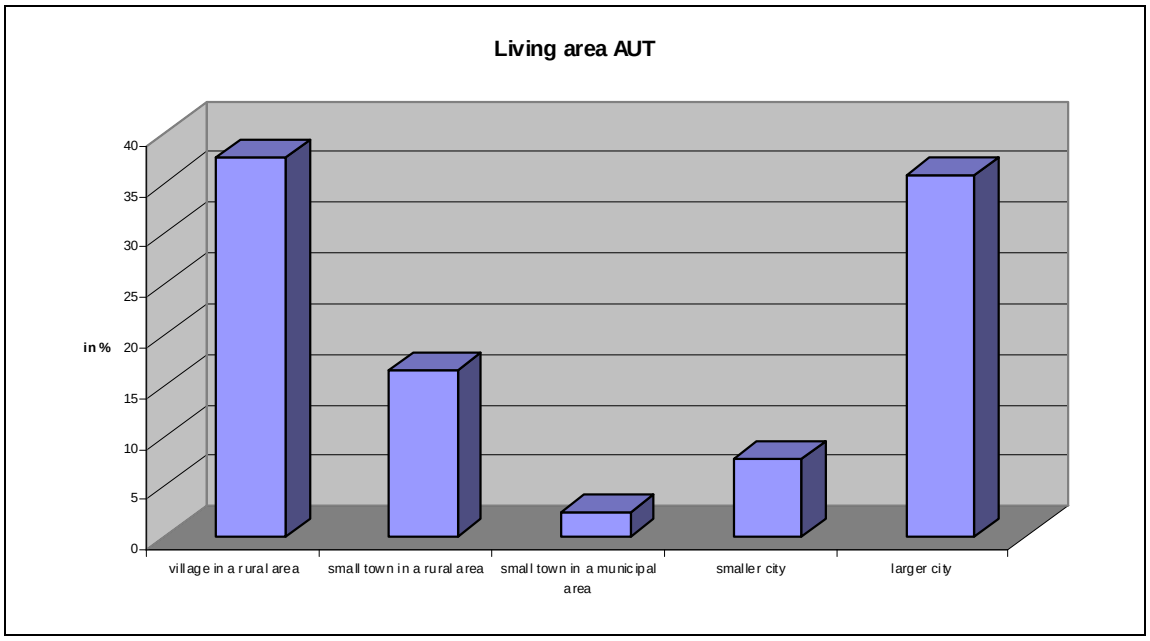


Figure 5-1-5 Number of children living in the household AUT



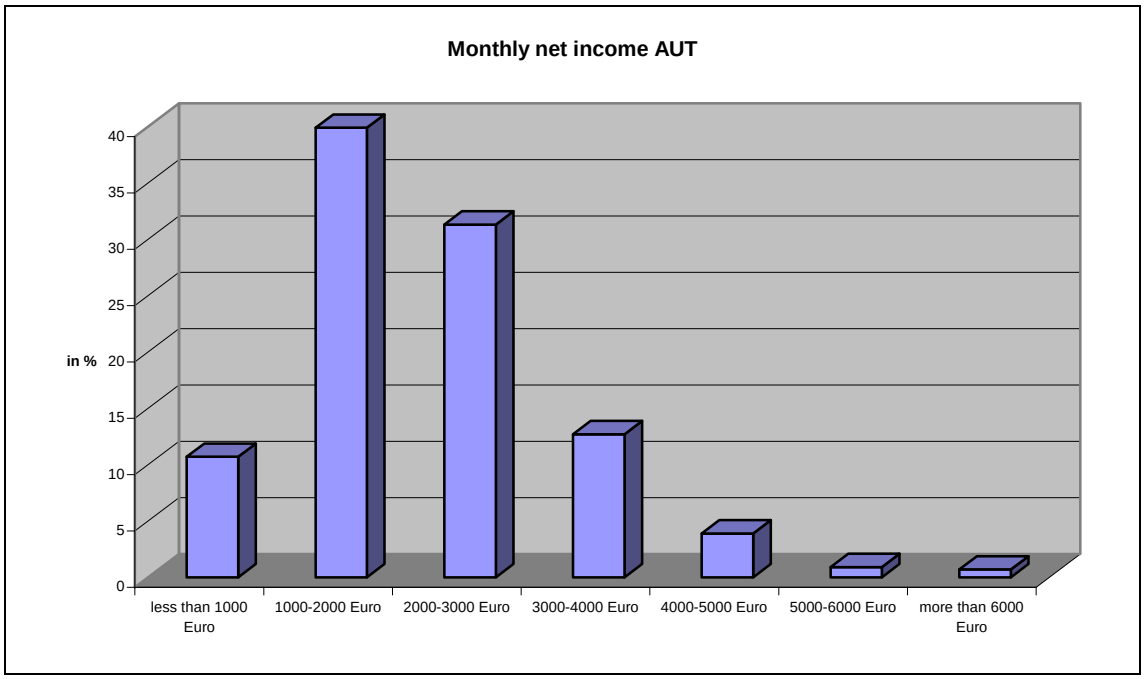
Concerning the living area there are nearly 40% of the respondents living in a village in a rural area (less than 1 000 habitants), 35% live in a larger city (more than 100 000 habitants), 16% in a small town in a rural area (less than 10 000 habitants) (see figure 5-1-6).

Figure 5-1-6 Living area AUT



In more than the half of the households several people have an income. 40% of the households earn 1000 to 2000 Euro, more than 30% of the households have a monthly net income between 2000 and 3000 Euro, 13% between 3000 and 4000 Euro, about 4% 4000 to 5000 Euro, 11% have less than 1000 Euro (see figure 5-1-7).

Figure 5-1-7 Monthly net income AUT



53% of the of the respondents live in single or two-family or terraced houses, 45% live in a flat. 20% of the respondents live in houses with solar collectors or photovoltaic panels.

5.2 Appliances in the households

The following appliances are used in the households:

Almost all households in Austria have washing machines and refrigerators, most of them electric cookers, dishwashers and deep freezers. Tumble dryers have one third of the households (see table 5-2-1).

Table 5-2-1 Using of household appliances

Household Appliance	**Austria (in %)**
Refrigerator	98
Washing machine	97
Electric cooker	93
Dishwasher	81
Deep freezer	81
Tumble dryer	30
Electric heated boiler (more than 80 litres)	16
Central heating pump	10
Electric water heater (up to 10 litres)	10
Electric space heating	3
Air conditioner	1

Which of these appliances have special features like start time delay, energy saving programs or use cheaper tariff options?

As you can see in the following table, the most common feature is an energy saving program for the washing machine, which can be found in about 71% of all households. Also 64% of the dishwashers and 37% of the tumble dryers have an energy saving program.

26% of the washing machines have start time delay, also 15% of the electric cookers and 11% of the dish washers.

31% of the tumble dryers are operated on a cheaper tariff option, also 8% of the electric heating boilers (see table 5-2-2).

Table 5-2-2 Special features of household appliances

1 = start time delay

2 = energy saving program

3 = cheaper tariff option

Household Appliance	**Austria (in %)**		
	1	**2**	**3**
Washing machine	26	71	1
Dishwasher	11	43	1
Tumble dryer	6	37	31
Refrigerator	-	-	2
Deep freezer	-	-	1
Electric cooker	15	-	2
Electric heated boiler (more than 80 litres)	2	-	8
Central heating pump	-	-	2
Electric water heater (up to 10 litres)	0	-	1
Electric space heating	0	-	1
Air conditioner	0	-	0

5.3 Use scenarios for smart appliances

In the questionnaire different scenarios were described regarding the usage of appliances in a smarter way. The respondents were asked whether they would accept such a scenario or not.

Scenario A: The washing machine starts after it receives a signal from the energy supplier that cheap and renewable energy is available. It is guaranteed that the process is finished at the desired time. Would people accept this for different appliances? And for financial or ecological or both reasons? (see figure 5-3-1).

Most of the residents would accept this utilisation, if financial and ecological reasons are given:

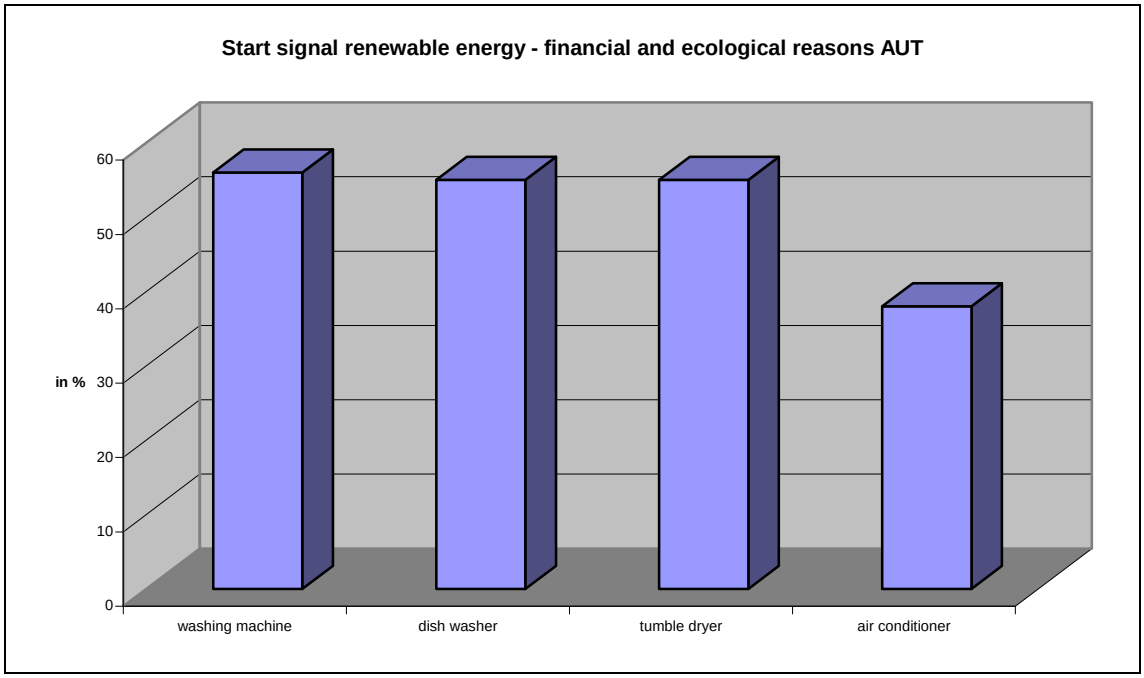
Washing machine: 56%. 12% would not accept it because they want to do the laundry immediately, they want to maintain control or they think that the laundry would stay too long in the washing machine.

Dishwasher: 55%. 12% would not accept it mostly because they want to wash the dishes on demand, they don't like that the dishwasher is not under their control or they don't use the dishwasher so often.

Tumble dryer: 55%. 14% wouldn't accept it because they think it's not flexible enough, the laundry should not stay wet for a longer time or they don't need a tumble dryer.

Air conditioner: Only 38%. Also 39% wouldn't accept it because they need the air conditioner on demand, they think air conditioning is unnecessary or they don't have one.

Figure 5-3-1 Start because of signal for cheap and renewable energy AUT



Scenario B: You are about to start the dishwasher when you receive the information that for financial and ecological reasons it would be better to start it at a specific time later that day. Would you postpone the start? (see figure 5-3-2).

53% of all respondents would postpone the start for financial and ecological reasons. If people don't want to do it (these are about 11%), it's mostly because they need clean dishes right away.

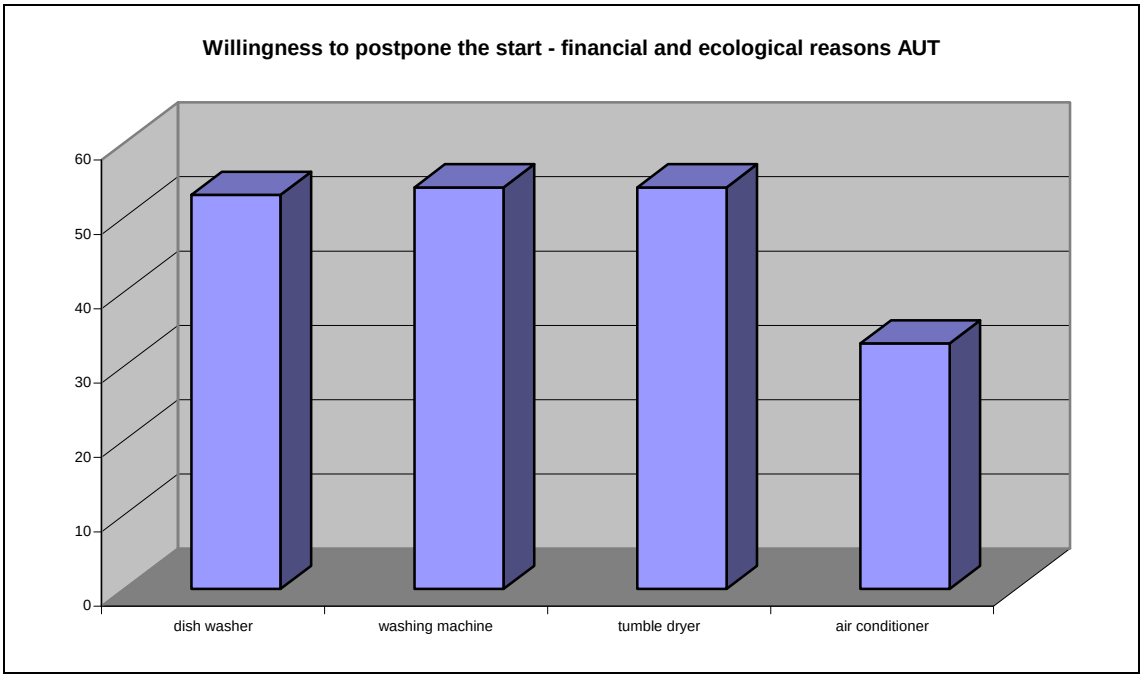
Washing machine: 54% would postpone the start because of financial and ecological reasons. About 10% would not do it mostly because this is not compatible with their daily life routine.

Tumble dryer: 54% would postpone the start because of financial and ecological reasons. 12% wouldn't do it mostly because this doesn't fit with their daily planning or

they need the tumble dryer right after the laundry has been washed in the washing machine.

Air conditioner: Only 33% of all respondents would postpone the start for financial and ecological reasons. 44% wouldn't do it because they need the air conditioner on demand or they think air conditioning is unnecessary.

Figure 5-3-2 Willingness to postpone the start of household appliances AUT



If yes, up to how long would the shift be acceptable?

Dishwasher: 30% the respondents would find it acceptable to postpone the start for any time if it is not longer than 24 hours, 10% would accept one hour, 15% would not postpone it longer than two hours, for 13% three hours would be acceptable (see table 5-3-1).

Table 5-3-1 Dishwasher – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
AUT	36	74	123	100	79	54	46	38	238
(n=788)	4,6%	9,4%	15,6%	12,7%	10%	6,9%	5,8%	4,8%	30,2%

Washing machine: 35% of the respondents would accept a shift any time if not longer than 24 hours, 14% would accept two hours, more than 10% would accept one, three or four hours respectively (see table 5-3-2).

Table 5-3-2 Washing machine – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
AUT	36	83	108	92	58	47	42	47	287
(n=800)	4,5%	10,4%	13,5%	11,5%	7,3%	5,9%	5,3%	5,9%	35,9%

Tumble dryer: 35% would accept a shift any time if not longer than 24 hours, 14% would accept two hours, 10% would accept one or three hours (see table 5-3-3).

Table 5-3-3 Tumble dryer – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
AUT	27	47	69	53	43	28	26	28	174
(n=495)	5,5%	9,5%	13,9%	10,7%	8,7%	5,7%	5,3%	5,7%	35,2%

Air conditioner: 21% would accept a shift any time if not longer than 24 hours, 34% would accept half an hour, 20% would accept one hour, 11% would accept two hours (see table 5-3-4).

Table 5-3-4 Air conditioner – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
AUT	77	46	25	13	6	6	6	2	48
(n=229)	33,6%	20,1%	10,9%	5,7%	2,6%	2,6%	2,6%	0,9%	21%

Scenario C: Imagine it is possible to set your freezer or fridge in a "smart operation mode" by pressing a button on it. This would cause breaks of two minutes maximum in its operation that you might not even notice. The food quality would definitely stay the same. Would you accept this? (see figure 5-3-3).

60% of all respondents in Austria would accept this for financial and ecological reasons, only four percent would not accept it mostly because they fear that this feature damages the appliance or that this will not save energy.

Dishwasher: 56% of the respondents would accept this for financial and ecological reasons. Eight percent would not want it mostly because they think this damages the appliance, this feature does not make sense or the energy saving is too small.

Tumbler dryer: 58% of the respondents would accept this for financial and ecological reasons. About eight percent would not want it mostly because they think breaks in the power are not good for the appliance or the cycle lasts too long.

Air conditioner: 53% of the respondents would accept this for financial and ecological reasons. 15% would not want it mostly because they need the air conditioner on demand and this is less comfortable or they think an air conditioner is unnecessary.

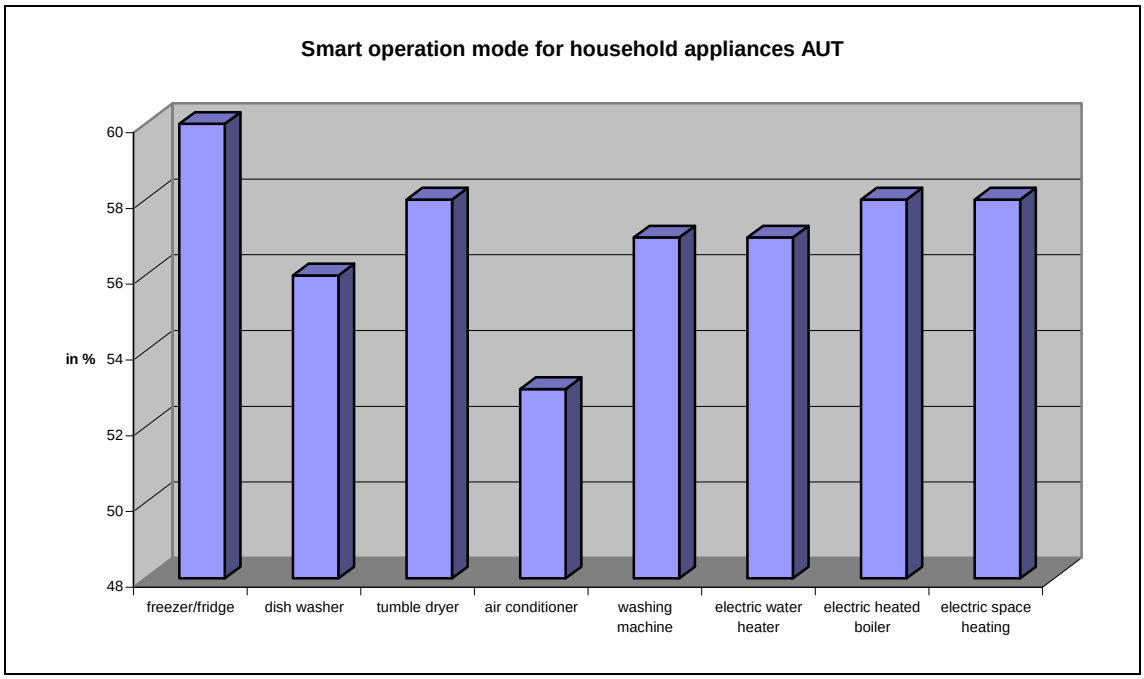
Washing machine: 57% of the respondents would accept this for financial and ecological reasons. Seven percent would not want it mostly because they think this would damage the appliance or the washing cycle would last too long.

Electric water heater: 57% of the respondents would accept this for financial and ecological reasons. 9% would not want it mostly because they need hot water on demand.

Electric heated boiler: 58% of the respondents would accept this for financial and ecological reasons. Five percent would not want it.

Electric space heating: 58% of the respondents would accept this for financial and ecological reasons. Eight percent would not want it mostly because they don't have an electric space heating.

Figure 5-3-3 Smart operation mode for household appliances AUT



5.4 Willingness to pay extra for smart appliances

Would the respondents be willing to pay extra for a freezer which uses stored electricity from a photovoltaic system and uses the stored cool during the night (by compensation via reduced electricity costs within 5 years) (see table 5-4-1).

55% of the respondents would pay 50 to 100 Euro more. About 13% would pay 100 to 200 Euro, about 22% would pay not more than 50 Euro.

If people are not willing to pay extra, this is because the refunding period is too long or the costs for this investment are too high.

Would people be willing to pay extra for washing machines or dishwashers which use hot instead of cold water (water heated by a solar collector)? Costs are saved for heating the water up. These types cost more than others but this is compensated via the energy savings within five years (see table 5-4-2).

56% of the respondents would pay 50 to 100 Euro extra for such a washing machine or dishwasher. 13% would pay 100 to 200 Euro extra, about 18% would pay not more than 50 Euro extra.

13% are not willing to pay extra for such an appliance mostly because the costs for the investment are too high, installation is too complex or they possess new appliances.

Table 5-4-1 Willingness to pay extra for a freezer with stored electricity

	0-50€	**50-100€**	**100-200€**	**I would not be willing to pay extra**
AUT	198	491	114	88
(n=891)	22,2%	55,1%	12,8%	9,9%

Table 5-4-2 Willingness to pay extra for a washing machine/dish washer with stored electricity

	0-50€	**50-100€**	**100-200€**	**i would not be willing to pay extra**
AUT	156	491	116	114
(n=877)	17,8%	56%	13,2%	13%

5.5 Acceptance of monitoring and information

For providing the appliances with cheap and renewable energy the energy supplier might have to monitor the energy consumption of his clients constantly. The information would be treated confidential and deleted after some time. Would the respondents accept this? (see table 5-5-1).

Nearly 90% of the respondents would accept this (definitely or probably), about 46% say definitely yes.

Table 5-5-1 Acceptance of monitoring

	definitely yes	**yes, probably**	**probably not**	**definitely not**
AUT	411	380	65	34
(n=890)	46,2%	42,7%	7,3%	3,8%

How would people prefer to be informed about the price and the availability of cheap and renewable energy from the energy supplier? (see table 5-5-2).

One third in total would like to get the information via internet/e-mail, about 30% would prefer automatic regulation or an information on display of the appliance, 27% would like to have it on a display in the flat, about 11% want to get it by SMS.

Table5-5-2 Information about price and availability (multiple responses)

	via internet/ e-mail	**by SMS**	**on display unit in my flat**	**on display of the appliance**	**prefer automatic regulation**
AUT	313	107	257	278	287
(n=848)	33,4%	11,4%	27,4%	29,6%	30,6%

5.6 Attitudes to smart appliances

Questions regarding the attitude towards smart appliances were asked in the questionnaire. The following section summarizes the answers to these questions (see figure 5-6-1).

“Smart appliances will play a bigger role in the next ten years.” 70% in total agree completely or mostly with this statement.

“Smart appliances will be too expensive for the average household.” 57% agree completely or mostly with this statement.

“Smart appliances are complex to operate.” Only 34% of the respondents agree completely or mostly.

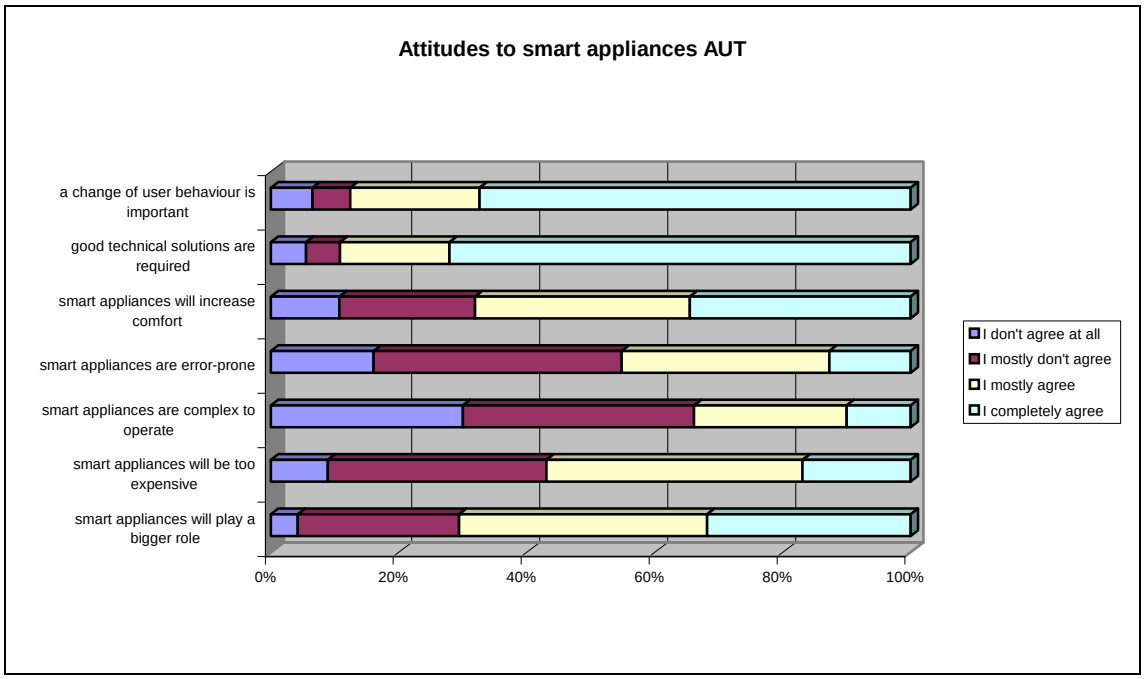
“Smart appliances are error-prone.” 45% of the respondents agree completely or mostly.

“Smart appliances will increase comfort.” 68% agree completely or mostly.

“To reduce energy consumption in households good technical solutions are required.” 90% agree completely or mostly.

“To reduce energy consumption in households a change of user behaviour is important.” 88% agree completely or mostly.

Figure 5-6-1 Attitudes to smart appliances AUT



5.7 Ecological awareness and engagement of the respondents

There were a few questions in the questionnaire to check the ecological awareness and engagement of the respondents.

45% know exactly the total of their electricity bill without looking it up, 42% know it roughly and only about 12% do not know it without looking it up (see figure 5-7-1).

22% purchase green energy (see figure 5-7-2).

64% of the respondents use energy saving bulbs often.

95% of all respondents let dishes cool down, before they put them in the refrigerator.

86% of all respondents are aware of energy labels and often buy appliances with A, A+ or A++.

91% of the people often operate the washing machine or the dishwasher only when they are full.

85% of all respondents turn down heating control when leaving home for a longer period.

49% of the respondents often use public transport, bicycle or walking for daily routine travels (see figure 5-7-3).

Figure 5-7-1 Knowledge about energy bill without looking it up AUT

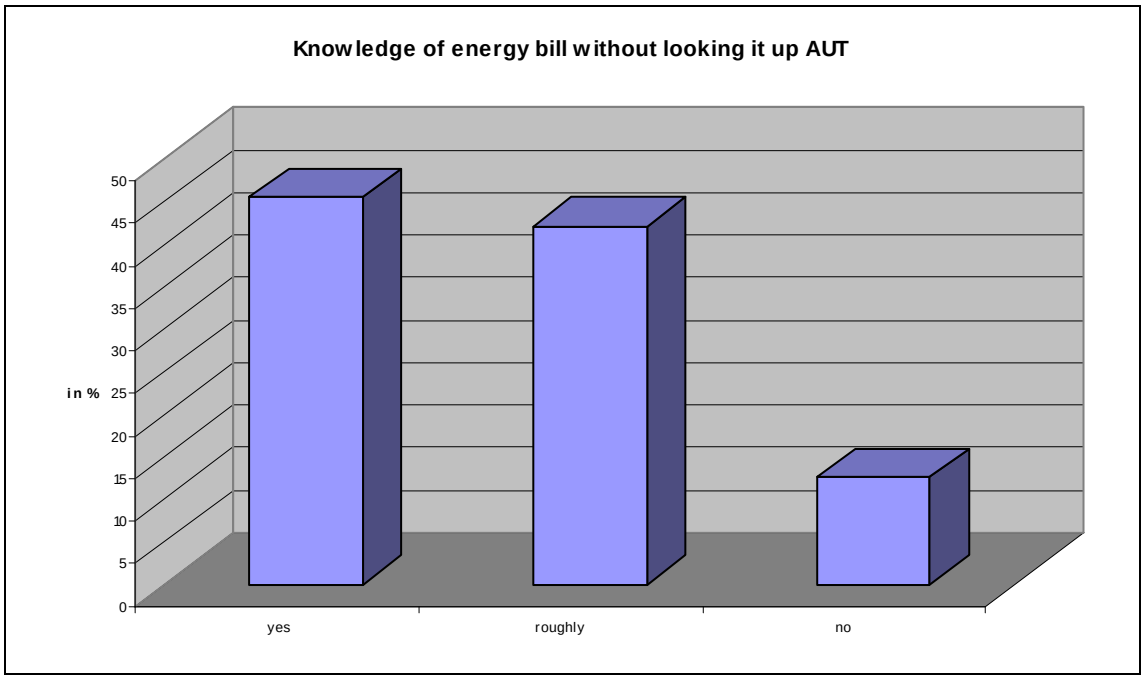


Figure 5-7-2 Purchase of green energy AUT

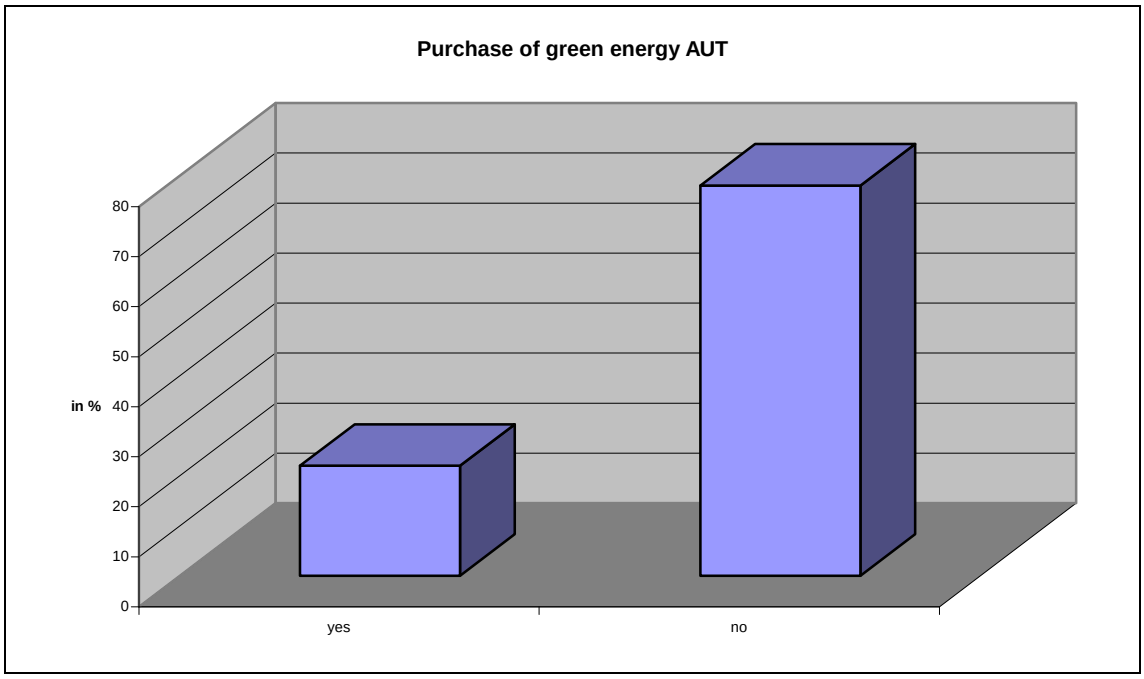
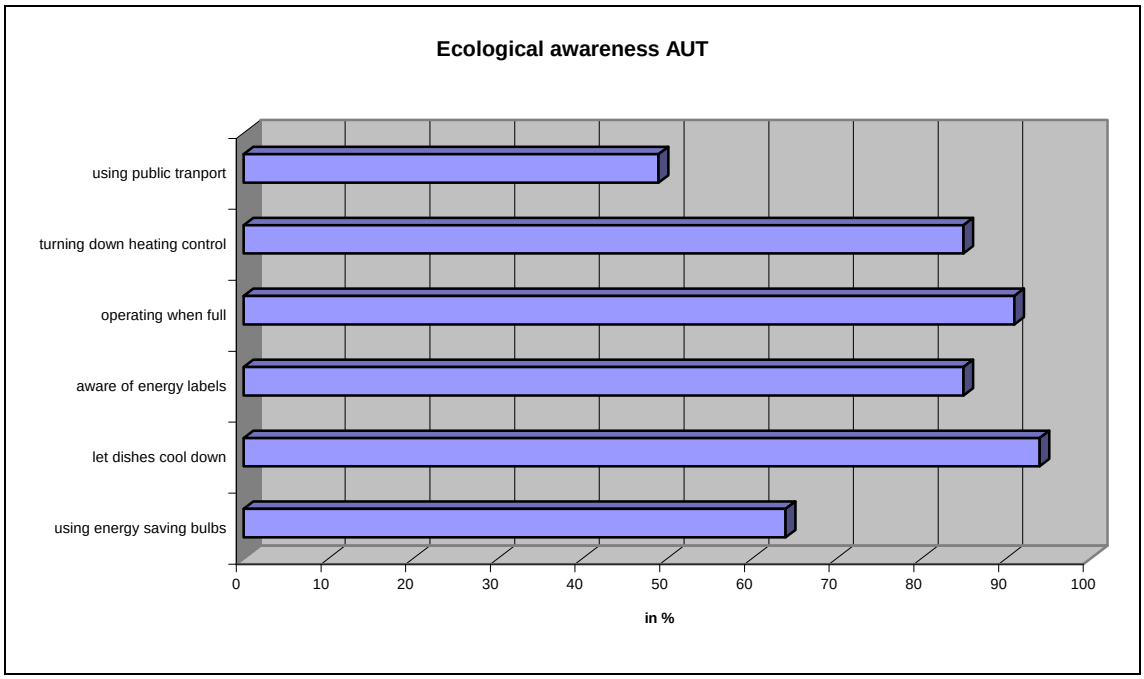


Figure 5-7-3 Ecological awareness AUT



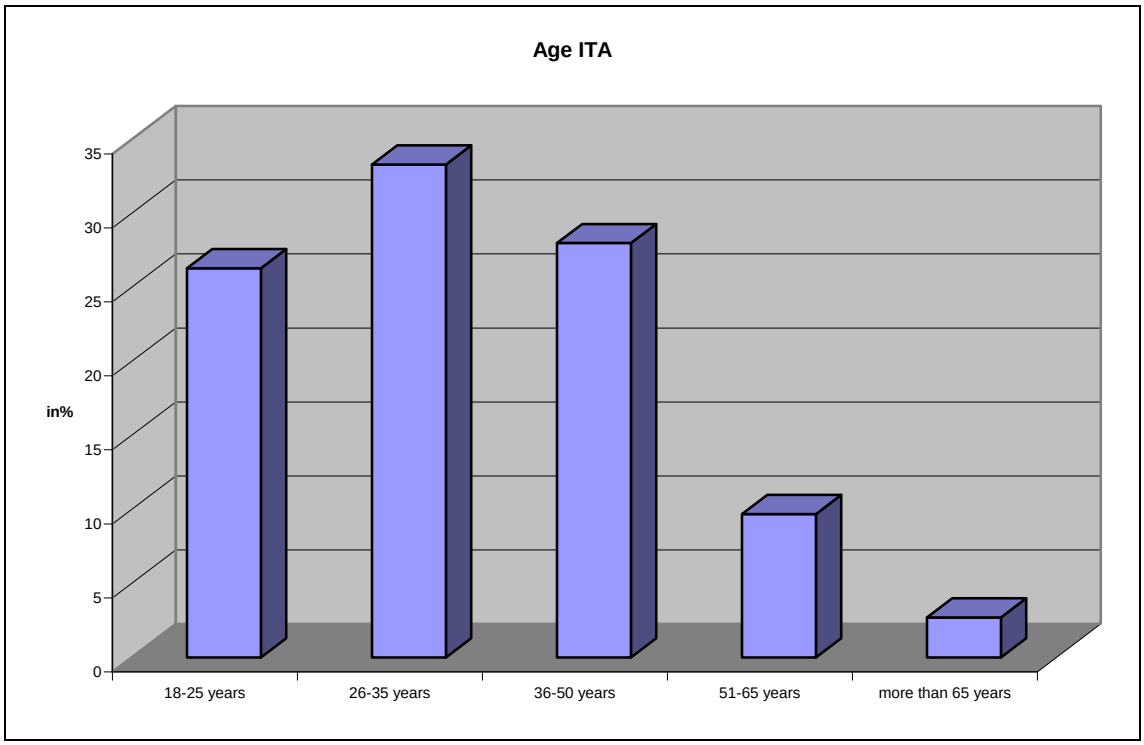
6 Italy

6.1 Socio-economic data

In Italy 232 questionnaires were filled in. 44% of the respondents are male, 55% are female.

Regarding the age there are about 30% between 18 to 25 years old, a little more than 30% between 26 and 35 years and also 30% between 36 and 50 years old. 12% are more than 50 years old (see figure 6-1-1).

Figure 6-1-1 Age ITA



Almost half of the respondents in Italy have academic degrees, 37% A-Level and 12% compulsory school (see figure 6-1-2).

35% of the respondents are employed, 27% self-employed, 25% are students (see figure 6-1-3).

30% work or have worked in a technical field, 70% didn't.

In 28% of all households two or three persons are living, in 25% of the households four persons are living, 12% have five persons or more, only 8% are one person households (see figure 6-1-4).

In Italy we have 75% of the households with no child, 13 percent have one child, about 5% two children (see figure 6-1-5).

Figure 6-1-2 Highest education level ITA

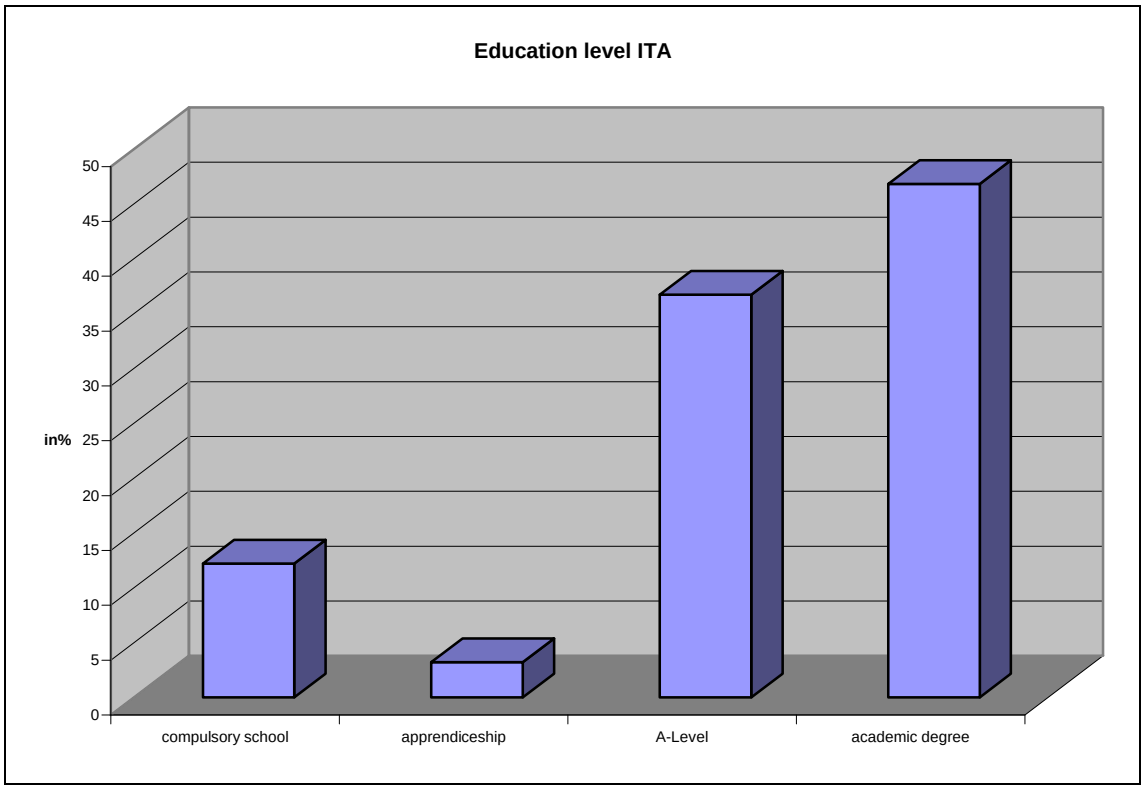


Figure 6-1-3 Employment status ITA

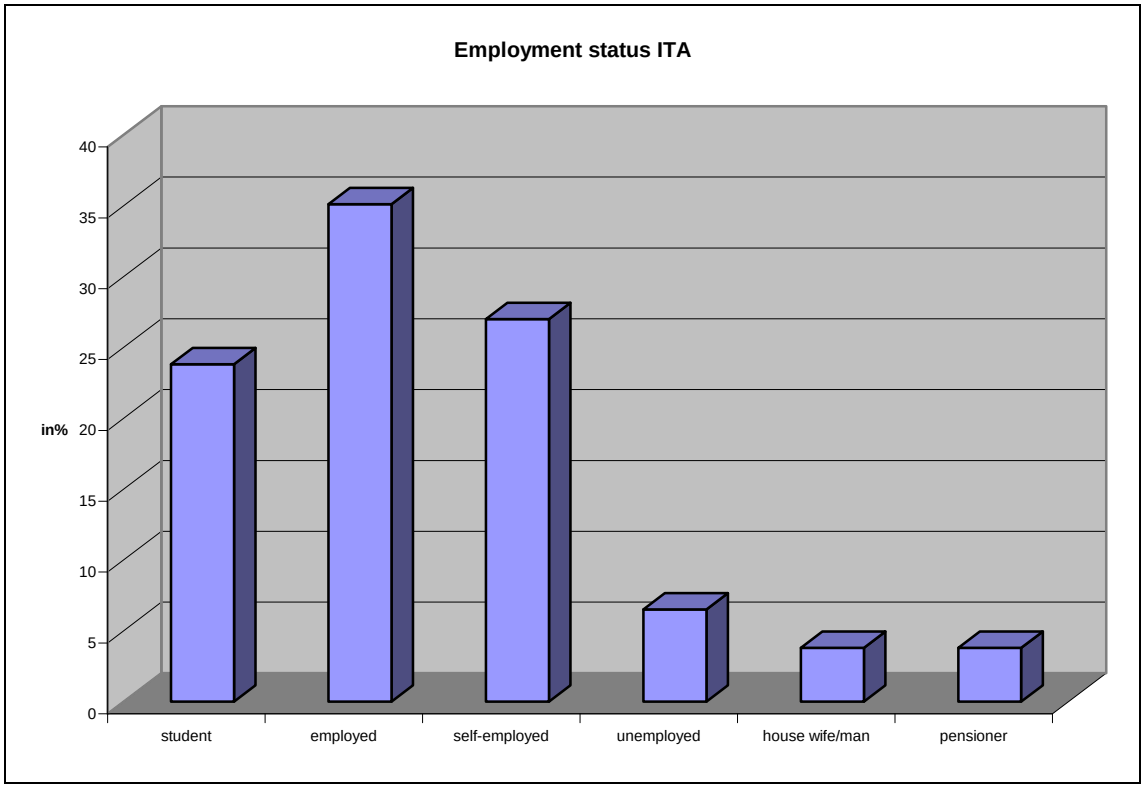


Figure 6-1-4 Number of people living in the household ITA

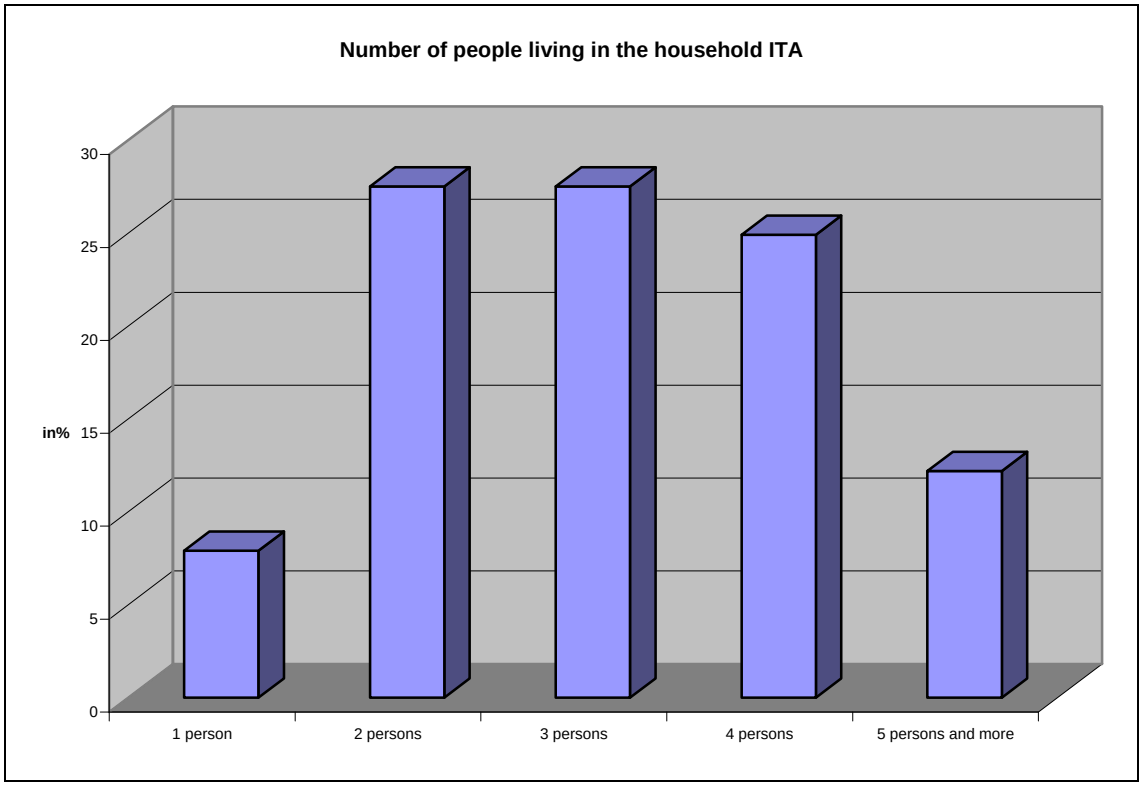
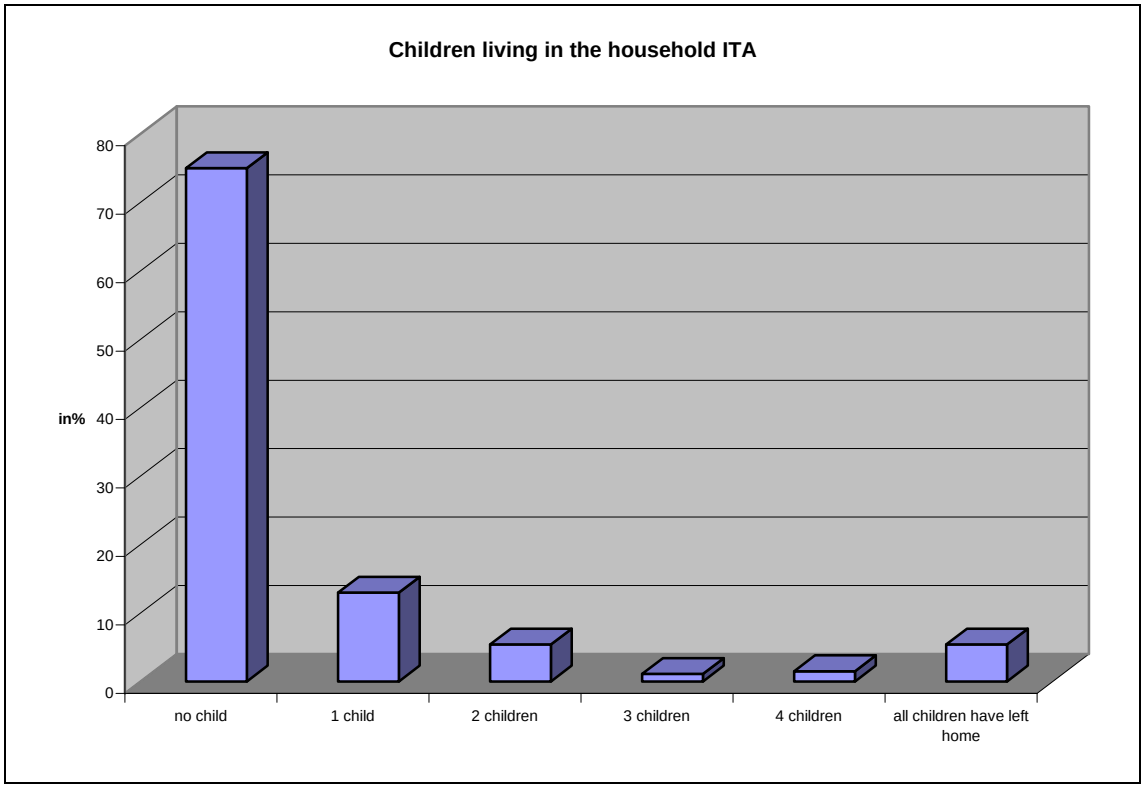
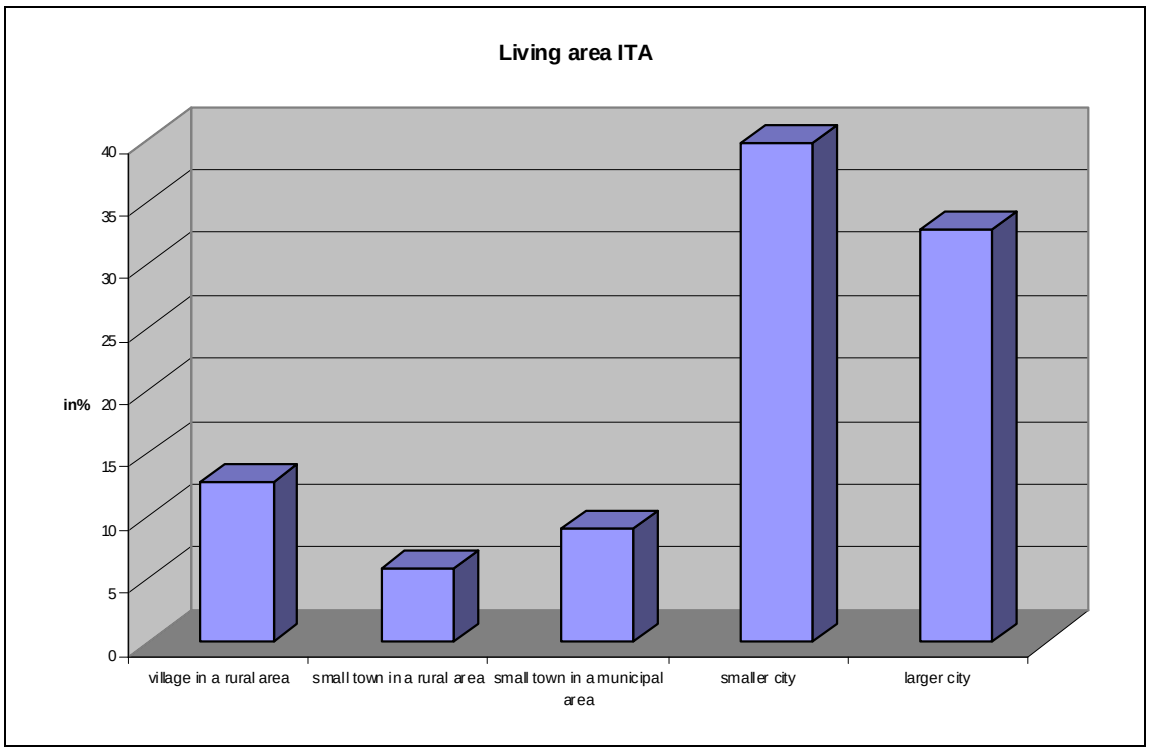


Figure 6-1-5 Number of children living in the household ITA



40% of the respondents live in a smaller city (more than 100 000 habitants), 30% live in a larger city (less than 100 000 habitants), 13% live in a village in a rural area (less than 1 000 habitants), 9% are living in a small town in a municipal area (less than 10 000 habitants) (see figure 6-1-6).

Figure 6-1-6 Living area ITA

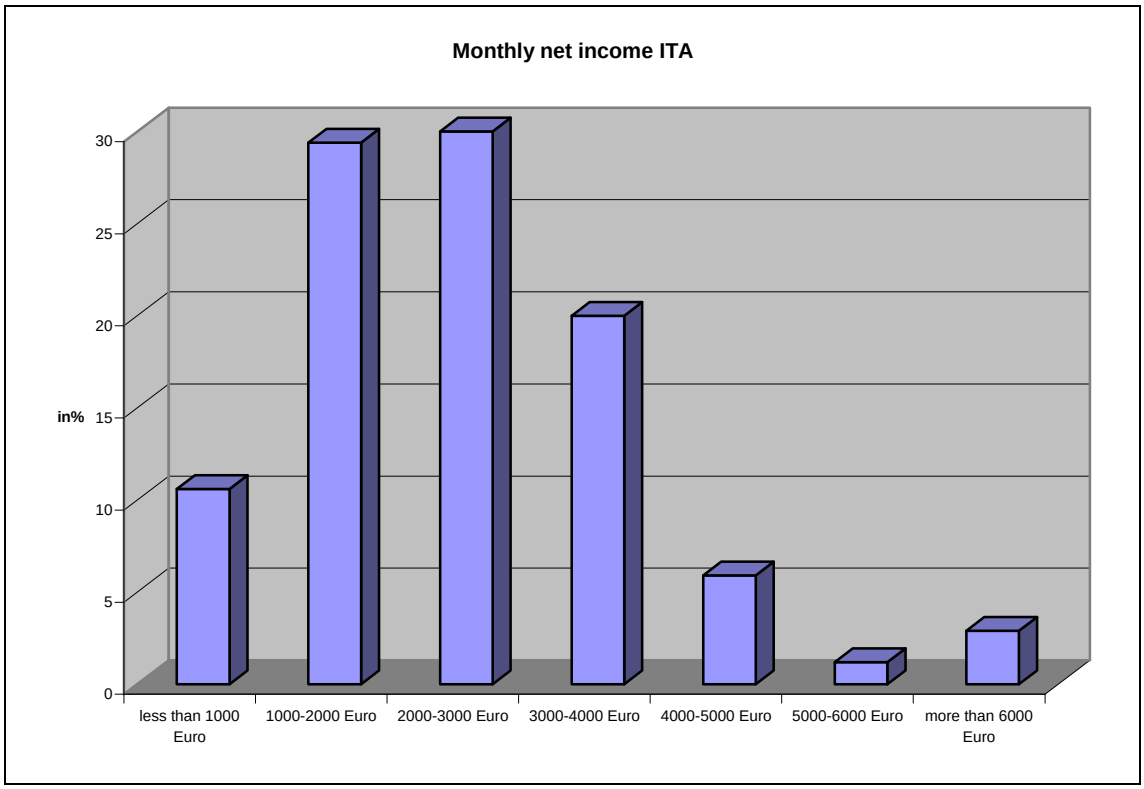


In total in 70% of the households several people have an income.

30% of the households earn between 1000 and 2000 or between 2000 and 3000 Euro each, 20% of the households have a monthly net income between 3000 and 4000 Euro, 10% of the households earn less than 1000 Euro (see figure 6-1-7).

60% of the respondents live in a flat or in a residential house, almost 40% are living in a house. More than 80% of the respondents live in houses with solar collectors or photo-voltaic panels.

Figure 6-1-7 Monthly net income ITA



6.2 Appliances in the households

The following appliances are used in the households:

Almost all households possess washing machines and refrigerators, almost 60% of them have deep freezers and dish washers. More than 30% of the households have electric cookers, less than 30% central heating pumps, air conditioners can be found in about 30% of the households (see table 6-2-1).

Table 6-2-1 Use of household appliances

Household Appliance	**Italy (in %)**
Washing machine	98
Refrigerator	99
Deep freezer	57
Electric cooker	33
Central heating pump	26
Tumble dryer	7
Dishwasher	58
Electric heated boiler (more than 80 litres)	8
Electric water heater (up to 10 litres)	14
Electric space heating	9
Air conditioner	27

Which of these appliances have special features like start time delay, energy saving programs or use cheaper tariff options?

As can be seen in the following table, the most common feature is an energy saving program for the washing machine (60%). Energy saving programs are also used for dishwashers (33%).

37% of the washing machines have start time delay, also 16-17% of the dishwashers, electric cookers and air conditioners. About 27% of the washing machines are operated with cheaper tariff option, also about 13% of the refrigerators and the dishwashers, 8% of the deep freezers (see table 6-2-2).

Table 6-2-2 Special features of household appliances

1 = start time delay (timer)

2 = energy saving program

3 = cheaper tariff option

Household Appliance	**Italy (in %)**		
	1	**2**	**3**
Washing machine	37	60	27
Refrigerator	-	-	13
Deep freezer	-	-	8
Electric cooker	17	-	4
Central heating pump	-	-	2
Dishwasher	17	33	13
Tumble dryer	3	5	5
Electric heated boiler (more than 80 litres)	1	-	1
Electric water heater (up to 10 litres)	7	-	2
Electric space heating	6	-	0,5
Air conditioner	16	-	6

6.3 Use scenarios for smart appliances

In the questionnaires different scenarios were described regarding the usage of appliances in a smarter way. The respondents were asked whether they would accept such a scenario or not.

Scenario A: The washing machine starts after it receives a signal from the energy supplier that cheap and renewable energy is available. It is guaranteed that the process is finished at the desired time. Would people accept this for different appliances? (see figure 6-3-1).

Most of the residents would accept this utilisation, if financial and ecological reasons are given:

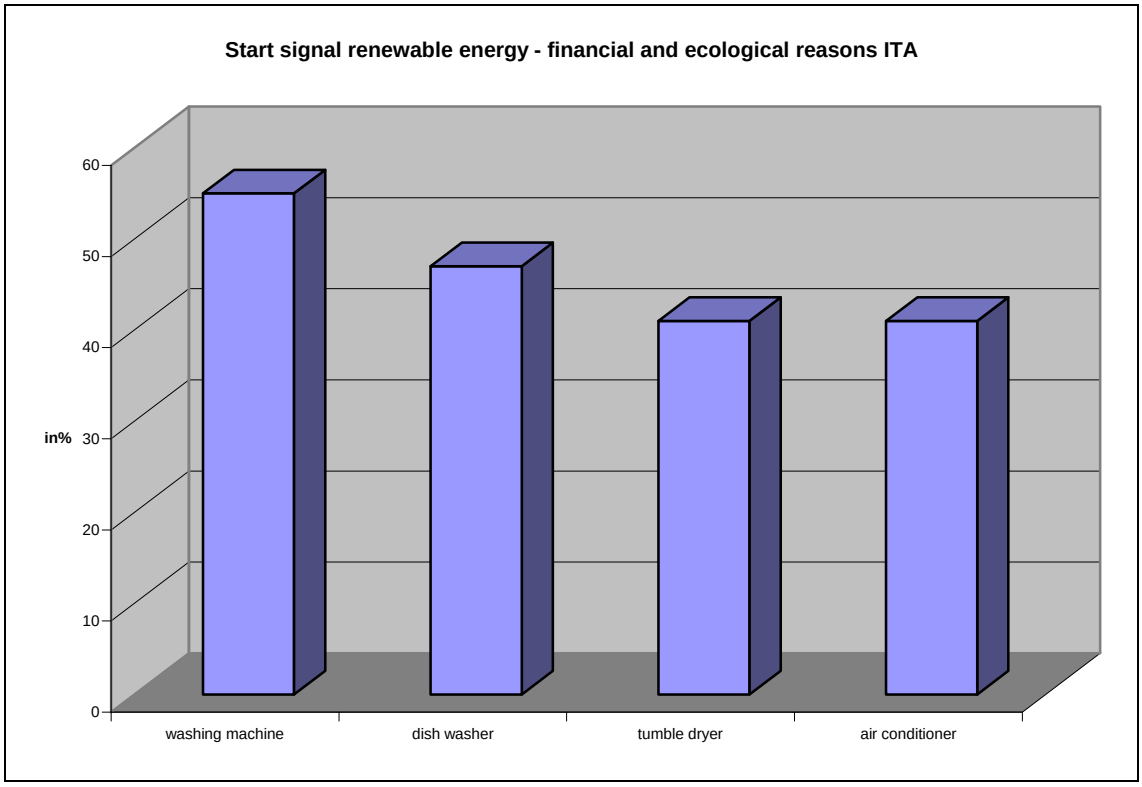
Washing machine: 55%. 3% would not accept it mostly because they want to use the device when they need it.

Dishwasher: 47%. 6% would not accept it mostly because they don't use a dishwasher or don't find it useful.

Tumble dryer: 41%. 15% don't use this device or don't find it useful.

Air conditioner: 41%. 19% wouldn't accept it because they need the air conditioner on demand or they don't have one.

Figure 6-3-1 Start because of signal for cheap and renewable energy ITA



Scenario B: You are about to start the dishwasher when you receive the information that for financial and ecological reasons it would be better to start it at a specific time later that day. Would you postpone the start? (see figure 6-3-2).

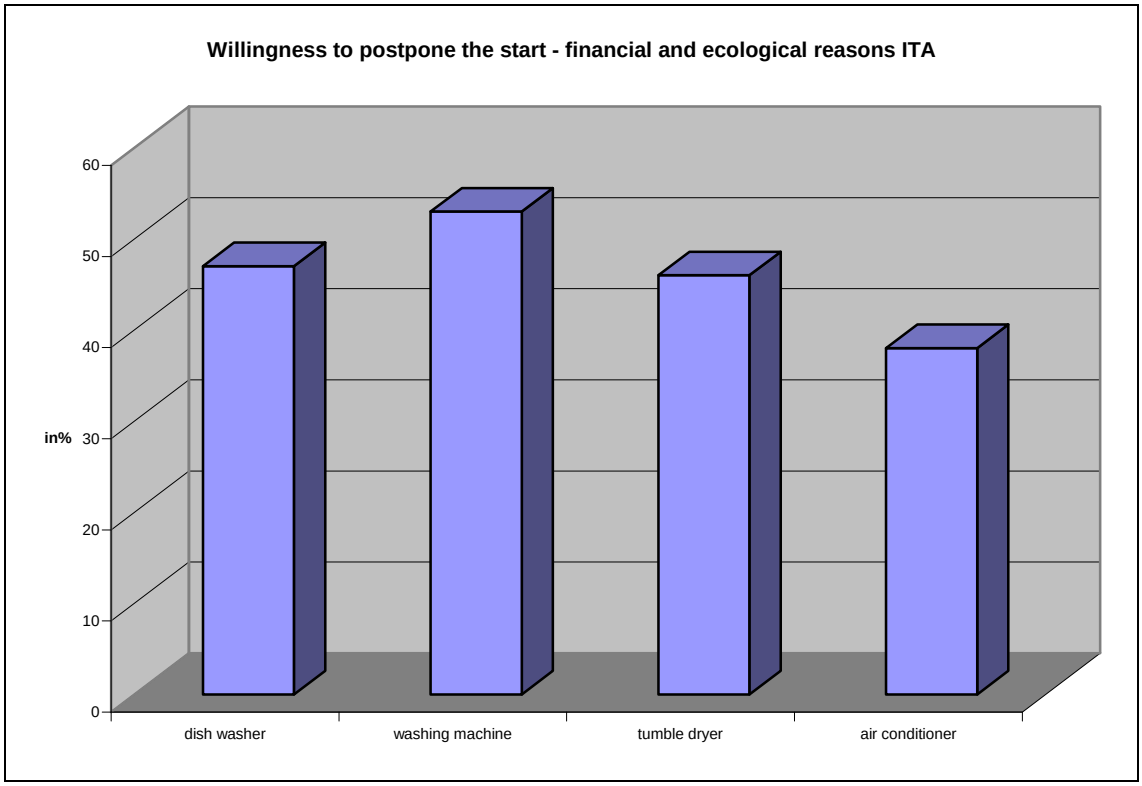
47% of all respondents would postpone the start for financial and ecological reasons. If people don't want to do it (these are about 10%), it's mostly because of time organisation - they need clean dishes right away.

Washing machine: 53% would postpone the start because of financial and ecological reasons. About five percent would not do it mostly because they don't want to leave wet laundry for too long in the machine.

Tumble dryer: 46% would postpone the start because of financial and ecological reasons. 14% wouldn't do it mostly because of their time organisation and because they need their clothes soon.

Air conditioner: 38% of all respondents would postpone the start for financial and/or ecological reasons. 30% wouldn't do it because they need the air conditioner on demand or they don't use this appliance.

Figure 6-3-2 Willingness to postpone the start of household appliances ITA



If yes, up to how long would the shift be acceptable?

Dishwasher: In total 56% of the respondents would find it acceptable to postpone the start for any time if it is not longer than 24 hours, for 15% it should not be longer than two hours (see table 6-3-1).

Table 6-3-1 Dishwasher – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
ITA	7	7	10	11	13	7	8	10	92
(n=165)	4,2%	4,2%	6,1%	6,7%	7,9%	4,2%	4,8%	6,1%	55,8%

Washing machine: More than half of the respondents would accept a shift any time if not longer than 24 hours, 20% would accept two hours (see table 6-3-2).

Table 6-3-2 Washing machine – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
ITA	6	13	16	9	9	2	7	15	101
(n=174)	3,4%	7,3%	9%	5,1%	5,1%	1,1%	3,9%	8,4%	56,7%

Tumble dryer: 61% would accept a shift any time if not longer than 24 hours, 17% would accept two hours (see table 6-3-3).

Table 6-3-3 Tumble dryer – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
ITA	4	9	7	5	4	3	5	9	74
(n=120)	3,3%	7,5%	5,8%	4,2%	3,3%	2,5%	5,2%	7,5%	61,7%

Air conditioner: 40% would accept a shift any time if not longer than 24 hours, 25% would only accept half an hour, 11% would accept one hour, 12% would accept two hours (see table 6-3-4).

Table 6-3-4 Air conditioner – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
ITA	29	13	14	6	3	1	0	3	45
(n=114)	25,4%	11,4%	12,3%	5,3%	2,6%	0,9%	0%	2,6%	39,5%

Scenario C: Imagine it is possible to set your freezer or fridge in a "smart operation mode" by pressing a button on it. This would cause breaks of two minutes maximum in its operation that you might not even notice. The food quality would definitely stay the same. Would you accept this? (see figure 6-3-3).

55% of all respondents would accept this for financial and ecological reasons, only 4% would not accept it because mostly they have no trust in this function.

Dishwasher: 46% of the respondents would accept this for financial and ecological reasons. Nine percent would not want it mostly because they don't use one or because they think this would damage the appliance.

Tumbler dryer: 45% of the respondents would accept this for financial and ecological reasons. 12% would not want it mostly because they don't have one or because they think this would damage the appliance.

Air conditioner: 45% of the respondents would accept this for financial and ecological reasons. 11% would not want it mostly because they don't have one or they need the air conditioner on demand.

Washing machine: 52% of the respondents would accept this for financial and ecological reasons. About five percent would not want it mostly because they think this function would damage the device and they don't trust it.

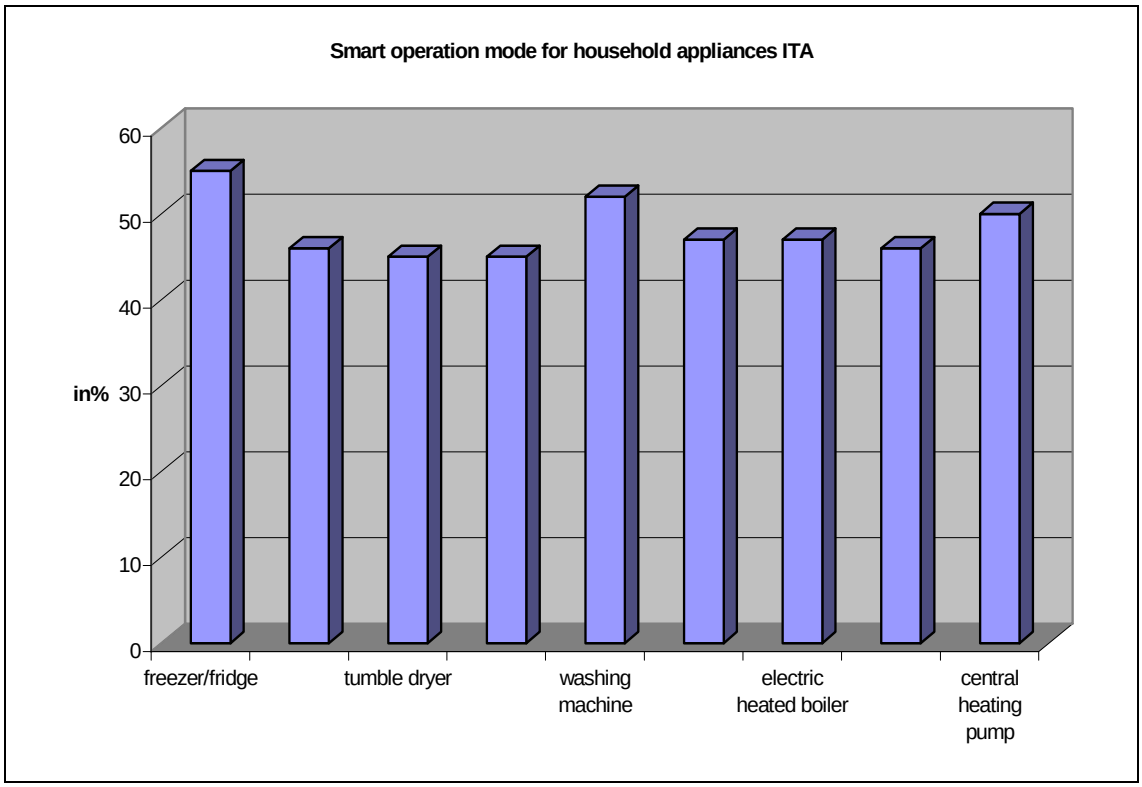
Electric water heater: 47% of the respondents would accept this for financial and ecological reasons. 12% would not want it mostly because they don't use this device, they think the appliance could be damaged or hot water is needed on demand.

Electric heated boiler: 47% of the respondents would accept this for financial and ecological reasons. 11% would not want it mostly because they don't use this device.

Electric space heating: 46% of the respondents would accept this for financial and ecological reasons. 10% would not want it mostly because they don't use this device.

Central heating pump: 49% of the respondents would accept this for financial and ecological reasons. Seven percent would not want it.

Figure 6-3-3 Smart operation mode for household appliances ITA



6.4 Willingness to pay extra for smart appliances

Would the respondents be willing to pay extra for a freezer which uses stored electricity from a photovoltaic system and uses the stored cool during the night (by compensation via reduced electricity costs within 5 years) (see table 6-4-1).

Almost half of the respondents would pay 50 to 100 Euro more. About a third would pay 100 to 200 Euro, about 14% would pay not more than 50 Euro.

If people are not willing to pay extra, this is because of the following reasons: They think this contribution should be done by the companies or the government or there should be no extra price for environmental friendly devices.

Would people be willing to pay extra for washing machines or dishwashers which use hot instead of cold water (water heated by a solar collector)? Costs are saved for heating the water up. These types cost more than others but this is compensated via the energy savings within five years (see table 6-4-2).

Almost half of the respondents would pay 50 to 100 Euro extra for such a washing machine or dishwasher. About 30% would pay 100 to 200 Euro extra, about 17% would pay not more than 50 Euro extra.

Some people are not willing to pay extra for such an appliance because they think this should be supported by the companies or the government and not by the costumers. Also they have no trust in this device.

Table 6-4-1 Willingness to pay extra for a freezer with stored electricity

	0-50€	**50-100€**	**100-200€**	**I would not be willing to pay extra**
ITA	26	87	64	11
(n=188)	13,8%	46,3%	34%	5,9%

Table 6-4-2 Willingness to pay extra for a washing machine/dish washer with stored electricity

	0-50€	**50-100€**	**100-200€**	**i would not be willing to pay extra**
ITA	32	87	61	7
(n=187)	17,1%	46,5%	32,6%	3,7%

6.5 Acceptance of monitoring and information

For providing the appliances with cheap and renewable energy the energy supplier might have to monitor the energy consumption of his clients constantly. The information would be treated confidential and deleted after some time. Would the respondents accept this? (see table 6-5-1).

92% of the respondents would accept this (definitely or probably), 56% say definitely yes.

Table 6-5-1 Acceptance of monitoring

	definitely yes	**yes, probably**	**probably not**	**definitely not**
ITA	103	66	11	3
(n=183)	56,3%	36,1%	6%	1,6%

How would people prefer to be informed about the price and the availability of cheap and renewable energy from the energy supplier? (see table 6-5-2).

44% in total would like to get the information via internet/e-mail, 30% on the display of the appliance or on a display unit in their flat, 14% want to get it by SMS and 12% prefer an automatic regulation.

Table 6-5-2 Information about price and availability (multiple responses)

	via internet/ e-mail	**by SMS**	**on display unit in my flat**	**on display of the appliance**	**prefer automatic regulation**
ITA	82	26	57	58	23
(n=187)	43,9%	13,9%	30,3%	30,9%	12,3%

6.6 Attitudes to smart appliances

Questions regarding the attitude towards smart appliances were asked in the questionnaire. The following section summarizes the answers to these questions (see figure 6-6-1).

“Smart appliances will play a bigger role in the next ten years.” 80% agree completely or mostly with this statement.

“Smart appliances will be too expensive for the average household.” 56% agree completely or mostly with this statement.

“Smart appliances are complex to operate.” Only 17% agree completely or mostly.

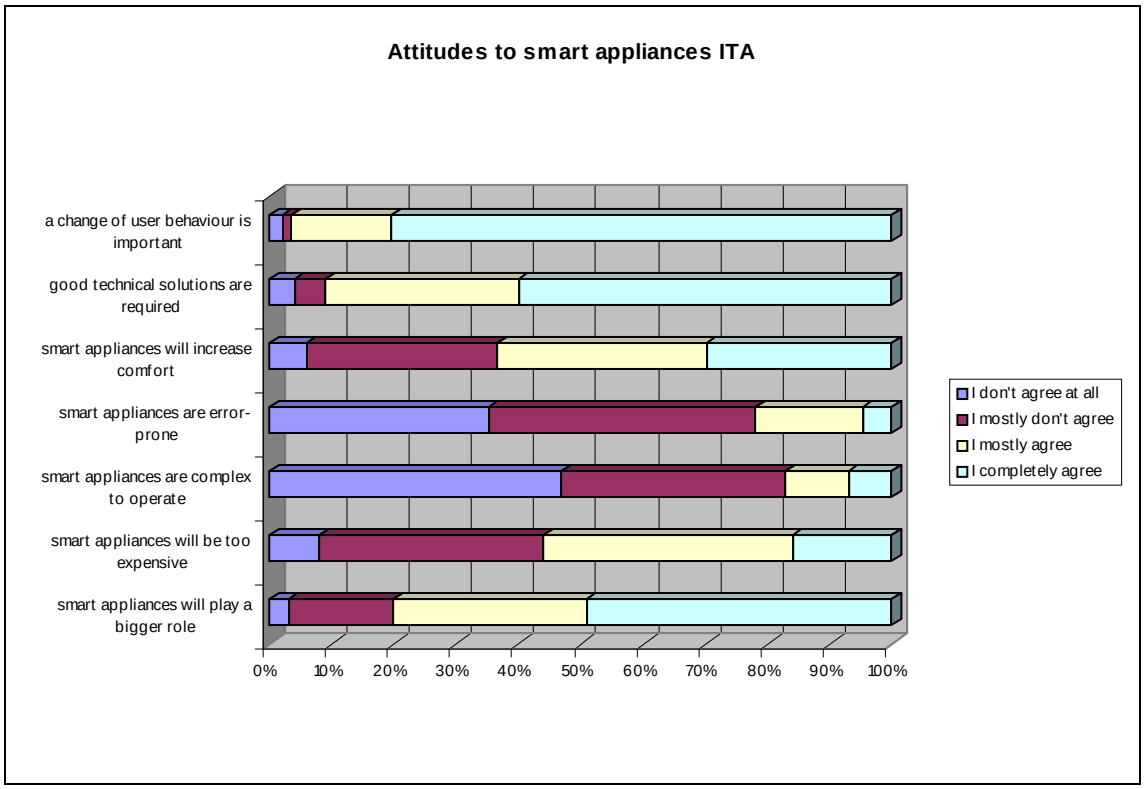
“Smart appliances are error-prone.” Only 23% agree completely or mostly.

“Smart appliances will increase comfort.” 64% in total agree completely or mostly.

“To reduce energy consumption in households good technical solutions are required.” 91% agree completely or mostly.

“To reduce energy consumption in households a change of user behaviour is important.” 96% agree completely or mostly.

Figure 6-6-1 Attitudes to smart appliances ITA



6.7 Ecological awareness and engagement of the respondents

There were a few questions in the questionnaire to check the ecological awareness and engagement of the respondents.

About 50% know roughly the total of their electricity bill without looking it up, about 15% know it exactly and about 35% do not know it without looking it up (see figure 6-7-1).

Only 6% purchase green energy in their households (see figure 6-7-2).

83% of the respondents use energy saving bulbs often.

Almost 90% of all respondents let dishes cool down, before they put them in the refrigerator.

About three quarters of all respondents are aware of energy labels and often buy appliances with A, A+ or A++.

87% of the people often operate the washing machine or the dishwasher only when they are full.

90% of all respondents turn heating control down when leaving home for a longer period.

50% of the respondents often use public transport, bicycle or walking for daily routine travels (see figure 6-7-3).

Figure 6-7-1 Knowledge about energy bill without looking it up ITA

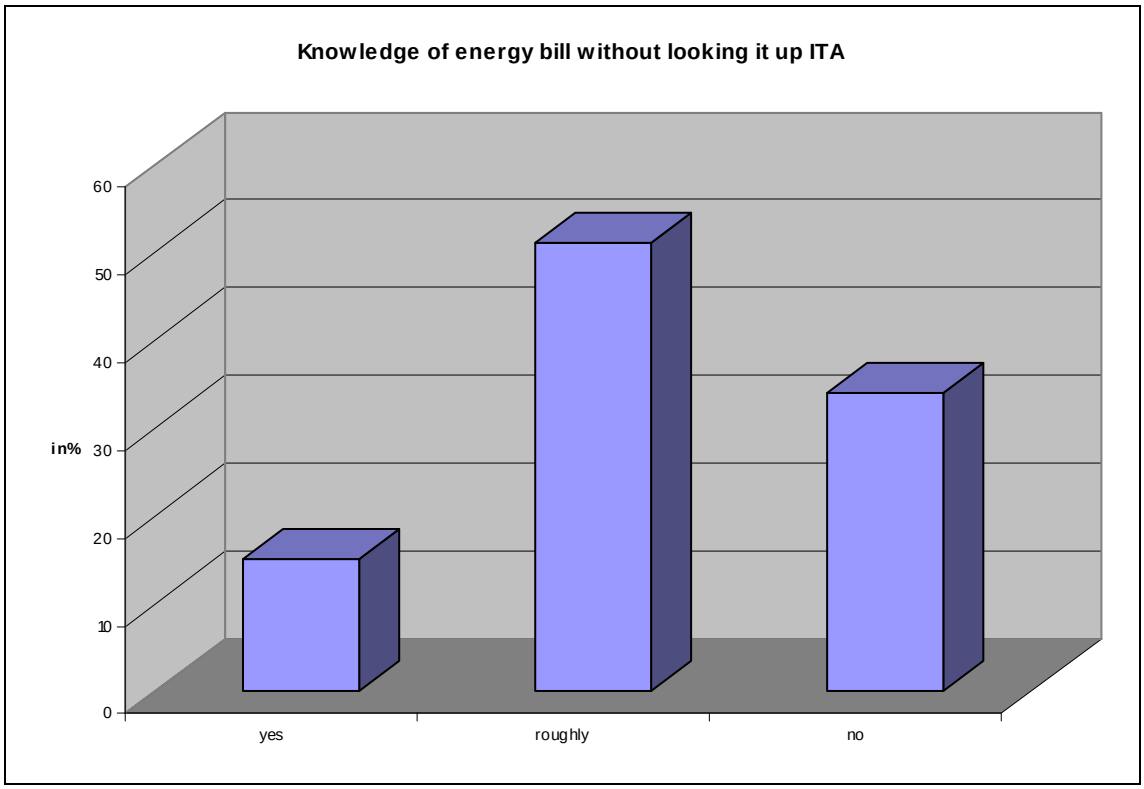


Figure 6-7-2 Purchase of green energy ITA

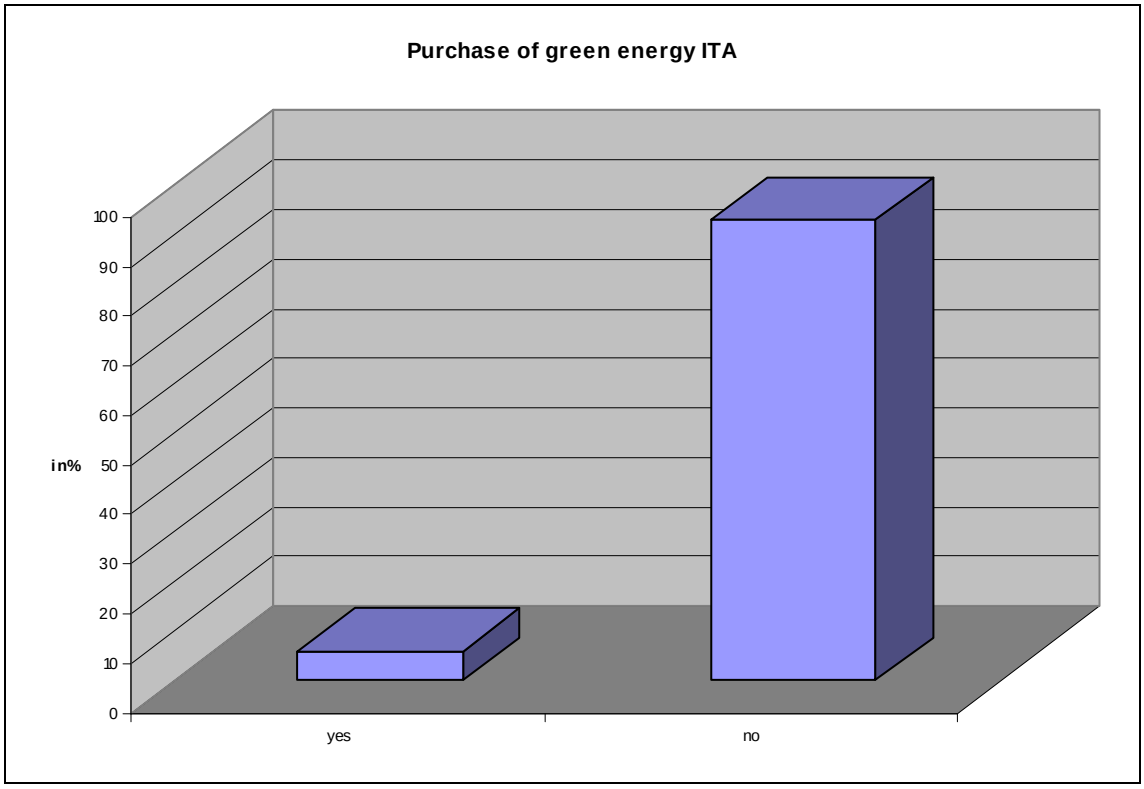
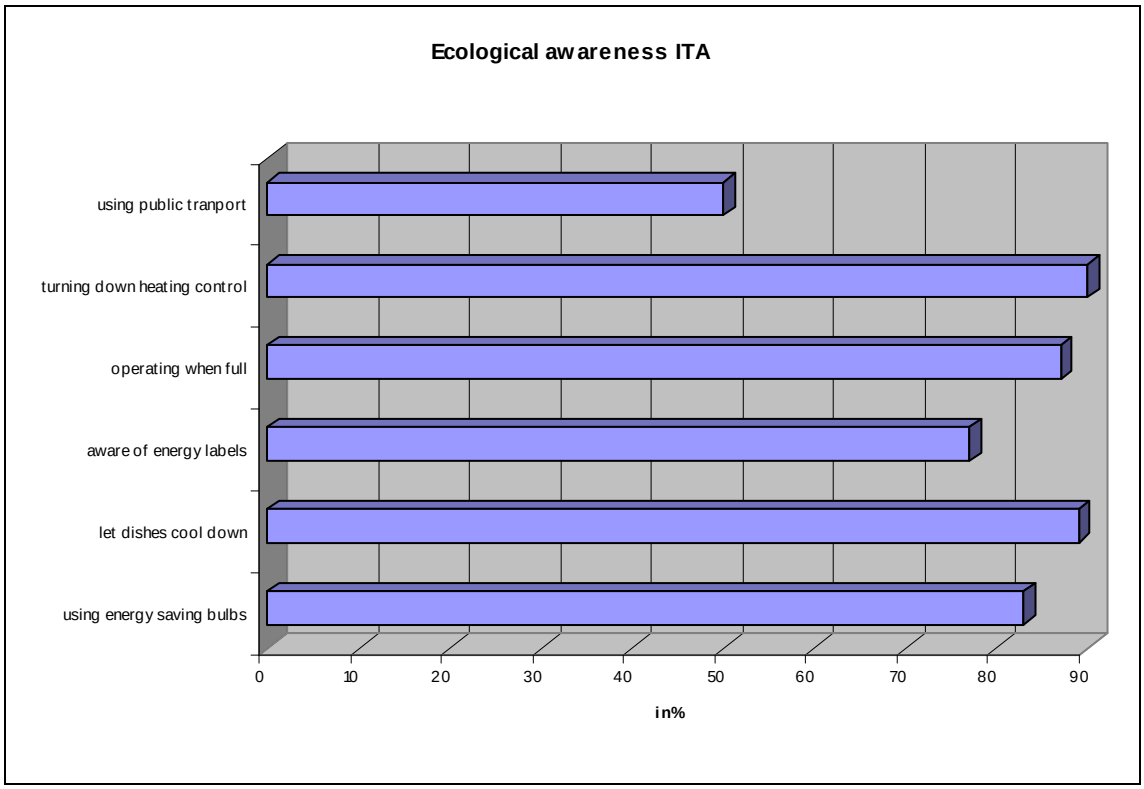


Figure 6-7-3 Ecological awareness ITA



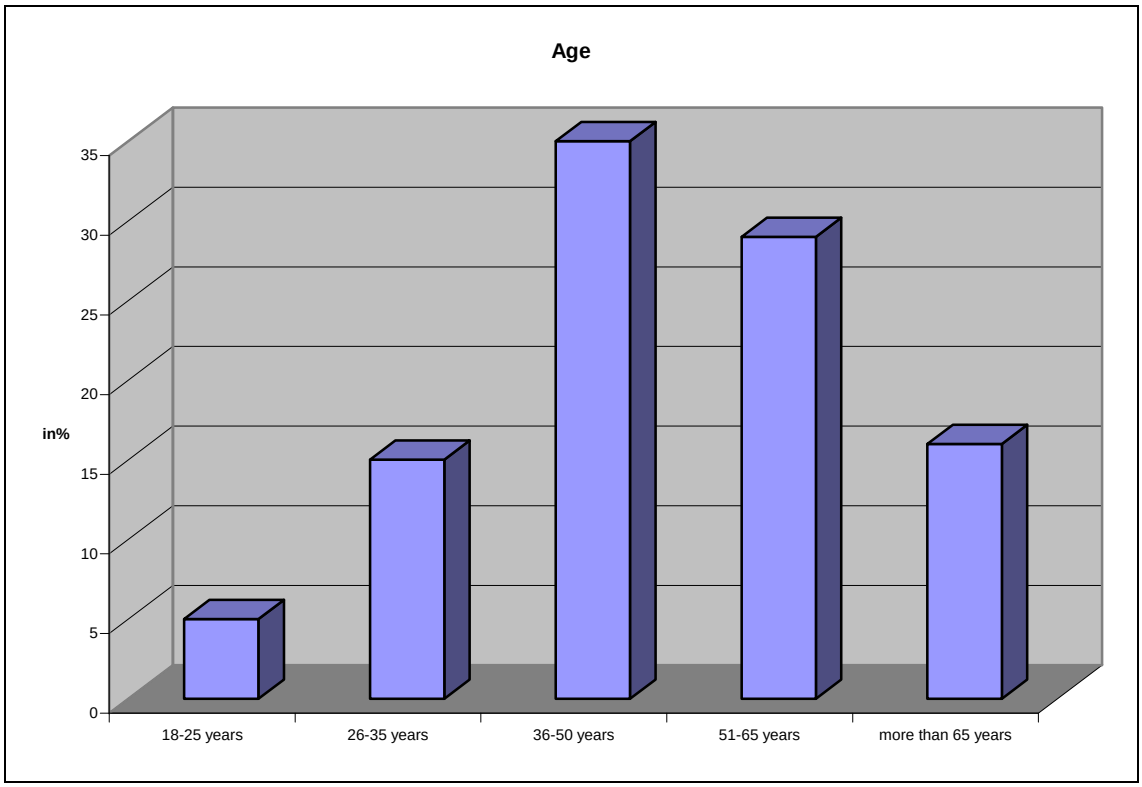
7 Overview all countries

7.1 Socio-economic data

In total 2907 questionnaires were filled in. 62% of the respondents are male, 38% are female.

Regarding the age there are 35% between 36 to 50 years old, 28% between 50 and 65 years, 16% between 50 and 65 or between 26 and 35 years old. Only 5% are between 18 and 25 years old (see figure 7-1-1).

Figure 7-1-1 Age



Almost 40% of all respondents have academic degrees, 25% compulsory school, 20% apprenticeship, 10% A-Level or other post 18 qualification (see figure 7-1-2).

60% of the respondents are employed, 20% pensioners, 9% self-employed and almost 5% are students (see figure 7-1-3).

53% work or have worked in a technical field, 47% didn't.

In 35% of all households two persons are living, in 20% three or four persons live in a household, about 12% have one person or five persons or more (see figure 7-1-4).

In total we have more than 60% of the households with no child, about 18 percent have two children, about 15% one child (see figure 7-1-5).

Figure 7-1-2 Highest education level

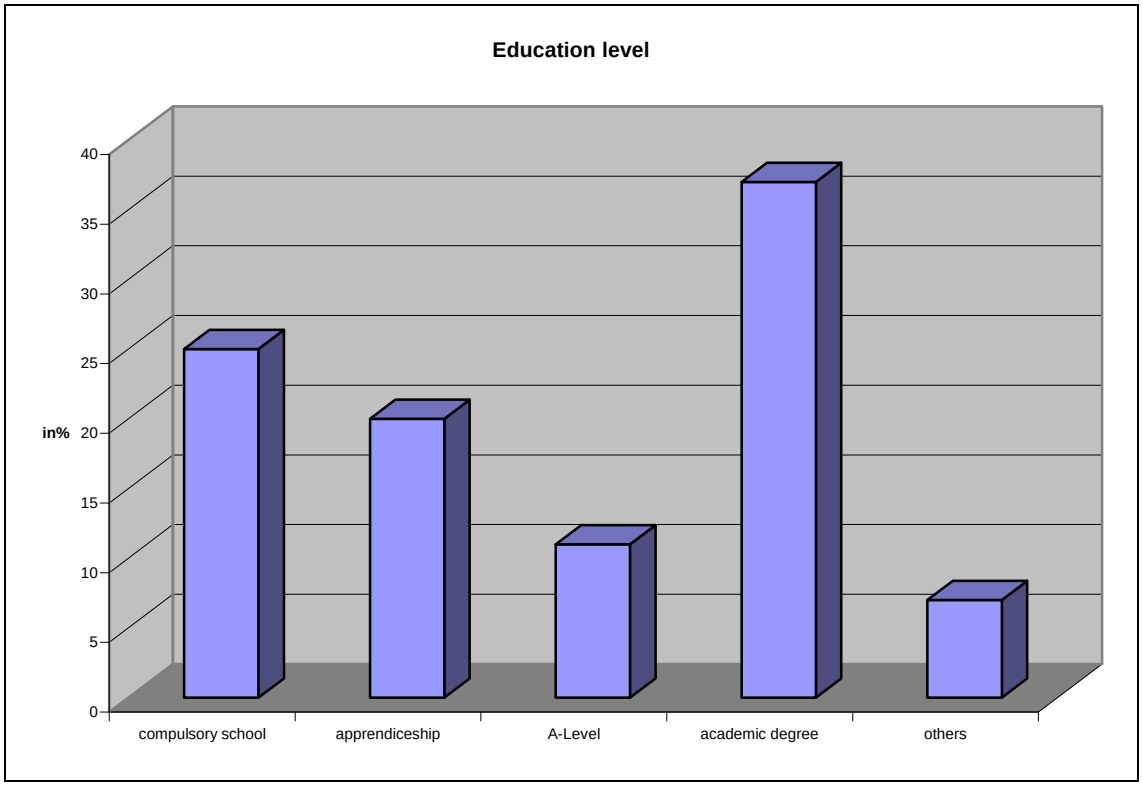


Figure 7-1-3 Employment status

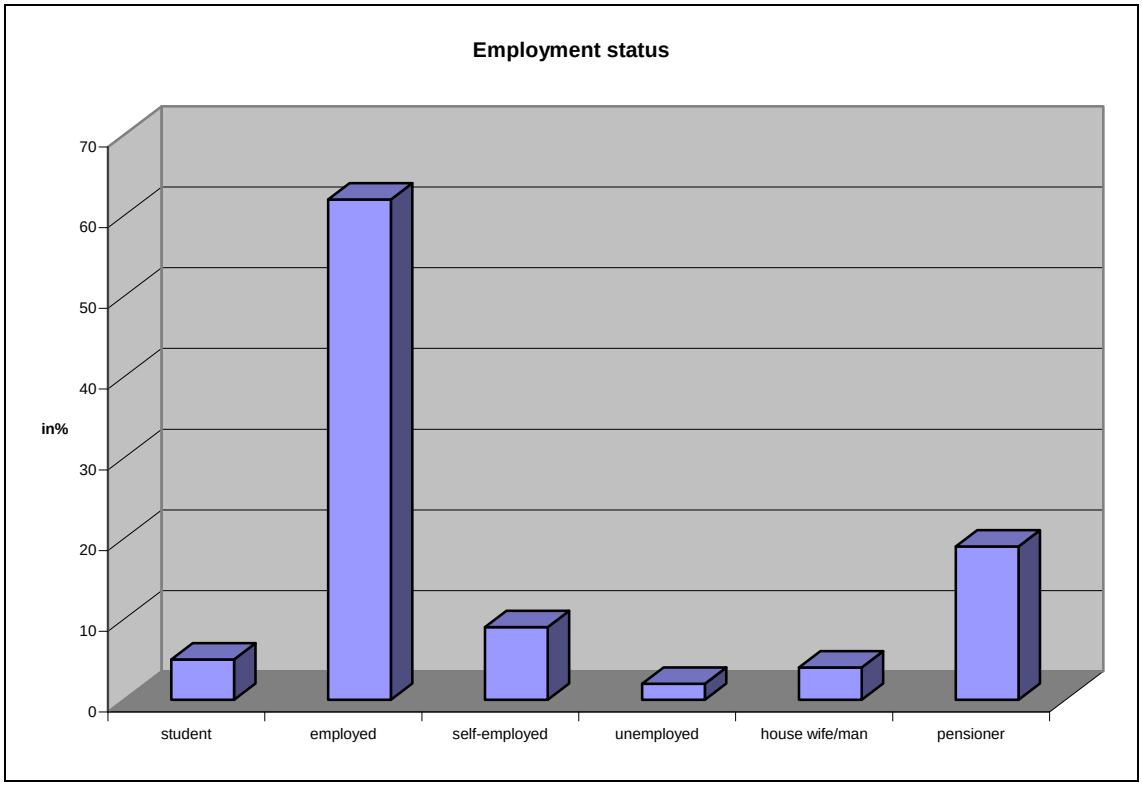


Figure7-1-4 Number of people living in the household

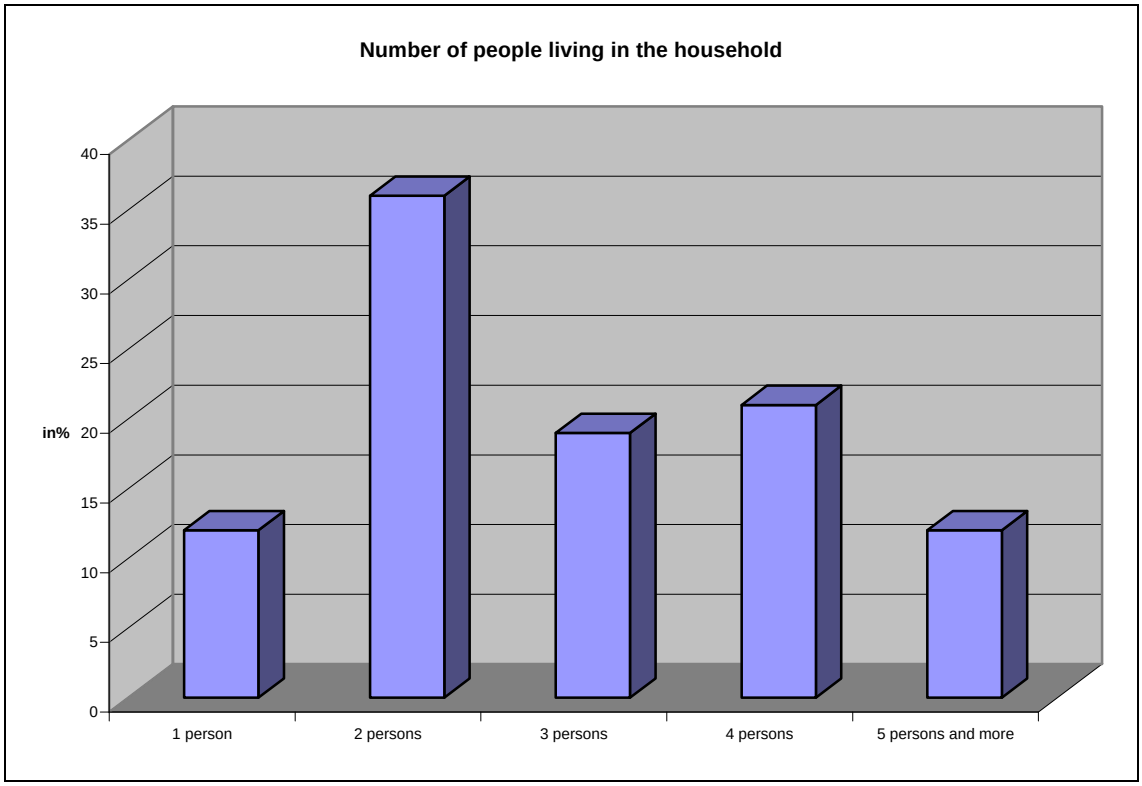
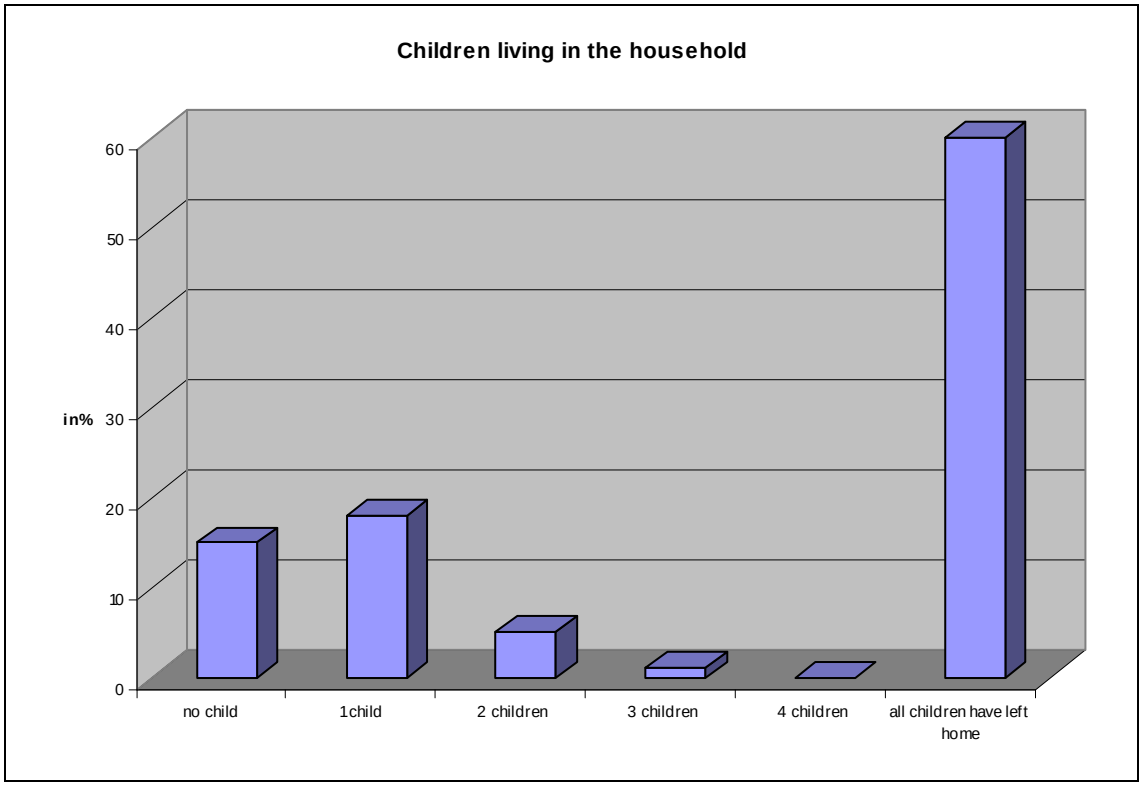
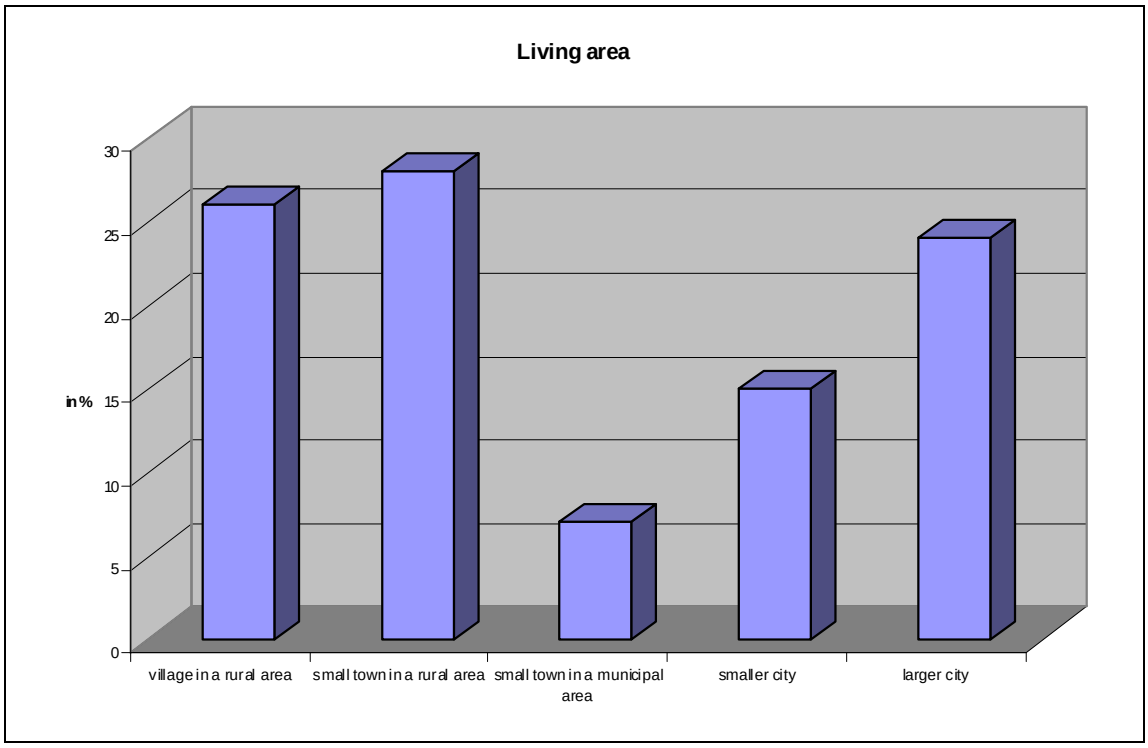


Figure 7-1-5 Number of children living in the household



About one quarter of the respondents either live in a in a small town in a rural area or in a in a village in a rural area or in a larger city (more than 100 000 inhabitants). 15% live in a smaller city (more than 100 000 habitants) and 6% in a small town in a municipal area (less than 10 000 habitants) (see figure 7-1-6).

Figure 7-1-6 Living area

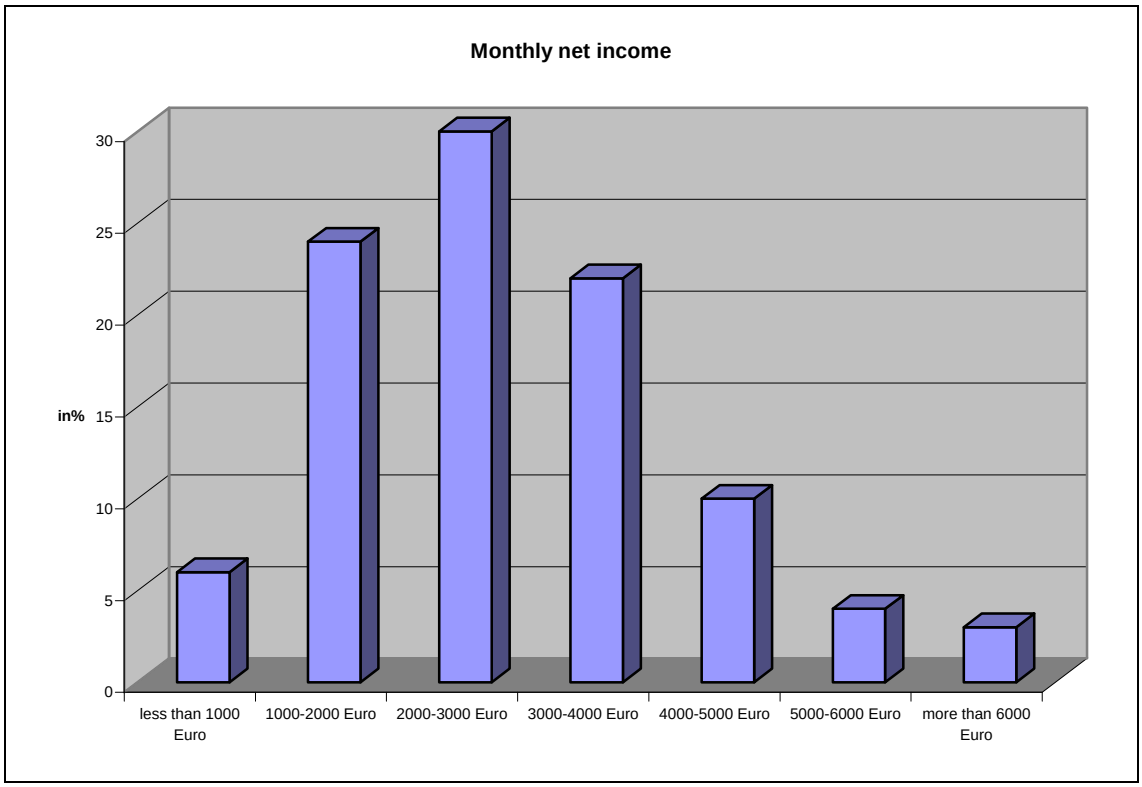


In total in 65% of the households several people have an income.

30% of the households earn between 2000 and 3000 Euro, about a quarter between 1000 and 2000 Euro, 22% of the households have a monthly net income between 3000 and 4000 Euro, 10% earn between 4000 and 5000 Euro, 7% earn more than 5000 Euro or less than 1000 Euro(see figure 7-1-7).

67% of all respondents live in a house, 30% are living in a flat. About 27% of the respondents live in houses with solar collectors or photovoltaic panels.

Figure 7-1-7 Monthly net income



7.2 Appliances in the households

The following appliances are used in the households:

Almost all households possess refrigerators and washing machines, more than 80% of them have electric cookers, deep freezers and dish washers, about half of them tumble dryers. Air conditioners have only 6% the households (see table 7-2-1).

Table 7-2-1 Use of household appliances

Household Appliance	**All countries (in %)**
Refrigerator	99
Washing machine	98
Electric cooker	85
Deep freezer	83
Dishwasher	82
Tumble dryer	51
Central heating pump	19
Electric heated boiler (more than 80 litres)	19
Electric space heating	13
Electric water heater (up to 10 litres)	11
Air conditioner	6

Which of these appliances have special features like start time delay, energy saving programs or use cheaper tariff options?

As can be seen in the following table, the most common feature is an energy saving program for the washing machine (about 70% of all households). Energy saving programs are also used for dishwashers (47%,) and tumble dryers (22%).

37% of the washing machines have start time delay, also 21% of the dishwashers, 17% of electric cookers and 14% of the tumble dryers. About 18% of the washing machines are operated with cheaper tariff option, also about 14% of the electric heated boilers, 12% of the dishwashers and 10% of the tumble dryers (see table 7-2-2).

Table 7-2-2 Special features of household appliances

1 = start time delay (timer)

2 = energy saving program

3 = cheaper tariff option

Household Appliance	**All countries (in %)**		
	1	**2**	**3**
Washing machine	37	72	18
Dishwasher	21	47	12
Refrigerator	-	-	7
Tumble dryer	14	22	10
Deep freezer	-	-	6
Electric cooker	17	-	3
Central heating pump	6	-	7
Electric heated boiler (more than 80 litres)	3	-	14
Electric water heater (up to 10 litres)	1	-	1
Electric space heating	2	-	12
Air conditioner	2	-	1

7.3 Use scenarios for smart appliances

Different scenarios were described regarding the usage of appliances in a smarter way. The respondents were asked whether they would accept such a scenario or not.

Scenario A: The washing machine starts after it receives a signal from the energy supplier that cheap and renewable energy is available. It is guaranteed that the process is finished at the desired time. Would people accept this for different appliances? (see figure 7-3-1).

Most of all residents would accept this utilisation, if both financial and ecological reasons are given:

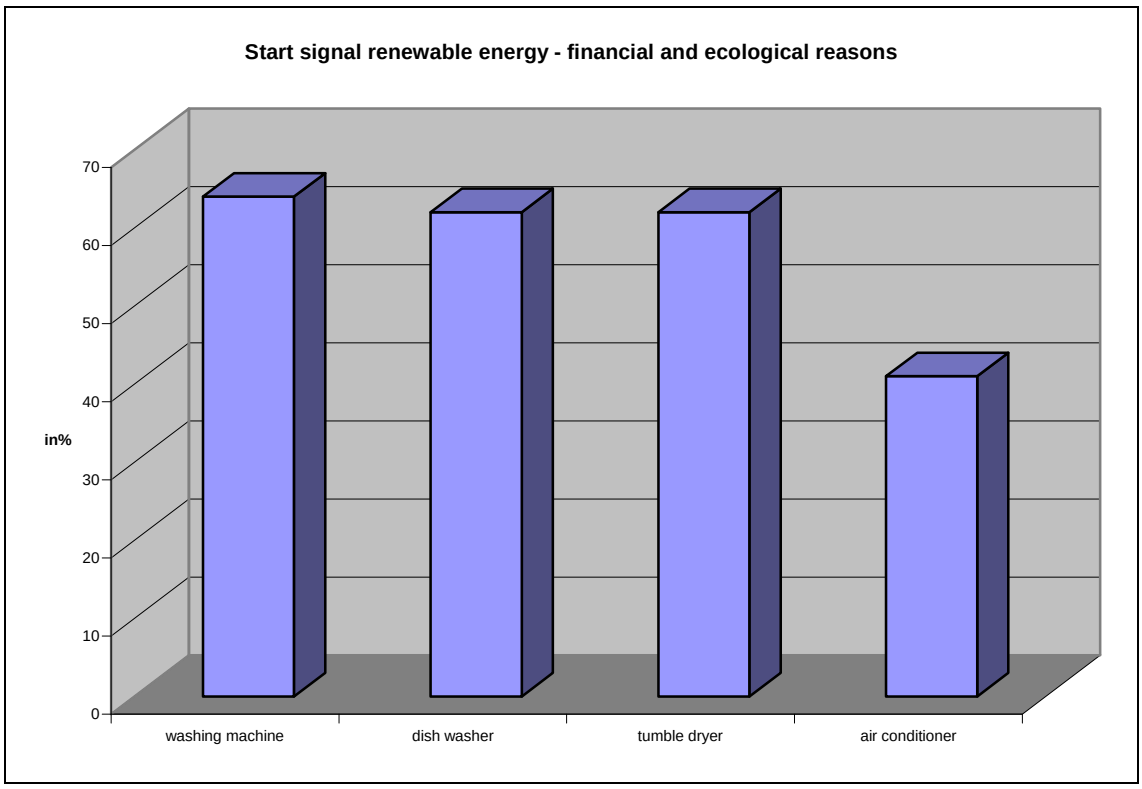
Washing machine: 64%. 8% would not accept it mostly because they want to use the device when they need it or they want to be present when the washing is done.

Dishwasher: 62%. 9% would not accept it mostly because they need the device on demand or don't use a dishwasher or don't find it useful.

Tumble dryer: 62%. 10% want to use the device on demand or they don't use a tumble dryer or they don't find it useful.

Air conditioner: 41%. 35% wouldn't accept it because they need the air conditioner on demand or they don't have one or they don't need one.

Figure 7-3-1 Start because of signal for cheap and renewable energy



Scenario B: You are about to start the dishwasher when you receive the information that for financial and ecological reasons it would be better to start it at a specific time later that day. Would you postpone the start? (see figure 7-3-2).

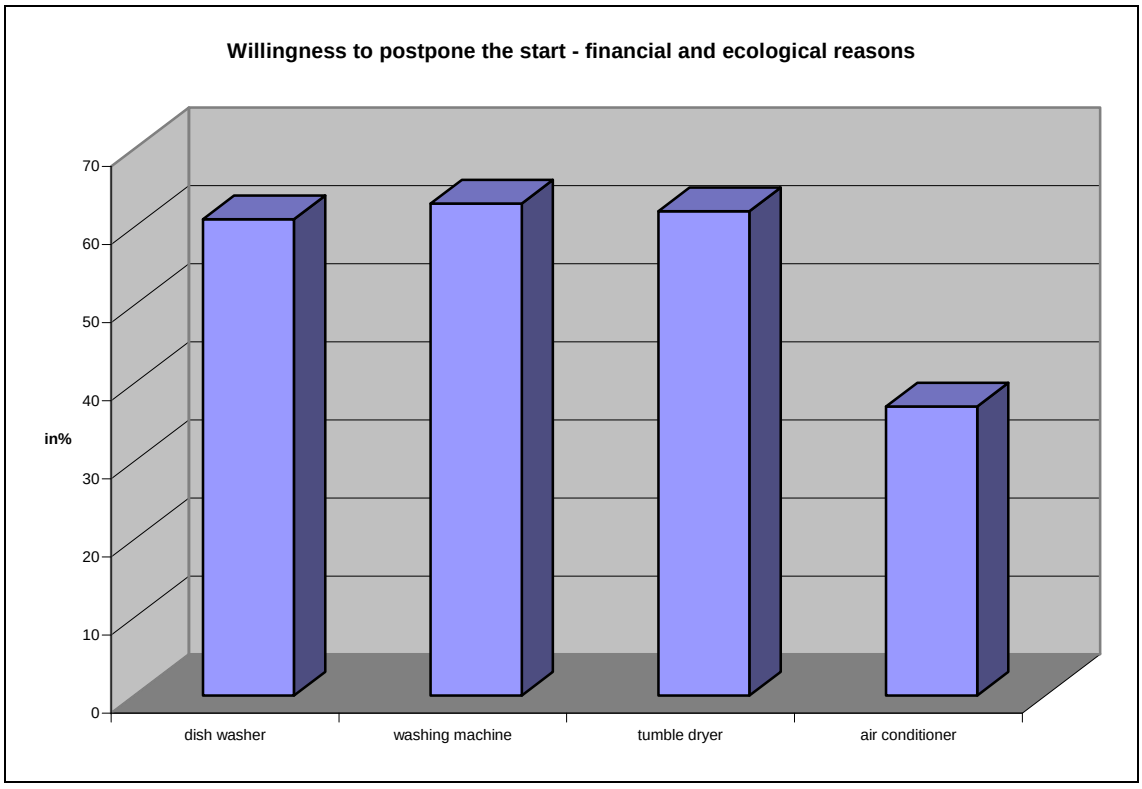
61% of all respondents would postpone the start for both financial and ecological reasons. If people don't want to do it (these are about 8%), it's mostly because of time organisation - they need clean dishes right away or they don't use a dish washer.

Washing machine: 63% would postpone the start because of both financial and ecological reasons. About seven percent would not do it mostly because they need the device on demand, they have no time for postponing or they don't want to leave wet laundry for too long in the machine.

Tumble dryer: 62% would postpone the start because of both financial and ecological reasons. About 8% wouldn't do it mostly because they need the device on demand or because of their time organisation.

Air conditioner: About 37% of all respondents would postpone the start for financial and/or ecological reasons. 42% wouldn't do it because they need the air conditioner on demand or they don't use this appliance.

Figure 7-3-2 Willingness to postpone the start of household appliances



If yes, up to how long would the shift be acceptable?

Dishwasher: In total 38% of all respondents would find it acceptable to postpone the start for any time if it is not longer than 24 hours, for 23% it should not be longer than two hours (see table 7-3-1).

Table 7-3-1 Dishwasher – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
(n= 2535)	81 3,2%	183 7,2%	314 12,4%	279 11%	257 10%	143 5,6%	158 6,2%	152 6%	968 38,2%

Washing machine: 42% of all respondents would accept a shift not longer than 24 hours, 23% not longer than two hours (see table 7-3-2).

Table 7-3-2 Washing machine – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
(n= 2597)	73 2,8%	193 7,4%	326 12,6%	250 9,6%	212 8,2%	143 5,5%	143 5,5%	176 6,8%	1081 41,6%

Tumble dryer: 41% would accept a shift not longer than 24 hours, 23% not longer than two hours (see table 7-3-3).

Table 7-3-3 Tumble dryer – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
(n= 2030)	75 3,7%	158 7,8%	236 11,6%	183 9%	195 9,6%	110 5,4%	112 5,5%	125 6,2%	836 41,2%

Air conditioner: 25% would accept a shift not longer than 24 hours, 25% only would accept half an hour, 11% would accept one hour, about 30% would accept more than half an hour (see table 7-3-4).

Table 7-3-4 Air conditioner – shift acceptable

	0,5h	**1h**	**2h**	**3h**	**4h**	**5h**	**6h**	**7h**	**any time if not longer than 24h**
(n= 984)	277 28,2	188 19,1%	138 14%	50 5,1%	30 3%	20 2%	15 1,5%	20 2%	246 25%

Scenario C: Imagine it is possible to set your freezer or fridge in a "smart operation mode" by pressing a button on it. This would cause breaks of two minutes maximum in its operation that you might not even notice. The food quality would definitely stay the same. Would you accept this? (see figure 7-3-3).

66% of all respondents would accept this for both financial and ecological reasons, only 4% would not accept it because mostly because they think this will be bad for the appliance or they fear that quality of food will be compromised.

Dishwasher: 62% of all respondents would accept this for both financial and ecological reasons. 7% would not want it mostly because they think this would damage the appliance or they don't use a dishwasher.

Tumbler dryer: 64% of all respondents would accept this for both financial and ecological reasons. About 7% would not want it mostly because they think this would damage the appliance or because they don't use one.

Air conditioner: 56% of all respondents would accept this for financial and ecological reasons. 13% would not want it mostly because they don't have one or they need the air conditioner on demand.

Washing machine: 64% of all respondents would accept this for financial and ecological reasons. 6% would not want it mostly because they think this function would damage the device, they think the washing cycles will last too long or they don't have time.

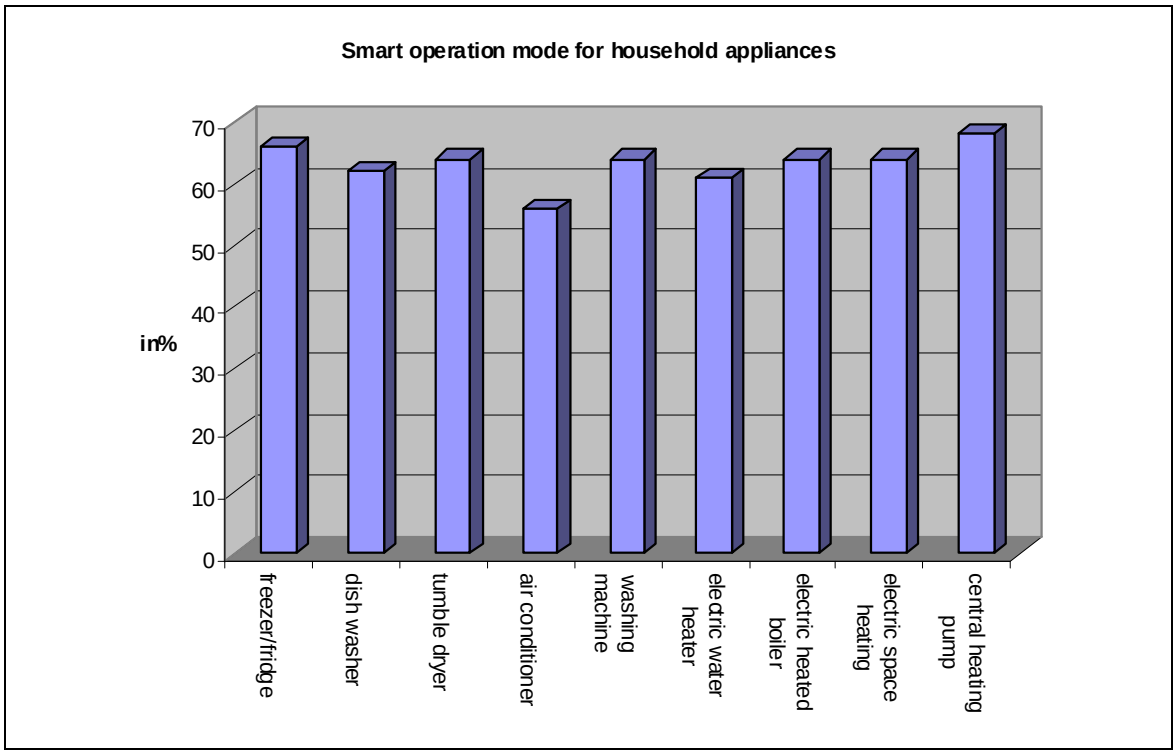
Electric water heater: 61% of all respondents would accept this for financial and ecological reasons. 9% would not want it mostly because hot water is needed on demand, they don't use this device or they think the appliance could be damaged.

Electric heated boiler: 64% of all respondents would accept this for financial and ecological reasons. 6% would not want it mostly because they need hot water on demand, they think this will be bad for the appliance, it is not economical or they don't use this device.

Electric space heating: 64% of all respondents would accept this for financial and ecological reasons. 7% would not want it mostly because they need the appliance on demand, they think this will damage the appliance or they don't use this device.

Central heating pump: 68% of the respondents would accept this for financial and ecological reasons. 5% would not want it.

Figure 7-3-3 Smart operation mode for household appliances



7.4 Willingness to pay extra for smart appliances

Would the respondents be willing to pay extra for a freezer which uses stored electricity from a photovoltaic system and uses the stored cool during the night (by compensation via reduced electricity costs within 5 years) (see table 7-4-1).

Almost half of the respondents would pay 50 to 100 Euro more. About 22% would pay 100 to 200 Euro, 18% would pay not more than 50 Euro.

If people are not willing to pay extra, this is because of the following reasons: They don't have the money, they think the usual appliances are expensive enough, they have new appliances or they think they are to old for buying new appliances.

Would people be willing to pay extra for washing machines or dishwashers which use hot instead of cold water (water heated by a solar collector)? Costs are saved for heating the water up. These types cost more than others but this is compensated via the energy savings within five years (see table 7-4-2).

Almost half of all respondents would pay 50 to 100 Euro extra for such a washing machine or dishwasher. About 21% would pay 100 to 200 Euro extra, 17% would pay not more than 50 Euro extra.

About 10% of all respondents are not willing to pay extra for such an appliance because they think they don't have the money or the usual appliances are expensive enough.

Table 7-4-1 Willingness to pay extra for a freezer with stored electricity

	0-50€	**50-100€**	**100-200€**	**I would not be willing to pay extra**
all	496	1467	599	197
(n=2759)	18%	53,2%	21,7%	7,1%

Table 7-4-2 Willingness to pay extra for a washing machine/dish washer with stored electricity

	0-50€	**50-100€**	**100-200€**	**I would not be willing to pay extra**
all	467	1426	581	269
(n=2743)	17%	52%	21,2%	9,8%

7.5 Acceptance of monitoring and information

For providing the appliances with cheap and renewable energy the energy supplier might have to monitor the energy consumption of his clients constantly. The information would be treated confidential and deleted after some time. Would the respondents accept this? (see table 7-5-1).

93% of all respondents would accept this (definitely or probably), 54% say definitely yes.

Table 7-5-1 Acceptance of monitoring

	definitely yes	**yes, probably**	**probably not**	**definitely not**
all	1483	1037	124	71
(n=2715)	53,7%	37,6%	4,5%	2,6%

How would people prefer to be informed about the price and the availability of cheap and renewable energy from the energy supplier? (see table 7-5-2).

50% in total would like to get the information via internet/e-mail, 37% on a display unit in their flat or on a display of the appliance, 24% prefer automatic regulation and only about 9% want to get it by SMS.

Table 7-5-2 Information about price and availability (multiple responses)

	via internet/ e-mail	**by SMS**	**on display unit in my flat**	**on display of the appliance**	**prefer automatic regulation**
all	1453	246	1067	1020	678
(n=2687)	51,5%	8,7%	37,8%	36,1%	24%

7.6 Attitudes to smart appliances

Questions regarding the attitude towards smart appliances were asked in the questionnaire. The following section summarizes the answers to these questions (see figure 7-6-1).

“Smart appliances will play a bigger role in the next ten years.” 78% agree completely or mostly with this statement.

“Smart appliances will be too expensive for the average household.” 54% agree completely or mostly with this statement.

“Smart appliances are complex to operate.” 29% agree completely or mostly.

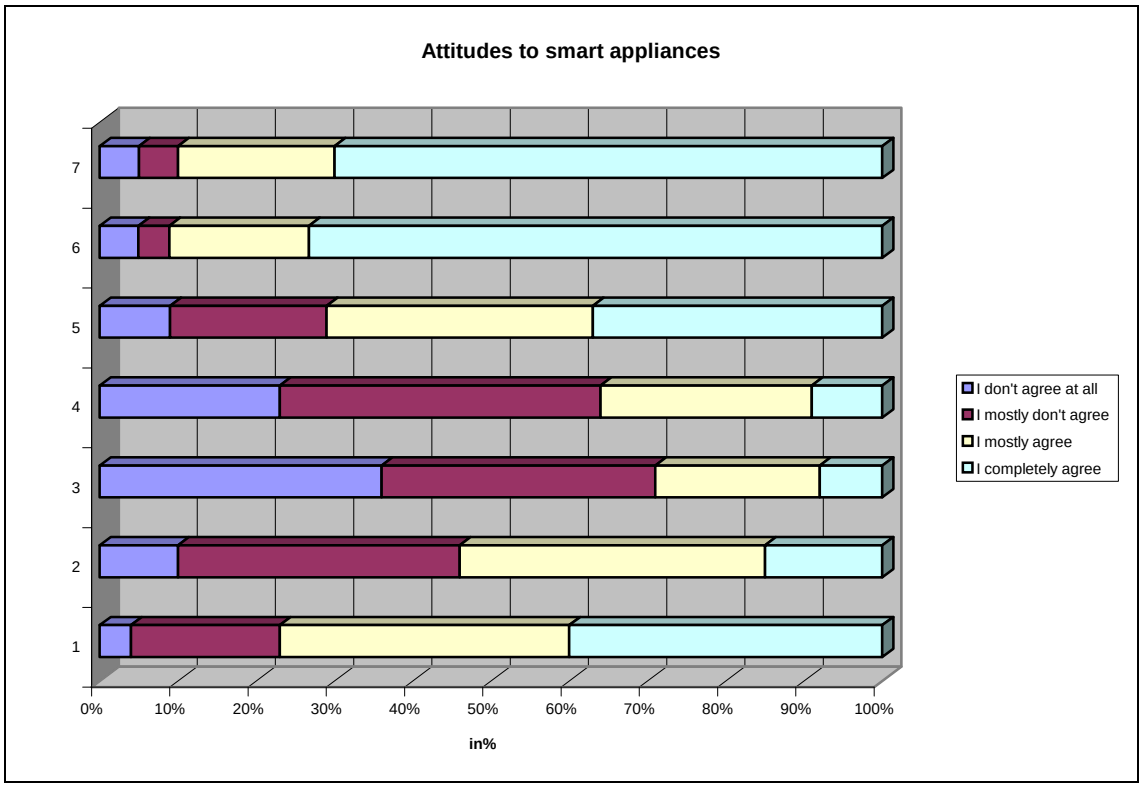
“Smart appliances are error-prone.” 36% agree completely or mostly.

“Smart appliances will increase comfort.” 71% in total agree completely or mostly.

“To reduce energy consumption in households good technical solutions are required.” 91% agree completely or mostly.

“To reduce energy consumption in households a change of user behaviour is important.” 90% agree completely or mostly.

Figure 7-6-1 Attitudes to smart appliances



7.7 Ecological awareness and engagement of the respondents

There were a few questions in the questionnaire to check the ecological awareness and engagement of the respondents.

46% know the total of their electricity bill without looking it up, 41% know it roughly and 13% do not know it without looking it up (see figure 7-7-1).

Only 9% purchase green energy in their households (see figure 7-7-2).

71% of all respondents use energy saving bulbs often.

Almost 94% of all respondents let dishes cool down, before they put them in the refrigerator.

86% of all respondents are aware of energy labels and often buy appliances with A, A+ or A++.

93% of the people often operate the washing machine or the dishwasher only when they are full.

87% of all respondents turn heating control down when leaving home for a longer period.

Almost 50% of all respondents often use public transport, bicycle or walking for daily routine travels (see figure 7-7-3).

Figure 7-7-1 Knowledge about energy bill without looking it up

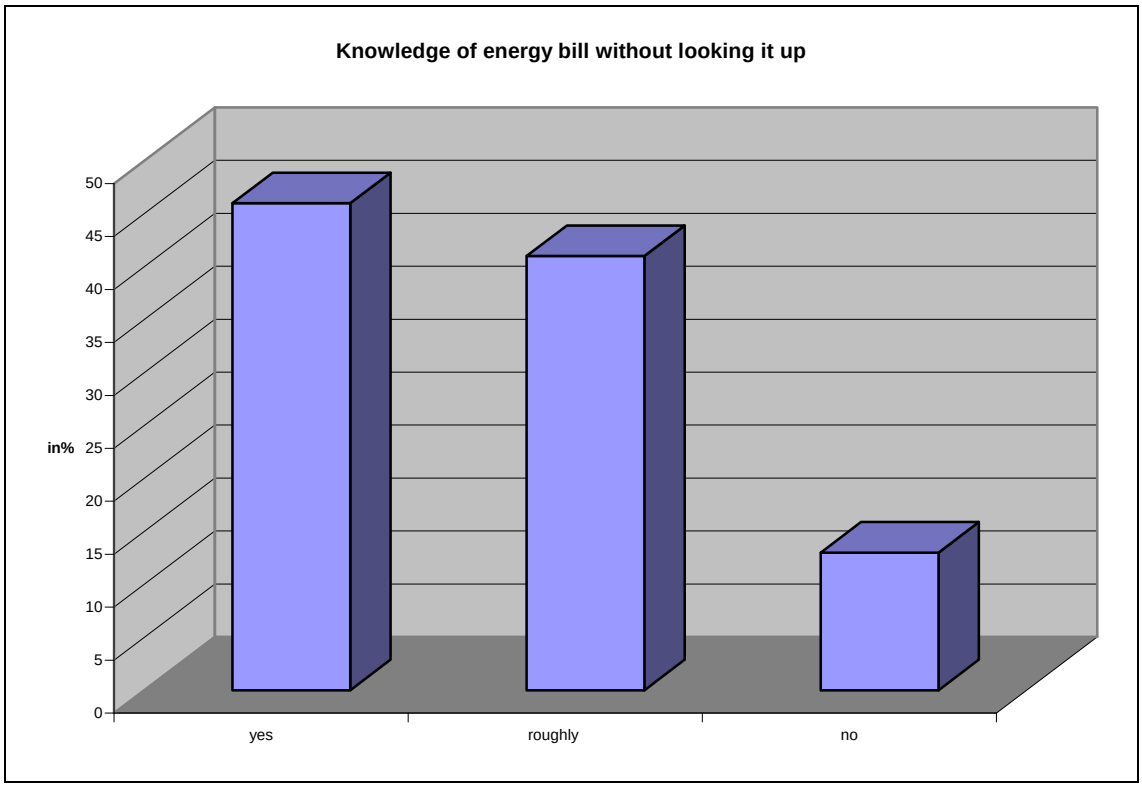


Figure7-7-2 Purchase of green energy

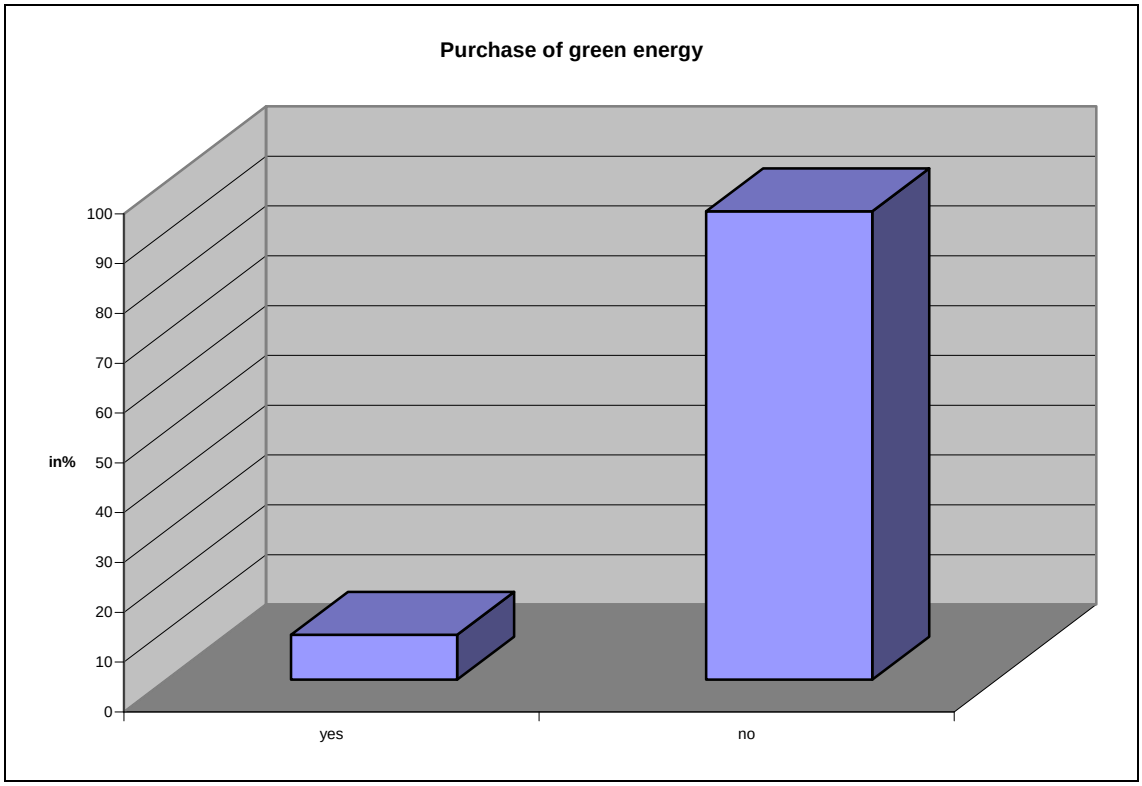
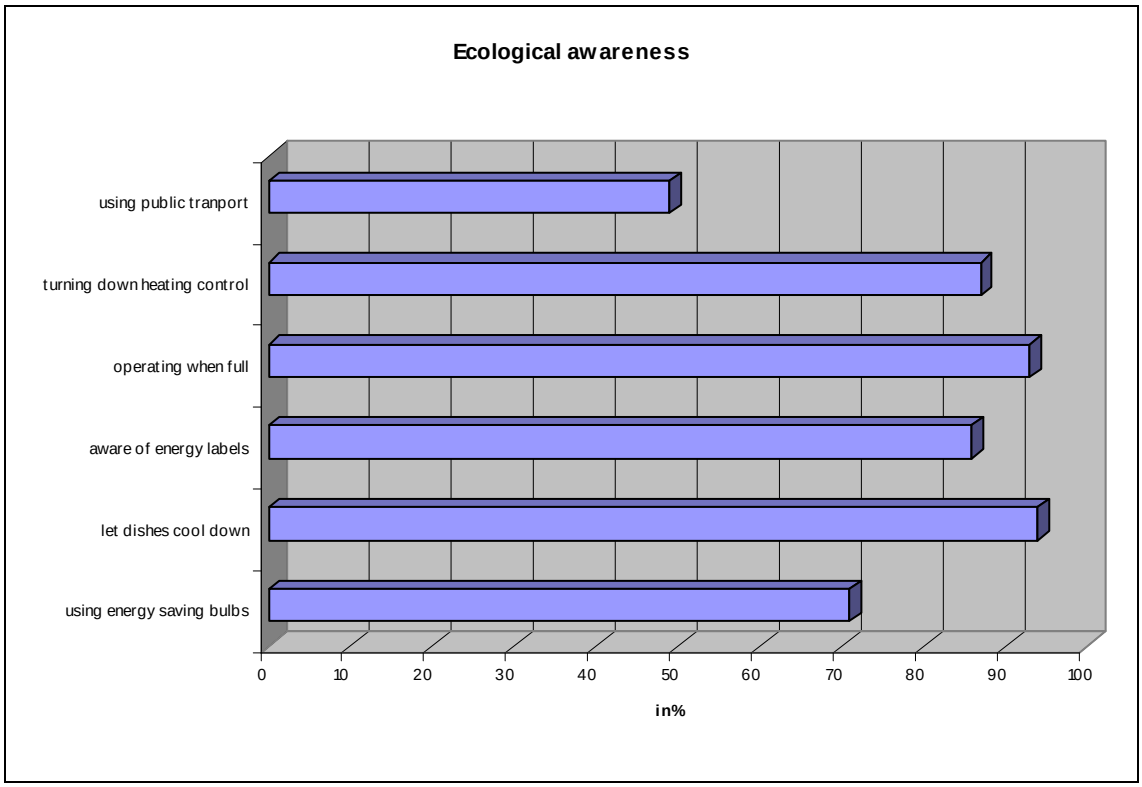


Figure 7-7-3 Ecological awareness



8 Specifics, sample differences and influencing factors

8.1 Specifics and sample differences between countries

There are some specifics of the different country samples which have to be considered for interpretation of the results. In the UK sample most of the respondents were academics because the questionnaire was distributed to a database of 11.000 persons on the university campus. The database included besides academic and research staff also administrative/management, clerical/secretarial, academic support and manual/craft staff, but it seems that mostly academics were interested to participate in the study. The same is the case for the other country samples. In total we have in our samples more academics than this would be the case in a normal population.

Also we have differences in the distribution of gender. In total 62% of all respondents are male, 38% female. There are differences in the countries: In Great Britain and Slovenia there are 70% female, whereas it is the other way round in Germany with 83% male respondents. In Austria and Italy the gender distribution is half-half.

Most of the respondents are middle-aged between 36 and 50 years old, there are few younger than 25 years, This is the same for Austria and Germany (in Germany we have more people who are older than 50 years), it is different for Italy (more younger people). In Great Britain we have also many people between 26 and 35 years old, in Slovenia there are more younger people.

About 60% of all respondents are employed. In Great Britain mostly all respondents are employed, in Slovenia about a third (there are more students in this sample). It's the same in Italy, in Germany and Austria, where about half of the respondents are employed.

About half of all respondents work or did work in a technical field. There are less in Slovenia (29%), Austria and Italy (about a third).

In total about 35% of the respondents live in households with two persons, this is more or less the same for all countries (25 to 45%). In total we have more than 60% of the households with no child in them, this is more or less the same in all countries (in Slovenia only about 40%).

There are differences concerning the living environment. In Great Britain and Slovenia about half of the people are living in larger cities, in Austria and Italy these are about 40%. In Austria also 40% are living in a village, in Germany 45% are living in a smaller town.

In total most respondents (about 30%) have a monthly net income between 2000 and 3000 Euro. The income level is higher in Great Britain and Germany, it's lower in Slovenia and Austria and Italy.

About two thirds of all respondents live in a house, about one third in a flat. This is similar in all countries except Italy. About 37% of the houses have solar-collectors or

photovoltaic panels, most in Italy, less in Great Britain and Slovenia about 20 to 30% in Germany and Austria.

Despite these differences in the samples the attitudes and opinions about smart appliances are very similar in all included countries.

What has to be considered is that the questionnaire did not ask how respondents really use their appliances, but how they can imagine to use them. There will be always a gap between real behaviour and attitudes. So we have to be careful with the interpretation of the results – we got very positive feedback concerning the attitude to smart appliances but a reality check is needed. To get a deeper sight and to have a reflecting board additional to the surveys telephone interviews and focus groups in the different countries were done (see Smart-A report D5.3 Summary report of the results of the phone interviews and D 5.4 Consumer acceptance – Summary report on the results of focus groups).

8.2 Hypotheses and influencing factors

Which factors influence the attitudes about smart household appliances? Are there specific factors (like gender, age, education level, income level, where people live etc.) which make a difference? Is the energy saving behaviour of respondents important?

Based on the information gained from analysed studies and from expert interviews (see Smart-A report D 5.1 Working paper on general consumer preferences and restrictions) several hypotheses were derived, which were tested with the results of the survey. However, in some cases the data was not sufficient to give a good interpretation of the results. For the interpretation of differences it has to be kept in mind that the differences are partly very small.

One hypothesis referred to the correlation between energy saving behaviour and acceptance of smart appliances. For the assessment of energy saving behaviour of the respondents an index was created: very low energy saving behaviour, middle energy saving behaviour, high energy behaviour. For the acceptance of smart appliances also an index was formed: very low acceptance, low acceptance, high acceptance, very high acceptance.

If we take all countries together, there is a slight influence of energy saving behaviour on the acceptance of smart appliances – the higher the energy saving behaviour the higher the acceptance. This is especially true for the acceptance of specific appliances like washing machine, dishwasher or tumble dryer. If people purchase green energy or if they possess solar- or photovoltaic-panels has no influence on the acceptance of smart appliances over all countries.

If we check the particular countries we can see a more clear tendency in Slovenia (higher energy saving behaviour – higher acceptance), in Great Britain it seems the other way round (lower energy saving behaviour – higher acceptance), in Germany this

is also true for specific advices but not for all, in Austria there is a slight trend and in Italy a more clear trend to more acceptance if energy saving behaviour is higher.

We had the assumption that consumers will be sceptical about the monitoring of their energy consumption. They will prefer less invasive communication methods, which leaves it up to them whether to react or not. Furthermore correlations between the acceptance of monitoring and the age of respondents are likely.

It was surprising that most consumers are not concerned about the monitoring of their energy consumption by their energy supplier. An overlook over all countries shows that older people (over 50 years) seem to be less sceptical, as well as respondents with apprenticeship or academic degree. More than half of the consumers want to get the information about cheap and renewable energy via internet – this is independent of social factors like gender or age. Especially those who have worked or work in a technical field prefer the internet.

The results are very similar in all countries – consumers are not concerned about monitoring, especially the older ones. In Great Britain the respondents prefer information on the display of the appliance, more female than male, rather people with apprenticeship or A-level. We have the same for Slovenia – more than half of them want to get the information on the display of the device. In Germany two thirds of the people like the information via e-mail or internet, no different influences can be seen. In Austria it's also internet or e-mail but not so clear like in Germany. Younger people seem to prefer it more, also higher educated and self-employed ones. In Italy a little more than half of the respondents like to get information via internet. Males like it more than the female respondents, also the younger ones more than the older ones, the higher educated more than the less educated, the "technical field-workers" more than the non-ones. Least popular is automatic regulation in all countries – except in Austria.

Another hypothesis was that consumer acceptance correlates with gender, age, education level, income level and living situation. Over all countries we can't find any statistical significant differences and influences. Basically the same is the case if we focus on the different respective countries.

Another idea was that types of households will have an influence on the acceptance level of smart appliances. Over all countries it makes no difference if people live in a house or in a flat. This is also true for Great Britain, Slovenia, Germany and Italy, in Austria there seems to be a slight tendency that people living in flats accept smart appliances on a higher level.

9 Conclusions

The current report summarizes the results of the surveys with questionnaires in Great Britain, Slovenia, Germany, Austria and Italy. In total 2907 questionnaires were analysed, 232 from Great Britain, 200 from Slovenia 1332 from Germany, 943 from Austria and 200 from Italy.

Most of the participating people use the usual household appliances like washing machines, refrigerators, deep freezers, electric cookers and dishwashers, tumble dryers are used by about half of all respondents. Special features of appliances which are known are mostly energy saving programs for the washing machines or dishwashers, few appliances have features like start time delay and only a few households use cheaper tariff options.

All together the respondents have rather positive attitudes regarding smart appliances. For the interpretation of the survey results however we have to consider that we have an overall sample with a high share of males, of middle-aged people, with higher education, technical background and high ecological awareness, with the majority living in a house without children.

Within the survey the consumers could indicate whether they would accept smart operation for either “financial reasons”, or “ecological reasons” or “financial and ecological reasons”. In most cases consumers claimed that they would use smart appliances, if both financial and ecological benefits are met. For washing machine, dish washer and tumble dryer about 60% of all respondents would accept a smart operation for both ecological and financial reasons. Whereas only 40% of all respondents would accept it for the air conditioner, where it is more important that the service is available on demand. Similar is the situation regarding the option to postpone the start of these appliances. 60% of all respondents would accept this operation mode because of financial and ecological reasons. Again the air conditioner is the exception, where only nearly 40% of all respondents would accept a postponement of operation. 40% of them would accept a time shift up to 24 hours, for the air conditioner about 20% would accept such a time shift. If all three categories of reasons to accept smart appliances are summed up, the acceptance of smart operation is up to 80 to 90% for the respective devices. Also smart regulation of appliances by the energy supplier is widely accepted. About 60% of the respondents would accept this kind of operation for the different appliances, if both financial and ecological benefits are met. Again if all three categories are summed up the acceptance is up to 80 or 90% for the respective devices.

If people are sceptical regarding smart appliances, this is because they need the appliance on demand, they can’t imagine how these features should work or they fear smart operation modes will damage their appliances.

About half of all respondents would pay 50 to 100 Euro more for a smart appliance, if the costs are compensated through energy savings. The need of a permanent monitoring through the energy supplier does not seem a big concern – about 90% would accept this definitely or probably. Regarding information about renewable energies, most of the

respondents would like to get this information by e-mail or internet or directly by a display on the appliance or in their flat.

Most of the respondents think, that smart appliances will play a bigger role in the next years, that they are easy to operate and they don't think that smart appliances are error prone. On the other hand more than the half think that smart appliances are too expensive for the average household. More than half of all respondents think that smart appliances will increase the comfort. Almost all respondents think that both good technical solutions as well as a change of user behaviour is important to reduce energy consumption. A major part of all respondents seems to have a rather high ecological awareness and engages in energy saving measures.

No significant correlations between age, gender, education and income level and living situation and the acceptance of smart operation of appliances could be found. But there is a correlation between energy saving behaviour and acceptance: the more consumers engage in energy saving behaviour the higher is the acceptance of smart appliances.